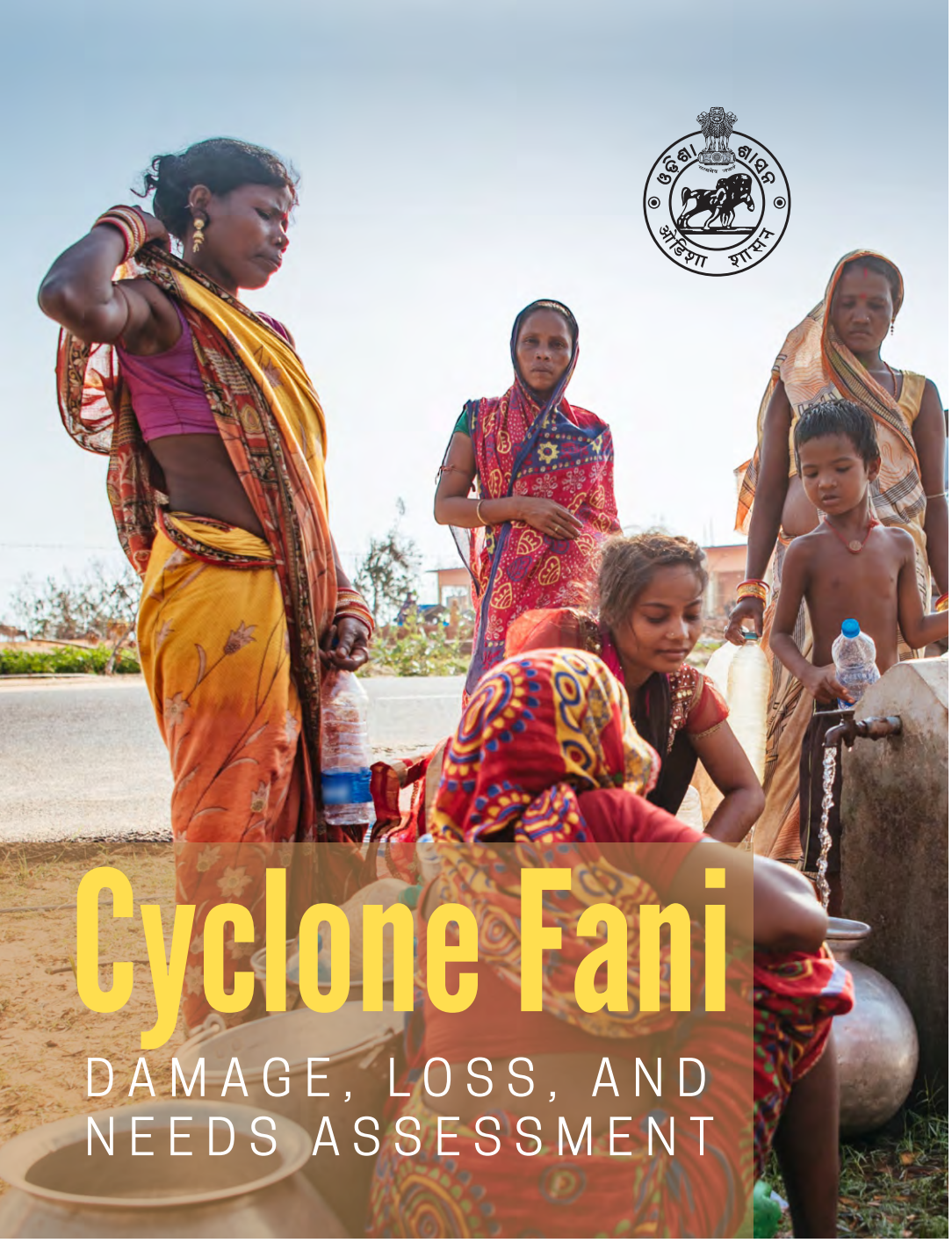

Cyclone Fani

DAMAGE, LOSS, AND NEEDS ASSESSMENT

UNITED NATIONS INDIA

Odisha

MAY 2019

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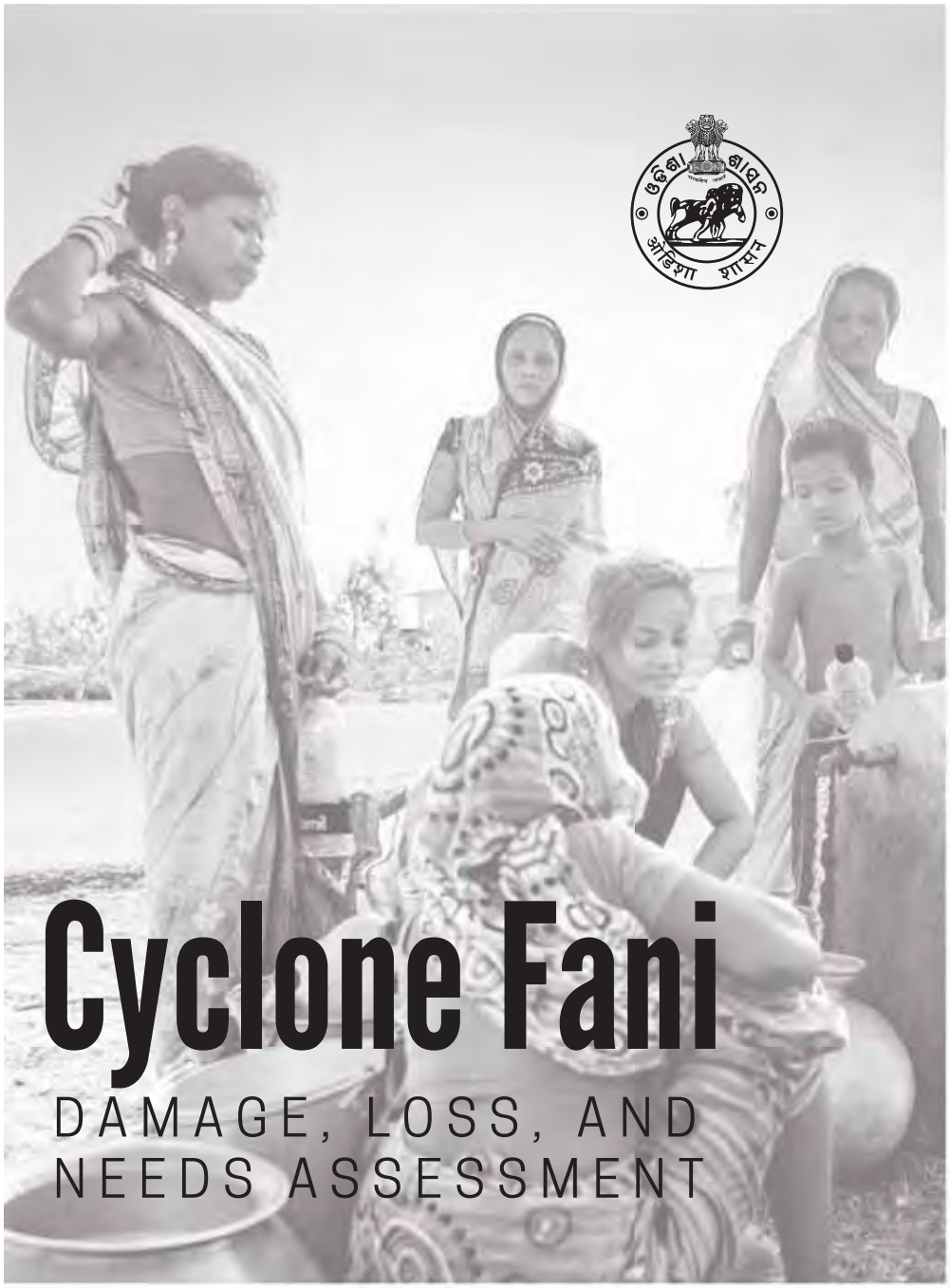

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Photographs: United Nations Children's Fund (UNICEF) and Odisha State Disaster Management Authority (OSDMA)
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Contents

HUMAN IMPACT AND MACROECONOMIC IMPACT

RECOVERY STRATEGY

ANNEXES

NAVEEN PATNAIK
CHIEF MINISTER, ODISHA

STATE SECRETARIAT
BHUBANESWAR

FOREWORD

Odisha faced Extremely Severe Cyclone 'FANI' on 3rd May this year. FANI was one of the rarest of rare summer cyclones, the first one to hit in 43 years and one of the only three cyclones to hit Odisha in the last 150 years. It caused havoc in Puri and Khurda districts and left marks of extensive damage to life and property of more than 1.65 crore people in 12 districts it passed through. As Odisha has already set global benchmark in handling disasters by leveraging technology, strengthening institutional capacities and building resilient measures, it was fully prepared to face all possible eventualities in the face of this calamity of national magnitude. It undertook one of the biggest human evacuations in history with a record 1.5 million people being shifted in just 24 hours. The exemplary courage and strength shown by the people of Odisha in the face of such a calamity and the human resource and services extended by various state Governments, national and international organizations was overwhelming.

While the relief operations were underway, the Government of Odisha in collaboration with The World Bank, Asian Development Bank and the United Nations undertook a detailed assessment of the damage and the recovery needs across 15 sectors. The Assessment spanned over a period of 20 days with a team of more than 100 multisectoral experts from all the three institutions, along with officials from various departments, local NGOs and eminent experts. Members of the civil society were consulted on their perspectives into the recovery.

The assessment report provides an overview of the macroeconomic and human impact of the disaster and is a first step towards the long road in recovery and achievement of a vision for Resilient Odisha. It proposes a recovery strategy based on the above vision which is built around three pillars; Resilient Housing, Resilient Infrastructure and Resilient Livelihoods.

Government duly acknowledges the work of the assessment team members in drafting this report that provides a way forward to recovery of the State. The Government of Odisha invites international agencies, national NGOs, the private sector and the civil society to join the recovery and reconstruction efforts together with the affected communities to rebuild Odisha.

(NAVEEN PATNAIK)

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Acknowledgements

The Damage, Loss, and Needs Assessment (DLNA) for Cyclone Fani in Odisha was made possible due to the collaborative efforts of the Government of Odisha, the Odisha State Disaster Management Authority (OSDMA), the United Nations agencies, the World Bank, and the Asian Development Bank.

The contributions of the following organisations, agencies, and partners is gratefully acknowledged.

1. Government of Odisha

Department of Agriculture and Farmer's Empowerment; Department of School and Mass Education; Department of Higher Education; Department of Women and Child Development; District Child Protection Units; Department of Health; National Health Mission, PFMS Cell, Government of Odisha; Department of Food Supply and Consumer Welfare; Housing & Urban Development Department; Panchayati Raj & Drinking Water Department; Odisha Urban Housing Mission, State Urban Development Agency; Cuttack Municipal Corporation; Bhubaneswar Municipal Corporation; Banapur Municipality; Odia Language, Literature and Culture Department; Department of Handlooms, Textiles and Handicrafts; Department of Tourism; Odisha State Archaeology; Orissa Tourism Development Corporation; Utkal University; Odisha State Archives; Odisha State Museum; Department of Horticulture; Department of Fisheries and Animal Resources Development; Odisha University of Agriculture and Technology; Central Electricity Supply Utility of Odisha (CESU); Odisha Power Transmission Corporation Limited (OPTCL); Chilka Development Authority; Water Resource Department; Department of Rural Development; Forest & Environment Department; Department of Revenue and Disaster Management; OSDMA; Odisha Livelihood Mission; Department of Social Security & Empowerment of Persons with Disabilities (SSEPD); Micro, Small and Medium Enterprises (MSME) Department; Skill Development & Technical Education Department; Directorate of Technical Education & Training; Directorate of Employment; Odisha Industrial Infrastructure Development Corporation; Odisha Skill Development Authority; Orissa Rural Development & Marketing Society (ORMAS); Department of Home; Fire Services; Odisha Disaster Rapid Action Force (ODRAF), Odisha Water Authority; Sriram Chandra Bhanj Medical College & Hospital; CTRAN Consulting Pvt Ltd., Consulting Company; IAG- Odisha, NETCOAST-NGO-Network; SPANDAN, Seeds India, NIHIDA, CYSD; ASRA Home Jagatsinghpur; Home for Elderly and Disabled and Girls, Jagatsinghpur; District Collectors of the 14 affected districts

2. Multilateral partners

United Nations Resident Coordinator's Office (UNRCO); Food and Agriculture Organisation (FAO); International Labour Organization (ILO); United Nations Children's Fund (UNICEF); United Nations Development Programme (UNDP); United Nations Educational, Scientific and Cultural Organization (UNESCO); United Nations Environment Programme (UNEP); United Nations Population Fund (UNFPA); UN Women (UNWOMEN); World Food Programme (WFP); World Health Organization (WHO); World Bank (WB); Asian Development Bank (ADB)

3. The members of the Assessment Coordination Team

Rita Missal (UNDP), Ranjini Mukherjee (UNRCO), Monika Nielsen (UNICEF), Deepak Singh (WB), Hemang Karelia (WB), and Ashok Srivastava (ADB)

4. The representatives of partner organisations

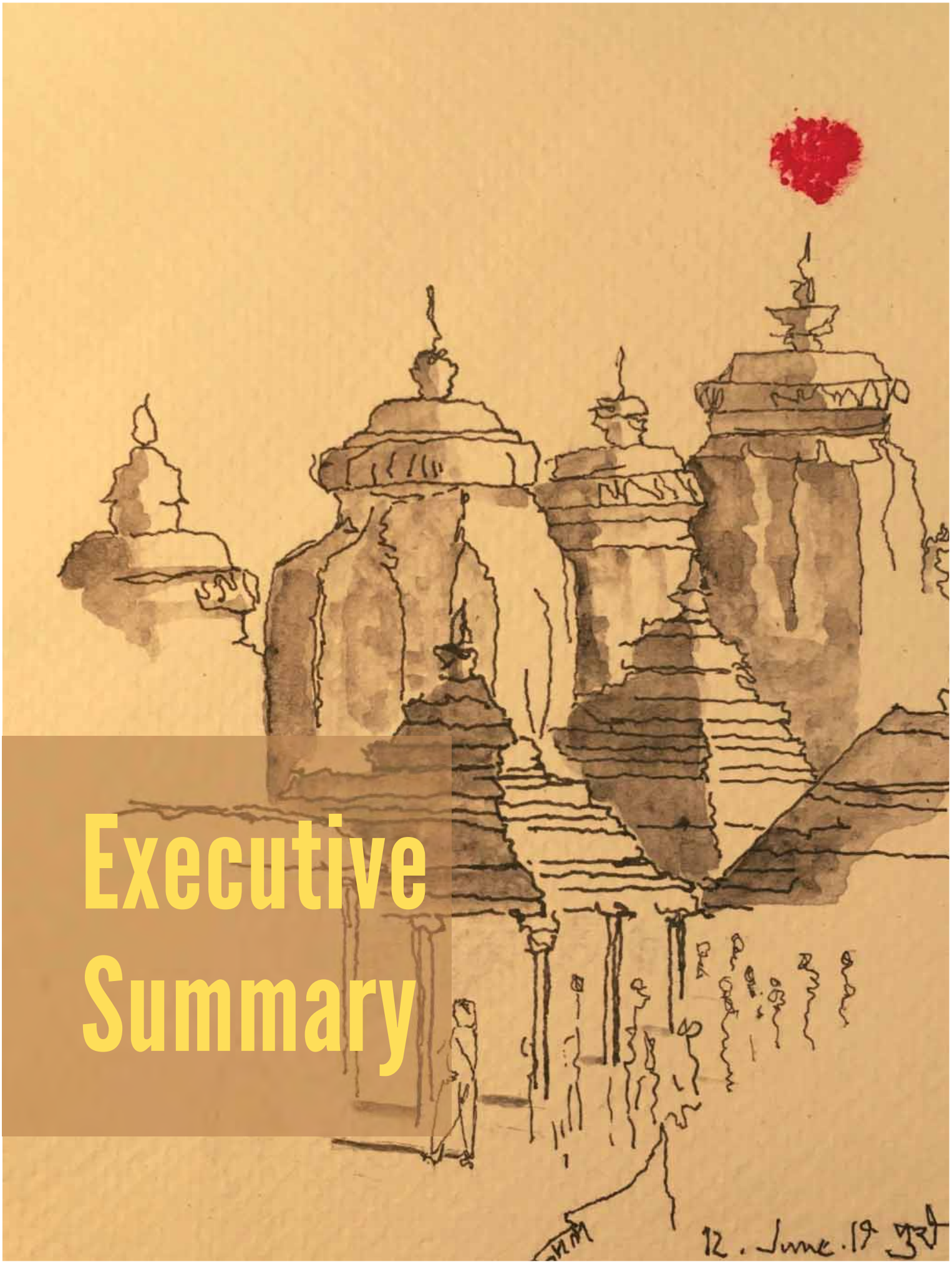
Renata Lok-Dessallien the UN Resident Coordinator, India; Heads of UN agencies; Junaid Kamal Ahmad, Country Director, World Bank; Kenichi Yokoyama, Country Director, ADB.

5. The experts who peer reviewed this report

Krishna Vatsa (UNDP); Muralee Thummarukudy (UNEP); Giovanni Boccardi (UNESCO); Saurav Dani (WB); Misaki Akasaka Ueda (UNICEF); Terry Durnnian, (UNICEF); Pravin Khobragade, (UNICEF); Gagan Gupta, (UNICEF); Dhuwarakha Sriram, (UNICEF), Marije Broekhuijsen (UNICEF); Abner Daniel, (UNICEF)i Hitesh Vaidya, (UNHABITAT)

6. Kamal Kishore, Member, National Disaster Management Authority for providing his sketch of the Iconic Puri Temple for the report.

7. To all the sector team members and contributors listed in at the end of the DLNA report.



Executive Summary

Executive Summary: Tables and Figures

Tables

Figures

Executive Summary

Background

Following the 'extremely severe cyclone' Fani, at the request of the Department of Economic Affairs, Ministry of Finance, Government of India; the United Nations, World Bank and Asian Development Bank, conducted a detailed damage, loss, and needs assessment (DLNA) in Odisha to support the recovery process. The assessment was led by Government of Odisha between 24 May and 4 June. A team of multisectoral experts conducted the assessment covering 14 districts and estimated the damage, loss, and recovery needs across 15 sectors. The assessment included **Social Sectors** (Housing Land, and Settlements; Education and Child Protection; Health, Nutrition, and Food Security; Cultural Heritage and Tourism), **Productive Sectors** (Agriculture, Fisheries, and Livestock), **Infrastructure Sectors** (Power; Telecommunications; Roads; Water Resources; Water, Sanitation, and Hygiene; Public Buildings), and **Cross Cutting Sectors** (Employment, Livelihoods, and Social Protection; Gender and Social Inclusion; Environment; Disaster Risk Reduction). The sector assessments present a consolidated view, based on information received from various line departments and the expertise of a multi-institutional and interdisciplinary assessment team. The estimates derived are conservative as very limited data was available on private losses. Hence the total damage and loss, as estimated at INR 29,315 crore in this report, would be higher if private losses were accounted for. The assessment has also attempted to analyse the human and macroeconomic impact of the disaster and to provide a broad recovery strategy to make Odisha more resilient in the future.

Odisha at a Glance

The state of Odisha, with a population of 4.2 crore (3.4% of India's population), is the eighth largest state in India comprising 4.7% of the Indian landmass. There are 30 districts in the state and 83% of the total population lives in rural areas which comprise 6,801 Gram Panchayats and 51,349 villages. The state has only 17% of the total population living in urban areas. There are five municipal corporations, 45 municipalities, 60 notified area councils and two industrial towns in the state. Agriculture is the backbone of the state economy and about 62% population of Odisha still depends in varying degrees on agriculture sector for its livelihood. Although the percentage of people living below the poverty line in Odisha has gone down from 57% in 2004–05 to around 33% in 2011–12, it remains well above the national average of around 22%. The districts in the south and west of Odisha have a very high level of poverty. One of the major concerns of the state has been very adverse human development and socio-economic indicators for Scheduled Tribes (ST) and Scheduled Castes (SC), who together constituted 39.9% (ST- 22.8% and SC- 17.1%) of the total state population in 2011.[1]

Due to its geographic and socio-economic condition, Odisha is highly prone to disasters. Its location on the east coast of India makes it one of the six most cyclone-prone areas in the world, the coast of Odisha having the highest vulnerability in terms of cyclone landfall.[2] In the last century, out of the 1019 cyclonic disturbances in the Indian subcontinent, 890 were along the eastern coast, and of these, 260 cyclonic disturbances had their landfall along the Odisha coast. The cyclones which hit the state in the last two decades are the 1999 super cyclone, Phailin 2013 and Titli 2018. There are ten major river systems in Odisha which cause flooding at regular intervals. Out of a total geographical area of 15,571 lakh hectares, 1.40 lakh hectares are prone to floods. Vulnerability to flash floods, landslides, earthquakes and tsunami is also high.

Disaster Event

The Fani, a rare summer cyclone, hit the Odisha coast close to Puri on 3 May 2019 between 0800 and 1000 hours. As reported by Indian Meteorological Department (IMD), the maximum sustained surface wind speed of 175–180 kilometres per hour (kmph) gusting to 205 kmph was observed during landfall at Satpada. Although human casualties were relatively low when compared to the Super Cyclone of 1999, cyclone Fani left 64 dead, affecting about

16.5 million people in over 18,388 villages in 14 of the 30 districts in the state (Figure 0.1). Puri, Khurda, Cuttack, Jagatsinghpur, and Kendrapara remain the five most affected districts (Table 0.1).

Due to the cyclone, power, telecommunication infrastructure, and road services were severely affected. Major roads were blocked due to the uprooted trees, road signages and damaged culverts with complete power outage in several parts of the state for almost two days. High wind speed also resulted in catastrophic damage to houses (about 3.62 lakh dwellings in all), leaving many homeless. Damage to agriculture, fisheries, and livestock has also been considerable. As per the estimate of the Department of Environment and Forestry, 21.9 lakh trees were uprooted or damaged across the state, including urban and rural areas as well as sanctuaries.

Preparedness to Response and Immediate Relief Operations

Upon receiving the early warnings from IMD, both national and state machinery geared up to assess the level of preparedness for an effective response after the landfall. Government of Odisha evacuated close to 1.55 million people towards 9,177 shelters including the 879 multipurpose cyclone/flood shelters and other safe shelters like schools and public buildings. About 25,000 tourists were evacuated from vulnerable areas by mobilising 23 special trains and 18 buses. All fishing activities were suspended two days prior to the landfall. The government organised massive awareness campaigns to inform people about the basic cyclone dos and don'ts. Twenty Odisha Disaster Rapid Action Force (ODRAF) units, 335 Fire Service units and 25 units of the National Disaster Response Force (NDRF) were deployed in the coastal districts for search and rescue operations. Volunteers were mobilised to support the local administration and the community in evacuation, distribution of relief, and shelter management. Instructions were issued to all the line departments to make adequate arrangements to provide immediate life-saving assistance to the affected people after the cyclone.

District and Block Emergency Operation Centres were activated 24×7 with deployment of senior government officials at the district level. Nearly 4.5 lakh polythene sheets (temporary shelter materials) were pre-positioned at district/ sub-district levels and 1.5 lakh kept ready for air-dropping after the cyclone. Nearly 600 pregnant women were shifted to *Maa Gruhas*/ delivery points before the landfall. To ensure food security in the aftermath of the cyclone, food grains were pre-positioned at the fair price shops for distribution among beneficiaries under targeted public distribution system (TPDS). To ensure safety, prior inspections of anganwadi centres (AWCs), food stocks

Table 0.1: Population Affected in Cyclone Fani by District

District	Population Affected (no.) by flood and cyclone	Blocks Affected (no.)	Villages Affected (no.)	ULB Affected (no.)	Human Casualty
Angul	5,709	5	67	0	0
Balasore	11,33,374	12	2,535	4	0
Bhadrak	10,15,742	7	910	4	0
Cuttack	30,96,874	14	2,095	4	6
Dhenkanal	93,699	8	652	4	0
Ganjam	20,00,000	22	2,673	12	0
Jagatsinghpur	500,000	8	256	2	0
Jajpur	21,92,630	10	1,865	2	3
Kendrapara	15,22,902	9	1,592	2	3
Keonjhar	7,160	9	163	1	0
Khordha	25,02,008	10	1,669	5	9
Mayurbhanj	1,73,095	26	1,126	2	4
Nayagarh	3,44,086	8	1,031	5	0
Puri	19,68,228	11	1,772	4	39
Total	1,65,55,507	159	18,388	51	64

Source: *Disaster Report*, issued by State Emergency Operation Centre, Odisha State Disaster Management Authority

Figure 0.1- Map of Cyclone-FANI affected districts of Odisha (OSDMA)

and essential items were carried out. Control rooms were set up for distribution of food supplies at district as well as block levels and the progress closely monitored by the state. Food supplies were also pre-positioned in child care institutions (CCIs), shelter homes, cyclone shelters, and schools to ensure food availability to the community during the cyclone. Take-home ration and eggs were distributed to pregnant women, lactating mothers, and children less than 3 years of age by 1 May 2019.

Ministry of Home Affairs (MHA) sanctioned an advance financial assistance of INR 340.87 crore to the Odisha government based on the decision of the National Crisis Management Committee (NCMC).

Relief and Rescue Operations

Immediately after the landfall, a massive rescue and response operation was launched. Sixty teams from NDRF, 18 units of ODRAF and 585 fire teams came into action. Nearly 45,000 volunteers were mobilised to carry out relief operations. Eastern Naval Command of the Indian Navy also supported the state government in rescue and relief operations. About 10,000 food packets were airdropped. More than 6,000 free kitchens were opened to serve hot cooked meals with the help of the local panchayats and self help groups (SHGs). Within 48 hours major roads were cleared and power supply restored within two weeks in the major towns of Puri and Bhubaneswar. Technicians were mobilised from the neighbouring states of Andhra Pradesh and West Bengal to restore the power and telecommunication services in the state.

A special package was announced by the Chief Minister of Odisha on 5 May 2019 with focus on food security, housing, livelihood assistance, environment management and additional monetary assistance. Government of Odisha also submitted an interim memorandum to the Government of India seeking assistance of INR 17,000 crore (USD 2,427 million). The Chief Minister of Odisha emphasised that coastal Odisha needs funds to the tune of INR 10,000 crore for building disaster-resilient power infrastructure. Similarly, an allocation of INR 7,000 crore (USD 999 million) was requested for building disaster-resilient, affordable houses. The state government also demanded a special allotment under the Pradhan Mantri Awas Yojna (PMAY) with increased support from the centre (90:10 funding ratio, i.e., 90% funding by central government and 10% by state government).[3]

Disaster Effects and Impact

Housing, power, telecommunication, agriculture, livestock, fisheries, and livelihoods were the most affected sectors (Figures 0.2 and 0.3).

The assessment estimates the total damage to be worth INR 16,465 crore (USD 2,352 million and total loss to be worth INR 7,712 crore (USD 1,102 million). The estimated recovery needs are INR 29,315 crore (USD 4,188 million) (Table 0.2, Figure 0.4).

Sector-wise Damage, Loss, and Recovery Needs

Housing: The damage to housing has been extensive, particularly in Puri district. A total of 3.62 lakh houses (2.96 lakh in rural and 66,040 in urban areas) have been damaged, of which 95% is in Puri, Khurda, and Cuttack. The most affected were people in rural areas, urban slums, and those in settlements along the coast line living in kutcha/ semi-pucca houses with low resilience against cyclonic winds. Although the government promptly evacuated a large number of people to safe cyclone shelters, several women, people with disabilities, and other socially and economically vulnerable groups were severely affected. The estimated reconstruction and recovery costs for the housing sector, including resilient and 'build back better' features, is INR 8,996 crore (USD 1,285 million). The post Fani recovery will provide the opportunity to improve the building stock of Odisha by reconstructing all the fully damaged and partially damaged kutcha houses as pucca structures. Since people have already started reconstructing their houses, as an immediate need housing facilitation centres should be set up at the block level to provide technology and design options to the community, build capacity of the local masons and engineers and support monitoring of the construction work on ground to ensure that disaster-resilient features are incorporated in the new houses. Rebuilding of houses will also have the potential to create job opportunities for

Figure 0.2: Assessment of Damage by Sector

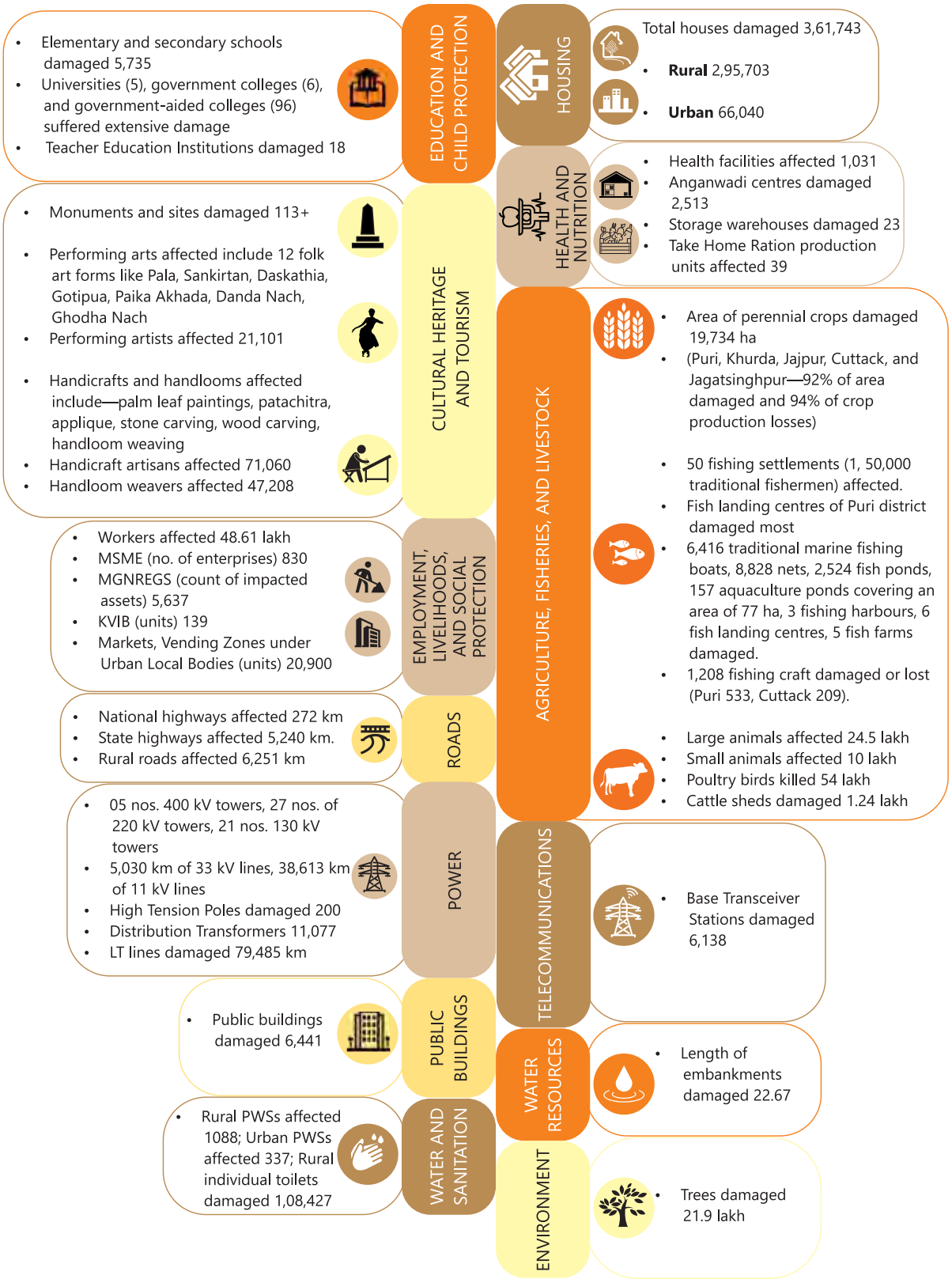


Table 0.2: Damage, Loss, and Recovery Cost by Sector (INR crore unless mentioned otherwise; values are rounded off to the nearest decimal)

Sectors		Damage		Loss		Total Effect (Damage+Loss)		Recovery Cost							
								Short-term		Medium-term		Long-term		Total	
		INR crore	USD million	INR crore	USD million	INR crore	USD million	INR crore	USD million	INR crore	USD million	INR crore	USD million	INR crore	USD million
Social	Housing	3,075	439	0	0	3,075	439	1,619	231	2,895	414	4,483	640	8,996	1,285
	Education	814	116	0	0	814	116	184	26	319	46	0	0	503	72
	Health & Nutrition	128	18	262	37	390	56	164	23	65	9	228	33	457	65
	Health	*73*	10	*232*	33	*305*	44	*104*	15	*35*	5	*27*	4	*165*	24
	Nutrition	*55*	8	*30*	4	*85*	12	*60*	9	*31*	4	*201*	29	*292*	42
	Culture	560	80	1,335	191	1,894	271	474	68	31	4	21	3	526	75
Productive	Agri & Agri-related	1,585	226	1,448	207	3,033	433	1,641	234	473	68	501	72	2,615	374
	Fisheries	*73*	10	*85*	12	*158*	23	*100*	14	*166*	24	*126*	18	*391*	56
	Crops	*364*	52	*1,304*	186	*1,668*	238	*440*	63	*155*	22	*375*	54	*970*	139
	Livestock	*1,149*	164	*58*	8	*1,207*	172	*1,102*	157	*152*	22	*0*	0	*1,254*	179
Infrastructure	Public Buildings	539	77	54	8	593	85		0		0		0	647	92
	Roads	326	47	22	3	348	50	369	53	56	8	0	0	425	61
	Water Resources	5	1	0	0	5	1	6	1	80	11	0	0	86	12
	Energy	8,139	1,163	254	36	8,392	1,199		0		0		0	9,748	1,393
	WASH	267	38	129	18	396	57	268	38	337	48	214	31	819	117
	Telecommunication	447	64		0	447	64		0		0		0	482	69
Cross-cutting	Environment	77	11	103	15	181	26	149	21	57	8	109	16	315	45
	ELSP	498	71	4,105	586	4,603	658	2,319	331	574	82	183	26	3,076	439
	DRR	6	1	1	0	6	1	41	6	200	29	36	5	277	40
	GESI		0		0	0	0	342	49		0		0	342	49
	Total	16,465	2,352	7,712	1,102	24,176	3,454	7,577	1,082	5,088	727	5,773	825	29,315	4,188

Figure 0.3: Share of Disaster Effects Across Sectors

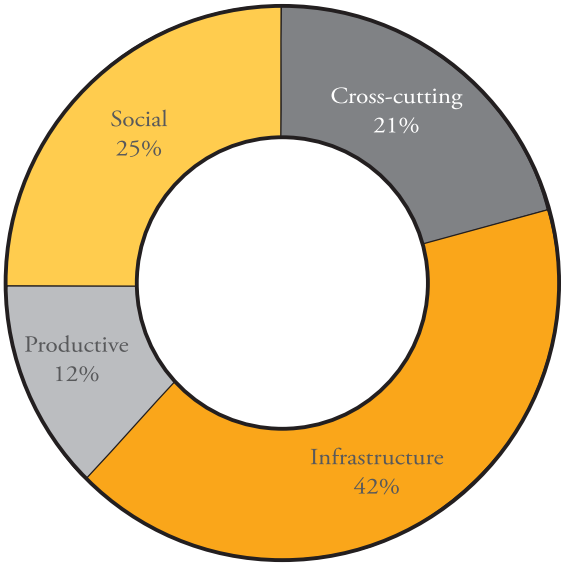
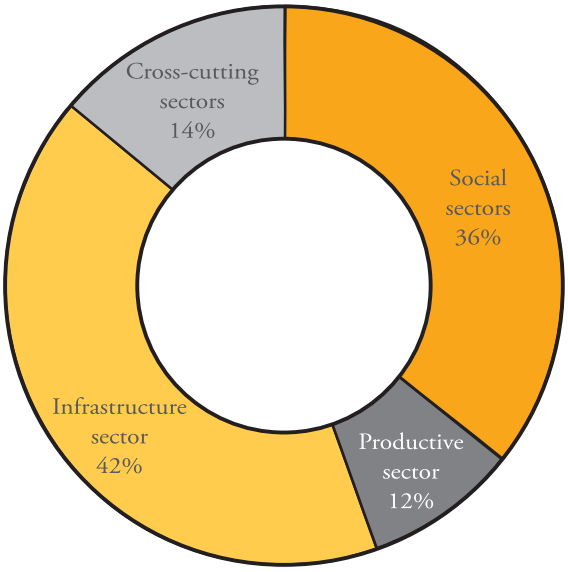


Figure 0.4: Share of Disaster Recovery Needs Across Sectors



the local communities. Local SHGs could be engaged in setting up of small building material production centres at the block level. As a medium- and long-term recovery need, it is proposed that the existing land use zoning regulations as well as the building regulations be reviewed and revised if needed, to ensure that future development of housing and other infrastructure is based on the principle of risk-sensitive land use planning.

Education and Child Protection: The impact on the education sector has been limited mainly to infrastructure, i.e., schools and higher education institutions. Old and dilapidated school buildings which could not withstand the high wind speed collapsed, particularly in the district of Puri. Ancillary buildings like verandahs and kitchens were also damaged. In some of the newly built higher education institutions, failure of non-structural elements like false ceilings, window glasses, unsecured gadgets and equipment were coupled with damage to the boundary walls due to falling trees.

The total damage in the education sector has been estimated to be INR 814.48 crore (USD 116 million). The total estimated recovery needs are INR 503.28 crore (USD 72 million). The overall recovery strategy for this sector focuses on ensuring uninterrupted services during a disaster. As an immediate recovery need, the structural safety assessment of all the damaged school buildings, higher educational institutions, and CCIs should be carried out, the unstable structures should be demolished, and the damaged schools should be reconstructed with application of disaster resilient technology. The long-term recovery need is to build the capacity of the government functionaries, CCIs, school management committees (SMCs), and Gram Panchayat Child Protection Committee (GPCPC) on school safety and protection of children during emergencies.

Health, Food Security, and Nutrition: The total damage cost to health infrastructure for the 14 affected districts amounts to INR 73 crore or USD 10 million. The total loss due to the disruption of health services including governance shortfall and associated risks amounts to INR 232 crore or USD 33.1 million. The total recovery needs for the 14 affected districts amounts to INR 165 crore or USD 23.7 million. For the nutrition sector, the total damage to institutions is estimated to the tune of INR 55 crore or USD 7.8 million. Total loss is estimated at INR 30 crore or USD 4.3 million. The total recovery needs are estimated at INR 291.79 crore or USD 42 million approximately.

Recovery of the health sector would focus on the "Safe and Green Hospital" initiative, which is more than just protecting buildings. It is about ensuring that health facilities are accessible and functional at maximum capacity, immediately after a disaster strikes. Making hospitals and health facilities safe from disasters is not just an economic requirement, but also a social, moral, and ethical necessity. This requires repair and restoration of physical assets including development of resilient infrastructure, equipment, and furniture. Investments in safe and green hospitals would benefit from the use of solar energy, LED lights, natural cooling and ventilation, and air-conditioning. A comprehensive vulnerability assessment of public health facilities is also suggested. Apart from this, strengthening psycho-social support, disease surveillance, more engagement with private sector, early warning and

Table 0.3: Overview of Damage, Loss, and Recovery Needs in Agriculture, Fisheries, and Livestock (INR crore)

	Damage	Loss	Disaster Effects	Recovery Needs			Total
				Short term	Medium term	Long Term	
Agriculture, Fisheries, and Livestock	1,585.18	1,447.52	3,032.70	1,641.38	472.78	500.50	2,614.66
Fisheries	72.92	85.43	158.35	99.50	165.50	125.50	390.50
Crops	363.54	1304	1,667.54	440.00	155.00	375.00	970.00
Livestock	1,148.72	58.09	1,206.81	1,101.88	152.28	0	1,254.16

Source: Estimation made by the sector team on the basis of government data and field visits

real time information systems with advanced emergency operation centres (EOCs) along with training and capacity enhancement will help to improve future response. Key areas requiring large investments for recovery of nutrition sector include repair, retrofitting, and building of cyclone-resilient AWCs, and provision of mobile vans to supply essential food items, along with community kitchens for vulnerable groups.

Cultural Heritage: The total damage and loss incurred in the cultural heritage and tourism sectors amounted to INR 560 crore (USD 80 million) and INR 1,335 crore (USD 191 million) respectively. While tangible cultural heritage like monuments and sites has been moderately affected without serious structural damage in most cases, there is a significant loss of livelihoods in the sector. The performing artists, particularly folk artists in rural areas and the artisans and handloom weavers (many of whom are women and/or belong to marginalised castes) have lost their incomes. In the case of performing arts and crafts sectors, this also means loss of knowledge associated with their traditional practices, acquired and honed over generations. As an immediate recovery need it is important to revive their livelihoods to ensure that they don't turn to unskilled jobs to sustain themselves. The recovery should also take into consideration the inherent resilience of the heritage sector such as traditional building practices. It is also an opportunity to review the huge potential of the cultural heritage and tourism sectors in Orissa and to further support and strengthen them for quick recovery and long-term growth.

Agriculture, Livestock, and Fisheries: Agriculture, Livestock and fisheries remain one of the most affected sectors. The total estimated damage and loss in this sector accounts to INR 3033 crore. The total estimated recovery needs is INR 2,615 crore approximately.

The agriculture sector, which also includes horticulture and cash crops, has been severely affected, accounting for 55% of the total damage and loss in the sector. The destruction of perennial crops will cause temporary loss of livelihoods, employment, and agri-income, and will result in increase of post-disaster government expenditure (including compensation for crop losses or other support to various crops damaged in the cyclone). Production losses are expected to last several years, and rural household income is expected to remain depressed over a long period of time.

Livestock rearing constitutes an integral part of the farming system. Around 24.5 lakh large animals, 10 lakh small animals and 54 lakh poultry birds have been affected due to cyclone Fani. Damage and losses to livestock were estimated at 1,206.81 crore, representing around 39.7% of the total losses to the sector, including production losses, death of animals, and decline in eggs and milk production.

The total damage and loss in the fisheries sector including damages to aquaculture and infrastructure is calculated at INR 158.35 crore (USD 23 million) amounting to 5% of the total damage and loss in the sector. Damage and Loss to the coastal/marine fishery and Chilka fishery remain high.The worst affected districts were Puri, Cuttack, Jagatsinghpur, and Khurda. Revival and restoration of assets lost both in fisheries and aquaculture, along with stocking of fresh stock, should be the priority. In the medium-term, registration of all aquaculture entities and inland fishers, strengthening of value chain initiative on inland fishery and riverine fishery including strengthening producer companies, skill building, and insurance are the proposed strategy for revival. In the long-term there is a need to strengthen the mechanism to adhere to Coastal Regulatory Zone (CRZ) regulations, promote shelter belt plantations to protect against cyclones and storm surges, regulate habitations very close to coast, promote alternative livelihoods, and maintain ecosystem services.

Power: Damage to the power sector remains very high. The power infrastructure in the 14 affected districts

consists of about 500 substations and 1,10,000 distribution transformers. These are connected with a total of about 14,000 transmission lines and 1,90,000 km of distribution lines. While damage to the transmission system is minor, damage to the distribution system includes about 80,600 km of distribution lines, 202 distribution substations, and 13,400 transformers. The total damage is assessed at INR 8,139 crore (USD 1,163 million) that corresponds to the requirement of 'bringing back the system to the pre-cyclone level'. Due to these damages and consequent power outages the estimated revenue loss to the utilities is INR 253.5 crore (USD 36 million).

To rebuild and create a robust and resilient network, three options were considered and estimated:

1. Use the overhead system with existing equipment and improved specification for installation of equipment, poles, and quality control which will amount to a recovery cost of INR 9,747 crore (USD 1,393 million)
2. Use the overhead system with spun poles and H poles and improved quality control which will amount to a recovery cost of INR 11,357 crore (USD 1,622 million)
3. Build a complete underground cable system for distribution network with a total cost of INR 25,920 crore (USD 3,703 million)

Telecommunications: Telecommunication services in coastal Odisha were severely impacted after the landfall of Fani, damaging telecom infrastructure and disrupting mobile and internet services in eleven most impacted districts. Based on discussions with line departments and the limited data made available, the preliminary damage and loss in the sector is estimated to be about INR 447 crore, with corresponding recovery needs to the tune of INR 482 crore, including public sector BSNL and private operators. The immediate recovery needs in the telecom sector include restoration of the telecom services and infrastructure. The medium to long term recovery needs will include strengthening resilience of telecommunication infrastructure by promoting underground cabling ducts rather than aerial cables, adoption of higher design standards and specifications for mobile towers to sustain wind speeds up to 250 kmph, improving the redundancy and reliability within telecom services and ensuring last-mile connectivity by deploying alternative communication systems for emergencies and testing them frequently with SOPs at community, block, and district levels.

Roads: The damage to the road sector has not been very high. The major causes for road damages were uprooting of trees, collapse of the compound walls and blockage of drains and footpaths. Damage to road furniture such as signage gantries, traffic signals, street lights, towers, poles and road signs was very high. A total damage of INR 326.2 crore (USD 46.6 million) is assessed for all roads including national highways, state roads, rural, and ULB roads. Overall recovery need is estimated at INR 425 crore (USD 60.7 million).

As an immediate recovery need, the State Works Department may coordinate with relevant authorities for developing design specifications for traffic signs, gantries, and other structures to withstand higher wind speeds. A road tree plantation strategy needs to be developed which will focus on cyclone resistant species, configuration of the plantation to reduce wind speed or to have less damage, lateral stiffening of plantation blocks and pre-cyclone pruning to reduce the damage. In the long run there is a need to build resilience by introducing climate friendly road designs and construction practices with adequate storm water drainage and overall institutional capacity to implement such practices.

Water, Sanitation, and Hygiene (WASH): Fani has impacted the WASH system and infrastructure both in rural and urban areas. In rural areas about 1,088 piped water supply schemes (49%) suffered structural, mechanical, and electrical damage. About 1,00,926 (18.9%) toilets constructed under Swachh Bharat Mission (Gramin) were partially damaged in the districts of Bhadrak, Khurda and Puri, while 7,758 (1.4%) were completely damaged due to the cyclone. Total damage to rural water and sanitation infrastructure in the seven districts is estimated at INR 99.04 crore (USD 14.3 million) Losses are estimated at INR 100.4 crore (USD 14.35 million).

FANI also caused much damage to water supply schemes in different ULBs affecting 337 urban water supply systems. The overall damages of the urban WASH facilities reach about INR 167.47 crore (USD 24.12 million) and losses are estimated at INR 28.65 crore (USD 4.12 million). Most of the damaged systems have been temporarily repaired, but will need to be redone on a more permanent basis to add resilience measures. The total recovery needs in the WASH sector including the reconstruction of damaged toilets has been estimated at INR 819 crore (USD 117 million).

Some of the important measures for strengthening the overall WASH system and infrastructure in the state are as follows:

- **Restoration of power at the water points/pumping stations** should be accompanied by repair of damaged piped water supply schemes. As a second step, appropriately safeguarded solar installations that can withstand high wind speeds should be constructed for pumping stations. This will reduce dependence on electricity or diesel power.

- **Contingency plans**, informed by existing standard operating procedures (SOPs), must be finalised at urban local body- (ULB) and block-level, through training and skill development of block- and district-level functionaries, with appropriate arrangements for pre-positioning of materials, supplies, and staff.
- **Self-employed mechanics** (SEMs) should undergo capacity building and be equipped to carry out emergency repairs.
- **Inter-departmental and inter-sectoral coordination** should be ensured at the district level and should be acted upon under the guidance of the District Magistrate.
- Design standards for WASH infrastructure should be reviewed and informed by future hazard impact.

Public Buildings: It is estimated that a total of 6,441 public buildings suffered damage worth about INR 539 crore (USD 77 million). Though the number of public buildings that suffered damage in the districts of Khurda, Puri, and Cuttack are in the same range, Khurda suffered maximum damage due to the nature of building stock exposure to the event. The estimated damage in Khurda is INR 288 crore (53%), followed by Puri at INR 125 crore (23%), and Cuttack at INR 48 crore (9%). As an immediate need, assessment of all the damaged public buildings should be carried out, along with an estimate of the amount required to repair and retrofit them. As a medium- to long-term recovery need, government should carry out rapid visual assessment of all the existing public buildings, create a comprehensive database and then start retrofitting them, if feasible, in a phased manner, to ensure resilience of all public buildings. This would also call for developing standard construction guidelines, implementation of non-structural safety and building redundancy to ensure that the critical buildings are accessible and operable during and after a major disaster.

Water Resources: The total estimated damage in the water resource sector is INR 5 crore (USD 0.9 million). The estimated recovery needs are INR 86 crore (USD 12 million). The short-term recovery strategy will include immediate measures to restore pre-cyclone status with minor additions such as erosion control measures, repacking of lost stones, etc. The medium-long term strategy would include technical studies to establish the design criteria for raising and strengthening of embankments, establishing enhanced technical specifications and performance criteria/characteristics, provision of sluices where necessary, and protection of river/seaside slopes and toe of the embankments by stone rip-raps, gabion mattress, toe wall, etc., as applicable.

Employment, Livelihoods, and Social Protection: The estimated damage amounts to INR 498 crore (USD 71 million) and income loss in 14 districts amounts to INR 4,105.13 crore (USD 586 million). The total recovery needs assessed so far are INR 3076 crore (USD 439 million). The key recovery strategies include initiatives to reconstruct all the 22 damaged government Industrial Training Institutes (ITI), 18 polytechnic institutes, nine skill development centres and the College of Engineering and Technology (CET) as soon as possible to resume education and training. The Khurda Industrial Estate needs to be restored if possible, as an industry standard for disaster resilient facilities.

- Parallel to reconstruction of all damaged technical institutions, industrial estates, and parks, it would be necessary to ramp up the skilling of youth to meet the emergent demand for skilled labour for reconstruction. The launch of massive skills training including masonry for rural housing construction (Pradhan Mantri Awas Yojana—Grameen) has the potential to generate 671 lakh person days of work. It is also proposed that the government provide for an additional 50 days of work under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) to support early recovery activities such as removal of debris, repair of community infrastructure and houses.
- Given the large need for replantation, the government may use programme funds under the Deen Dayal Upadhyay Grameen Kaushalya Yojana (DDU-GKY) and *Pradhan Mantri Kaushal Vikas Yojana* (PMKVY) schemes to create nurseries for planting of trees. This programme can generate jobs for the youth.
- Restoration of livelihoods is a core area of recovery. Under this, it has been proposed to provide soft loans to micro, small and medium enterprises (MSMEs) for handicrafts, handloom, textile industries, and small grants for fishery, poultry, horticulture, coconut growers, urban informal workers and promote group insurance for the MSMEs. The Employment, Livelihoods, and Social Protection chapter reviews the existing social protection programmes and emergency top-up of National Social Assistance Programme (NSAP), Madhu Babu Pension Yojana (MBPY), and Banishree. It proposes that benefits to the most vulnerable may be advanced before a cyclone to provide the much needed cash in hand to address immediate needs after a disaster.

Gender and Social Inclusion: The cyclone has affected women, girls, boys, men, elderly and PwDs in different ways. Due to pre-existing discrimination based on gender, caste and differential socio-economic disadvantages, these groups of population have been disproportionately affected and have shown uneven levels of resilience and capacities to recover.

The immediate short-term recovery measures required in this sector are to identify the most marginalised households and provide them targeted assistance like advance payment of social security entitlements and payments, housing assistance to women-led households, cash for work assistance, and supply of assistive devices to the PwDs. In the medium to long term, financial support needs to be provided to the Women SHGs and PwDs with mechanisms to ensure better market linkages. Different types of skill building programmes should be organised for the various SHGs in a targeted manner.

Environment: A large number of trees have been damaged due to the cyclone, particularly in the landfall area between Satpada and Konark, which includes the Ramsar wetland, Chilika, and the Balukhanda–Konark sanctuary. About 9 lakh trees were damaged inside the forest and protected areas. The cyclone and associated storm surge resulted in the opening of four new bar mouths in Chilika. A huge number of trees have been uprooted in the three severely affected districts of Puri, Khurda, and Cuttack. The tree debris drying on the forest floor and in other storage areas is posing a serious risk of fire. There was no significant wildlife loss. Nature based solutions such as coastal shelterbelts around Chilika were damaged but have demonstrated their significance in reducing the effects of the cyclone. In the aftermath of the cyclone, the quantum of tree debris, infrastructure debris, household level dry waste and plastic increased dramatically.

In the environment sector, the damage and losses to the natural assets and related infrastructure are INR 181 crore or USD 26 million. The recovery needs are INR 315 crore or USD 45 million. Recovery needs for damages and losses due to the waste and debris generated are INR 150.18 crore or USD 21.45 million. The immediate recovery needs are to manage the massive quantity of dried material lying on the forest floor, restoration of partially damaged trees, renovation and reconstruction of the landing centres and jetty and compensation for the damaged boats and fishing nets in Chilika Lake. Some of the medium- to long-run recovery needs are coastal shelterbelt replanting beyond the sand dune systems as per the CRZ notification and strengthening of the waste management systems in the coastal districts.

Disaster Risk Reduction (DRR): Since the devastating Super Cyclone of 1999, Odisha has taken major strides in developing a robust disaster management system for the state. By evacuating more than 1.5 million people the government has been able to minimise fatalities (only 64 compared to nearly 10,000 in 1999). However, the damage to infrastructure and economic losses has been very high, clearly indicating the need for integrating DRR measures across all sectors of development.

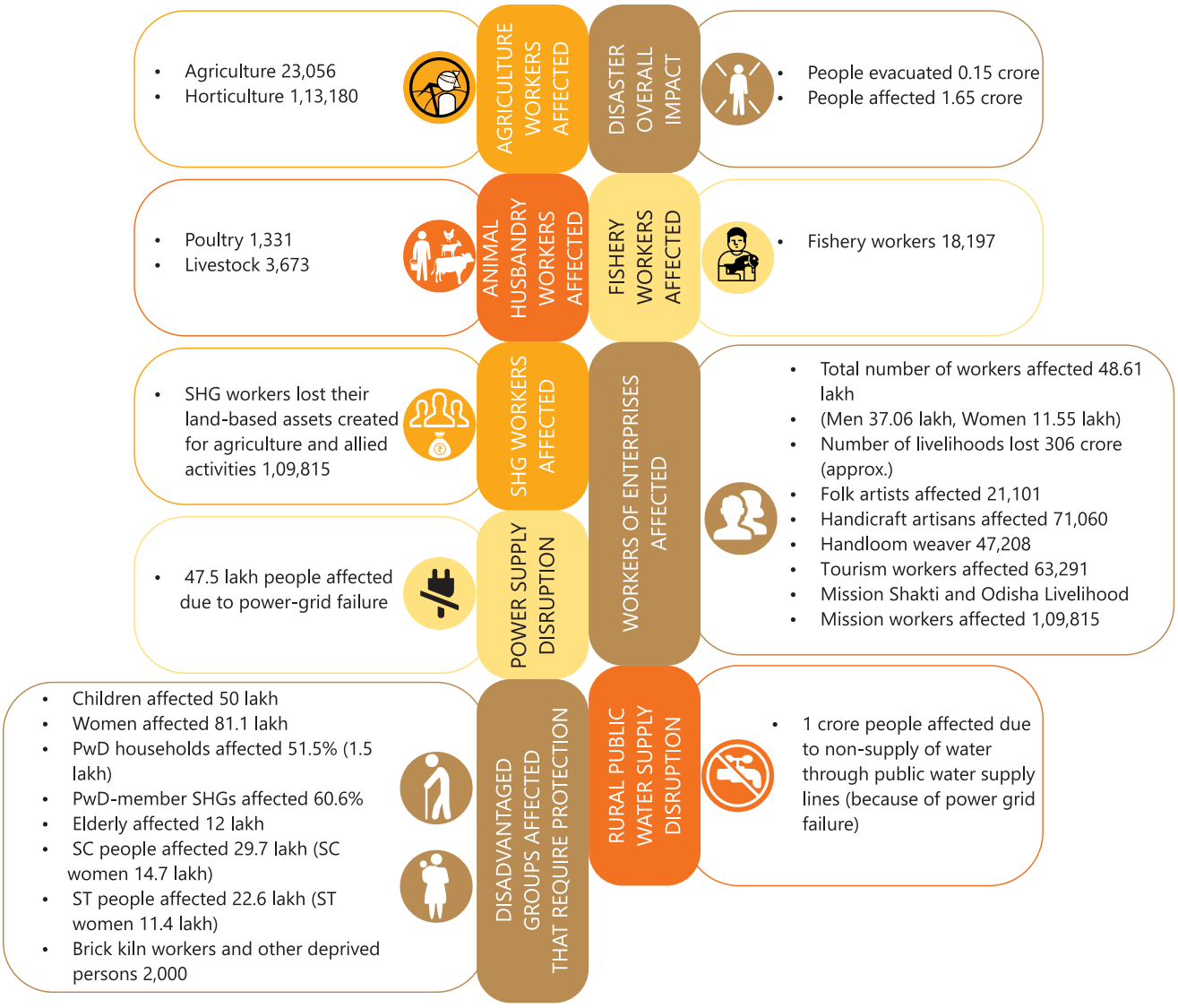
The estimated damage in the DRR sector amounts to INR 5.5 crore (USD 0.9 million). The estimated recovery needs amount to approximately INR 277 crore (USD 40 million). The recovery strategy for DRR sector focuses on enhancing preparedness, reducing economic loss by and building capacity on DRR across all sectors. The immediate recovery needs are improving preparedness through strengthening Early Warning Dissemination System (EWDS), revision of disaster management plans and standard operating procedures, strengthening GoO-NGO coordination to respond to the early recovery needs and building capacity on construction of resilient infrastructure. Some of the important mid- to long-term recovery needs will include setting up of a disaster management information system at the district level, implementation of special disaster risk management programmes for people with disabilities (PwDs), state wide hazard risk and vulnerability assessment and strengthening of the state response force.

Human Impact: Cyclone Fani has had comparatively higher and differential impact on the socially vulnerable and marginalised population groups, especially women and adolescent girls, children, members of the SC and ST communities, PwDs, fisher-folk, daily wage earners such as brick kiln workers, small traders, artisans and urban slum dwellers. Poverty, location of residence, inequality, social and gender discrimination were some factors that further compounded the pre-cyclone vulnerabilities of these groups and resulted in a differential impact (Figure 0.5).

An analysis considering the five dimensions—Health, Education, Agri-livelihood, Living standards, and Safe housing (HEALS)—across the 14 affected districts shows that Fani has further increased the incidence of income poverty in Odisha which could be transient but needs special attention. A build back better (BBB) approach with community-specific, occupation-specific and location-specific interventions involving different stakeholders will prevent the increase in incidence of income poverty in the state.

Macroeconomic Impact: Damage, loss, the need for recovery, and disaster resilient reconstruction will impose a substantial fiscal burden on the state. Innovative ways to finance disaster risk and investment in disaster risk reduction (DRR), and mitigation in a manner that does not jeopardise the financial condition of households as well the state, is the need of the hour. With damages and losses estimated at 5% of GSDP, the needs for recovery and reconstruction must be structured in a judicious manner.

Figure 0.5: Sector-wise Impact on Humans



Odisha should be given special treatment by the Centre on account of its chronic vulnerability and exposure to frequent natural disasters. Also, it is estimated that there has been a decline in the Net State Domestic product of Odisha. In order to improve the fiscal health of the state and reduce the human impact of Fani on people of Odisha, the Government needs to explore risk insurance mechansims and low-interest loans from various financial institutions including multilateral agencies particularly to build in the element of resilience across the sectors and apply the principles of BBB.

Way Forward to a Resilient Odisha

The Government of Odisha has received international acclaim for significantly reducing the loss of lives from nearly 10,000 in the Super Cyclone to less than a hundred in the recent cyclones Phailin and Fani. While the goal of zero mortality is close to realisation, the economic losses in livelihoods and infrastructure have been increasing. The combined economic losses of INR 40,447[4] crore (USD 5.7 billion) from recent cyclones, Phailin, Titli, and Fani demonstrates the need for the government to establish a strong framework of disaster risk governance and integrate

the principle of resilience in every area of development planning and recovery process to achieve a substantial reduction in the economic losses.

It is important to recognise that reducing economic losses due to these disasters is critical to reducing poverty and vulnerability in Odisha. It requires a continuous support for recovery as well as improving the quality of housing and infrastructure through better building standards and regulations. A recovery programme is the right context for bringing these long-term changes and improving resilience at the household, community, and state levels.

As per the latest data available, the Cyclone Fani Damage, Loss and Needs Assessment (DLNA) estimates the costs of recovery to be INR 29,315 crore (USD 4.1 billion). As part of the recovery process, the Government of Odisha has emphasised the need for building resilience across all sectors in the state. The narrative for building a resilient Odisha also resonates with civil society groups and development partners including the United Nations, World Bank, and Asian Development Bank.

The strategy for building a Resilient Odisha is a based on three pillars: **Resilient Housing**, **Resilient Livelihoods,** and **Resilient Infrastructure**.[5] These pillars are elaborated below:

Resilient Housing: The cyclone hit the housing sector the hardest, damaging nearly 3.62 lakh units of houses across the 14 districts. The high damage to the housing stock can be attributed to two factors, the first is the quality of houses and the second is poor quality of construction. The total recovery needs are estimated to be INR 8,996 crore (USD 1,285 million) which include resilient and 'build back better' features.

Cyclone reconstruction is an opportunity to incrementally replace all the housing stock and provide safe and affordable housing to reduce the human and economic costs in recurrent cycles of disaster. The key strategy is owner-driven reconstruction done through massive capacity building and skills training in disaster-resilient construction technologies. The owners will be assisted through 99 housing facilitation centres, each staffed by a technical team of three engineers/ architects supported by three technical assistants. The team would work over a duration of 18 months alongside house owners, masons, and carpenters to oversee training and construction and certify its structural worthiness.

Alternative and environmentally sustainable construction materials for house construction will have to be explored. Reconstruction of houses of households headed by women, PwDs, the elderly and low-income individuals will be prioritised with the objective of providing safe shelter for all vulnerable people within five years. The reconstruction of all houses would significantly contribute to the resilience of households and communities.

Resilient Livelihoods: Accelerating economic growth commensurate with growth in employment and livelihood opportunities has been one of the key objectives of Odisha's economic policy. These are regarded as policy imperatives for inclusive development and reversing poverty. Despite achieving impressive reduction in poverty in the last decade, from 58% to 33%, there is still a significant percentage of people (33%) living below the poverty line. Extreme weather events such as Fani have a detrimental impact on the livelihoods and coping capacities of people, particularly the extremely vulnerable groups reliant upon a single source of income and social protection schemes.

The major sectors of the economy are extremely vulnerable to changes in weather patterns and impact of climate change, and among them fisherfolk, small farmers, sharecroppers, and the people in the tourism sector are severely hit by the repeated cyclones. In the short term it would be necessary to replace all livelihoods-related assets of people, with cash assistance and interest subvention to support the recovery of small businesses. Using the MGNREGS, the state can support restoration and creation of livelihood assets.

In the long run, it is important to assist businesses to move from the informal to formal sector to qualify for insurance coverage, credit assistance and better-quality services. A group insurance for all MSMEs is recommended to encourage better coverage with reduced premium. The tourism sector can provide significant opportunities for employment in the state. A large skill upgradation programme will prepare youth to enter the sector.

Social protection schemes make critical contribution to a broader disaster recovery effort by aiding disaster-affected households to protect their immediate well-being and helping them to recover more quickly. For example, the instant cash provided to the affected population post-Fani helped households in purchasing basic household items essential to resume economic activity.

The existing social protection schemes can be made more effective through top-ups to beneficiaries who are pre-enrolled in an existing safety net program. An expansion of social protection schemes maybe considered to add additional eligible people. An integrated package of support to vulnerable households through safe housing, supplementary income source and expanded social protection schemes will insulate them from the effects of disasters.

In recovery, restoration of livelihoods and skills-building of women should be a priority. Women's SHGs engaged in handicrafts and cottage industries and service sector

employment should be supported with cash grants and soft loans to help them resume economic activities. Women's participation in the economy should be encouraged through necessary skills and credit to diversify their livelihoods. Financial independence of women improves household resilience significantly.

Resilient Infrastructure: Infrastructure needs across all sectors are estimated to be more than INR 21,000 crore (USD 3 billion). The housing and power sectors have the highest needs among all sectors, followed by the stock of public buildings. Repair and reconstruction of all infrastructure works in the 14 affected districts has already begun, especially in the power sector, given its critical importance in restoring services and economic activities.

A total of 6,441 public buildings, suffered damage worth about INR 539 crore (USD 78 million).

The immediate priority should be that of securing damaged buildings, removal of debris and repair to make them functional. In the process of repair, efforts should be made to enhance the resilience of sloping roofs, doors and windows, compound walls and other associated elements like water tanks.

In future, for all upcoming building stock should be made cyclone (and multi-disaster) resilient with a focus on detailing the designs of door and windows, water tanks, piping, solar panels, and AC units. Special care should be taken in terms of sizing, location, design specifications, and construction supervision. Large glass windows, glass and aluminium panels need to be designed in manner that could withstand wind speeds. Tree planted in compounds of public buildings should be of species that are able to withstand high wind speeds and should be planted at a distance from the building so that falling trees do not cause damage.

Additionally, the approach should be to create comprehensive inventory and database of all public buildings in current use and under construction and recommend steps to prevent and reduce future damage. Buildings should be prioritised based on usage and a phased plan should be developed to repair, retrofit and reconstruct the buildings. Guidelines need to be prepared to protect public buildings and assets in cyclone-affected districts. Buildings that can function as evacuation centres need to be equipped with communications, power supply, water, and food.

In addition to public buildings, other structures like embankments, roads, power supply and telecommunication infrastructure need to be evaluated in the light of the recent cyclone. Designs and technical specifications for all these structures need to be improved for hazard-resistance and capacity to provide uninterrupted services during disasters. A gradual and incremental approach to upgrading all the services to disaster-resilient standards may be undertaken. As the government continues to invest in infrastructure for economic growth, it is important to invest in making the assets multi-hazard-resistant.

Principles of Recovery: The process of recovery in the state of Odisha will be guided by the following principles aimed at improving the quality of recovery, emphasising social inclusion, and promoting resilience of all sectors. These guiding principles are articulated below:

- Recognising the differential impact of the cyclone on people, the recovery will prioritise the needs of the most vulnerable, which include PwD, women-headed households, fisherfolk, slum dwellers, artisans, scheduled caste communities, and people in extreme poverty.
- Recovery interventions should be based on the principle of gender equity with a specific orientation towards investing in women's capacities to contribute to the recovery process. The SHG groups established through Mission Shakti may be further capacitated to take up non-traditional reconstruction jobs including construction of public works and higher paid skilled jobs to build their resilience.
- Recovery should be risk-informed and disaster-resilient. This can be done through establishing project approval processes which ensure that locations, designs and construction of all public and private infrastructure are multi-hazard-resilient.
- Nature based solutions (NBS) should be promoted in recovery, using environmentally safe and locally produced materials, establishing coastal belt plantations as opposed to concrete infrastructure-based solutions. The reconstruction of infrastructure will take environmental risks into consideration and will be undertaken in a manner prevents further degradation.
- Recovery will build on international best practices bringing in ideas and approaches that proved to be sustainable and resilient; at the same it should promote vernacular designs, traditional building craftsmanship, and the work of its artisans and weavers to retain Odisha's cultural identity.
- Recovery should be a collective effort, using the resources and expertise of the government and the civil society, the development partners and the private sector.
- Recovery should be implemented in a transparent manner and all the information related to recovery must be available in the public domain and be widely disseminated, using means of communication that are accessible to the affected communities. Frequent monitoring and third-party audits will be conducted to provide quality assurance to works undertaken through government and private parties in recovery.

Policy recommendations: Some key policy recommendations emerged which have a bearing on planning and implementing recovery. Each chapter provides relevant recommendations in the respective sectors. The following recommendations are meant to guide the overall recovery process and are applicable across sectors:

- **Equity in delivery and management of relief and recovery assistance**: It was noted that the immediate cash transfer of INR 2,000 and 50 kilograms (kg) rice provided critical support to families. However, the precondition that it be distributed only to ration card holders excluded many vulnerable families, including migrants and brick kiln workers who are non-residents but were equally affected by the cyclone. The rice assistance of 50 kg per family, irrespective of the family size, while enough for nuclear families was not enough for large joint families. Though unintended, this created disparity. As a follow up, it is recommended that the government assistance of cash and food grains should be made to all people affected by the disaster, without the precondition of proof of residency. Food grains distribution could also be done based on family size. A more judicious approach in delivery of relief aid should be taken and the Odisha Relief Code, the State Disaster Response Fund (SDRF) and National Disaster Response Fund (NDRF) norms may be reviewed to include guidance on conditions for relief to affected people.
- **Equitable access to services:** Cyclone shelters proved to be lifesaving for the millions of evacuated inhabitants. Following the days after the cyclone, details emerged of segregated arrangements for food and use of facilities by a dominant social class, forcing the socially vulnerable groups to take shelter in other buildings such as the anganwadi centres or available pucca structures in the village. This narrative of discrimination must be addressed within the recovery process with a deliberate strategy to include low income communities in decision-making bodies for reconstruction work. Prioritising restoration of services for health and education, and reconstructing infrastructure in locations where poor communities reside would be desirable. Additionally, any new cyclone shelters constructed may be located closer to Dalit hamlets to ensure access to people who need it most. Programmes to create social cohesion among diverse social groups may also be taken up.
- **Enforce the Coastal Zone Management Regulations:** The Coastal Vulnerability Index prepared by the Indian National Centre for Ocean Information Services (INCOIS)[6] notes that vulnerability arising from loss and damage due to sea level rise, coastal geomorphology, tidal range, and elevation in the 107 km of Odisha's coastline is high. These include parts of Puri, Jagatsinghpur, Kendrapara, northern and southern Bhadrak, and southern Balasore. Any construction of lifeline buildings in this zone should be reviewed carefully not only for its potential to withstand cyclonic wind speeds of 250 kmph but also shore erosion, coastal flooding, storm surge, and inundation. The Integrated Coastal Zone Management Project (ICZMP), Odisha has also delineated areas proposing approaches to management of shoreline and settlements around it which also needs to be taken into consideration in the recovery process.
- **Resilience building linked to livelihoods resilience and social protection:** The impact of disasters is felt more strongly in poor communities. Odisha's accelerated rate of poverty reduction could be impeded by repeated disasters. Therefore, any recovery programme should focus on building livelihoods of communities and extending social protection to the most vulnerable people.
- Communities dependent on agriculture, fisheries, and livestock are vulnerable to disasters and climate change. Promoting their resilience to disasters by integrating disaster-resilient practices in the sub-sectors[7] is critical. At the same time there should be a special effort to provide a secondary source of income to the families through work opportunities in the service sector. This will also help low income families to move from the informal to the formal sector, thus providing security to the family. Additionally, all low-income families covered by social protection schemes should receive a steady source of support through this aid. These schemes may be extended to ensure coverage of all eligible individuals and include provisions for topping up the monthly benefit following a disaster. This would go a long way in ameliorating the impoverishment following a disaster.
- **Institutional arrangements:** Recovery should be coordinated by Odisha State Disaster Management Authority (OSDMA) while line ministries implement reconstruction. The OSDMA's departments may be strengthened with additional capacities to coordinate and guide recovery over the next five years. OSDMA may consider opening project offices in the most affected districts with technical staff such as engineers, architects and planners, and livelihoods experts to coordinate recovery. Similarly, line departments may consider augmenting their offices in districts and blocks with technical experts for specific areas such as housing, roads, power, water resources and livelihoods. Line departments of Panchayati Raj and Public Works could implement a

major share of the recovery programmes; therefore, the departments need to be boosted with additional staff capacities for undertaking reconstruction. At the district level, the District Collectors could coordinate the work of line departments and funds and programmes of all national and international agencies. It is recommended that a strong reporting mechanism be established at the district level and led by the District Collector to review progress on a quarterly basis.

- **Implementation arrangements**: It is recommended that before the recovery process is initiated, detailed sector recovery plans for each district based on the recovery needs be drafted. Such plans would be based on available resources and would assist in prioritising the recovery needs based on urgency, and directing resources for projects where they are needed most. The detailed implementation arrangements may be developed by analysing the existing capacities of the line ministries and departments vis-a-vis the quantum of work to be done.
- While line departments implement, it would be important for gram panchayats to be entrusted with the responsibility of restoring community infrastructure such as local roads, drainage, community centres, markets sheds, and water supplies. Adequate technical support may be provided to panchayats to undertake these activities. Gram panchayats can also play an important role in preparing communities for disasters through plans, drills, and small mitigation projects.
- Local NGOs, the private sector and international agencies should also be invited and their participation in the recovery process should be facilitated. The government, in consultation with the civil society, should delineate areas of support and use allocated resources for projects within a community. Private sector may be invited to fund and implement projects against government-set building designs, standards, and guidelines. The support of local NGOs can also be used to mobilise community-based organisations and women's SHGs in the recovery, and they can be trained and provided with knowledge and skills to participate in recovery programmes.
- **Geographical coverage**: The recovery programme would be implemented in 14 affected districts of the state with a focus on the five most affected districts of Puri, Jagasinghpur, Khurda, Cuttack, and Kendrapara. These districts are identified based on the severity of the damage to infrastructure and loss of economic activities.
- **Time Frame:** The DLNA proposes implementation of recovery in three phases: short, medium and long term. The duration of short-term recovery is set for 12 months, medium-term recovery for two years and long-term recovery is 24 months and beyond. The total duration is anticipated to last for five years. The time-frame of the recovery programme suggests a broad timeline for the completion of activities.

Conclusion

It is important to recognise that recovery is an effort that goes beyond humanitarian assistance, leads to rebuilding assets and livelihoods, improves government services, and builds resilience at all levels. Recovery should, therefore, be organised as a distinct effort, targeting people who are heavily affected by cyclone FANI. At the same time, the government should upgrade public buildings, services and infrastructure facilities so that they can withstand future disasters.

However, while the government must lead the recovery effort, it need not be an only government-centred effort. It should be supported by all segments of society and economy—civil society organisations (CSOs), NGOs, private sector and international development partners. A more inclusive and collective recovery effort would help the state reach out to all the affected areas and communities and reduce the burden on the state. People are active participants in recovery, and the government must create enabling conditions for their active participation and contribution.

A sustained recovery effort would bring accelerated development to Odisha. It would bring in more investment, skills and regulations which create more opportunities. Recovery should, therefore, be taken as an opportunity for building resilience, meeting the Sustainable Development Goals, and improving the well-being of the people.

DLNA Methodology

This report is a collaborative effort of the Government of Odisha, the Asian Development Bank, the United Nations and the World Bank in response to a request from the Government of India. The DLNA was carried out in accordance with the PDNA methodology developed through a tripartite agreement between the European Union (EU), the World Bank (WB) and the United Nations. As per the decision of the Government of Odisha, the assessment includes the following sectors.

- Social sectors:
    - Housing, land, and settlements
    - Health, nutrition, and food security
    - Education and child protection
    - Cultural heritage and tourism
- Productive sectors:
    - Agriculture, fisheries, and livestock

- Infrastructure sectors:
  - Power
  - Telecommunications
  - Roads
  - Water, sanitation, and hygiene
  - Public buildings
  - Water resources
- Cross-cutting areas:
  - Employment, livelihoods, and social protection
  - Gender and social inclusion
  - Environment
  - Disaster risk reduction

The assessment in Odisha was initiated on 24 May 2019, engaging over 100 people from government, United Nations, World Bank, and ADB. An orientation programme was organised by Government of Odisha to finalise the scope, methodology, and data collection templates for the assessment.

The assessment covered 14 most affected districts prioritised by the state government. A coordination team led by the Principal Secretary, Department of Agriculture & Farmers' Empowerment, was set up by Government of Odisha to provide overall guidance to the assessment team. Fifteen sector teams were constituted to assess the damage and losses across the sectors. The assessment teams used the data made available by Government of Odisha and further validated it through field visits in the five most affected districts and detailed meetings with the various line departments

The assessment included five steps:

- Collection of pre-disaster baseline data to compare with post-disaster conditions
- Evaluation of the disaster's effects and impacts in each sector and identification of the recovery needs
- Prioritisation and finalisation of the recovery needs based on the sector context and deliberations with line departments
- Development of sector-wise recovery strategy that suggests appropriate interventions to meet priority recovery needs

During the assessment, a few cross-cutting issues such as gender and social inclusion, environment, disaster risk reduction and employment, livelihoods, and social protection have been addressed. Each sector has also discussed the impact of the disaster in qualitative terms and outlined the emerging issues arising from the disaster event. A civil society consultation meeting was organised to hear out the voices from the grassroot level functionaries and assess the needs of the most vulnerable communities.

Most of the sectors have quantified the damage, loss, and recovery needs in monetary terms. The values assessed by all the sectors have been aggregated, to arrive at the total cost for recovery after cyclone Fani. Also, the cost of recovery needs has not been estimated at the replacement value; rather, a cost estimate has been provided based on fiscal prudence and acceptable levels of recovery including the principles of building back better. The cross-sectoral linkages have further made it possible to avoid double or multiple counting in estimating the value of the damage and loss. Further, the aggregated value of damages and losses as well as qualitative information available through various information sources has been used to derive the overall macroeconomic and human impact of the cyclone. The assessment has also attempted to provide an overarching recovery strategy.

The estimation of the damage and losses by the assessment team is based on the data made available by the various line departments. It must be noted that the data on damages may vary in granularity as the various sectors reflect either data from the most affected districts and/or the whole state, as per data availability. This assessment presents a consolidated view, based on relevant information received and the expertise of a multi-institutional and interdisciplinary assessment team. It neither supersedes nor disregards the assessments of damage and needs made by other entities.

Notes

[1] World Bank, 2017

[2] State Disaster Management Plan, 2017

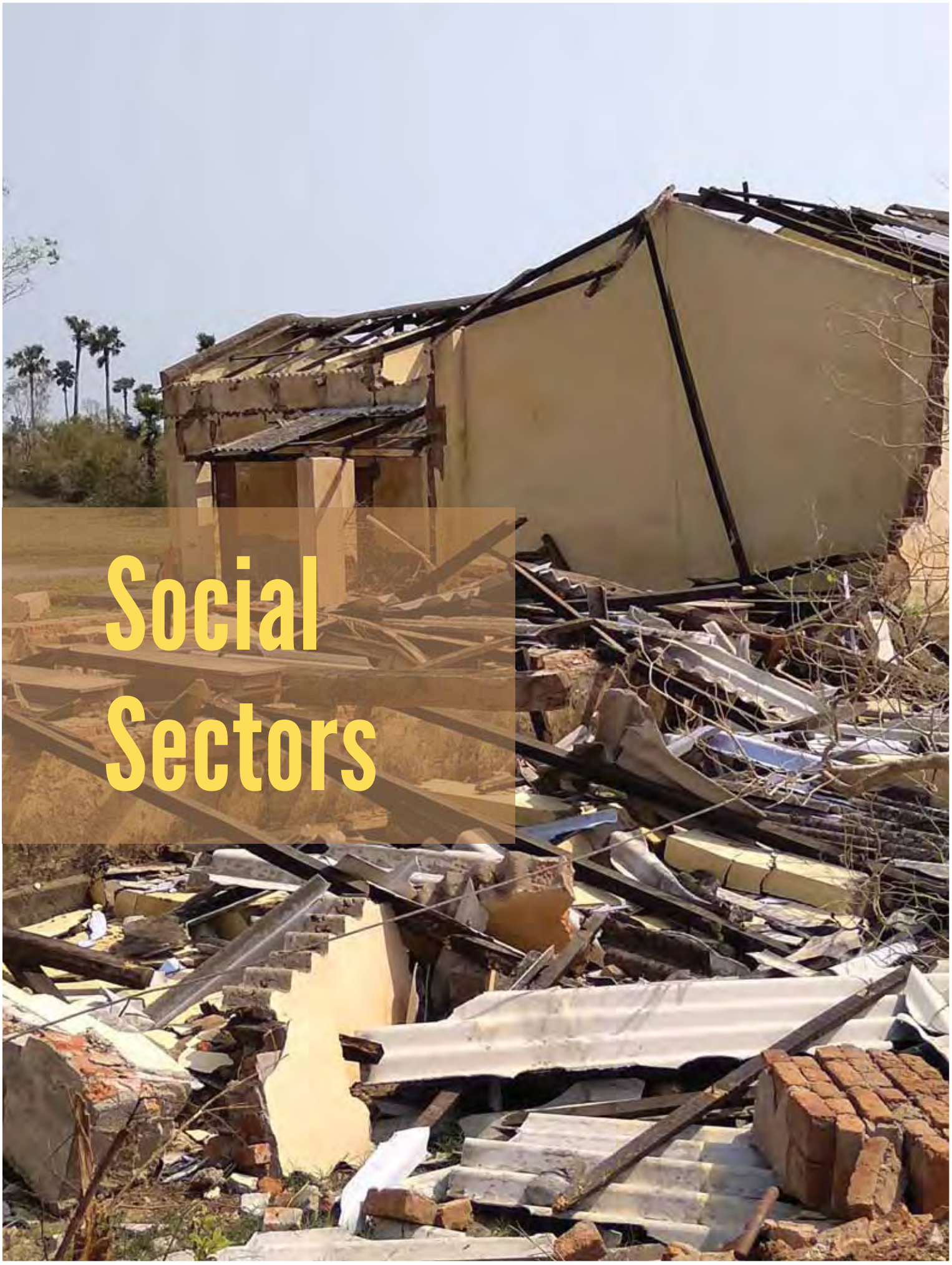
[3] To address the housing gap in the country as well in view of government's commitment to providing "Housing for All" by 2022,the scheme, Pradhan Mantri Awas Yojana, has been launched with effect from 1 April 2016. The cost of unit assistance under the programme is shared between central and state governments in the ratio 60:40 in plain areas and 90:10 inthe north-eastern and Himalayan states.

[4] Phailin RDNA report; Final Memorandum of very severe cyclonic storm "Titli" and subsequent floods GoO.

[5] UNDRR terminology defines Resilience as "The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management"

[6] Odisha State Climate Change Action Plan, Forest and Environment Department, Government of Odisha, 2018

[7] The Odisha State Climate Change Action Plan, Government of Odisha, 2018 provides suggestions on climate resilient practices for Agriculture, Animal Husbandry and Fisheries.



Social Sectors

Social Sectors: Tables and Figures

Tables

Figures

1

Housing, Land, and Settlements

1.1 Pre-Disaster Context

This section summarises the pre-Fani housing situation in Odisha, which provides the baseline data. This data serves to develop an understanding of the post-Fani effects and impact, based on which, the recovery strategies and recommendations have been put forward.

1.1.1 Overview of Housing, Land, and Settlements

The following baseline information is relevant in the context of housing in Odisha.

- **Population density and degree of urbanisation:** The density of population in Odisha is 270 inhabitants per sq km as compared to the all-India figure of 368 persons per sq km. Urbanisation is 16.68% compared to the all-India figure of 31.16 %.[1]
- **Structure of houses**: About 31.93% of households live in pucca structures, 16.03% in semi pucca[2] and 52.04% in kutcha houses[3].
- **House ownership status:** Approximately 92.72% families live in houses they own, while about 4.86% live in rented accommodations.[4]
- **Houseless**: There are 8,547 households that are houseless in rural and urban areas together.[5]

The state of Odisha is one of the poorest in the country with about 33% population below the poverty line.[6] The total number of households in Odisha is 99,42,101, of which 86,77,615 are rural and 12,64,486 are urban.[7] The population in both rural and urban areas is vulnerable to the effects of severe disasters such as the Fani cyclone. As many as 64 of the 114 urban local bodies (ULBs) are Notified Area Councils (NACs) which are more rural in terms of housing structures. Further analysis shows that 22.96% of the total urban households in Odisha (in the most-affected districts except Angul) comprise urban slums, with Puri district being the highest at 37.64%. The numbers are significant for a disaster-prone state like Odisha since slum dwellers and households belonging to economically weaker sections (EWS) (even if living in non-slum areas) are the most vulnerable and consequently the most affected during extremely severe cyclones and other natural disasters.

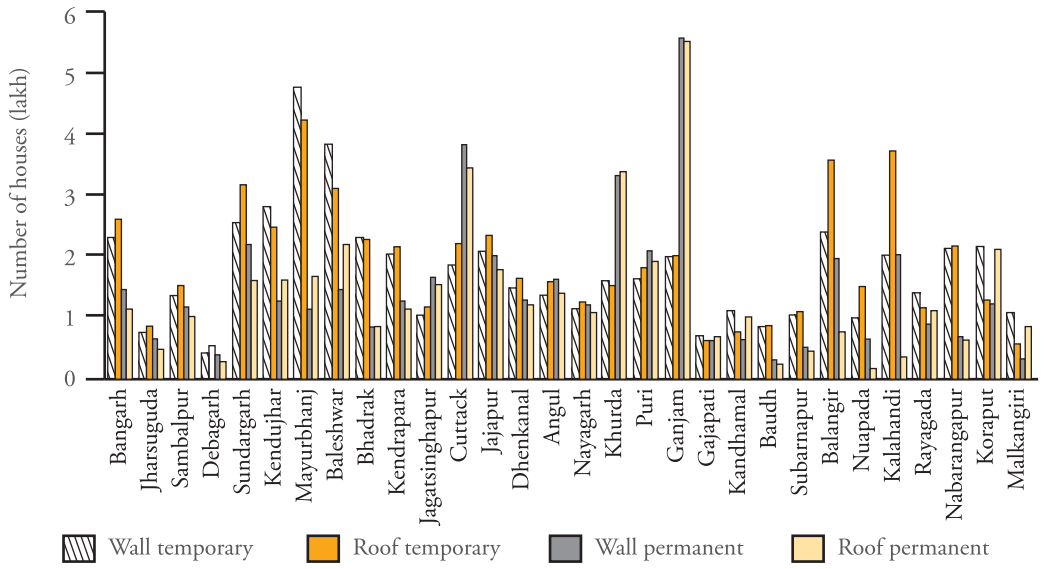
Settlement pattern: The pattern of rural settlements varies widely across Odisha. During the field visits it was observed that most of the large settlements grew organically with a few main access roads joined by many narrow arterial lanes. In many cases, the revenue villages are surrounded by other smaller villages and hamlets. The Scheduled Caste (SC) and Scheduled Tribe (ST) communities usually dwell in these isolated hamlets. Some of the smaller settlements are aligned to a main access road and the houses are located alongside the road, without much space in front.

Many villages visited in Puri, Khurda, and Cuttack predominantly had kutcha and semi-pucca structures with comparatively few pucca buildings. The settlement pattern of urban areas is similar to rural Odisha. Urban slums comprise a significant part of the households in cities such as Puri and Bhubaneswar. The slum areas are densely populated with several small semi-pucca and kutcha houses.

1.1.2 Housing Stock in Odisha by Type

Figure 1.1 demonstrates that the significant number of kutcha (temporary wall and roof) houses in Odisha, and in particular, in the worst cyclone-hit districts of Puri, Khurda, and Cuttack made the sector highly vulnerable. Kutcha wall structures would suffer massive destruction if cyclone and floods occur simultaneously or the latter follows the former. Figure 1.1 presents very useful baseline data to develop a disaster preparedness plan for housing, by type and cost of intervention, keeping in mind the vulnerability of structures say in the districts such as Mayurbhanj and Baleshwar.

Figure 1.1: Patterns of Walling and Roofing Material in Odisha (Rural and Urban Combined)



Source: Total (Urban and Rural) Housing Stock as per Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.

Of the total urban population in Odisha, 23.86% dwells in urban slums where nearly 91% houses are either kutcha or semi-pucca, rendering them extremely vulnerable to calamities such as the Fani. In larger and economically more significant coastal cities such as Puri and Paradeep, the kutcha or semi-pucca slum settlements located along the coastline are inhabited by marine fisherfolk. Such populations bear the brunt of cyclonic disasters, not only in terms of fatalities but also livelihoods loss.

1.1.3 Housing Policy and Enforcement

With limited engineers in the departments to guide rural housing, the enforcement of the codes and guidelines is not ensured. In the urban housing sector, Comprehensive Development Plan (CDP) Land and Implementation Policy, 2015 elaborates a long-term vision for development of city and peripheral areas and provides a framework for organised urban development. Its interventions include transfer of government land to development authorities, and allotment of serviced land and properties by development authorities. The Policy for Housing for All in Urban Areas, Odisha 2015 aims to create a comprehensive, holistic policy framework to address all aspects of housing for the urban poor, including slum rehabilitation and redevelopment, as well as new housing and rental housing. Its objective is to work towards a set of strategies to create a steady supply of affordable housing stocks to meet the growing demand.

1.1.4 Government Social Housing Programmes

Rural Housing

The nodal department in Odisha for rural housing is the Panchayati Raj and Drinking Water Supply Department (PR & DW) under the Director, Special Projects. Rural households dwelling in kutcha houses in Odisha are eligible for assistance and can avail housing benefits from the following programmes supported by the government.

- Pradhan Mantri Awaas Yojana–Gramin (PMAY–G): Government of Odisha incentivises timely completion of construction of new houses. Jobwork under MGNREGA could be utilised for house construction under PMAY–G.
- Apart from PMAY-G, Government of Odisha provides assistance for house construction through Biju Pucca Ghara Yojana (BPGY), Matsyajivi Basagruha Yojana (MBY) for fisher folk communities, Nirmaan Shramik Pucca Ghara Yojana (NSPGY) for construction workers and Pucca Ghara Yojana (Mining) for workers in the mining sector.
- Additional support for construction of toilets can be availed through Swachh Bharat Mission (SBM).

Urban Housing

Under the nodal Housing & Urban Development (H&UD) Department, Government of Odisha, the Odisha Urban Housing Mission (OUHM) was set up in 2016 for improving the housing stock in the state. For urban housing, there

are programmes such as PMAY (Urban) comprising of four verticals: Beneficiary Led Construction (BLC), In-situ Slum Rehabilitation (ISSR), Affordable Housing in Partnership (AHP), and Credit Linked Subsidy Scheme (CLSS). In Odisha, the most popular social housing programme in urban areas is the BLC which helps people to build their pucca houses on their own land where the Record of Rights of the land is in possession with the beneficiary. As in the rural areas, additional support for the construction of toilets can be availed through SBM. The Government of Odisha has passed the Land Right to Slum Dwellers Act, popularly known as "Jaga Mission" in which slum dwellers are facilitated to own land.

1.1.5 Building Materials and Technologies

Odisha being a large state with 30 districts, and varying climate types and cultures across diverse communities, the rural housing patterns also vary widely. The predominant walling materials are laterite stone, fly-ash and clay brick, cement, sand, aggregates, mud, bamboo, etc. In many places people use mud walls and reinforced bamboo mud walls (locally called *jhatimati*). In rural areas roofing is also done with timber/bamboo rafters and purlins with asbestos/ Corrugated Galvanised Iron (CGI) sheets/clay tile roofing, thatch/straw, etc. Doors and windows are made of timber, steel and in some places with bamboo.

In the urban sector, 46.92% of the total houses have concrete roofs while the rest are made of grass, bamboo, wood, mud, asbestos, etc.[8] This exposes a significant portion of the urban population to the effects of natural calamities and disasters. The second most commonly used material for roofing is galvanised iron (GI)/metal/asbestos which, if not constructed properly, will lead to damages in case of cyclone or other natural calamities. There is also a scarcity of shuttering materials and bricks. Overall, the vulnerability index of housing in Odisha is very high.

1.1.6 Capacities: Engineers, Building Materials, Masons, Labour

Government engineers are already burdened with ongoing construction programmes and implementation of various schemes. Therefore, the time and attention required for offering technical guidance to the house-building process by owners is difficult to find. However, there is adequate know-how among government engineers about Reinforced Cement Concrete (RCC) construction works. All that is needed is to infuse technical know-how regarding disaster-resilient construction practices and alternative technologies.

The masons and labour are largely untrained or semi-trained. Therefore appropriate training is critical for building resilience in house construction work, especially since these areas are not only cyclone-prone, but also flood-prone, and located in Seismic Zone III.

1.2 Post-Disaster Context

1.2.1 Effects of the Cyclone

The cyclone affected 14 districts of Odisha especially Puri, Khurda, Cuttack Jagatsinghpur, and Jajpur. It is estimated that about 2.96 lakh[9] rural and 0.66 lakh[10] urban houses were affected; district-wise details are furnished in Table 1.1.

Table 1.1: Damage to Housing in Odisha

	Structure	Type of Damage	No. of Houses Affected	Total Number of Houses Affected
Rural	Pucca	Completely	937	**2,95,703**
		Substantially	14,181	
		Partially	61,074	
	Kutcha	Completely	21,015	
		Substantially	75,556	
		Partially	1,22,940	
Urban	Pucca	Completely	379	**66,040**
		Substantially	5,435	
		Partially	27,352	
	Kutcha	Completely	3,125	
		Substantially	12,571	
		Partially	17,178	
		Total		**3,61,743**

Note: The geo-tagged photo analysis has revealed that partially damaged pucca buildings as per PR&DW's database are actually semi-pucca structures with pucca wall and CGI or asbestos roof.

While the pucca buildings generally withstood the high wind load, 15,118 rural and 5,814 urban pucca buildings were badly damaged/destroyed due to trees and other structures falling on them. Puri has the highest number of destroyed pucca buildings. In the affected districts, 61,074 rural and 27,352 urban pucca buildings need repair and retrofitting. Puri Rural alone has about 69% of the total number of affected houses among the 14 districts. The wind speed was so high that many kutcha buildings (i.e. with kutcha walls) have been levelled to the ground, rendering many families temporarily homeless, compelling them to stay with relatives/neighbours or in makeshift tarpaulin tents.

During the field visits it was observed that the slums are severely affected in the urban areas. More than half the slums affected (829 slums of 1508[11]) are situated in the three most severely affected districts of Puri, Khurda, and Cuttack. Approximately, 93%[12] of the houses in these urban slums were either kutcha or semi pucca. Further, in cities such as Puri and Cuttack, there are several slums which are situated on the river/coastal side. These factors increased the vulnerability of the slums and therefore the damages were largely concentrated in these areas.

1.2.2 Damage Analysis of Buildings and Settlements Due to the Cyclone

The predominant type of kutcha buildings in Odisha are made either with mud walling of varying thickness (300 millimetres [mm]–450mm) or with bamboo reinforced mud walls, commonly called as *jhatimati*. The roofs are made of bamboo under-structures, with closely-spaced-split bamboo grids, like a mesh supporting bunched up straws on top. The front verandas are mostly with the same roofing system, supported on bamboo or timber posts. It was observed that while high wind suction blew off the straws in many kutcha houses, the under-structure remained intact. The kutcha houses which were in poor condition and had gable walls have collapsed. The affluent families in rural Odisha live in three to four pucca rooms with a few kutcha rooms and verandas; the kutcha structures have been destroyed during Fani.

A large number of semi-pucca buildings had brick or laterite stone walls with CGI or asbestos as roof cladding material laid on mostly timber trusses. Many primary and upper primary schools and relatively affluent households had this type of building. This pattern was observed while going through the villages and while moving from one block to another. What was common to all of the damaged buildings was missing purlins and roof covers, while the trusses were intact. Close observations revealed that the timber purlins with the asbestos roof covering were blown away by the high wind leaving very little remains of the roofing materials (e.g., upper primary school at Balianta, Khurda [Bishuniapada]). However, the timber trusses were intact and standing in place. Inspection revealed that the building did not have any maintenance for a prolonged period causing deterioration of the structure and hence loss of strength. The anchorage of the truss sitting on the wall was grossly inadequate.

Some of the well-built kutcha buildings could have survived the cyclone if they had cross bracings, ensuring truss action against the wind load. The use of bracing was not observed even in the buildings and sheds with RCC pillars and CGI sheet structures owned by rich people. For example, in Balianta block of Khurda district, there were 60 poultry farms and none of them had cross bracings. These buildings had shallow roof slopes making them vulnerable to wind suction. About 40 of 60 such sheds collapsed like a pack of cards, causing massive financial losses and a considerable number of birds perished during Fani.

Many semi-pucca buildings in the affected districts had laterite, brick or fly-ash brick walls. Those who could not afford RCC roofs had adopted mono-pitch roofs cladded with asbestos or CGI sheets with timber or steel under-structures. These roofs did not have adequate anchorage with the wall to withstand the high wind suction. A roof structure should be suitably tied with the wall through RCC band to avoid uprooting due to high wind suction. Another reason for damage of the roof cladding materials, such as asbestos and CGI, was the lack of wind arresters. The roof sheets were only bolted to the purlins of the under-structure and hence, the failure started from the weakest joint that could have been due to a construction error or due to the aging of the structure. This happened due to stress concentrating at the bolts leading to sudden failure. Many buildings could have been saved by using two to three wind arresters (mild, steel-flat members) on the top of the roof sheets and anchored to the under-structures as an additional wind stopper. The lack of wind arresters causing the blowing off of roof sheets was observed in the high-end structures as well (close to Batamangala).

The sheet-roofed buildings (majorly AC sheets) were the most affected with varying degrees of damage to the roof structures. They were either damaged due to the wind suction displacing and breaking them, or from flying objects and falling trees.

During the field visits, many toilets were found to be roofless. In summary it may be said that the main cause of cyclone damage was non-compliance with the safety norms recommended by the National Building Code (NBC) and the related Bureau of Indian Standards (BIS) codes.

Debris

The building debris is limited to collapsed kutcha houses where mud and bamboo were used. The quantity of the damaged asbestos and CGI roofing sheets is considerable in Puri followed by Khurda and Jagatsinghpur. The total volume of the debris from the pucca houses, based on 30 square metres (sq m) covered area of each house, is 12.5 lakh cubic metre (cu m) (rural + urban), which is the total volume of the materials present in the buildings, excluding the foundation. For the mud houses, the total volume of materials would be 115 lakh cu m (rural + urban). While mud as debris could be reused in the reconstruction work, e.g., plinth filling; the debris from the pucca buildings is not in a condition for reuse except the 0.01 lakh cu m of steel that could be reused/recycled.

1.2.3 Increased Risk

In all the settlements visited, it was observed that people have started repairing/rebuilding their kutcha and semi-pucca houses in the same manner as they used to do in the pre-disaster situation, resulting in increased risk.

In Odisha, the traditional construction system using bamboo reinforced mud walls and straw roofs with bamboo under-structures does not include any diagonal bracing. This makes the structure extremely vulnerable to horizontal load caused by wind. In many other high-wind-prone areas people either use split bamboo on top of the thatched roof as wind arresters, or they use net to stop the thatch/straw from flying off. In Odisha that is not the trend. As a result, the rebuilding of the kutcha houses right after Fani, following the traditional system, is increasing the vulnerability of the people. This problem could be resolved by organised training of the traditional bamboo- and mud- construction workers along with bamboo treatment process, which would increase durability and strength of the bamboo used in building works.

The wind-damaged semi-pucca structures made with laterite/brick walls with gently sloping asbestos or CGI sheets are being repaired by the people on their own initiative. It is just repair work following the same traditional principles, thus making the buildings as vulnerable to high wind as they were before Fani. It may be noted that a roof slope of 30 degrees is preferable for wind safety. A gentle slope in the roof is vulnerable to high wind suction leading to the roofsheet being blown off. This could be avoided by adequate anchorage of the roof under-structure to the supporting wall. Further, there is no wind arrester on the roof sheeting to hold the roof down safely during high wind. There is no roof band where the roof could be anchored either.

1.3 Impact Assessment

1.3.1 Impact on Housing Sector Goals

The cyclone Fani has adversely affected the progress towards housing goals. A significant number of people in Odisha have lost their homes. As a result, many households with senior citizens, women, and children are compelled to live in sub-standard shelters affording poor quality of life. With the massive damage to housing stock, the targets for Housing For All may have to be reworked. In addition to financial constraints, constructing additional houses will be a challenge since the available materials and human resources for construction are inadequate in most of the districts.

1.3.2 Impact on the People—Women, Children, the Elderly, People with Disabilities, and SC&ST Communities

Women were significantly affected during the cyclone as the cyclone shelters offered no privacy. Families started moving to the cyclone shelters on the evening of 2 May 2019. However, women took time to wind down their households and moved to the shelters through the high winds that had already started blowing. In Bramhagiri and Satybadi blocks of Puri and Balianta block Khurda, some of the aged people could not move to safe places and took shelter in the corners of rooms. Many households had kutcha kitchens which were totally destroyed in the cyclone. Therefore, women had difficulties in terms of arranging resources to restart cooking in makeshift sheds. The women also faced difficulties in using the toilets since the asbestos/CGI-sheet roofs of several toilets were blown away by the cyclonic winds.

Field visits in Kantapada and Niali blocks revealed that the extent of damage was far greater in the SC and ST hamlets (locally called *padas*/*sahis*), with predominantly kutcha houses as compared to general caste homes which were mostly pucca or semi-pucca.

Urban difficulties were not too different from those faced by the rural population. During interactions with the local communities it was learnt that there was some resistance by the slum-dwellers to move to the shelters (possibly fearing eviction).

During the field visits it was observed that many marginally above-poverty-line (APL) households were pushed below the BPL threshold by the cyclone. Some of them still have one small pucca room, but all other rooms including the kitchen and veranda that were kutcha, had been completely destroyed. People with disabilities were amongst the most affected groups since many of them lost their mobility devices.

Livestock losses have been observed in all the villages visited due to destruction of sheds and shelters. In Balianta, 40 out of the 60 poultry farms were destroyed by the cyclonic winds. The cows and the goats were set free during the cyclone since there was no safety arrangement made for them. Livestock is an integral part of rural living, and as of now there is no viable option for the safeguard of livestock. These issues need support through focused efforts of the administration and community participation.

1.3.3 Homelessness

While incidence of homelessness is relatively low in the rural areas, people without homesteads are common among BPL households. The assessment covered marine fisherfolk that resided close to the coast in Puri Sadar block in Beldala Panchayat (rural), and in Puri slums (urban) like Pentakotha. Most of these rural households were homeless and would require support from the government.

The field visits (in Khurda, Puri, Cuttack, etc.) also indicated that many families were rendered temporarily homeless by the destruction of their kutcha houses.

1.4 Damage and Loss

The damage assessment in rural housing is based on the data received from the PR&DW, Government of Odisha on 1 June 2019 at 11:29 a.m. Since the data related to damages in urban housing was not available at the time of the assessment, the percentage of damage observed in the rural housing (vis-à-vis the baseline data) has been used to calculate the damages to urban housing. This assumption was verified during field visits to the three slum areas in Khurda and Puri districts. The percentage of damage in rural housing was applied by district and house type on the urban baseline data. Based on field visits and interactions with the government engineers, the team worked with the assumption that all the partially damaged kutcha houses would need to be reconstructed, while calculating the reconstruction cost in the housing sector. The cost for partially damaged semi-pucca buildings was considered for repair and retrofitting to increase their resilience.

1.4.1 Basis and Assumptions

All unit costs of reconstruction and repair in rural areas are in accordance with the Bill of Quantities furnished by the PR&DW, Government of Odisha, as per the prevailing market rates. Discussions with city engineers revealed that the cost for reconstruction and repair in urban areas should be considered to be 10% to 15% higher than in rural areas. Calculations for determining the cost of damage to houses were based on the following assumptions.

1. All damaged kutcha houses need reconstruction and hence, the value of damage has been assessed at 25% of the reconstruction cost of a pucca house, viz., INR 71,250 per dwelling unit
2. Cost for all pucca houses that are totally or substantially damaged has been considered as equivalent to the reconstruction cost viz., INR 2.85 lakh per dwelling unit
3. For semi-pucca houses that have been partially damaged, the cost of damage has been assumed to be 27% of the reconstruction cost viz., INR 76,950 per dwelling unit

1.4.2 Cost of Housing Damage

Table 1.2: Cost of Damage to Housing

Type of Damage to Housing	Rural (Nos.)	Urban (Nos.)	Total (Nos.)	Damage Cost (INR crore)
Kutcha houses damaged	2,19,511	32,874	2,52,385	1,798.24
Pucca houses totally and substantially damaged	15,118	5,814	20,932	596.56
Semi-pucca houses partially damaged	61,074	27,352	88,426	680.44
Total			**3,61,743**	**3,075.24**

1.4.3 Loss of Household Goods, Cleaning of Mud and Debris from House

Though field visits revealed that people had lost household goods and stored food, data on this was not available. Therefore, the Damage, Loss, and Needs Assessment (DLNA) on housing has not been able to ascertain the losses incurred by the households in this regard.

1.4.4 Cost of Recovery

Cyclone Fani has affected 2.96 lakh rural and 0.66 lakh urban houses in 14 districts of Odisha. The team in consultation with the government officials assumed that a total of 2.736 lakh houses would need to be reconstructed (2.346 lakh houses in rural areas and 0.39 lakh in urban areas), and a total of 0.885 lakh houses would need to be

repaired/retrofitted (0.61 lakh houses in rural areas and 0.275 lakh in urban areas). In Puri alone, 1.68 lakh houses need reconstruction; this includes both kutcha and pucca buildings. It is important to note that the partially damaged houses must be retrofitted in line with BBB principles in order to enhance their resilience against not just cyclones, but other disasters such as floods, seismicity, etc. (applicable in some places).

Cost of Reconstruction and Repair/Retrofitting

The principles adopted for undertaking reconstruction, repair, and retrofitting have been outlined below.

- Reconstruct the completely damaged, substantially damaged, and partially damaged kutcha buildings.
- Reconstruct the completely damaged and substantially damaged pucca buildings.
- Repair and retrofit the partially damaged semi-pucca buildings in line with BBB principles.
- The cost of repair and retrofitting was calculated by the PR&DW Junior Engineers based on the current government schedule of rate and labour cost as per the market rates.

Cost estimates for reconstruction of a house of 25 sq m area plus area for toilet in rural areas, was carried out in consultation with the PR&DW Assistant Engineers and Junior Engineers as per the latest government schedule of rates and labour cost as per the market rates. The value arrived at is INR 2.85 lakh, which is inclusive of a pucca building with all resilient features, brick/fly-ash wall and RCC roof with artificial stone flooring and steel doors and windows along with toilet construction with soak pits, plumbing works with overhead water tank and electrification.

For urban areas, based on consultation with city engineers, it was decided that the construction cost of a 30 sq m house should be calculated by first taking into consideration the increase in built-up area and thereafter increasing the unit cost of a rural house by 10%. The estimated cost arrived at is INR 3.77 lakh, which includes, the cost for toilet construction and services.

For repair and retrofitting, the actual cost of the BBB elements and the repair as per the latest Schedule of Rates (SoR) and labour as per the market, worked out to be INR 0.674 lakh for rural areas. For urban areas, the cost has been worked out by first taking into consideration the increase in built-up area and thereafter increasing the unit cost over a rural house by 15%. The value arrived at is INR 0.93 lakh.

Based on the above table, the total cost of reconstruction, repair and retrofitting would be as follows.

Table 1.3: Reconstruction and Repair + Retrofitting Needs—Rural and Urban (Number of units)

District	Rural				Urban				TOTAL (Urban + Rural)
	Reconstruction		Repair & Retrofit	Rural Total	Reconstruction		Repair & Retrofit	Urban Total	
	Pucca	Kutcha			Pucca	Kutcha			
Angul	0	0	0	**0**	0	0	0	**0**	**0**
Baleshwar	0	21	0	**21**	0	2	0	**2**	**23**
Bhadrak	0	20	0	**20**	0	3	0	**3**	**23**
Cuttack	267	31,560	961	**32,788**	148	3761	530	**4,439**	**37,227**
Dhenkanal	0	2,174	2	**2,176**	0	110	1	**111**	**2,287**
Ganjam	2	123	6	**131**	1	14	2	**17**	**148**
Jagatsinghpur	28	4,096	138	**4,262**	3	622	12	**637**	**4,899**
Jajapur	6	12,383	79	**12,468**	1	373	7	**381**	**12,849**
Kendrapara	6	1,152	12	**1,170**	1	48	2	**51**	**1,221**
Kendujhar	0	4	0	**4**	0	1	0	**1**	**5**
Khurda	740	32,674	5,418	**38,832**	1,421	12,760	10,399	**24,580**	**63,412**
Mayurbhanj	7	942	1	**950**	3	37	1	**41**	**991**
Nayagarh	1	203	2	**206**	1	4	1	**6**	**212**
Puri	14,061	1,34,159	54,455	**2,02,675**	4,235	15,139	16,397	**35,771**	**2,38,446**
Total (nos.)	**15,118**	**2,19,511**	**61,074**	**2,95,703**	**5,814**	**32,874**	**27,352**	**66,040**	**3,61,743**
		2,34,629				**38,688**			

Source: PR&DW, Government of Odisha, 1 June 2019 11:29 a.m.

Figure 1.2: Reconstruction, Repair, and Retrofitting Needs in Rural and Urban Odisha (Number of units)

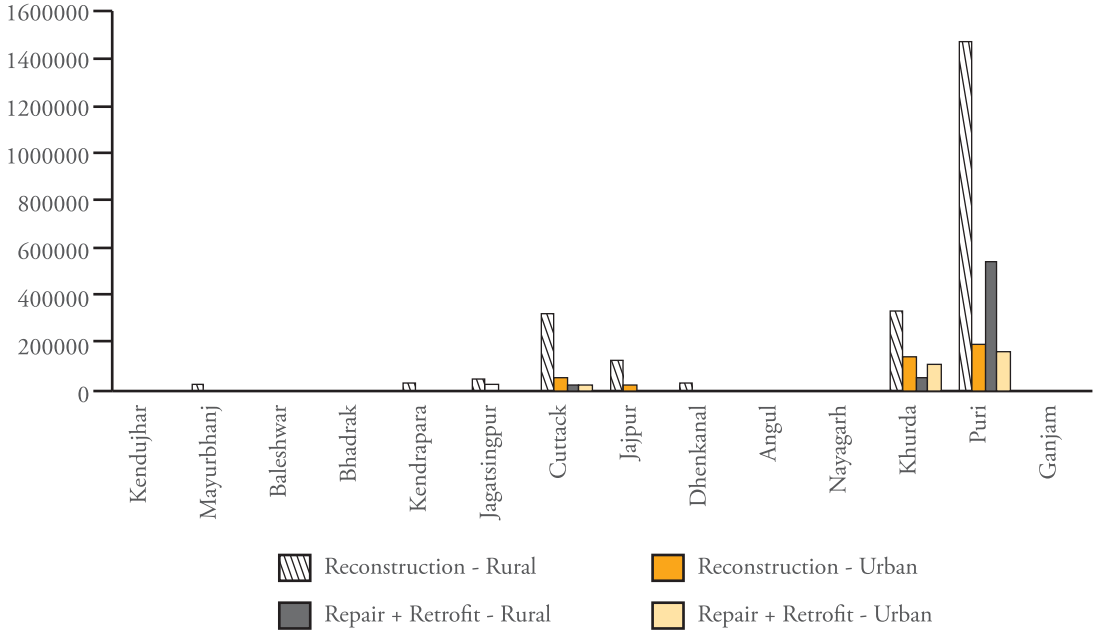


Table 1.4: Financial Implications of the Reconstruction, Repair, and Retrofitting Due to Cyclone Fani

Loss Items	Amount in INR (crore)	USD (million)
Rural: New construction: totally damaged kutcha and pucca buildings + drinking water (DW) + overhead (OH) tank + toilet + pit + electricity	6,694	956.22
Urban: New construction: totally damaged kutcha and pucca buildings+ DW + OH tank + toilet + pit + electricity	1,457	208.13
Rural: Repair and retrofitting of semi-pucca buildings with partial damage + BBB features + minor damage to toilet + DW+ electrical works	412	58.84
Urban: Repair and retrofitting of semi-pucca buildings with partial damage + BBB features + minor damage to toilet + DW + electrical works	254	36.34
Loss of household goods and house cleaning	0	
Figures include electricity, sanitation, and drinking water cost		
Grand Total	**8,817**	**1,259.53**

Cost for Capacity Building of Human Resources

As mentioned earlier, people have started rebuilding/ repairing their destroyed or damaged houses without any BBB features. Therefore, capacity building of the local masons (including traditional builders) as an immediate intervention can ensure resilience and avoidance of past mistakes. The traditional masons should be trained to adopt the four basic features of multi-hazard safety: A–anchorage, B–bracing, C–connection and D–detailing. Along with that, people should immediately be made aware of what a safe building is, even if it is made of local mud and bamboo (many traditional buildings survived cyclone Fani).

Multi-skilling: There is a need for repair and retrofitting of over 0.88 lakh semi-pucca buildings in 14 districts, with the highest demand in Puri district. Retrofitting requires multi-skilled workers who can simultaneously play the role of a mason, carpenter, electrician, and plumber—all four in one person. Such multiskilled workers would need a fully fitted toolkit, an electric drill, and other equipment. Special training for multi-skilled workers would require expert trainers and training programmes.

Entrepreneurship: The reconstruction phase is bound to see a spurt in the demand for building materials. As a feasible option, local entrepreneurs could supply building

Table 1.5: Housing Reconstruction and Repair Needs – Cost of Recovery by District (INR crore unless mentioned otherwise)

District	Rural			Urban			Total
	Reconstruction Cost	Repair & Retrofit Cost	Rural Total	Reconstruction Cost	Repair & Retrofit Cost	Urban Total	(Urban + Rural)
Angul	0.00	0.00	**0.00**	0.00	0.00	**0.00**	**0.00**
Baleshwar	0.60	0.00	**0.60**	0.08	0.00	**0.08**	**0.67**
Bhadrak	0.57	0.00	**0.57**	0.11	0.00	**0.11**	**0.68**
Cuttack	907.97	6.48	**914.45**	147.20	4.93	**152.13**	**1,066.58**
Dhenkanal	62.02	0.01	**62.03**	4.14	0.01	**4.15**	**66.19**
Ganjam	3.57	0.04	**3.61**	0.56	0.02	**0.58**	**4.19**
Jagatsinghpur	117.65	0.93	**118.58**	23.54	0.11	**23.65**	**142.23**
Jajapur	353.44	0.53	**353.97**	14.08	0.07	**14.15**	**368.12**
Kendrapara	33.04	0.08	**33.12**	1.85	0.02	**1.86**	**34.98**
Kendujhar	0.11	0.00	**0.11**	0.04	0.00	**0.04**	**0.15**
Khurda	953.24	36.54	**989.78**	534.02	96.77	**630.79**	**1,620.57**
Mayurbhanj	27.07	0.01	**27.08**	1.51	0.01	**1.52**	**28.60**
Nayagarh	5.82	0.01	**5.83**	0.19	0.01	**0.20**	**6.03**
Puri	4,228.46	367.22	**4,595.68**	729.57	152.59	**882.16**	**5,477.84**
Total cost (INR crore)	**6,693.56**	**411.85**	**7,105.41**	**1,456.89**	**254.54**	**1,711.42**	**8,816.83**
Total cost (USD million)	**956.22**	**58.84**	**1,015.06**	**208.13**	**36.36**	**244.49**	**1,259.55**
*Dollar conversion rate considered at USD 1 = INR 70							

materials produced using local resources, cost-effective, labour intensive, and environment-friendly methods. Such small units run by Self-Help Groups (SHGs), if supported by adequate equipment and skill training could produce fly-ash, lime, and gypsum (FALG) blocks as a sustainable option for walling. The cost of this option has been included in Table 1.7.

Housing Facilitation Centres: To ensure that the houses are actually resilient, there is a need for technical assistance at the door step of the affected people, which could be done through housing facilitation centres. This should ideally be within the BDO office interfaced with the district Executive Engineer (EE) for rural areas and the city engineers for ULBs. The Housing Facilitation Centres (HFCs) have been assumed to have minimum staff strength of three engineers/architects supported by three technical assistants to help house owners, masons, and carpenters to build resilient structures. The facilitators' main job would be to prepare drawings, estimates for all the reconstruction activities, be it new construction or repair and retrofitting. There is a need for monthly peer review by a committee led by the block engineer, with the help of the local engineering college teachers and private practising architects and engineers who have worked in the field of BBB. This would result in thousands of green and resilient buildings in the 14 districts—particularly in Puri, Khurda, and Cuttack.

Table 1.6: Cost of Running a Housing Facilitation Centre for the First 18 Months of the Recovery Period

Expenditure of the HFC	Amount in INR crore	Amount in USD million
Run by 3 architects/engineers x 18 months x 99 blocks	30.472	4.353
3 technical assistants for transport, communications x 18 months x 99 blocks	19.780	2.826
INR 4 lakh capital cost/HFC	3.960	0.566
Communication: Awareness campaigns, workshops, peer review, evaluation, and overhead: 25%	13.553	1.936
	67.766	**9.681**

Table 1.7: Cost of Recovery and Related Developmental Activities

Summary Total Costing for Recovery and Other Developmental Activities	Amount in INR crore	Amount in USD million
Cost of new constructions (urban + rural): totally damaged kutcha and pucca buildings with toilet + pit + DW + electricity and cost of repair and retrofitting of semi-pucca buildings (urban + rural) with partial damage + BBB features (Grand Total derived from Table 1.4)	8,817	1,259.53
Developmental Activities		
Capacity building	49.5	7.071
Small entrepreneurship 50 units/INR 50 lakh	25	3.571
Industry partnership: Production yards 50 @ INR 75 lakh/unit	37.5	5.357
Housing Facilitation Centre	67.766	9.681
Grand Total	**8,996**	**1,285.210**

Table 1.8: Value of Damage, Loss, and Recovery: Summary

Summary of Damage, Loss, and Recovery	Damage	Loss	D+L	Recovery
Housing, land, and settlement	INR 3,075.24 crore	0	INR 3,075.24 crore	INR 8,996 crore
	USD 439.32 million		USD 439.32 million	USD 1,285.21 million

1.5 Impact of Recovery

Post-Fani interventions include reconstruction of 2.73 lakh fully damaged houses and repair and retrofitting of 0.88 lakh houses. This section is on the impact of such interventions on building materials, livelihood, environment, gender, and disaster risk reduction (DRR).

1.5.1 Impact of Recovery on Building Materials

The damage caused by Fani has resulted in a huge demand for material required to reconstruct, repair, and retrofit a large number of houses in limited time. Unless the reconstruction and repair/retrofitting are well planned, the management of supplying construction materials in the post-disaster scenario will turn out to be a major challenge. Table 1.9 shows the quantities of the major construction materials required for the reconstruction, repair, and retrofitting work in the housing sector. It would help the state to prepare a procurement plan for each district and will enable reconstruction work to start at the earliest.

The massive requirement for material shown in Table 1.9 would be difficult to arrange. The required materials for PMAY–G housing in 2016–17 were 30.3 million bags of cement and 2.5 billion bricks for the whole state.[13] Therefore, there is a strong need for alternative building

Table 1.9: Rural: Major Material Requirements for Reconstruction

Key Building Materials	Reconstruction Need (A)	Partially Damaged Pucca Houses (B)	Total Material Required (A+B)	PMAY–G Total for 2016–17
Cement (bags)	2,20,07,368 bags	11,93,122 bags	232 lakh bags	302.53 lakh bags
Sand (cu m)	1,09,21,509 cu m	66,089 cu m	109.9 lakh cu m	48.03 lakh cu m
Aggregate (cu m)	9,13,872 c um	1,32,177 cu m	10.5 lakh cu m	26.26 lakh cu m
Brick (nos.)	1,92,55,21,712 nos.	50,12,139 cu m	19,305 lakh nos.	24,969.51 lakh nos.
Steel (tons)	9,30,77,324 tons	24,872 tons	931 lakh cu m	1,292.43 lakh cu m
Shutter (sq m)	89,93,938 sq m	11,74,911 sq m	101.7 Lakh sq m	80.29 lakh sq m

Note: For urban housing, reconstruction is 16.49% and repair-retrofit is 44.79% of the values in columns A and B
cu m = cubic metre
Source: Based on Bill of Quantities of a typical PMAY–G house, PR&DW, Government of Odisha

materials to ensure that the reconstruction works under post-Fani recovery is completed on time while ensuring quality and resilience.

Materials such as cement, bricks, and steel are highly energy (embodied) and CO_2 emission intensive and will have a significant negative impact on the environment. Under the PMAY–G, the Government of India is promoting cost effective and environment friendly approaches to construction[14] using local building materials and appropriate alternate technologies. Therefore, the state can reinforce this approach and promote sustainable green development with BBB features.

1.5.2 Impact of Recovery on Livelihood and Employment

The post-Fani housing reconstruction will create a variety of livelihood opportunities for the local people. Approximately 172 lakh days of work for skilled masons, and about 393 lakh days of work for unskilled workers will be created. Alongside, there will be opportunities for skill upgrading through BBB training programmes. The painting component of the repair, retrofitting and reconstruction work could be taken up by the women SHGs, either as organisations or individually after appropriate training. This way the reconstruction activities could lead to immense gender gains. Women's organisations could also manage building supplies alongside the HFCs, creating numerous alternate employment opportunities in every district.

1.5.3 Impact of Recovery on the Environment

(a) Reconstruction and Repairing: While the reconstruction, repair, and retrofitting is a good opportunity for creating resilient housing, while creating local level employment, the use of high (embodied) energy and emission intensive technologies would have significant negative impact on the environment. It is very important that the reconstruction programme focuses on the use of green design and appropriate technologies that are climate change resilient, and mitigate the negative impact on the environment. The reconstruction, repair, and retrofitting will embody 4,889-megawatt hour (Mwh) of non-renewable energy, and will emit 2,597 thousand tonnes of carbon dioxide (CO_2) at the production centre (Table 1.11). As an alternative to bricks if FALG and rattrap bonded brick walls are used for reconstruction, a considerable amount of non-renewable energy and emission could be saved. In Odisha, Compressed Stabilised Earth Blocks (CSEBs) and treated bamboo are good green technologies provided they are discussed with and accepted by the people.

(b) Immediate relief: With regard to immediate relief and recovery, the government was very prompt and provided polythene sheets to cover damaged roofs. As on 20 May

Table 1.10: Rural Employment Potential of Major Building Components (lakh work days)

Type of Worker (A)	Reconstruction (B)	Repair + Retrofitting (C)	Total lakh work days (B+C)
Unskilled	382	10	393
Semi-skilled	26	2	28
Skilled	167	5	172
Highly skilled	59	3	62
Women workers (unskilled for painting)	35	9	44
Women workers skilled in painting	31	8	38
Total	699	37	737

Note: For urban housing, reconstruction is 16.49% and repair-retrofit is 44.79% of the values in columns B and C.
Source: Calculations carried out with the PR&DW, Government of Odisha, JE and AE based on damage data from PR&DW 28 May 2019.

Table 1.11: Rural: Embodied Non-renewable Energy and CO2 Emission

Emissions Due to Recovery Impacts	Reconstruction (A)	Repair & Retrofitting (B)	Total (A+B)
Embodied non-renewable energy kilowatt hour (kWh)	47,05,602 kWh	1,83,730 kWh	48,89,333 kWh
CO2 emission tons	24,99,218 tons	97,582 tons	2,596,801 tons

Note: For urban housing, reconstruction is 16.49% and repair-retrofit is 44.79% of the values in columns A and B
Source: PhD thesis, Das PK (BMTPC, Development Alternatives, and other sources)

2019, the government had distributed polythene sheets (or equivalent financial assistance of INR 500) to more than 0.7 million families.[15] While the sheets were immensely helpful for the families, the arrangement is only temporary. Eventually, the roofs will be rebuilt/repaired, and the polythene sheets will be discarded. Considering the large volume of polythene sheets supplied, the government needs a plan to dispose of the sheets safely and effectively, in order to avoid a negative impact on environment. In addition to the polythene sheets, trees fallen on the houses and other debris collected from the houses, also pose significant environmental risks.

1.5.4 Gender, Social Inclusion, and Disaster Risk Reduction

Of the households in Odisha, 11%–12% are headed by women.[16] These households should be prioritised in the recovery framework. The destroyed kitchens, the toilets without roofs, the lack of access to drinking water, lost livestock, etc. have put the women in great distress after Fani. During the community interactions it was learnt that the old and the pregnant women have been the worst sufferers owing to Fani. In the villages, the third gender has experienced social isolation. Lack of legal land ownership is high among the SC and ST communities and other marginalised groups and hence, such households should be given special emphasis in reconstruction. People with disabilities were also one of the most affected, since many of them lost their mobility devices. All these groups will need enhanced technical and financial assistance from the government for rebuilding their houses.

1.5.5 Resilient Cities and Urban Poor

The vulnerable communities of the cities are the least resilient. As such, cities must acknowledge that a resilient informal sector strengthens the resilience of the city at large. Hence, efforts towards enhancing the resilience of the urban poor living in slums must view them as key agents of change. Rebuilding after the disaster is an opportunity to factor in resilience by increasing access to safe and affordable housing, reducing human vulnerability caused by tenure insecurity, and building networks for community support, collective identity, and social cohesion. The Government of Odisha already has the 'Jaga Mission' which aims to provide land rights to around 18 lakh landless urban slum dwellers residing in all Municipal Corporations and Notified Area Councils (NACs) in the state. The state government plans to retrofit existing dwellings and also relocate some of the households and this is an opportunity to identify more resilient locations and impart technical know-how and support for more resilient constructions. Further, vulnerability assessments of the slums by a specialised institution can be taken up to identify risks and hazards, and develop a plan to support each community in addressing their prioritised needs and provide required hardware and training. In addition to the land titles and assistance for construction of dwellings, basic infrastructure such access to improved water, sanitation, connectivity to the main city by public transport, and waste management services should be ensured simultaneously.

1.6 Sector Recovery Strategy

The planning and implementation of post-Fani reconstruction would require a team of dedicated workers working on mission mode, since the line department staff members are already overloaded with the existing housing and other projects and programmes. In Puri, Khurda, and Cuttack there would be a need for strengthening the existing human resources of the line departments by hiring trained technical personnel for a period of three years, so that the routine activities of PR&DW, Rural Development, Works Department staff are not affected. The main focus of the reconstruction, repair, and retrofitting work would be to ensure owner-driven/community-driven, high quality resilient housing in Odisha, based on green and cost effective technologies in line with BBB principles. Capacity building of the construction workers is the key to resilient housing. An in-depth study on the capacities of the construction materials suppliers would help in planning and managing the reconstruction.

1.6.1 Immediate Response

It was observed that within two weeks after Fani, people started rebuilding and repairing houses in anticipation of the impending monsoons (in June) without adequate safeguards against high wind. Direct government support for promoting resilient construction amongst the people is an immediate need to minimise risks.

The immediate support from the government is required to: a) build improvised traditional houses with local materials (e.g. timber from fallen trees, cement stabilised *jhatimati* walls, treated bamboo roof under-structure, etc.) for the temporarily homeless people having no resource to rebuild on their own, b) use tarpaulin or equivalent materials to cover those bamboo roof structures where the straws have been blown off and carryout retrofitting, c) retrofit and repair the semi-pucca buildings if the people have not done it yet, and d) retrofit the semi-pucca buildings that have been repaired by the people but are not safe against the wind.

A cadre needs to be put together of technicians, expert masons, and engineers who have the prior experience of

resilient construction and retrofitting. Such groups could travel on bikes while carrying the repair and retrofitting materials and tools on an accompanying vehicle. Some materials could be procured locally, such as timber from the fallen trees. The teams could reach out to the masons on site and provide hands-on training.

1.6.2 Role of Line Departments

The PR&DW, Public Works Department (PWD), RD, Housing and Urban Development (H&UD) and other construction departments need to coordinate with each other for the procurement of materials and masons for the reconstruction work. The PR&DW and H&UD department would play a very important role in the implementation of reconstruction work. However, they need to strengthen their capacity in DRR by undergoing training. It is important to map the different stakeholders and their needs under the recovery project. For monitoring and control, adequate staff members need to be deputed with clear job descriptions. Considering this situation, HFCs should be established in all the blocks of Puri, Khurda, Cuttack, which would assist local house owners in developing designs, sourcing materials, and in ensuring quality control.

1.6.3 Principle of "Build-Back-Better"

All the reconstruction, repair, and retrofitting must be multi-hazard safe and not focused only on cyclones. The basis for this action should be the relevant BIS codes, hazard maps, and in particular cyclones and flooding which are frequent. Recovery should be integrated with DRR measures built into it (Priority 4 of the Sendai Framework). Each retrofitted house would act as a good example of resilient housing, and inspire, educate and motivate others in the community to adopt BBB. The objective is to embed resilience into the culture and construction practices.

1.6.4 Proposed Economic and Technical Arrangements for Reconstruction

- PR&DW would be the nodal agency for all the reconstruction work in the rural areas
- Based on the past experience of post-disaster interventions, the new construction would be based on the PMAY-G in the rural, and PMAY-U in the urban areas and the affected people will get the same degree of technical support, covered area, etc. to avoid social conflict and disparity.
- To ensure that the recovery is in line with BBB principles techno-managerial support can be brought to the doorstep through the HFCs at block level. Considering the extent of damage, it would be necessary to immediately establish 64 HFCs in each block of Puri (15x2), Khurda (10), Jajpur (10), and Cuttack (14). In the second phase, eight in Jagatsinghpur and six in Mayurbhanj would be established. In the same districts there would be 21 HFCs (urban areas) making a state total of 99 HFCs. Apart from technical support for the reconstruction, repair, and retrofitting, the HFC facilitators would provide information on the ongoing governmental programmes to the households, e.g., on financial assistance, toilets, drinking water, solar lighting programmes, and entitlements, increasing transparency in the system.

1.6.5 Design Assistance in the Context of Odisha

People's aspiration for their dream homes (not shelter), should be at the centre of the reconstruction project. This would be done by conducting participatory design exercises involving the affected people. In this process a basket of zone-specific designs could be made available wherein the household takes the final decision on the house design. People would have the flexibility of customising the design to suit their pattern of living and culture. Design and detailing would have the flexibility of expansion to suit household-specific needs and grow incrementally.

A complete house should have facilities for a toilet, drinking water, power supply, and shelter for the livestock. The facilitators of the HFC would act as technical support to the people and prepare the working drawings, estimation of materials and cost of house construction. House design and access to the common facilities should be barrier free for people with disabilities (both temporary and permanent), the elderly, pregnant women, and children. This aspect of house design is very important especially during emergencies. The designs would provide for the multipurpose veranda which is an integral part of rural life to be used for income generating activities, relaxing, chopping, sorting, cooking, etc. Since floods are frequent in many districts, it is advisable to have flat roofs with the provision for a staircase. Ledges at lintel level could be used for storing household goods during floods.

1.6.6 Materials, Technologies, and Costs

Odisha has a tremendous potential for fly-ash based construction materials. FALG is an environment-friendly material that is acceptable, durable, cost effective, and non-pollutant.

To reduce the consumption of clay burnt bricks, rat-trap-bonded walls could be used. While being more labour intensive, it would save cement and bricks by 20%. As far as possible, the designs should use local materials. In the reconstruction works, the house owners would select the

materials. Home owners could either order the construction materials directly or seek help from the HFCs.

In consultation with the government engineers at block level, the facilitators of HFC would prepare the estimates, working drawings, models, etc. to be displayed at the municipality, block office, and the Gram Panchayat (GP).

1.6.7 Building Capacity for BBB

The key role players in BBB are the masons, engineers, BDOs, and support staff since BBB is not just a technical issue. Resilient development is only possible when the teams at the block office and ULBs understand the philosophy of BBB. Therefore, training for all involved should be the top priority and a part of the immediate response. The first group to be trained includes the masons, to develop skills in a cost effective, labour-intensive way, and with a view to using green technologies with multi-hazard safety to ensure that all houses are indeed built back better. In the reconstruction programme only the practising masons would be trained.

By conducting five training programmes in the 99 HFCs (40 masons per batch), a total number 19,800 master masons would be created (a 10-day training module) in six months. Each of these trained masons will work with five semiskilled/helpers and therefore eventually there would be 99,000 BBB-trained masons and helpers in the five districts to support recovery. The training of masons should be implemented with the help of appropriate training providers. If the households agree, the training of masons could be carried out hands-on at the houses of the aged, women-headed households, and the PWDs so that additional assistance can be extended to them on first priority.

The HFCs after completing the reconstruction work would continue to work in the sector, supporting the private and government housing programmes. The facilitators would remain as human resources for future decades to come, and thus help creating a resilient and eco-friendly environment.

1.6.8 Implementation Method

Owner-driven/community-driven reconstruction and repair, with technical support of the HFCs, would be a feasible option in the present context. However, reconstruction of houses for the people with physical or mental disabilities, the elderly, women-headed households, etc., would need government support as well as additional support of HFCs.

1.6.9 Monitoring and Quality Control

There is a need for a high-tech system for monitoring and control of the reconstruction work since high quality construction would reduce the frequency of maintenance and enhance the durability of the buildings. The technical staff at grassroot level would use mobile phone-based data collection and documentation. The HFC would coordinate with the material suppliers and contractors at the local level.

1.6.10 Odisha's Own Resources on Alternative Environment-friendly Design and Technologies

The culture of green and resilient technologies began in Odisha soon after the 1999 Super Cyclone. A big team of young architects, engineers, and construction workers was trained and several Technology Demonstration Units (TDUs) set up across the coastal districts of Odisha. Most of the trained people are already there in the state. In 1999, the Odisha Health and Family Welfare Department had initiated a programme of cost effective, environment friendly, primary healthcare buildings. There are NGOs that have been working in rural Odisha for decades in the field of cost effective and green technologies in housing. From the above discussion, it is clear that Odisha has many options of cost effective and green technologies and that there are trained and experienced human resources in the state who could help in making the reconstruction resilient.

1.6.11 Green Odisha

By constructing a complete house with local materials-based technology, the emission of CO_2 and depletion of non-renewable natural resources could be reduced significantly. Even energy intensive materials (brick, cement, etc.) could be used prudently by reducing their consumption in building construction, e.g. rat-trap-bonded brick work consumes less brick and cement than conventional solid brick work. The reconstruction of 3.62 lakh houses is a good opportunity to promote green architecture that would take a few steps forward towards achieving a green and resilient Odisha. The Government of Odisha could incentivise the use of green design and technologies as well.

1.7 Key Policy Recommendations

To support the rebuilding of Odisha and to restore normalcy by promoting resilience, the following initial policy recommendations may be considered.

1. To ensure transparent recovery, clearly communicate to the cyclone-affected people: a) who are entitled to assistance (selection criteria), b) what kind and amount of assistance would be provided by the Government of Odisha and others, and c) what are the responsibilities of the beneficiaries, etc.

2. **Use multi-hazard maps for all reconstruction work:** Site selection and type of building structure should be according to the multi-hazard maps.
3. **Multi-hazard maps to be in 1:5000 scale:** In order to take decisions on the buildability of safe structures there is a need for multi-hazard maps in a scale of 1:5000.
4. **Designate the no-building zones in the land-use maps:** Review the existing Coastal Regulation Zone (CRZ) guidelines. Strictly enforce the guidelines while rebuilding and relocating vulnerable people. Anyone building in the no-building zones will not be entitled to government facilities (grants or reliefs). This is particularly applicable for the coastal belt of Odisha.
5. **Revisit the cyclone shelter designs to enhance comfort and privacy for women**
6. **Construct livestock-safe places:** So far there is no effective, safe, and sustainable solution for livestock during cyclones. There is a need for referring to the international success stories and adapting them in the context of Odisha.
7. **Land and settlement planning**
   Among the affected communities, it was found that there are a number of families that are without homesteads. The Basundhara and Jaga missions can take care of the rural and urban homestead-less people by making provisions for land with titles where the houses can be constructed.
8. **Building rules and enforcement**
   - Review and amend (if needed) the existing building bye laws in the context of multi-hazard safety of buildings.
   - In an owner driven reconstruction process, certain rules and guidelines regarding good practices in rural housing need to be framed and enforced.
   - Strengthen enforcement mechanisms in all zones, with adequate staffing of regulatory agencies and capacity-building of regulatory staff members.
   - Discourage the construction of boundary walls using energy intensive materials and encourage the use of bio-fences, in all new constructions.
9. **Recovery interventions to 'build-back-better' and integrate DRR and environment safety considerations**
   - Build capacities in the local building fraternity—including engineers, architects, and masons in all municipalities and panchayats.
   - Every household in a hazard-zone should be insured. The premium for low-income households could be subsidised or be paid for by the government.
10. **Relocation and resettlement planning**
    - People may be incentivised to move from hazardous zones to safety.
    - If 'safe' land is not available for separate homesteads, a cluster housing approach may be considered.
11. **Culture of alternative environment-friendly design and technologies**
    There have been efforts made earlier by international agencies and other organisations to promote appropriate disaster-resilient construction technologies, post the Super Cyclone of 1999. The same could be revitalised through the HFCs. NGOs, trusts, etc, having prior experience of post-cyclone reconstruction could be approached to utilise their resources for the recovery.
12. **Monitoring and control**
    Existing database management system of the PR&DW, DRDA, H&UD and Odisha Urban Housing Mission should be strengthened with adequate staff. Also, mobile-based applications should be developed for on-site data monitoring and acquiring data on the progress and quality of the construction.

1.8 Implementation Plan

The following implementation plan is being suggested to achieve resilient and green recovery of the housing sector of Odisha.

- Reconstruct and retrofit houses owned by women, persons with disabilities, and other vulnerable groups.
- Establish HFCs at the earliest and make them operational at the block and ULB level.
- Take stock of how many skilled masons and labourers exist and where they are located (migratory and local). Also, carry out a skill-gap analysis and implement training (BBB) in all 14 districts.
- Prepare a procurement plan of the construction materials that are available in the state and assess how much is to be acquired from the neighbouring states. Conduct a resource-mapping exercise in all the districts through the HFC.

Immediately establish a control room at the PR&DW and H&UD, networked with HFCs at district-level for tight supervision and technical support to the HFC. The control room should be led by a professional project manager with computerised planning, scheduling, monitoring, and control skills.

Table 1.12: Implementation Timeline: Short, Medium and Long-term Interventions for Recovery

Sr. No.	Period and Task	Who Does it	Expenditure on Recovery
Short term 0–12 months			
S1	Complete damage assessment	Revenue Dept., Office of the SRC, PR&DW, DRDA, H&UD, Collectorate	Cost of establishing a HFC at 64 in rural + 12 in urban in Puri, Khurda, Cuttack districts = INR 4 lakh × 76 = INR 3.05 crore Salary + transportation of housing facilitators + HFC's other expenditure =INR 48.98 crore Repair and retrofitting in the urban and rural areas=INR 666.3 crore 15,200 master masons' training on BBB=INR 38 crore Establish 38 Small entrepreneurship units = INR 19 crore Establish 38 production centre–industry partnerships = INR 28.5 crore Reconstruction (10%) for the vulnerable group, homeless, women led HHs INR 815.04 crore
S2	Control room at PR&DW and H&UD	Revenue Dept., Office of the SRC, PR&DW, DRDA, H&UD, Collectorate	
S3	Establish HFCs at 76 of 99 locations in 14 districts	PR&DW, DRDA, H&UD, Collectorate	
S4	Identification of land for the people without homesteads (government and private land) and transfer of development rights	State government, Collectorate and the people— participatory	
S5	Resource mapping exercise to identify materials and multi-hazard zone-specific technologies	State- and district-level architects and engineers	
S6	Participatory design and preparation of zone-specific designs (prepare a menu of options)	The people, PR&DW, DRDA, H&UD and practising architects/engineers	
S7	Preparation of region-specific designs and technology options along with the estimates	The people, BDO, PR&DW, DRDA, H&UD, and practising architects/ engineers	
S8	Capacity building: Preparation of the course content and study materials as per the guidelines of the National Skill Development Council (NSDC) and Construction Skill Development Council of India (CSDCI)	OSDMA, private architects and engineers, Central Statistics Office (CSO)	
S9	'Build-Back-Better' training of the affected community, masons, contractors, government and private architects, and engineers including building inspectors	OSDMA, private architects and engineers, CSO and other training providers	
S10	Collaboration with the Construction Skill Development Council of India, examination and certification of the trained people could be done	OSDMA, NSDC, Construction Industry Development Council, and CSDCI	
Medium term 0–36 months			
M1	Review the existing building rules and update them to be in line with the multi-hazards in Odisha.	OSDMA, PR&DW, DRDA, H&UD and practicing architects/engineers, CSO	Cost of establishing a HFC at 14 in rural + 9 in urban in Jajpur, Jagatsinghpur and Mayurbhanj districts = INR 4 lakh x 23 nos. = INR 0.92 crore Salary + transportation expenses of the facilitators + HFC's administrative costs = INR 14.82 crore
M2	Review plans and approval of building plans – additional guidelines for 'Build back Better'	BDO, PR&DW, DRDA, H&UD, ULBs, practicing architects/ engineers	
M3	Set up small production units for alternative, cost effective green building components based on local materials	Collectorate, Industry partnership, Dept. of Industries	

M4	Partnership with industries for innovative building materials and high-quality products at affordable prices, setup district level centres; industry to pay for this.	Multi-departmental activity: Dept of Industries, W&CD Department	4,600 master masons' training on BBB=INR 11.5 crore Establish 12 Small entrepreneurship units = INR 6 crore Establish 12 production centre–industry partnerships = INR 9 crore Reconstruction (35%) INR 2,852.64 crore
M5	Preparation of a contour map with zone-wise soil depth and bearing capacity	OSDMA, and other state departments	
Long term 0–60 months			
L1	Implementation, monitoring and control	Government of Odisha, People, CSO, OSDMA	Reconstruction (55%) INR 4,482.72 crore

1.9 Sector Assessment Methodology

The nodal Panchayati Raj and Drinking Water Supply (PR&DW) department under the Government of Odisha provided information on damages in rural housing stock due to Fani. The engineers of the PR&DW department from the state office in Bhubaneswar and from the block offices provided the cost related data comprising analysis of rates and bills of quantities. The Secretary, Director Special Projects and Deputy Secretary from PR&DW Departments were consulted.

The main source for urban housing data was the Office of the Special Relief Commissioner, Bhubaneswar. The Census of India, 2011 and the Socio Economic and Caste Census (SECC), 2011 were also referred to in order to arrive at the baseline housing stock. Apart from the state officials in the two nodal departments, other senior officials consulted include the District Magistrate (DM) cum Collectors of Cuttack, Puri, Block Development Officer (BDO) of Puri Sadar block, Deputy Mission Director of Odisha Urban Housing Mission and engineers from the ULBs. On 31 May 2019, a Central Statistics Office (CSO) consultation was held at the state level, in which a focused group discussion was held on housing.

The main focus of the needs assessment was the affected people. Interactions with the communities, particularly women and other vulnerable social groups helped in understanding the ground level situation, people's immediate and long-term needs, existing difficulties, etc. The field visits enabled the DLNA team to understand why and how the buildings collapsed and why there was no damage to some buildings due to Fani.

Notes

[1] *Census of India 2011*, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.

[2] Pucca, semi-pucca and kutcha houses are as per SECC 2011; https://secc.gov.in/faqReportlist

[3] *Socio Economic and Caste Census 2011*, Ministry of Rural Development, Government of India

[4] *Socio Economic and Caste Census 2011*, Ministry of Rural Development, Government of India

[5] *Socio Economic and Caste Census 2011*, Ministry of Rural Development, Government of India

[6] *Poverty Growth and Inequality Report*, Odisha, World Bank, 2016, http://documents.worldbank.org/curated/en/484521468197097972/Odisha-Poverty-growth-and-inequality

[7] *Socio Economic and Caste Census 2011*, Ministry of Rural Development, Government of India

[8] *Socio Economic and Caste Census 2011*, Ministry of Rural Development, Government of India

[9] Data Management Section, PR&DW Department, Government of Odisha, as on 1 June 2019 11:29AM

[10] Urban Housing damage assessment based on the district-wise rural house by house type and severity

[11] Data on urban slums provided by H&UD, Odisha. Data pertains to 13 most affected districts only (except Angul)

[12] Data on urban slums provided by H&UD, Odisha. Data pertains to 13 most affected districts only (except Angul)

[13] Banerjee A, 'Quantification of Housing Materials Demand/ Requirements For PMAY-G Designs', UNDP report, 2017

[14] https://pmayg.nic.in/netiay/Pahal.pdf

[15] Situation report 'Fani' dated 28 May 2019

[16] *Socio Economic and Caste Census 2011*, Ministry of Rural Development, Government of India

2

Education and Child Protection

2.1 Pre-Disaster Context

Odisha has fared reasonably well in terms of literacy. According to the 2011 Census, the literacy rate of Odisha is 72.87%, which is marginally less than the national literacy rate at 72.98%. The male literacy rate is 81.59% and the female literacy rate is 64.01%, compared to the national figures of 80.88% and 64.63% respectively. Literacy rate of SC population in Odisha is (69% compared to national figure of 66%) and ST population is (52.2% where national average is 59%). The Gross Enrolment Ratio (GER) of the state is 100.2% at primary level (99.02% girls, 101.38% boys) and 94.6% at upper primary level (93.56% girls, 95.67% boys). The annual average dropout rate is 4.2% at primary (4.4% girls, 4% boys) and 5% at upper primary levels (4.9% girls, 5.1% boys).[1] The public school enrolment in Odisha is higher than in most of the other low-income states[2] and the transition rate from upper primary to secondary is 91.2%.

The state is one of the first in the country to implement the Integrated Child Protection Scheme (ICPS). Odisha has also established the State Commission for Protection of Child Rights (SCPCR) as well as the High Court Committee on Juvenile Justice and Children Courts. State rules for legislations such as the Juvenile Justice Act, the Prohibition of Child Marriage Act, Child Protection and Protection of Children from Sexual Offences (POCSO) are in place. The state has been working on innovative campaigns such as '*Pari Pain Katha Tie*' (campaign to educate people about child abuse) by the police department to spread awareness in the community and among various duty bearers such as teachers, collectors, CSOs etc., regarding the safety of minor girls in the state.

Table 2.1: Child Protection Structure and Mechanism at a Glance[3]

	Name of the Structure/Mechanism	Number
Statutory Bodies	Juvenile Justice Board (JJB)	Functional in all 30 districts
	Child Welfare Committee	31 are functional in 30 districts
Service Delivery Structure	Special Juvenile Police Unit	36 in 30 districts
	District Child Protection Unit	30
	District Child Protection Committee	30
	Block Child Protection Committee	314
	Gram Panchayat Level Child Protection Committee	6262
Child Care Institution	Government-run CCI	17
	NGO-run CCI	253

All schools in Odisha come under the Department of School and Mass Education (DSME) except 1,630 schools of the SC/ST Development Department. The Directorate of Teacher Education and State Council for Education Research and Training (DTE and SCERT) is the state academic authority. Recently, 1,247 higher secondary

schools/junior colleges were transferred to the DSME from Higher Education department, out of which 757 are government/government-aided. After this transfer of higher secondary schools, DSME manages all 69,208 schools from Grade to XII.

There are 11 state universities, one national law university, five private universities, 52 government colleges, 526 aided colleges, 140 aided Sanskrit colleges, 294 un-aided colleges and 143 self-financing colleges[4] in the state. Of these, five universities, six colleges and 99 non-governmental (aided colleges) are located in the five affected districts. With a view to promote academic excellence, autonomous status has been conferred upon 18 government colleges and 17 non-government colleges. About 164 colleges and 11 universities have received National Assessment and Accreditation Council (NAAC) accreditation.

Odisha is the only state in India that has developed a departmental plan for response and mitigation across identified 22 key departments. It is reviewed and updated every year in coordination with Odisha State Disaster Management Authority (OSDMA). The plan covers the vulnerability of the state to different disasters and possible impact on the various departments and services. It includes a response, mitigation and capacity building plan as well. All schools are mandated to prepare a school safety action plan, following guidelines of the Supreme Court on school safety.

The assessment team evaluated the effects of cyclone Fani on education and child protection based on the above-mentioned baseline data in terms of physical infrastructure, service delivery and governance mechanisms. There are 72,587 Anganwadi Centres (AWC) in the state, of which 40,528 are in the 14 affected districts. The damage to the infrastructure and assets of the AWCs including pre-school kits has been captured under the health and nutrition sector and the damages to the special schools are covered under the social inclusion chapter. These details are not included here.

The DSME had issued instructions to all the districts on how to prepare for the cyclone. These instructions included the use of Mid-Day Meal grains for the community members, shifting important official documents, text books, office records to safe places, not using unsafe school buildings as relief shelters and the operationalisation of a 24-hour control room to attend to any emergency.

Though the schools and District Institutes of Education and Training (DIETs) were closed for summer vacations, the state government issued necessary instructions to open the schools so that they could be, if required, be used as shelters for the affected population. Teachers were also asked to report on duty to oversee the work in these schools-turned-relief shelters.

2.2 Disaster Effects: Damages and Losses

Based on the quantitative and qualitative records, the assessment team identified varying degrees of effects of the cyclone on the educational infrastructure and other physical assets. A summary of the effects on education and child protection is provided below.

Due to cyclone Fani, 5,735 elementary and secondary schools, out of 29,804 elementary and secondary schools were reportedly damaged in 14 districts. The main damage, however, was in the Puri district with 1,527 elementary and 181 secondary schools impacted, out of a total of 1,790 elementary and 192 secondary schools. Their roofs (asbestos) were damaged, along with sources of water outlets, toilets, kitchen sheds, windows, boundary walls, furniture, and sports equipment. A total of 2,181 classrooms, out of which 2,098 were from five severely affected districts, were fully damaged, and another 7,601 classrooms were partially damaged in elementary and secondary schools across all 14 affected districts. However, a detailed break up of this damage is not available from all districts.

Samagra Shiksha Abhiyan (SSA) has proposed a budget of INR 300 crore for restoring educational institutions following post cyclone Fani to the Project Approval Board (PAB) of 2019–20. It will be presented to Ministry of Human Resource Development (MHRD), Government of India.

At many higher education institutions, libraries, computer and science labs were completely damaged. Trees were uprooted in almost all the educational institutions. In the Jagannath Sanskrit University in Puri district, close to where the cyclone made its landfall, 38 buildings in the compound are damaged. Libraries accounting for more than one lakh books and resources are also completely damaged. In the five most cyclone-affected districts, five universities, six government colleges and 96 government aided colleges have suffered extensive damage. The HE department has sent a note with a checklist to all colleges and universities (government and government-aided) to assess the loss and submit a report to the Department.

There are 324 government and NGO-run CCIs in the state, of which 115 CCIs are functional in the 14 affected districts. Of these, only four districts have government-run CCIs and the rest are managed by NGOs. The CCIs were functional during the cyclone Fani as most of their buildings are *pucca* (RCC) buildings, except a few with asbestos roofs which were either blown away or fell apart. The building and assets such as water tanks, water purifiers, electric equipment, solar panels were partially damaged in the CCIs of Utkal Balashram Balasore, Puri and Jajpur. There was no electricity for almost a week in most of the CCIs in these affected districts and the CCIs of Puri went without

electricity for over 20 days. The government supplied water to the children through tankers to tackle the water crisis created due to the cyclone. The data on school education and CCIs includes government institutions, while the data on higher education includes government as well as non-government aided colleges (Table 2.2).

Table 2.2: Estimation of Damages and Losses to Infrastructure and Physical Assets

Damage to Infrastructure and Assets	Public Damage (in INR crore)
School education	
Classrooms and office rooms	360.68
Administrative offices	4.65
Teacher Education Institutions (TEI)	2.75
Higher Secondary and Junior Colleges	30.77
Textbooks (DSME, Government of Odisha plans to provide books for students in Grades IX–X.)	99.35
Sub Total	**498.2**
Infrastructure from institutions comprising of both university and government colleges from 5 districts	316.22
Sub Total	**316.22**
Child Protection	
Infrastructure and equipment damaged cost for CCIs	0.06
Sub Total	**0.06**
Grand Total	**814.48**

2.3 Impact

2.3.1 Impact on Teaching and Learning

As the schools were closed due to vacations, there was no immediate discernible effect on the teaching and learning of the children. Some remediation work books were, however, damaged in some schools. This could impact the teaching-learning process unless they are replaced before the schools reopen. The teaching-learning process of schools and classrooms completely damaged by the cyclone Fani will, on the other hand, be adversely affected. The DSME plans to supply textbooks to all students studying in grades IX–X in government schools in the five affected districts.

Examinations have been postponed in a majority of colleges and universities and will be conducted when the colleges and universities reopen after the summer vacation. In Utkal University (Bhubaneshwar), expensive chemicals and specimens stored at -80 degrees Celsius were completely damaged because of the lack of power backup. Replacing these resources will take time. This will affect the teaching and learning process.

2.3.2 Impact on Service Delivery and Governance Mechanisms

State-level institutions buildings, such as those of the DTE and SCERT, were without electricity for over a week with at least two to three rooms flooded due to the rain. Disruption in electricity supply as well as communication channels hampered work at the state and district offices. Information related to the damages and losses in the districts took time to reach the state capital. Thirteen block education offices, including the office of the District Education Officer (DEO) and the District Project Office (DPO) SSA in Puri were affected due to cyclone Fani.

Eighteen Teacher Education Institutions (TEI) such as DIET, Elementary Teacher Education Institutions (ETEI), Colleges of Teacher Education (CTE) in eight districts were damaged. This included damage to their boundary walls, administrative buildings, hostels, as well as library books and ceiling fans etc. The damaged hostels in the TEIs may lead pupil teachers (those training to be teachers) to move into rental rooms, which may affect their attendance. In many universities, especially Jagannath University, Puri, the entire administrative section has been badly affected, with rainwater causing damage to thousands of several university files and documents. Although the staff has tried to dry the files, there is a possibility of fungi damage on the files due to the saline water and presence of moisture. The Child Line service was disrupted for a week as communication lines were down. However, while interacting with Child Line functionaries, it was found that after the restoration of the services, there was no substantial increase in the number of calls in the affected districts. The District Child Protection Unit (DCPU), Child Welfare Committees (CWCs) and Juvenile Justice Boards (JJBs) are functional as the District Collectorate offices were not damaged.

2.3.3 Increased Risks and Vulnerabilities

There is always a danger that any disaster will further aggravate the existing disparities in terms of access, retention and learning based on the level of vulnerability across different equity dimensions (gender, caste, disability, socio economic status, etc.). Disasters create new threats or conditions of vulnerability that can be aggravated, if not attended to immediately.

In case there is a delay in reopening the schools and cleaning of debris, it will affect the schooling of children. Vulnerability is further increased as the affected areas are low-lying and flood prone. Damaged school walls built with mud mortar are in a very vulnerable state, which could pose a big hazard to the children and the school staff during the impending monsoon. These areas are frequented by snakes and tree debris provides a good hideout for them. There may be a drop in the attendance of children, especially adolescent girls and Children with Special Needs (CWSN), due to toilets that have been damaged and rendered unusable.

In Odisha there are 10 districts where the incidence of child marriage is high with the district averages ranging from 39.3% to 25.4%. Out of these, the three districts of Mayurbhanj, Balasore and Ganjam have been most affected by the cyclone, which puts adolescent girls, especially those who belong to the most marginalised communities in a vulnerable situation. Children from migrant families, such as those of brick kiln and construction workers, need equal attention as they were equally affected and are most vulnerable. There is a likelihood of increased risks of child labour, trafficking and child abuse and exploitation in these communities. The exposure to such a disaster is a traumatic experience for children and adolescents and affects their emotional and behavioural adjustment negatively. The degree of vulnerability may vary for different individuals; however, focused interventions are required to reduce psychological morbidity following such disasters.

2.4 Recovery Costs and Strategies

The overall vision of the sector is 'all children should be in school and learning in a protected and safe environment'. The focus of the recovery and reconstruction strategy in the education and child protection sectors is always to ensure uninterrupted continuation of education service where girls and boys are able to receive quality education in a safe and child-/learner-friendly environment. In addition to this vision, it is natural to entrust the sectors with the role of playing a critical role in building stronger and resilient communities and individuals.

The main objective for the recovery and reconstruction strategy in these two sectors is to align all planned activities to ensure it is well-implemented and that education and protection services are uninterrupted. This calls for a focus on both the structural and non-structural aspects of the education and child protection systems so that they can be made resilient to future disasters. This includes enabling a learning environment that is participatory and has strong links with the education community, including students, teachers and community to name a few.

The overall recovery strategy will prioritise the education system to reopen schools on time, to rebuild and/or demolish the unsafe school structures. School buildings need to be constructed or refurbished keeping in mind the concept of safe schools and Disaster Risk Reduction (DRR) norms as relevant to the Odisha context.

There is a need for on-going and in-depth risk assessment of educational infrastructure in the state, which needs to be updated regularly with the measures required to reduce or withstand future risks. Building reconstruction should also entail adoption of building technology that promotes the use of local construction materials to reduce carbon footprint. The design should endeavour to include principles of green building by deliberately including greening elements in the educational building design that also need to be cyclone and flood resistant. The rebuilding should ensure proper protected drinking water supply and toilet facilities that are child-friendly and cater to CWSN while allowing for effective waste and water management, including rainwater harvesting, wherever applicable and possible.

The roadmap to recovery for the education and CP sector is divided into three phases—short-term, medium-term and long-term. The plan seeks to address both short- and long-term needs, which include academic and infrastructure components, in addition to structural changes.

2.4.1 Short-Term Needs (up to 12 months)

1. Education
    a. Infrastructure and Assets:
        i. Detailed and comprehensive structural assessment of damaged buildings to ascertain the damages and losses as well as feasibility of reconstruction/retrofitting in existing sites, including infrastructural needs of educational institutions and CCIs.
        ii. Debris removal and site clearance of damaged schools to prepare the sites for setting up of transitional classrooms and, eventually, permanent buildings.
        iii. Demolition of brick-and-mud-mortar-wall schools which can pose a hazard to children and adults, especially with the impending monsoons.

iv. Certification of school buildings and CCIs as safe through the process of safety audit before reopening.
v. Repair and restoration of the overhead water tanks and toilets supplying running water to toilets.
vi. Provision of emergency kits to elementary schools and CCIs which can include solar lamps/torch, etc.

b. Teaching–learning/curriculum reforms:
i. Setting up temporary/transitional learning centres with teaching learning, co-curricular and WASH facilities (including separate facilities for girls) need to be established in the affected districts.
ii. Provision of textbooks and teaching-learning materials in the affected districts to schools that have lost the material.
iii. Organise classes in two shifts, especially in schools where some rooms are damaged beyond repair, but some rooms are usable.
iv. Provision of school-in-a-box/bag, tarpaulin, tents, sports equipment to severely damaged schools.
v. Strengthening the quality of pre-school education in AWCs.

c. Communication and Advocacy:
i. Social mobilisation and behavioural change communication drives to ensure that the effects of the disaster, together with damaged schools, do not lead to absenteeism among children. The 'Sabudina Jiba School' – 'To School Every Day' (regular attendance campaign) to be initiated one week before school resumes and should continue for at least a month.
ii. Develop awareness on increased risk of separation from family, child labour, child marriage, sexual abuse and exploitation. Need for increased community vigilance to ensure safety of children and adolescents.
iii. The state can explore the option to use the funds under the "Mo School Initiative" (My schoolalumni) for rebuilding a new cyclone and floods resistant Odisha.

2. Child Protection
a. Roll-out and monitoring strategies along with risk-informed/resilience strategies
i. School Management Committees (SMC) and Gram Panchayat Child Protection Committee (GPCPC) should start visiting the homes of children, especially those who are most vulnerable, a week before the schools reopen to convince the families to send their children to school. Continuous follow-up through home visits and phone calls should be done on daily basis for at least a month after the school reopens in the case of families of irregular children.
ii. GPCPC and SMC, along with the support of Anganwadi Workers and Self-Help Group (SHG) members, should prepare a the list of vulnerable adolescent girls and boys and track them on regular basis to prevent human trafficking, cases of child marriage, child labour and ensure transition or continuation of schooling.
iii. Intensified outreach services by Child Line 1098 for children in distress, linkage with local police

3. Education and CP
a. Capacity building
i. Promotion and capacity building of various stakeholders in CCIs and Education Department personnel, including teachers, counsellors on DRR, adolescent wellness and psycho-social recuperation.

2.4.2 Medium-Term Needs (1–2 years)

1. Education
a. Infrastructure and Assets:
i. Construction of educational institutions including schools and those for higher education on the principles of cyclone and flood resistant construction, sustainable development and green schools. Recommend for relocation/reconstruction using principles of 'Build Back Better' including disaster resilience technology, greening elements, better learning environments and quality services for all children/learners including accessible toilets for CWSN. (Refer to Annex 2.1 for features of disaster-resilient buildings). The main pillars of these schools are good sanitation, waste management, water and energy conservation.
ii. Provision of solar panels in schools and higher education institutions as part of the greening efforts for conserving energy.
iii. Plantation of trees, medicinal plants in the campuses by acquiring saplings from the forest department.

b. Institutional/structural reforms
   i. Review of the SMC/Parent Teacher Association (PTA) module and incorporation of DRR resilience principles and approaches. Based on the outcome develop the School Disaster Management Plan. Simulation exercises and mock drills to be part of the schools and practised periodically.
   ii. Inclusion of school safety components in School Development Plans.
   iii. Strengthening disaster preparedness and response at the school and community level, through regular school-based Disaster Risk Management (DRM) training and planning, by enhancing the capacity and preparedness of parents, teachers, student associations such as Meena Manches, child cabinets and communities.
   iv. School emergency response plan, including evacuation plan during a disaster to be developed and displayed in schools.
   v. Roll-out and monitoring strategies along with risk-informed/resilience strategies.
   vi. Social Audit of schools by PTA/SMC on all school related indicators including DRR and emergency preparedness.
   vii. Strengthening the Educational Management Information System (EMIS) to include indicators on DRR and school safety.
   viii. Roll-out and capacity building of education functionaries as per Inter-Agency Network for Education in Emergencies (INEE) standards.
c. Teaching–learning/curriculum reforms.
   i. Curriculum and text book revision to include and strengthen the issues of DRR and Life Skills at all levels right from school to higher education.

2. Child Protection
   a. Capacity Building:
      i. Continuing the capacity building of volunteers and counsellors of CCI on DRR, Psycho-social support and group therapy.
      ii. Institutional/structural reforms.
      iii. Emergency response plan, including evacuation plan during disaster to be developed and displayed in CCIs.
      iv. Capacity building of NSS volunteers on DRR.

3. Education and CP:
   a. To develop a roadmap on DRR for the state with focus on Education and CP issues.

2.4.3 Long-Term Needs (36–60 months)

1. Education:
   a. Institutional/structural reforms
      i. Develop a comprehensive school safety plan within the District Disaster Management Plan and revisit it regularly for addressing safety needs at schools from time to time.
      ii. Strengthen disaster preparedness and response at the school and community level, through regular school-based DRM training and planning, by enhancing the capacity and preparedness of parents, teachers, student associations such as Meena Manches, child cabinets and communities.
2. Child Protection:
   a. Institutional/structural reforms
      i. To prioritise the needs of children, both girls and boys, living in CCIs and include it as part of state-sponsored relief measures, so that the most vulnerable children living in institutions get equal entitlements before in pre-, during and after a disaster.
      ii. Develop CCI Safety Plans with mock drills as part of the plan for all CCIs.
   b. Capacity Building:
      i. Strengthening GPCPC and enable them to monitor child protection issues with a special focus on emergency situations.
      ii. Regular engagement with adolescents and youth groups such as NCC and NSS focusing on DRR and local environmental issues.

2.5 Implementation Strategy for Recovery

Cost of Recovery: Details of the recovery plan and the associated comments and timelines are delineated in Table 2.3.

The recovery strategy for higher education only includes government colleges and universities, but the damage and loss estimates account for both government and non-governmental aided colleges

2.5.1 Role of Line Departments

1. Department of Elementary, Secondary, Higher Secondary and Higher Education
   a. Set timelines for educational institutions to complete the reconstruction of basic infrastructure.

Table 2.3: Recovery Table

Recovery Needs	Recovery Cost (INR crore)		
	Short-term	Medium-term	Long-term
Education			
Debris removal and site clearance of damaged schools	5.74		
Setting up temporary/transitional learning centres with teaching learning and co-curricular and accessible WASH facilities	32.72		
Construction of educational institutions on the principles of cyclone and flood resistant construction, sustainable development and green schools (Refer to Chapter 2 Annex).		218.1	
'Sabudina Jiba School' – 'To School Every Day (Social Behaviour Change Communication (SBCC) Attendance campaign)	0.07	0.07	
Provision of emergency kits to educational institutions	14.9		
Demolition of brick and mud-mortar schools	4.36		
Repairing cost for partially damaged classroom	114.02		
Repairing of existing toilets including water supply and hand washing platform		28.68	
Repairing and construction of kitchen sheds		7.82	
Repairing/Construction of boundary walls in all educational institutions.		46.9	
Restoration of DIET/ ETEI in 8 districts	0.65		
Strengthen the implementation of the Comprehensive School Safety Programme		17.03	
CCI Safety Plans with mock drills			0.05
Review of the SMC/PTA module and incorporation of DRR resilience principles and SBCC approaches		0.2	
Capacity building of various stakeholders in CCIs and Education Department including teachers, counselors on DRR, adolescent wellness and psycho-social recuperation	1.14		
Provision of solar panels	8.6		
Development of tools on social audit and pilot testing of the same		0.14	
Promotion and capacity building of various stakeholders in CCIs and education department on DRR, SBCC, adolescent wellness and psycho-social recuperation.	1.14		
Repairing and provisioning of equipment, emergency kits to schools and CCIs	0.17		
Strengthening quality of pre-school education in AWCs	1.5		
Roll out and capacity building of education functionaries as per INEE standards		0.42	
Sub Total	**183.87**	**319.36**	**0.05**
Grand Total		**503.28**	
Note: 5%–10% inflation has been accounted for medium and long-term needs			

Any delay will have serious repercussions on the education and safety of the children.

b. Follow up and design strategies to internalise the psycho-social training extended to teachers as a co-curricular component that could be sustained on a regular basis in the schools and CCIs.

2. Women and Child Development and Mission Shakti
   a. Support CCIs in rebuilding their physical and system requirements through training and consultancy for ensuring protection to CWSN and those in conflict with the law.
3. Local Self-Government
   a. Draw up timelines with the participation of the community and the children to build back each school as a violence-free space with requisite safeguards.
   b. Create community-based disaster preparedness plans that include the schools and CCIs.

2.5.2 Issues on Gender Equity and Social Inclusion, Environment, and DRR

School safety planning empowers the school community, particularly the students, to be actively engaged in discussions around disaster risk and mitigation measures, as well as how to stay safe both at their schools and homes.

The disaster could also have an impact on the education of both boys and girls, especially CWSN. Sixty-four schools are run by the Social Security and Empowerment of Persons with Disabilities Department (SSEPD). These schools cater to the most vulnerable group of CWSN, who were badly affected by cyclone Fani. Although these schools have been mentioned in the social inclusion chapter, it is essential to mention here that as per reports from the SSEPD department, 30 schools and hostels in eight districts were damaged due to the cyclone. The aids, therapy instruments, teaching-learning materials, assistive devices have all been damaged leaving them even more vulnerable.

Given the high costs of post-disaster survival and sustenance imposed on families, children, particularly girls, from lower income groups could become irregular in schools in order to support their families through alternative livelihoods. It is therefore recommended to monitor school attendance rates in districts that were affected by the disaster.

2.6 Sector Assessment Methodology

The Education and Child Protection sector's DLNA utilised a combination of qualitative and quantitative assessment tools.

The major component of this assessment is the estimation of damages and losses for—school education (grades I–XII), higher education and CP structures. Tools were developed through a consultative process of focus group discussions with children, adolescents, students pursuing higher education, teachers, faculty members of universities and colleges, community members, PTAs/SMCs, DCPUs, interviews with officials and Panchayat members and an observation tool for educational institution damage assessment. The calculation of damages and losses for the sector are based on the data and information provided by various sub-sectors—Integrated Child Protection Services (ICPS), SSA, DSME, SCERT, Women and Child Development (WCD).

For damages and losses, data was obtained through the education departments of all the 14 affected districts. Field functionaries such as Cluster Resource Coordinators (CRC) and senior technical consultants and technical consultants (civil engineers) of SSA undertook field visits to assess the damage. The damage was assessed in the presence of the head teacher and SMC. The cost for repair and restoration of damage were analysed by the technical consultant keeping in view the quantum of items damaged and funds requirement as per the current schedule of rate – 2014, labour rate – 2018 approved by Government of Odisha. The amount so far derived is tentative and the estimate cost may increase or decrease by 10%. Cost has been derived differently for classrooms, toilets and drinking water (WASH), kitchen shed to prepare MDM and other items including boundary walls, dining halls, etc.

A field visit was undertaken by the Education and Child Protection sector team during 26–28 May 2019 in Puri, Khurda and Cuttack districts covering around 42 institutions in total which included schools, higher education colleges, CCIs, DCPUs, DIETs to understand the local perspective of the damages/losses.

Discussions were undertaken with the state and district level officials of School and Mass Education, Higher education, WCD and Mission Shakti, teachers, SMCs, children, adolescents, CWC members, DCPU, parents, and Panchayat members. Meetings were also held with the Elementary Education and Higher Education Secretaries, Collector (Puri), Additional Secretary, Deputy Secretary, Under Secretary to understand the impact of the disaster on the education and CP system as well as to solicit their inputs on the potential recovery strategies and interventions. Intersectoral meetings on nutrition, WASH, public buildings and DRR were held.

2.6.1 Assumptions and Limitations

1. The break-up of the assets damaged is not available; the figures provided by the department are an estimate.
2. For school education, only the government schools have been considered for estimation.
3. Data from Higher Education department includes both government and aided (non-government)
4. Data for vocational education was not available with the department at the time of the preparation of the report.
5. The CCIs managed by NGOs were not assessed.

Notes

[1] U-DISE, 2016-17

[2] World Bank Group Report on state indicators, 2016.

[3] OSCPS/ WCD

[4] http://www.osdma.org/Download/Departmental_Disaster_ManagementPlan.pdf

3

Health, Nutrition, and Food Security

3.1 Pre-Disaster Context

3.1.1 Overview and Baseline Information: Health

Odisha is situated in the eastern part of India with a population of 41,974,218 (83.3% in rural) with decadal population growth rate of 14%; has a population density of 270 people per square kilometre (km2), a literacy rate of 72.9%, and sex ratio of 979 women per 1,000 men.[1] Odisha ranked 18th among the 21 larger states of India, in terms of Health Index by the National Institution for Transforming India (NITI Aayog).[2] Thirty-three percent of its population is below the poverty line (based on the poverty line as defined by the World Bank); per capita health expenditure is INR 927 per annum and only 1.19% of GDP expenditure is on health (National Health Profile 2018).

Risk and Sustainable Development Goals

Odisha has the second-highest Infant Mortality Rate (IMR) of 41 per 1000 live births; and the highest Neonatal Mortality Rate (NMR) of 32 in the country.[3] The state also has a high still birth rate of 13 against the India average of four. The Maternal Mortality Ratio (MMR) at 180 per 100,000 live births is the fifth highest in the country. Realising the need to achieve the Sustainable Development Goals (SDGs), the state had rolled out "SAMMPurNA" for 'accelerated reduction of infant and maternal deaths by 2020'[4], with the fiscal outlay of INR 114.5 crore in 2018–19 focused on 15 high burden districts of the state. The vulnerability of the costal districts can be considered in this composite index. For ensuring Universal Health Coverage (UHC) by 2030, the state has empanelled 208 private health facilities for the cashless curative services for the 70 lakh economically vulnerable families with a budget of INR 250 crore under the 'Biju Swastya Kalyan Yojana' (Table 3.1).

Disease Burden

Odisha has a high burden of communicable and non-communicable diseases. Acute respiratory illness (64%) followed by acute diarrhoeal diseases, including cholera (21%) and malaria (12%) are the most commonly reported

Table 3.1: Health Profile of Odisha as Compared to India

Indicator	Odisha	India	Source
Birth rate	18.3	20.2	Sample Registration System (SRS), 2017
Life expectancy at birth	65.8	67.9	SRS (2010–14)
Total fertility rate (TFR)	2.1	2.2	National Family Health Survey (NFHS-4) (2015–16)
Under-five mortality rate	48	50	NFHS-4 (2015–16)
Infant mortality rate (IMR) (per 1000 live births)	41	33	SRS, 2017
Neonatal mortality rate (NMR)	32	24	SRS, 2016
Still birth rate	13	4	SRS, 2016
Maternal mortality ratio (MMR) (per 100,000 registered live births)	180	130	SRS (2014–16)
Full immunisation coverage	78.6	62	NFHS-4 (2015–16)
Government physicians, nurses, and midwives per 1,00,000 population	220.96	316.42	NFHS-4/MIS

communicable diseases. Other communicable diseases like tuberculosis, leprosy, typhoid, anthrax and measles; pregnancy-related problems like anaemia (47.6%), preterm birth complications; and childhood illnesses like pneumonia and neonatal encephalopathy are the major health conditions of the state.

3.1.2 Overview and Baseline Information: Nutrition and Food Security

Odisha presents a unique set of opportunities to undertake nutrition action indeed; there have been substantial improvements in most nutrition indicators in the past decade. Curbing malnutrition among children is an explicit political will of the state. Despite the prominence of agriculture in Odisha's economy and livelihood, food insecurity has always remained a real risk, especially in terms of poor access to adequate and diversified foods, as natural disasters frequently hit the state. Increasing effects of climate change are beginning to adversely impact agricultural outputs and crop patterns further.

The key indicators of child undernutrition (below 5 years of age) such as incidence of underweight children, stunting, wasting, and severe wasting in Odisha stand at 34.4%, 34.1%, 20.4% and 6.4%, respectively. More than half of the adolescent girls (15–19 years), 47.6% of pregnant women and 44.6% of children aged 6–59 months are anaemic. Only 8.9% of breastfed and 5.0% of non-breastfed children between 6–23 months of age receive adequate diet. Literacy rate of women (67.4%) has a major implication on child-caring practices. These suboptimal nutritional indicators make this set of population highly susceptible to long-term nutrition and food insecurity post-disasters. The food consumption patterns in Odisha are changing.[5] Diversification of household food basket is seen in both rural and urban area with increased consumption of meat, fish, egg, vegetables, fruits, milk and milk products; especially in the coastal districts of Odisha—which are adversely affected by cyclone Fani.

3.1.3 Preparedness before the Cyclone: Health

Planning and communication: The state government conducted a series of meetings with senior officers and development partners on 1 May 2019, for contingent planning and strategy development, under the leadership of Hon'ble Minister and Commissioner-cum-Secretary. Early dissemination of alerts and warnings through different modes of communication, well-planned advisories and action led to the early evacuation of the people. Advisory was issued in print, electronic and social media for preventive health care actions. Fani Health Action WhatsApp group was also created. Health-related information was posted on Swasthya Kantha (dedicated health messaging walls) for information to the community.

Control rooms were made operational at state, district and block level. These were tasked with daily review of the updated status and with providing solutions to the challenges faced.

Shifting of pregnant women and sick people: All women (1,945 in total) with expected date of delivery within next 15 days (10 May) were shifted to nearest MaaGruha/Delivery Points or Maternity Waiting Home for safe delivery, through use of Rashtriya Bal Swasthya Karyakram (RBSK) vans. Accredited Social Health Activists (ASHAs) were deployed to manage transfer of sick people, including infants and children from villages/shelters to the nearest hospitals. Ambulances were kept ready at all health facilities for transfer of patients. Ambulances were pre-positioned, with deployment of additional ambulances for management of emergency.

Disease surveillance: Standard Operating Procedures (SOPs) and checklists were prepared to strengthen disease surveillance.

Monitoring plan: Monitoring and supervision plan was developed for state nodal officers who were assigned and deputed to the various districts.

Cyclone shelters: Cyclone shelters were made available in all the high-risk districts. Temporary shelters were also prepared in school buildings. Dry food packets were placed for three days in all the shelter homes.

Shifting of vaccines: To prevent wastage, vaccines were shifted from cold chain points of Community Health Centres (CHCs) to the block and district cold chain points, which had better backup facilities.

Medicine and logistics: Essential drugs, First Aid Kits and logistics were prepositioned at all facilities and shelter homes. Bleaching powder and halogen tablets were made available in all the shelters and villages for disinfection. Drugs and consumables were shifted to a safer place. Capital Hospital in Bhubaneswar had stocked rations to feed its staff and patients.

Power backup: 24×7 power backup, including fuel for health facilities, was provided by prepositioning of gensets on hire, wherever not available.

Deployment of manpower: Presence of state nodal officers at high focus districts along with doctors and paramedics in all health facilities was ensured. Leave of all staff were cancelled and staff already proceeded on leave were re-called.

Medical relief centres and medical health teams: As per the evacuation plan and in lieu of population in low lying areas likely to be affected more, number of Medical Relief Centres (MRCs) were planned and established at

strategic locations and Rapid Response Teams (RRTs)/ Mobile Health Teams (MHTs) were made ready. A total of 164 MHTs, 6 Medical Health Units (MHUs), 137 of 108 vehicles and 168 of 102 vehicles were kept ready for the high focus districts. State also issued a letter to depute 52 MHUs and MHTs from other districts to the affected districts. The vehicles had to report at the districts by 2 May 2019. MHTs were deployed in focussed districts.

Rapid response team: Rapid response teams were activated for immediate action at field level.

3.1.4 Preparedness before the Cyclone: Nutrition and Food Security Sector

Multi-sectoral programmes such as, Targeted Public Distribution System (TPDS), SNP under Integrated Child Development Services (ICDS) and Mid-Day Meal (MDM) of the Government of Odisha, are in place to fulfil nutritional requirements of the different sections of the population. In the 14 districts affected by Fani, supplementary nutrition is provided to children, pregnant and lactating mothers through 40,582 AWCs and MDM is provided to children 6–14 years through 38,014 schools. Dry THR is produced through 330 THR production units, run by the women SHGs under Mission Shakti (MS). Further, food grains are distributed through 9,000 authorised FPSs on subsidised rates under TPDS.

To ensure safety, prior inspections of AWCs, food stocks and essential items were carried out and safety protocols related to food and nutrition issued to the cyclone shelters and relief centres. Control rooms for distribution of food supplies were set-up at district as well as block levels and the progress were closely monitored by the state. Instructions were given to the Women and Child Development Department (WCD) and MS officials on ensuring the safety of children, pregnant and lactating women. Prior to the cyclone, 36 children with Severe Acute Malnutrition (SAM) were admitted in Nutrition Rehabilitation Centres (NRCs) of Cuttack, Puri, Khurda, Jagatsinghpur and Kendrapara; 8 referrals and 22 follow-ups were also done during this period. The Nutrition Counsellors in the NRCs were instructed not to discharge these children immediately post the cyclone. Food supplies (like flattened rice—*chuda* and jaggery—*gur*) were prepositioned in Child Care Institutions (CCIs)/shelter homes/cyclone shelters/schools, to ensure food availability to the community during the cyclone. By 1 May 2019, THR and eggs were distributed to pregnant women, lactating mothers and children less than three years of age. Stock of rice and wheat in FPSs for dispensing of Public distribution system (PDS) rations for May and June was also pre-positioned.

Hot cooked meals provided through the community kitchens and local panchayats, schools and AWCs post the cyclone, played a key role in ensuring nutrition and food security. Schools kitchens were converted into community kitchens, operated by SHGs, for 3–7 days. The Food Supplies and Consumer Welfare Department (FSCW) supplied 1627.5 MT of rice for free community kitchens in the affected districts. Relief packages for the families of severely affected districts like Puri and Khurda comprised of 50 kilograms (kgs) of rice, INR 2000 and polythene (or INR 500). Till 2 May 2019, 60,853.5 MT rice had been distributed to families of the affected districts, to ensure food sufficiency at the household level. As a part of the relief operation, the Government of Odisha provided 402.2 MT flattened rice, 77.8 MT of jaggery, 8 MT of salt, 12.2 MT of onion, 28.5 MT of potato, 2.3 lakh packets of biscuits in Puri. Families in the other affected districts like Cuttack, Kendrapara and Jagatsinghpur were provided with INR 500 and an additional one-month quota of rice through FPSs. Similarly, supply of THR from various locations was facilitated to avoid disruption of THR due to damage of THR producing units (1,07,919 *chattua* packets were shifted from Ganjam to Puri).

3.2 Post-Disaster Context

3.2.1 Health

Health Infrastructure and Physical Assets: A total of 1,031 health facilities were affected. Major damages were related to the infrastructure, electricity, water supply (overhead tanks and piping), air-conditioning and communication system. Structures like doors and windows (glass panels), false ceilings, tin and/or asbestos roof, outdoor units of air-conditioners suffered varying degree of damages. Boundary walls along with the iron grill over the boundary walls of many health facilities were partially or completely destroyed. Tin and/asbestos roof installed at health facilities/offices blew off partially or completely. This indicates that standards and codes were not followed for public hospital buildings. Design codes were also not followed.

Health Service Delivery and Access to Services and Goods: Health services were majorly interrupted due to lack of power at the facilities, lack of communication and due to broken trees blocking the paths/roads. Though diesel gensets were pressed into service, equipment requiring larger amount of power could not be utilised, e.g., X-ray and CT scan machines.

Rescue operation: Injured patients were transferred to the nearest health facilities. A total of 110,116 minor ailments were treated.

Cleaning drive: Fallen trees and other heavy debris were cleared from all hospitals within a week. Altogether, 22,340 village cleanliness drives were conducted.

Power: Uninterrupted electricity at all referral facilities was ensured through back-up. Power to Capital Hospital in Bhubaneswar was restored on a priority basis within less than 72 hours.

Health services: Routine services, like out-patient departments (OPD), in-patient departments (IPD), emergency, deliveries and surgeries were made operational. Surgeries were conducted, and babies were delivered in the Operation Theatre (OT)of the Capital Hospital while the storm was raging, even though specialised diagnostic services like X-ray, ultrasound, CT scan, etc. were interrupted. Routine Immunisation (RI) programme continued uninterrupted with alternate vaccine delivery mechanism. The cold chain points in the five districts were assessed and restored quickly by the state team and vaccines were shifted back. Patients requiring emergency dialysis service were given due services by the health teams, who worked tirelessly to resume services in the Dialysis Unit of the District Head Quarters Hospital (DHH) of Puri, within 10 days of cyclone Fani. Teams of Paediatricians were sent to examine the most vulnerable Sick Newborn Care Unit (SNCU) discharged babies in the blocks.

Water and Sanitation: Overhead water supply restored with a record time of 10 days at all affected Hospitals. At the community level ASHAs conducted House-to-House distribution and in time replenishment of ORS Sachets (2.69 million), Halazone/Chlorine tablets in Bottles (4.05 million), Disinfection of Open wells using bleaching powder on weekly basis (0.13 million), Free Distribution of Sanitary napkins to Adolescent girls & women for 2 months (2.4 million). Community activities were done by Gaon Kalyan Samity (GKS) led by Ward Member in a convergence manner. They also undertook cleaning and clearing of debris immediately wherever required, conducted regular sensitisation meetings at village level for promoting use of safe drinking water, hand washing and sanitation etc. fixing up of warning signs near the contaminated water bodies stating that the same are not safe for use by the community, ensure immediate transfer of patients to nearest hospital for treatment in case of emergencies. Unsafe water bodies (83) were barred from public use.

Vector control measures: These included measures such as fogging, drain cleaning and medication of mosquito nets.

Communication: Massive Information Education Communication (IEC) and Behaviour Change Communication (BCC) campaigns were held through print, electronic and social media. 265 TV spots, 244 radio spots and 82 newspaper advertisements were given on health awareness. Miking was undertaken before and after cyclone, on preventive health care measures. More than 0.6 million leaflets were distributed through ASHAs. Swasthya Kantha were extensively used to communicate healthy practices.

Coordination across Government of India and United Nations (UN) agencies: Disease surveillance for predicting early warning signals for possible outbreak, monitoring of disinfection water sources. Ministry of Health and Family Welfare (MoHFW), Regional Medical Research Centre (RMRC) and National Centre for Disease Control (NCDC): For supply of drugs and logistics, and vector surveillance. National Institute of Mental Health and Neuro-Sciences (NIMHANS): Psycho-social support and National Neonatology Forum (NNF): Distribution of hygiene kit in all urban slums, cold chain assessment, follow-up of babies discharged from Sick Newborn Care Units (SNCUs).

Coordination with line departments: This was critical for immediate restoration of water, electricity and minor repairing of civil infrastructure at public health facilities, disinfection of tube wells and drinking water supply through tankers, shifting of animal carcasses, cleanliness, disinfection of water sources, vector control measures, drinking water supply focusing on urban slums, support in shifting of pregnant women, management of shelter homes, distribution of ORS, chlorine tablets and sanitary napkins.

Food Safety Measures included alerting Food Safety Officers (FSOs) in all affected districts. To strengthen surveillance, three FSOs were diverted to Puri district, which was worst-hit. The Mobile Food Testing Unit/Lab was utilised for food and water testing and creation of awareness—219 on-spot samplings were done for water and food. The food in relief camps was tested thrice a day by a team of two FSOs. The Food Business Operators (FBOs) which started functioning were also inspected throughout the district—with 617 establishments inspected, 553 samples taken, and 157 kg stale food destroyed.

Mental health: Psychological counselling included eight teams from Mental Health Institute, Cuttack that visited all six highly affected blocks of Puri district and provided psychological counselling to the people in distress. District mental health teams also visited affected areas for counselling support.

Training and meetings: Daily review, planning, monitoring and field visits were done on restoration activities and disease surveillance and action points drawn for the next day. Field visits were done by senior officers led by Commissioner-cum-Secretary Health. Engineering teams visited the affected hospitals for immediate restoration works. Consultants and officers also visited the affected blocks to provide support.

3.2.2 Nutrition and Food Security

Effect on Infrastructure and Physical Assets: A total of 2, 513 AWC buildings have been damaged. A total of 39 THR production units have been affected by the cyclone, the raw material damaged and THR production stopped.[6] Public Distribution Supply chain was affected due to damage to 26 storage warehouses; however, supplies have been ensured by moving food grains from six districts (with buffer stocks). Loss to equipments such as weighbridges, computers at warehouses could not be assessed in Puri and Cuttack due to absence of power supply, whereas other districts had minimal equipment losses.

Effect on Service Delivery and Access to Services and Goods: Interactions with government officials, panchayat members during the field visits, visits to AWCs, THR units and focused group discussions with beneficiaries, revealed that the immediate need of food security was taken care through the food provided as relief. Pre-cyclone initiatives of the state government such as distribution of THR including ready to eat dry ration (*Chattua*) and eggs for the pregnant and lactating women and children less than three years of age, distribution of flattened rice and jaggery contributed to availability of food during and immediately after the emergency. Due to summer vacation the schools were closed, hence, the mid-day meals were not provided. The AWCs in the affected districts were closed for three to five days. Services at AWCs such as Village Health Nutrition and Sanitation Day, growth monitoring, SAM identification, micronutrient supplementation services were majorly disrupted during the period especially in centres running in rented premises. Despite the challenges, AWC services resumed and hot cooked meals under SNP were provided at available places in villages.

3.3 Damage, Loss, and Recovery Needs

3.3.1 Damage and Loss: Health

The total damage cost to the physical assets including public health buildings, equipments and the furniture for the 14 affected districts amounts to INR 72.9 crore or USD 10.4 million. The loss due to the disruption of health services including the governance and the risks amounts to INR 231.9 crore or USD 33.1 million, while the total damage and loss stands at INR 304.8 crore or USD 43.5 million. Out of the 14 affected districts, nine districts; Puri, Cuttack, Khurda, Kendrapara, Jagatsinghpur, Mayurbhanj, Balasore, Jajpur, Bhadrak account for maximum damage and five districts Puri, Cuttack, Khurda, Kendrapara, Jagatsinghpur account for 70 % of the damage and 87% of the total loss (Table 3.2).

Table 3.2: Health Sector Damages and Loss (in INR crore unless mentioned otherwise)

District	Damage*	Loss	Total
Balasore	5.2	2.5	**7.7**
Bhadrak	4.1	1.6	**5.7**
Cuttack	18.5	48.8	**67.3**
Dhenkanal	1.7	1.4	**3.1**
Gajapati	0	1	**1**
Ganjam	0.1	4	**4.1**
Jagatsinghpur	7.1	27.8	**34.9**
Jajpur	4.1	2	**6.1**
Kendrapara	3.8	34.2	**37.9**
Keonjhar	0.4	2.8	**3.2**
Khurda	9.7	40.3	**50**
Mayurbhanj	5	4.2	**9.2**
Nayagarh	1.5	1.3	**2.8**
Puri	11.8	56.8	**68.6**
State Level	0.0	3.2	**3.2**
Total in INR crore	**72.9**	**231.9**	**304.8**
Total in USD million	**10.4**	**33.1**	**43.5**

*Damage includes infrastructure, equipment, and furniture.

3.3.2 Recovery Needs: Health

The district-wise distribution of health facilities that are part of the reconstruction plan are given below (Table 3.3):

Table 3.3: Health Sector Recovery Needs and Costs (in INR crore unless mentioned otherwise)

District	Short Term	Medium Term	Long Term	Total Recovery Needs
Balasore	7.8	1.2	0	**9**
Bhadrak	5.8	0	0	**5.8**
Cuttack	17.4	3.2	11	**31.6**
Dhenkanal	3.3	0	0	**3.3**
Gajapati	0	0	0	**0**
Ganjam	0.1	0	0	**0.1**
Jagatsinghpur	4.7	0.9	6.8	**12.3**
Jajpur	5.3	6.5	0	**11.8**
Kendrapara	4.5	5.8	3	**13.3**
Keonjhar	1.1	0	0	**1.1**
Khurda	18.5	1.3	0	**19.7**
Mayurbhanj	14.4	0	0	**14.4**
Nayagarh	4.8	0	0	**4.8**
Puri	15.8	10.8	6	**32.6**
Total in INR crore	**103.4**	**29.6**	**26.7**	**159.6**
Total in USD million	**14.8**	**4.2**	**3.8**	**22.8**

The total recovery needs for the repair and restoration of the physical assets including the resilient infrastructure for the 14 affected districts amounts to INR 159.6 crore or USD 22.8 million. The short-term requirement—12 months for restoration works amounts to INR 103.4 crore or USD 14.8 million. The medium-term requirements from 12–24 months stands at INR 29.6 crore or USD 4.2 million. The long-term requirements from 24–60 months amount to INR 26.7 crore or USD 3.8 million (Table 3.4).

Table 3.4: Health Recovery Needs and Costs Including Build Back Better (BBB) (in INR crore unless mentioned otherwise)

Interventions	Short Term	Medium Term	Long Term	Total Recovery Needs
Repair and retrofitting	103.4	29.6		133
Hazard vulnerability assessment	0.7			0.7
Cyclone resilient building			26.7	**26.7**
Psycho-social support				1.4
Early Warning, Alert and Response System (EWARS)		0.5		0.5
Emergency Operations Centre (EOC)		2		2
Training and capacity enhancement		1.4		1.4
Total in INR crore (break-up)	**104.1**	**34.9**	**26.7**	**165**
Total in USD million	**14.8**	**4.9**	**3.8**	**23.6**

Apart from the physical assets to BBB, the following components were cost-accounted for: hazard vulnerability assessment, cyclone resilient building, psycho-social support, EWARS, EOC, and training and capacity enhancement. The state health department with the Odisha State Disaster Management Authority (OSDMA) had undertaken a structural and functional vulnerability assessment of a sample of public health facilities in the 14 coastal districts.[7] The findings and recommendations of this important study should be taken into consideration for building back better, safer disaster resilient health facilities. The total amount including the BBB component came to INR 165 crore or USD 23.6 million.

3.3.3 Damage and Loss: Nutrition and Food Security

Estimates of Damage and Loss: Data related to estimated cost of damage and loss in nutrition and food security sector are depicted in Table 3.5. Out of total 40,582 AWCs; 13,260 are operating through rented/community building/others, the losses to which are not available. The THR units run by SHGs under MS are operating through rented building and machinery purchased on loans managed through SHG's profits. While the incurred losses have impact on continuity of services; only losses of grains are considered. Similarly, the FPSs run by private dealers/entities are not covered under the damage recovery plan. The grains and warehouse buildings are covered under insurance and thus the recovery costs for restoration are not considered.

The total damage is estimated at INR 51.44 crore (USD 7.5 million), whereas the loss is estimated at INR 30.45 crore (USD 4.4 million). This brings the total estimated damage and loss to INR 81.89 crore or USD 11.89 million in nutrition and food security sector.

Table 3.5: Nutrition and Food Security Sector Damage and Loss (in INR crore unless mentioned otherwise)

District	Damage	Losses	Total
Angul	0.26	0.00	**0.26**
Balasore	1.44	0.00	**1.44**
Bhadrak	0.34	0.00	**0.34**
Cuttack	6.05	1.36	**7.41**
Dhenkanal	0.78	0.00	**0.78**
Ganjam	7.74	0.14	**7.80**
Jagatsinghpur	6.79	0.02	**6.58**
Jajpur	1.98	0.79	**2.77**
Kendrapara	0.17	0.04	**0.21**
Keonjhar	0.00	0.00	**0.00**
Khurda	10.34	1.11	**11.45**
Mayurbhanj	1.02	8.96	**9.98**
Nayagarh	2.13	0.00	**2.13**
Puri	15.52	18.02	**33.53**
Total	**54.56**	**30.45**	**85.00**
Excluding cost of organic solid waste/chopped wheat straw	51.44	30.45	81.89
Total (USD million) @ INR 69.58 = USD 1	**7.5**	**4.4**	**11.89**

3.3.4 Recovery Needs and Costs: Nutrition and Food Security

In order to restore, resume and improve the nutrition and food security services, the following long term, medium term and short-term strategies are being proposed.

For the nutrition sector the recovery cost is estimated at INR 56.63 crore (INR 566.3 million) or USD 8.1 million in the short term, INR 30.6 crore (INR 306 million) or USD 4.4 million in the medium term and INR 201.5 crore or USD 29 million in the long term.

Specifically for the food security sector, the short-term recovery will cost INR 4.2 crore (INR 42 million) or USD 0.6 million, out of which INR 3.2 crore will be recovered through insurance, thus net recovery cost is INR 1.1 crore (INR 10.8 million).The medium-term recovery will cost INR 22.5 crore (INR 225 million) or USD 3.2 million. **Thus, the total recovery need for the nutrition and food security sector is pegged at INR 288.66 crore or USD 41.5 million.**

Disaggregated cost for short term, medium term and long-term strategies for nutrition and food security sector are depicted in Table 3.6.

3.4 Impact on Development Goals

More than 83% of Odisha's population live in the rural areas and depends mostly on agriculture as their livelihood. Their socio-economic vulnerability, weak coping mechanisms, lack of alternative employment and income opportunities and poor infrastructure, make these sections of society extremely vulnerable to disasters including cyclone. They include women, children, old and infirm people. People with disabilities, widows, the sick and the malnourished are more vulnerable to disasters. Poor access to information compounds their vulnerability and is discriminated against during relief and rehabilitation efforts after disasters.

Severe food insecurity was not seen in the affected areas. Focussed group discussion with the communities revealed that quantity and meal frequency (to two meals a day from 3–4 meals) was reduced along with low dietary diversity. The local markets became functional only after 4–5 days, and when functional, the prices of common vegetables were higher (their backyard farms were destroyed) by amounts ranging between INR 8–20, further compromising the access to nutritious food. Most of the mothers confirmed that they continued breastfeeding for children under two

Table 3.6: Nutrition Sector Recovery Needs and Costs (in INR crore unless mentioned otherwise)

Interventions	Short Term 12 Months	Medium Term 12 – 24 months	Long Term 24 – 60 months	Total Recovery Needs
Repair & retrofitting	58.4			58.4
Hazard Vulnerability Assessment		2.0		2.0
Cyclone resilient building of AWC damaged and maintenance			201.5	**201.5**
Training and capacity building		5.2		5.2
Logistics and supply of THR	0.1			0.1
Additional supply of SNP/Milk	1.3			1.3
Mobile Vans to ensure nutrition and food security by extending coverage		17.5		17.5
Community kitchen gardens for vulnerable groups		5.9		5.9
Total (in INR crore)	59.8	30.6	201.5	**291.8**
Total excluding cost OSW/CWS (in INR crore)	56.63	30.6	201.5	288.7
Total in (USD million) @ INR 69.58 = USD 1	**8.1**	**4.4**	**29.0**	**41.5**

Note: OSCSC = Odisha State Civil Supplies Corporation; OSWC = Odisha State Warehouse Corporation; and CWC = Central Warehouse Corporation

years of age, but complementary feeding was compromised. The post-emergency shock and trauma led to compromised eating patterns among the family members. This has potential impact on the nutritional status of the community, especially the younger children, pregnant and lactating mothers.

3.5 Recovery Strategy

3.5.1 Health

Short Term (12 months)

Infrastructure: All building materials and building techniques must follow the applicable Indian Standard Specifications. Immediate temporary work should be restored.

- **Safe and green hospitals:** using energy-efficient LED light bulbs; replacing old air-conditioners with newer, more energy-efficient models; making the premises mobility-friendly for the disabled and the geriatric patients; ensuring piped water supply; using proper material for standards as per Indian Standardised Codes (IS codes). Windows, frames, glass in the cyclone areas must adhere to standards including window films. Well-designed thicker glass panes must be provided. Further, recourse may be taken to reduce the panel size to smaller dimensions. Also, glass panes can be strengthened by pasting thin film or paper strips to them. This will help in holding the debris of glass panes from flying in case of breakage. It will also introduce some damping in the glass panels and reduce their vibrations. Alternate energy source such as solar energy to be explored.
- Higher capacity gensets in all CHCs and Primary Health Centres (PHCs)
- Dedicated transformer and power sub-station for all CHCs
- Deeper wellbore needed for drinking water
- Third-party inspection during procurement and installation
- Ensure that skilled workers are used in the completion of the restoration works

Disaster Risk Reduction: In health services, the focus should be on vulnerable groups (persons with disability, chronic diseases, elderly, adolescents, neonates, children and pregnant women); in terms of quality assured service provision.

- There is a need for enhanced disease surveillance, including electronic daily surveillance and the use of the MoHFW, Integrated Health Information Platform for real-time information on preparedness and response to disasters such as cyclone and for disease outbreak detection and response. Immunisation of high-risk groups must be considered for epidemic prone diseases.
- Psycho-social support through outreach services must continue and be further strengthened. Hygiene promotion within the communities and encouraging community participation for cleanliness drives needs to happen in parallel. There is also a need to engage the private sector. Training and capacity-building programmes must be tailor-made to the roles and responsibilities of the health-sector workforce.
- A coordinated approach is required for the provision of health services and district and sub-district coordination mechanisms need to be developed.
- Risk profiling for blocks can guide this planning. Key stakeholders may need to be engaged, to ensure 'all-hazards preparedness', and may look at aspects of civil society and private sector engagement.

Medium Term (12–36 months)

Focus should be on repair and restoration of cyclone resistant infrastructure and design newer constructions that are disaster resilient.

- Disaster Response Plan to be updated and tested and this must include business continuity planning for health care facilities. There is a need to address the shortage of Human Resources (HR) (especially medical officers).
- State-of-the-art health control rooms are required to coordinate and manage emergencies. The EOC at the state and the districts must be upgraded with the latest technology and communications.
- Build capacity for laboratory diagnosis of most common endemic/epidemic diseases at central and district level by ensuring availability of a minimal package of essential laboratory tests and confirmatory tests at the peripheral level.
- (i) Improve case management of common endemic/epidemic diseases by confirming diagnosis (eg, malaria, Tuberculosis (TB), Human Immunodeficiency Virus (HIV)/Acquired Immunodeficiency Syndrome (AIDS), trypanosomiasis, etc.); (ii) support outbreak investigation and response by ensuring prompt confirmation of epidemic prone diseases; (iii) provide data to surveillance system for monitoring of communicable disease burden; (iv) ensure safe water by monitoring water quality.
- Standard treatment guidelines (STGs) needed. STGs can be implemented effectively and thereby we can ensure a quality health care, at the primary care level, at an affordable cost as part of the now redefined Universal Health Coverage (UHC).

Long Term (36–60 months)

- Strategies for establishment of cyclone resistant hospital buildings in 14 vulnerable districts with construction

of new SC/PHC/CHC buildings with cyclone-proof technology.
- The setting up of an International Centre for Disaster Prevention in Odisha will also help create a pool of experts on epidemiological investigations as well as capacity building of doctors, paramedics and healthcare managers on disaster management.

3.5.2 Nutrition and Food Security Sector

Short Term (12 months)

The short-term focuses on immediate restoration of services by undertaking repairs and retrofitting so that nutrition and food security needs of affected populations are met. It consists of:
- Repairing of the damaged 2,513 AWCs, THR production units
- Replenishment of the machineries and equipment
- Providing pre-school education kits, weighing machines and growth charts at the AWCs.
- The warehouse repairs are already being undertaken whereas alternate arrangements for supply to food, THR and other services must be taken care to avoid interruption in services.
- Transportation costs for THR to the affected areas should be factored as an immediate measure.
- Social and Behaviour Change Communication (SBCC) for families to provide appropriate complementary feeding to young children 6-24 months and provision of micronutrient supplements to pregnant and lactating women.
- The Mid Day Meal (MDM) for the schools, which was not operational during this period needs to be made operational as soon as the schools reopen after the summer holidays. This will help in stopping child labour and works both ways—as households have scarcity of food and means of cooking the school meals can mitigate that risk.

Medium Term (12–36 months)

- Hazard assessment of all key structures in the supply chain of food and nutrition services delivery to make them more disaster resilient, is essential to avoid recurrent losses and damages. A periodic monitoring of these structures from emergency preparedness perspective is an important strategy that could be strengthened in the Standard Operating Procedures (SOPs).
- While the Disaster Management Plan (DMP) and SOPs are defined for each of the sector/department, there is a need for frequent updation of the DMP with inclusion of specific food and nutrition components. Conducting more frequent mock-drills and simulation exercise will help in improving response and resilience.
- It is essential to build capacities of the frontline functionaries of health and ICDS (AWW, ASHA and ANM) on nutrition in emergencies with focus on IYCF practices, community-based management of Severe Acute Malnutrition, nutrition services and supplements as part of Ante Natal Care.
- Investment in mobile vans by the Food and Civil Supplies and Consumer Welfare Dept. (an existing good practice) to ensure wider supply/sale of essential food commodities (rice, potatoes, onions and other nutritious food items) will have immense impact in mitigating nutrition and food security immediately after the disaster by stabilising the prices and resuming normalcy.
- Community kitchen garden will be developed with active support of SHGs which will help in providing diversified diet to severe underweight, severe acute malnutrition, pregnant women and lactating mothers at risk.

Long Term (36–60 months)

- The most affected district Puri has only 24% functional AWCs in own buildings; therefore, steps may be initiated to convert rest of the AWCs into own buildings with provisions of LPG, electricity and child-friendly toilets in a phased manner. The damaged AWCs will be made disaster resilient and accessible with baby-friendly toilet facilities.
- CDPO offices in affected areas, under the build back better strategy, are proposed to be converted into resource centres for 'Women in Disaster', an innovative concept envisaged by the department of Women and Child Development and Mission Shakti. A policy directive from the Department of School and Mass Education for making the existing and under construction MDM kitchen sheds more disaster resilient is required.
- The warehouses will need to be compliant with the recommendations of the hazard assessment based on which the BBB cost will be estimated. These recommendations will be extended to all new public building constructions.
- The possibilities of ready to eat nutrient dense foods for relief, keeping in mind specific requirements of younger children and other vulnerable groups and long-term agreements for the same should be explored.
- A database management system which provides real time monitoring of most vulnerable population with respect to the food and nutrition security for example women at nutritional risk, children with severe underweight (SUW) and Severe Acute Malnutrition (SAM) linked to

OSDMA/proposed State Institute of Disaster Management for early actions will be worth an investment to be considered. This will also require strengthening existing systems within the state and linking them better.

- A protocol for management of severely malnourished children through referral if required and through community-based program needs to be designed and implemented as a convergent program between ICDS and Health Departments. A specific initiative for strengthening Complementary Feeding needs to be included as a part of ICDS program. An initiative to comprehensively address anaemia in pregnant and lactating women and across the life cycle needs to be in place.

3.6 Sector Assessment Methodology

The assessment was carried out through review of primary and secondary data sources made available by the Government of Odisha. This was done over a 3-day period, through field visits by respective sector teams to the 14 most affected districts. This included an interaction with the officials at the district headquarters, health workers at the facilities at various levels as well as the community. The above tailor-made methodology helped to not only gather first-hand information on the extent of damage and take stock of the public health sector response, but also provided an opportunity to validate relevant data. The visits proved to be of immense use in assessing the human impact of the disaster and to develop recovery strategies with a special focus on the most vulnerable sections of the society.

The health sector field teams comprised of nine members from WHO, UNFPA, UNICEF and the World Bank. They were grouped together to form four teams which were accompanied by ten state officials and five National Health Mission (NHM) consultants to visit a total of seven districts (Bhadrak, Cuttack, Jagatsinghpur, Jajpur, Kendrapara, Khurda, Puri) over three days. During the visits, the teams obtained feedback from the District Collector, Chief District Medical Officer (CDMO) and other district officials. Health facilities at various levels were visited and included the primary health centres, community health centres, district hospitals, medical colleges, city hospitals and public tertiary care hospitals, where the assessment team received valuable inputs from the doctors, nurses, program managers, project officers, hospital managers, public health managers and supporting health staff. Additional facilities or sub-centres or AWCs visited by team included Brahmagiri and Krushna Prasad on Day 2 and Satyabadi on Day 3.

In the nutrition sector, a 11-member team from WFP and UNICEF visited 14 blocks, 6 THR production units, 7 NRCs, district social welfare offices, civil supplies office, CDPO office, 50 AWCs to interact with the community people of five adversely affected districts as suggested by the government. Basic information was collected from the department of WCD and MS, NHM, Odisha State Medical Corporation Limited (OSMCL) and e-Portals (e-ausadhi and e-pragati). The existing data was supported by information collected from post cyclone assessment data of five adversely affected districts conducted by Centre of Excellence (CoE) Child Health and Nutrition. District Social Welfare Office (DSWO), CDPO, Central Statistics Office (CSO), ICDS supervisors, AWWs were interviewed and 38 focused group discussions with pregnant and lactating mothers as well as with other community members were conducted. Damage and loss data was collected and analysed for assessment of damage, loss and recovery.

Notes

[1] *Census of India 2011*, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India; http://www.censusindia.gov.in/2011census

[2] NITI Aayog, *Healthy States, progressive India*. http://social.niti.gov.in/uploads/sample/health_index_report.pdf

[3] SRS 2017 and SRS 2014–16

[4] SAMMPurNA Strategy

[5] 61st and 68th rounds of NSS, Consumer Expenditure surveys published by the Ministry of Statistics and Programme Implementation, Government of India.

[6] The SHG units are usually in rented premises and machinery is procured by the unit. State government provides food allocation. INR 50,000 is sanctioned by the department for repairs and restoration.

[7] http://www.osdma.org/Download/FindingRecommend.pdf

4

Cultural Heritage and Tourism

4.1 Pre-Disaster Context

4.1.1 Cultural Heritage and Crafts

The state of Odisha is known for its huge wealth of tangible and intangible cultural heritage. It has 79 monuments protected by the Archaeological Survey of India (ASI) and 218 monuments under state protection besides numerous unprotected heritage structures. Among them are the world-renowned Sun Temple at Konark, a United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Site, and the Jagannath Temple in Puri popular for its annual *Rath Yatra* or the Chariot Festival. The Ekamra Kshetra area in the old city of Bhubaneswar known for its centuries' old temple architecture is on the tentative list of the UNESCO World Heritage Sites.

Odisha has several important museums that house a large number of rare artefacts. These include the Odisha State Museum which is estimated to have one of the largest collections of palm leaf manuscripts in Asia, the Museum of Tribal Arts and Artefacts, the Odisha State Archives, and the recently opened Kala Bhoomi, a museum complex of local handicrafts and handlooms.

Besides its tangible heritage, Odisha is also home to several intangible cultural traditions such as performing arts, folk and tribal arts, festive and ritual events, and handicrafts and handlooms. As per estimates by the Odisha Sangeet Natak Akademi (SNA), more than 470 varieties of folk and tribal performing art traditions are practiced across the 30 districts in Odisha. About 8,735 artist groups that include about 1,14,686 artists, practice these varied art forms and derive their livelihoods from them. The average monthly income of the performing groups ranges from INR 6,000–20,000 (USD 86–288). It is estimated that about 67% (76,840) of the performing arts practitioners belong to tribal communities. About 22% of them are estimated to be women. Out of the 165 intangible cultural heritage traditions listed so far on the national inventory of the Sangeet Natak Akademi under the Ministry of Culture, 17 belong to Odisha, including Singrai (folk songs of the Santhals), wall paintings of the Saura tribe, palm-leaf scripts, and the world-recognised Odissi dance.

The state is also well known for its various festivals that are an integral part of the cultural core of Odisha. Its festival calendar consists of major festivals such as the *Rath Yatra* which is also an important tourist event, as well as several community-based rituals such as the *Akshaya Trituya*, *Snana Purnima* (when non-Hindus can also witness Lord Jagannath), *Shiv Ratri*, and Raja Festival among others. Festivals such as the Puri *Rath Yatra* for instance, involve mass participation across communities, castes, genders, and age groups. The Jagannath Temple at Puri and the *Rath Yatra* support hundreds of priests and those involved in ancillary services, as well as a large number of people in associated creative industries including handicrafts, garland making, decorative materials, as well as local cuisines.

Odisha is well recognised for its rich handicraft and handloom traditions that represent excellence in craftsmanship acquired over generations of practice, such as the *Patachitra* paintings, palm-leaf paintings, wood carving, stone carving, *ikat* tie and dye weaving, *dhokra* bell metal casting, appliqué, natural fibre crafts, and natural dyed woven textiles. It is estimated that about 50 types of handicrafts and handlooms are currently practiced in Odisha. The state's artisan sector is considered to be the second largest source of rural livelihoods and employment, after agriculture. It is estimated to directly employ 1,92,339 weavers[1] and about 1,30,000 craftspersons,[2] besides providing employment in ancillary activities such as pre-loom processes. Being traditional home-based activities, they involve the active participation of women in central and

auxiliary activities. About 44% of the weavers and artisans employed in Odisha's handloom and handicrafts economy are from the Scheduled Castes (SC) and Scheduled Tribes (ST), which is substantially higher than the national average of 18.4%. About 45% of the handloom households are below the poverty line, which is higher than the national average of 34%. The handloom and handicrafts sector has been identified by the Government of Odisha as a priority sector.[3] The state government provides substantial support to the sector through implementation of various central and state government schemes, and through apex marketing institutions, including Boyanika, Utkalika and Sambalpuri Bastralaya. They source from about 500 primary weaver cooperatives (constituting 35% of the state's weavers) and 193 craft cooperatives (constituting 21% of the state's artisans), spread across the 35 handloom and 109 handicraft clusters in the state. The state also facilitates substantial sales through handloom and handicraft fairs in Bhubaneswar and other prominent cities, as well as through weekly *haats*/ fairs in prominent clusters.

4.1.2 Tourism

Odisha has a rich blend of historical, religious, cultural, spiritual, and nature tourism assets,[4] including centuries-old temples, Buddhist stupas and monasteries, Ashokan rock-inscriptions, marine habitats, wildlife sanctuaries, hot springs, pristine beaches, and many more. The total tourist footfall in the state was 14.11 million in 2017, of which 99% were domestic tourists. The Golden Triangle of Puri–Bhubaneswar–Konark drives Odisha's tourism industry, with Puri and Khurda districts alone accounting for over 45% of the domestic tourist traffic and 83% of the foreign tourist traffic to the state.[5] In 2017, 60% of the total tourist traffic to the state was registered in the six peak-season months of January to March and October to December. The total inflow of money through tourist expenditure in Odisha is estimated at INR 147 crore (USD 2.1 billion). The overall tourist footfalls to the state have registered a year-on-year growth of over 9% since 2015.[6]

According to government records, there are 1,864 hotels, 38,558 rooms, and 77,024 beds in the state that are privately-owned. Of the hotels, 17% target the High Spending Group (HSG), 22% the Middle Spending Group (MSG), and 61% the Low Spending Group (LSG). Puri and Khurda districts account for 46% of the total hotels and 63% of the HSG hotels in Odisha.[7] The Odisha Tourism Development Corporation (OTDC) operates 20 tourist accommodation units including Panthanivas, Panthika, Panthasala, Yatrinivas, and Aranyanivas units. The Department of Tourism operates three tourist accommodation units.

Odisha's tourism industry employs an estimated 1.05 million people. Tourism is an important driver of related cultural industries such as the handlooms, handicrafts, and food and wellness sectors, particularly in the Golden Triangle region. For example, tourist inflow to the Raghurajpur Crafts Village, which is situated at a short distance from Puri is a huge contributor to the crafts sector and other related livelihoods in the area. Tourism has been identified as a priority industry by the Odisha Government.

Table 4.1: Cultural Heritage of Odisha

Type of Cultural Heritage	Concerned Authority	Number
Tangible Cultural Heritage		
Monuments and Archaeological Sites	Archaeological Survey of India	79
	Odisha State Archaeology (under Odia Language, Literature and Culture Department)	218
Intangible Cultural heritage		
Handlooms and handicrafts	Handlooms, Textiles, and Handicrafts Department	About 50 kinds of crafts and weaving traditions
Performing arts, and folk and tribal performing arts	Odia Language, Literature and Culture Department	More than 470
Movable Heritage		
Museums	Odia Language, Literature and Culture Department	About 17. The State Museum has about 60,000 manuscripts and 40,000 artefacts
Archives	Odia Language, Literature and Culture Department	The Odisha State Archives have about 6,02,050 archival items including government and private records, old newspapers, old books, photographs

Source: Concerned authorities mentioned above

4.2 Disaster Effects: Damages and Losses

4.2.1 Tangible Heritage: Monuments and Sites

The tangible heritage assets of Odisha namely monuments, archaeological sites, museums, and public cultural institutions have weathered the cyclone Fani to some extent, and in most of the cases the degree of damage is moderate. The damage has been mainly to the boundary walls or adjacent structures without affecting the main structures. The resistance to damage, particularly in the case of monuments, has been mainly due to three factors: the building material of the monuments; the architectural form of most of the monuments; and their geographical location, as many of them are not located close to the coastline. Furthermore, some monuments, especially those under the ASI, have already been cleaned up and partially restored thus minimising risks of further damage.

In most of the monuments and architectural heritage, the materials are khondalite stone and laterite stone that enabled them to withstand the wind and floods. It is noticeable that laterite stone is so compatible with the local climate and resistant to damage risk, that in some of the monuments the mortar consists only of sundried mud with aggregates. In some of these heritage structures there is neither extra joinery nor lime plaster, which has been used allowing them to breathe and drain water without causing structural damage.

A more serious and long-term damage by the cyclone has been the uprooting of the trees around the heritage sites. This is significant particularly for sites like the Konark Sun Temple which is located on the seashore. In the coastal areas of Odisha, the casuarina trees around sites like the Sun Temple protected the monument from weathering as they shield the structure from salt-laden sea winds. However, the majority of these trees have been damaged in the cyclone. The loss is serious as they require about 10 years to reach maturity. Vegetation has been seriously affected in many other sites as well.

Overall, the tangible heritage in the districts of Puri and Khurda has been significantly hit. The Odisha State Archaeology Department has assessed the damage to 113 monuments and sites across the 12 most affected districts of Odisha. The damage estimated for the monuments and sites so far is about INR 15.9 crore (USD 2.3 million). The ASI has made the damage assessment for 21 monuments in six districts namely, Puri, Khurda, Dhenkanal, Cuttack, Jajpur, and Jagatsinghpur.

4.2.2 Movable Heritage: Museums and Archives

Most of the museums or cultural institutions suffered minor damage or were unharmed in terms of structural efficiency. A few glass windows have been damaged and small cracks seen in the walls. The cyclone has affected tin roofs, secondary steel installations such as room dividers, or has resulted in small cracks in the case of concrete buildings. In some of the buildings, small portions of humid spots have developed fungus due to the flooding of buildings. In the case of Netaji Museum in Puri town, the signage and CCTV have also been damaged. However, the main structure has not suffered any serious structural damage except hairline cracks on the wall and roof.

The building of the Odisha State Museum in Bhubaneswar however, has suffered a lot of damage, including broken glass windows, lights, air conditioners, and roofs. More significantly, there is damage and further risk to the traditional artefacts and manuscripts housed there. This includes the ancient manuscripts on specially processed palm leaves, of which the State Museum has one of the largest collections in Asia.

Similarly, due to the leaking glass windows in the Odisha State Archives in Bhubaneswar, rare archival materials such as old and rare newspapers and rare books have been damaged by flooding in the rooms. The materials are risk-prone as only about 5% of them are appropriately maintained in acid-free boxes or in rooms with dehumidifiers.

In the Odisha State Archives, steel is used as part of the structure in windows, doors, room dividing installations, and tin for roofing in certain parts. Due to high temperature and extremely high levels of humidity in Odisha, extra corrosion is noticed as an effect of the cyclone. The total damage estimated for museums, archives and cultural institutions that are under the authority of the Odia Language, Literature and the Culture Department/ Directorate of Culture is estimated to be INR 55.9 crore (USD 8 million).

4.2.3 Intangible Heritage

Performing Arts

The numerous folk performing art practices of Odisha such as Pala, Sankirtan, Gotipua, Paikha Akhada, Danda Nach and others that involve thousands of practitioners in rural areas have been severely affected in Cuttack, Khurda, and Puri districts. About 21,101 folk artists associated with these practices have been affected. As many of them live in thatched houses, they are vulnerable to the adverse impact of such disasters. Due to lack of adequate storage facilities, musical instruments such as the *mridang* (a double-sided drum), *jhanja* (brass alloy cymbals), harmonium, *mardala* (percussion instrument), and costumes required for the performances have also been damaged. There has been damage to the infrastructure required for performances like

the rehearsal spaces. The makers of musical instruments have also been affected. Due to the effect across the value chain, the practitioners seem unable to resume their performances over the next few months leading to a loss of daily income as they are fully dependent on the performances for their livelihood.

The learning and transmission of art forms such as Odissi vocal music and Odissi dance has also been affected due to the infrastructure damage suffered by important institutions such as the Ramhari Das Odissi Gurukula Trust in Puri and the Utkal Sangeet Mahavidyalay in Bhubaneswar. The former has also lost a significant source of income for sustenance, due to the destruction of a large number of coconut trees in its campus. Raghurajpur, the heritage crafts village in Puri, one of the most severely affected districts, is also an important centre for Gotipua dance, a dance tradition that is considered to be the origin of Odissi dance and has a big influence on it. Also in Raghurajpur, an important residential Gotipua training institution called the Padmashree Guru Maguni Das Gurukul has been affected badly. Due to the damage caused to the roofs, window panes, and the kitchen of the ten-room hostel, training has stopped, and the students have been sent home. Similarly, Natyagram, an important theatre village and institution in Khurda that draws on Odisha's folk theatre forms and trains youth from the state's tribal communities as actors, has also been affected. Apart from the damage to the buildings in the theatre village, a large number of mature trees have also been uprooted. The damage to the performing arts particularly in rural areas is estimated at INR 11.2 crore (USD 1.6 million) and the income losses to the performing artists and institutions is estimated at INR 57.2 crore (USD 8.2 million).

Festival, Rituals, and Social Practices

The cyclone has had an effect on the vibrant cultural life of the communities in Odisha. The Chandan Yatra and Jagannath Rath Yatra which are celebrated during the months of June or July are major festivals that involve mass participation and celebration in Odisha. Besides cultural well-being, these festivals also contribute to the economy in terms of tourism and income generation for thousands of people associated with them, such as craftspeople, priests, cooks, florists, and garland makers.

Besides these major festivals, several others are organised by the Odisha SNA and Odisha Tourism. Odisha SNA has had to postpone its upcoming calendar of festivals, including the Rangabati Western Odisha dance and music festival; Odissi, Karnataki, and Hindustani Tridhara Festival; and classical dance and music programmes.

Handicrafts and Handlooms

The cyclone has had a substantial effect on the handloom and handicrafts sector. An estimated 47,208 weavers and 71,060 artisans across the 14 affected districts have suffered damage and losses. Weavers and artisans in Puri and Khurda districts are the worst affected. The affected crafts primarily include *patachitra* painting, palm-leaf painting, applique, stone carving, wood carving, and handloom weaving.

Across the 14 affected districts, both individual assets (such as looms, tools and equipment, work sheds, raw material and finished good stocks) as well as community infrastructure or cluster assets (such as the Weaver Cooperative Society [WCS] offices, Handicrafts Cooperative Society [HCS] offices, Common Facility Centres [CFCs], and the raw material stocks at HCS/WCS offices) were damaged. In many of these districts, namely, Puri, Khurda, Cuttack, Jagatsinghpur, Kendrapara, Balasore, and Bhadrak, showrooms and offices of the Odisha State Handloom Weavers Cooperative Society Ltd. (Boyanika) have suffered infrastructure damage and loss in terms of material stocks. Showrooms of Sambalpuri Bastralaya and Odisha State Co-operative Handicrafts Corporation Ltd (Utkalika) in Puri and Khurda districts have been affected as well. State-owned institutions such as the State Institute for Development of Arts & Crafts (SIDAC), the Stage Agency for Development of Handloom Clusters (SADHAC), and Kalabhoomi Crafts Museum in Bhubaneshwar (Khurda district) have suffered infrastructural damage. The total estimated damage to individual-, community- and public-owned assets in the handloom sector and handicrafts sector is estimated at INR 98.4 crore (USD 14.1 million) for handlooms and INR 221.6 crore (USD 31.7 million) for handicrafts.

The assessment team observed that a large number of weavers and artisans who suffered significant damage to tools, equipment, raw materials, and finished goods had semi-pucca worksheds and/or asbestos roofs, which were damaged or blown off by the cyclone. Many of these weavers and artisans were beneficiaries of the workshed-cum-housing scheme under which they constructed a pucca workshed/room. However, it was observed that since the rest of the house was semi-pucca (or kutcha), the families had used the worksheds as living quarters and moved the looms, equipment and stocks to the semi-pucca part of the houses.

In addition to damages to infrastructure and other assets, the weavers and artisans have suffered, and are expected to further suffer, income losses due to forced inactivity on account of damaged equipment, loss of raw material stocks, damaged workspaces and intermittent power

supply. At the time of writing this report, electricity still hadn't been restored in many clusters in Puri and Khurda districts and wasn't expected to be restored soon. This means that even those weavers and artisans who have their tools and equipment intact are severely constrained in terms of the requisite lighting for their artisanal activities. The assessment team estimated that weavers and artisans in the severely affected districts of Puri and Khurda, as well as in the moderately affected districts of Jagatsinghpur, Cuttack and Kendrapara will be out of work for a longer period than those in other districts. Since a large part of the crafts sector in Puri and Khurda districts depends on tourism, recovery and resumption of normal levels of activity will depend on the revival of the tourism industry in Puri and the revival of the hospitality industry in particular. The total income losses in the handloom and handicrafts sector are estimated at INR 31.7 crore (USD 4.52 million) and INR 90.3 crore (USD 12.91 million) respectively.

A substantial proportion of the affected weavers and artisans are estimated to be women and members from vulnerable sections. The handloom and handicrafts sectors employ a significant number of women. Handloom weaving, in particular, is a household activity, and involves both the male and female adult members of the family in central and ancillary activities. Therefore, at least 50% of the affected weavers are estimated to be women. The proportion of members from SC and ST households among the affected weavers and artisans is estimated to be about 44% (extrapolating from baseline figures).

4.2.4 Tourism

Odisha's tourism sector has been substantially affected by the cyclone. Puri which is the number one tourist destination of Odisha was also the point where the cyclone made landfall. The Golden Triangle of Puri–Bhubaneswar–Konark that receives over 45% of the annual tourist traffic, faced the brunt of the cyclone and has suffered significant damage and loss. Almost all major tourist sites in Puri have suffered damage. The scenic Puri–Konark marine drive is now unrecognisable, with large-scale uprooting of trees and damage to the greenery bordering the roads.

The hospitality industry, which is critical for overnight tourist footfalls, has been substantially hit by the disaster. At least 904 private sector units in Puri and Khurda districts including hotels, accommodation units, tourist amenities have suffered damage estimated at INR 132 crore (USD 19 million). At least 30 accommodation units owned by the Department of Tourism and the Odisha Tourism Development Corporation Ltd (OTDC), and tourist amenities and tourism offices across the state have suffered damage estimated at INR 24.0 crore (USD 3.43 million).

At the time of writing this report, the recovery of Puri's hospitality industry was still in its early stages. Power had not been restored to a major part of the district and the city. Less than 15% of the hotels had reopened, with significantly fewer rooms/beds. As a result, overnight visitors were down to 10% of the 2018 levels. Footfalls of day visitors showed a gradual recovery and were observed at 30% of the 2018 levels in tourist destinations in Puri, as well as at tourist sites enroute to Puri from Bhubaneswar. Resumption of tourist footfalls at normal levels will largely depend on how soon electricity distribution is normalised in the Golden Triangle, and on how quickly the hospitality industry in Puri recovers and hotels reopen after repairs/restoration works (only 30% of the hotels in Puri are estimated to be insured). The assessment team estimates tourist footfalls to gradually normalise by August 2019 in Puri district, and at a relatively faster rate in other affected districts. The total revenue losses suffered by the tourism industry in the three affected months of May, June and July, as calculated using average domestic and international visitor spend figures, is INR 1,115 crore (USD 165 million). The estimated number of livelihoods affected directly (tourism characteristic industries) and indirectly (tourism connected industries) by the cyclone is 7,36,000.

4.3 Disaster Impact

4.3.1 Human Development Impact

The already vulnerable population living in poverty, such as the rural artists and craftspeople, is likely to face further distress due to loss of livelihood on which it is solely dependent. The lack of quick support to recover from their losses may force the skilled craftspeople and performing artists to take up unskilled jobs or migrate to seek other work. This could potentially result in the loss of knowledge and skills associated with these traditional practices and affect the transmission of such knowledge and skills. The stress-burden of women, especially those who are the bread-earners of the family and have dependents, may have increased, leaving them more vulnerable.

The cultural and community life of people is significant for the sense of well-being of the society. Fani has left a deep mark on this aspect. Of foremost significance is the impact on the big annual festivals slated for June and July. Further, community spaces such as places of worship and social congregation, which are linked to the identity of a place and its people, have been damaged and need repair and restoration. For instance the *mandap*, *yagna*, and kitchen spaces of Nikunja Bihari Temple have been damaged and that has had a fall out for the community.

Table 4.2: Estimates of Damage and Loss (value in INR crore)

Sub-sector	No. of livelihoods affected	Damage	Loss	Total value of damage and loss	Value of damage and loss by ownership	
					Public	Private
Tangible Heritage: Monuments and sites		15.9		15.9	15.9	
Museums, Archives and Cultural Institutions		55.9		55.9	55.8	
Intangible Heritage: Performing Arts	21,101	11.2	57.2	68.4	5.0	63.4
Intangible Heritage: Handloom & Handicrafts	1,24,268	320.0	122.0	442.0	15.1	426.9
Tourism	7,36,000	156.5	1,155.4	1,311.9	38.0	1,273.9
Total	**8,81,369**	**559.5**	**1,334.6**	**1,894.1**	**129.9**	**1,764.2**
Total (in USD million)		**79.9**	**190.7**	**270.6**	**18.6**	**252.0**

Detailed sub-sector damage and loss assessment is available in Annexe 4.1, 4.2, 4.3, 4.4, and 4.5.

For Cultural Heritage:

1. *Damage estimates are based on preliminary assessment by the State Department of Archaeology of 113 structures in 12 of the affected districts. The extent of damage was corroborated by field-visits to a few of the sites like Nikunja Bihari Temple in Khurda and the Gundicha Temple in Puri.*
2. *Damage estimate for performing artists was collected by the Odisha Sangeet Natak Akademi/UNICEF. As per data compiled by Odisha SNA/UNICEF, the folk performing artists in other districts were not affected. Data was collected through field visits and interaction with about 20–30 artists from five to six groups.*
3. *Estimates of damage to performing spaces are based on data collected by the Directorate of Culture as well as field-level discussions with heads of non-public performing spaces.*
4. *Income losses were calculated using average income earned by an individual folk performing artist per day based on rates provided in government outreach programmes conducted through UNICEF. An estimated loss of 45 days of work due to damaged equipment/costumes, limited opportunities and other factors like damaged living spaces was considered.*

For Museums, Archives, and Cultural Institutions:

Damage estimates are based on data collected by the Directorate of Culture on 'eye estimation', data collected by individual departments like the Odisha State Museum, Odisha State Archives, Utkal University of Culture, as well as data collected by PWD for certain buildings, corroborated by field-level observations.

For Tourism:

1. *Damage estimates are based on data collected by the Department of Tourism on government-owned tourist assets and a large sample of private hotels in Puri and Khurda.*
2. *Revenue losses are calculated using average visitor spend data as reported in tourism statistics published by the Department of Tourism.*
3. *Estimates have been qualified based on field-level observations made in Puri and Khurda districts and discussions with relevant stakeholders.*

For Handloom and Handicraft:

1. *Damage estimates are based on data collected by the Department of Handlooms, Textiles and Handicrafts across 14 affected districts, and field-level discussions with weavers, artisans, cooperative leaders, and other stakeholders in five most affected districts including Puri and Khurda.*
2. *The estimates do not include damages to workshed-cum-rooms, i.e. housing. These are addressed in another part of this report.*
3. *Income losses are calculated using average per-day wage for weavers and artisans and an estimated period of artisanal inactivity ranging from one month to three months after the cyclone depending on the district.*

However, the cyclone aftermath also opens a window for different stakeholders to assess the current situation and move towards more resilient solutions. It provides an opportunity for the government authorities, civil society, communities, private sector, and concerned citizens to come together.

4.3.2 Macroeconomic Impact

There has been a significant loss of revenue for the state due to substantially reduced tourist footfalls in the months following the cyclone. Apart from the hospitality industry, a number of other related industries are hit. The handloom and handicrafts sector, which has been growing at over 8%

every year, is likely to experience a slowdown in growth. Nearly 0.9 million weavers, artisans, tourist guides, boat operators, hospitality sector employees, vendors, restaurants, producers, and various other self-employed sections have been affected.

Restoration works on tangible heritage include the demand for specific materials such as the native khondalite stone and laterite stone and specific services. This will most likely increase the prices of these building materials and services temporarily.

4.4 Recovery Costs and Strategies

As Odisha is prone to disasters like the recent cyclone, it is essential to develop more sustainable and resilient solutions for the recovery of its cultural heritage and tourism sector and build back better. The disaster Damage, Loss, and Needs Assessment (DLNA) has identified some areas which are crucial for the recovery and disaster preparedness of these sectors for the future. All of these activities, particularly those related to intangible cultural heritage and cultural/creative industries, should be planned and implemented in close consultation, and with the participation of, local community members, paying special attention to ensuring that all groups, in their cultural diversity, are included.

4.4.1 Tangible Cultural Heritage

- A detailed assessment of cultural heritage sites, prioritised based on the extent of damage, should be undertaken so that the repair and restoration of damaged areas can be initiated on an urgent basis.
- Priority should be given to the use of local construction materials and craftsmanship which are compatible with the existing traditional structures.
- All the respective infrastructure needs to respect the archaeological physiognomy of the monuments and sites without disturbing it.
- Preventive measures such as Risk Management Plans need to be undertaken. These will include detailed documentation of heritage sites that do not have such mapping, comprising details of their construction and environment. The risk mitigation plan should also focus on minimising the likelihood of a serious disaster against human life itself, such as the carrying capacity of the sites, emergency exits (especially for people with disabilities), fire protection, and flood protection.
- Training sessions need to be conducted for awareness and capacity building on risk reduction.
- The engagement of communities that are the main custodians of several unprotected living sites, is crucial for site conservation and disaster preparedness.
- A holistic and material-sensitive approach needs to be adopted in dealing with damaged structures, thus avoiding short-cuts in repair work. This principle should also be considered for secondary structures around monuments, such as tourist amenities and infrastructure.
- A database of cultural heritage sites, with maps, photographs, reports, etc., can be developed so that information is easily accessible when required.

4.4.2 Museums, Archives, and Other Cultural Institutions

- The repair of damage to the building infrastructure should be conducted on a priority basis, so that the valuable materials housed in these institutions are not futher exposed.
- A risk profiling of the museum collections can be initiated so that necessary steps can be taken to ensure that valuable archival and other rare materials can be appropriately preserved.
- Awareness and capacity building on risk mitigation is important for museum staff.
- Adequate funding and staffing is crucial for the implementation of recovery and resilience-building measures so that new risks can be mitigated in the future.

4.4.3 Intangible Cultural Heritage

- Provision of grant support on a priority basis is required to enable the performing artists to repair and replace their musical instruments and rehearsal spaces, and resume work. Similarly, important performing art institutions need to be provided grant support to help them resume activities, including activities aimed at supporting critical processes for the enhancement of relevant skills and traditional knowledge, and their transmission to the younger generation.
- Good baseline data for intangible cultural heritage, such as performing arts and crafts, and particularly disaggregated data based on gender, age, disability, skill level, etc., is important, together with a strategy to reduce disaster risks, for example to prevent the loss of critical equipment and tools in the future.
- Financial literacy for rural performing artists and artisans can create awareness about savings and reducing further vulnerabilities, such as indebtedness, during disasters.
- Written and audio-visual documentation of folk-art forms, including interviews of gurus (teachers), will support the preservation of knowledge regarding these traditional practices. The youth from the communities can be trained to document their own heritage.
- Training may be conducted for practitioners of folk-art forms to evolve programmes suitable for different

kinds of audiences, to create new livelihood opportunities and strengthen economic resilience, while paying special attention to ensure that the social and cultural function of the intangible heritage is not lost within the community.

- Exchange programmes for the practitioners, with contemporary performing arts groups, is required to encourage collaboration and evolve the art practices, thus enabling them to thrive.
- The immediate needs for traditional/folk-art recovery of the handloom and handicrafts sector, include provision of power supply, restoration of tools and equipment, and supply of raw materials through the WCS and HCS. This should be complemented with capacity building efforts in disaster risk reduction and disaster risk mitigation planning among key stakeholders, including department officials at all levels, WCS/HCS leaders, craft enterprises, artisans and weavers.
- The recovery strategy needs to be aligned with the overall long-term vision for the transformation of the sector. This means enhancing the economic resilience of weavers and artisans, and improving their share in the markets, while complementing it with an integrated strategy to rapidly develop the sectors over the next five years. The state needs to adopt specific strategies for various types of players in the sector, based on their roles in the sector's development, the constraints faced by them, and their growth potential:
    - **Individual weavers/artisans:** Facilitate strengthening of artisan skills, access and inputs to improve their abilities to link to the market and increase their share in revenues. This includes upskilling, artisan business education programmes, establishing an Information and Communications Technology- (ICT) based system that can track and monitor all artisan/weaver initiatives, and increasing direct marketing opportunities in state and national markets.
    - **Cooperatives/Federations:** Reform state-supported apex marketing institutions, strengthen competitiveness of primary cooperatives and improve their access to markets and establish productive alliances with large private sector enterprises. This includes re-engineering government subsidies to incentivise up-skilling and innovation, mentorship programmes for WCS and HCS leaders, and facilitation of productive alliances with upstream players.
    - **Artisan enterprises:** Facilitate modernisation of micro, small and medium artisan enterprises, including women entrepreneurs, to improve their ability to participate in national/global value chains. This includes value chain studies of key craft sub-sectors, facilitation of productive alliances with upstream players, incentives to enhance competitiveness and competence in supply chain management, design development, marketing, and establishing an e-marketplace for supply chain actors for real-time information on goods and services in the value chains.
    - **Large players:** Partner with large private sector players to incentivise them to create downstream demand/jobs and propel the sector. This includes facilitation of participation in international fairs, exhibitions and buyer-seller meets, Made-in-Odisha branding and promotional campaigns, and tax incentives to promote exports.

4.4.4 Tourism

The immediate recovery needs are centred on the revival of the hospitality industry. Debris clearing, repair and restoration of government and private accommodation units, using 'build back better' (BBB) principles for improved resilience is critical for resumption of tourist footfall. Soft loans may be offered to the private sector to catalyse this process. This should be complemented with capacity building in business-continuity planning and disaster risk mitigation among government stakeholders and private sector participants, as well as efforts to widen insurance coverage among private sector enterprises. The industry may benefit from a 'Resurgent Odisha' communication campaign to catalyse resumption of tourist footfalls.

The state can supplement its ongoing long-term efforts at transforming Odisha's tourism industry with developing smart tourist destinations, beginning with selected sites in Puri. This may include aspects such as enhancing consumer experience through digitalisation of tourist sites using technologies such as virtual reality and augmented reality; information exchange mechanisms for efficient and real-time sharing of information between tourists, tourist sites, businesses, government institutions and other stakeholders; dedicated vending zones with resilient structures for vendors and other tourism-connected sectors such as food and handicrafts; ensuring accessibility for old people and the differently-abled, among others. The state may also explore thematic tourism concepts (taking lessons from the Raghurajpur model) focusing on traditional Odia cuisine, traditional performing arts, wellness and traditional medicine, etc., in villages within and adjacent to the Golden Triangle as well as other popular tourism circuits in the state.

4.5 Assessment of Recovery Needs

Table 4.3: Summary of Recovery Needs for Cultural Heritage and Tourism Sector

Sub-sector	Recovery needs (INR crore)			
	Short term	Medium term	Long term	Total
Tangible Heritage: Monuments and sites	6.8	13.7	0.0	20.5
Museums, Archives and Cultural Institutions	61.5	0.0*	0.0*	61.5
Intangible Heritage: Performing Arts	12.5	1.5	0.9	14.9
Intangible Heritage: Handloom & Handicrafts	332.4	10.0	10.0	352.4
Tourism	61.0	6.0	10.0	77.0
Total (INR crore)	**474.2**	**31.2**	**20.9**	**526.3**
Total (in USD million)	**67.7**	**4.5**	**3.0**	**75.2**

Note: *The medium and long-term recovery is not estimated as it should be based on detailed assessment of the individual needs of the institutions.

Table 4.4: Recovery Needs for Tangible Cultural Heritage (Monuments and Sites) (costs in INR crore)

Short-term needs	Costs	Medium-term needs	Costs	Long-term needs	Costs
Based on individual site requirements, urgent repair and restoration of damaged monuments and sites, including cleaning of concrete, repair of cracks, boundary wall, and demolished adjacent structures, lighting installations, re-plantation, etc.	6.8	Based on individual site requirements, assessment of the structural integrity of the structures and stabilisation of ground surface, proper landscaping, extension of boundary walls around the monuments/sites, stone paving, and signages.	13.7	Detailed documentation of sites and their risk assessment. Disaster Risk Management Plans (DRMP) to be developed and implemented. Information sessions and workshops may be conducted for increasing awareness on proper conservation and maintenance.	

Notes: Recovery estimates for damaged infrastructure include a 10% markup on estimated damages and to facilitate repair and restoration based on conservation and BBB principles.

Table 4.5: Recovery Needs for Museums, Archives, and Cultural Institutions (costs in INR crore)

Short-term needs	Costs	Medium-term needs	Costs	Long-term needs	Costs
Urgent repair of building infrastructure like windows, doors, ceilings, air conditioners, water tanks, lights, plantation, etc. in line with BBB principles.	61.5	Institutions like the Odisha State Museum and Odisha State Archives need solutions for proper preservation of artefacts, archival material, and rare manuscripts. Disaster Risk Management Plans for museums and archives, along with training and awareness on risk mitigation, need to be developed.		Strengthening of the institutions through better infrastructure, adequate staff capacity and specialised training support.	

Notes:

1. Recovery estimates for damaged infrastructure in cultural institutions include 10% markup on estimated damages.
2. The medium- and short-term recovery is not estimated as it should be based on detailed assessment of the individual needs of the institutions.

Table 4.6: Recovery Needs for Intangible Cultural Heritage: Performing Arts (costs in INR crore)

Short-term needs	Costs	Medium-term needs	Costs	Long-term needs	Costs
Repair and restoration of damaged performance spaces based on BBB principles.	6.1	Introduction of art forms like Gotipua and others in schools and colleges that are providing cultural education to sustain learning.	0.75	Provision of arts and cultural centres at the district and block level which can become active cultural hubs for learning and exchange, regular performances and for visitors.	0.75

Grant support to performing artists to repair and replace musical instruments and costumes, rehearsal spaces, and storage facilities like almirahs and portable boxes, to facilitate resumption of activities	6.4	Written and audio-visual documentation of folk arts forms for the preservation of knowledge on these traditional practices. Trainings to youth from the community to document their own heritage	0.75	Trainings for practitioners of folk-art forms to evolve programmes suitable for different kinds of audience paying special attention not to lose the social and cultural function of the intangible heritage element within the community	0.1
Total (in INR crore)	**12.5**		**1.5**		**0.85**
Total (in USD million)	**1.79**		**0.21**		**0.12**

Notes:
1. Recovery estimates for damaged tools and equipment, costumes and accessories are based on a 10% markup on estimated damages to account for inflation.
2. Recovery estimates for damaged infrastructure (performing spaces/training centres) are based on a 10% markup on estimated damages to facilitate reconstruction based on BBB principles.
3. Other cost estimates of medium- and long-term needs are based on cost trends of similar initiatives in the region.

Table 4.7: Recovery Needs for Intangible Cultural Heritage: Handlooms and Handicrafts (costs in INR crore)

Short-term needs	Costs	Medium-term needs	Costs	Long-term needs	Costs
Repair and replacement of tools and equipment for artisans and weavers to facilitate resumption of weaving and craft activities	126.7	Capacity building of stakeholders in handloom and handicrafts sectors (including government departments, HCS/WCS, craft enterprises, artisans, weavers, traders) for disaster risk management planning and business continuity planning	2.5	Developing a roadmap and technical specifications for a comprehensive Management Information System (MIS) with dashboard to track and monitor delivery of all weaver/artisan-focused schemes to improve targeting and strengthen access to designs, skilling, technology, equipment, raw materials, finance, as well strengthen disaster response	3
Supply of raw material stocks through WCS and HCS, coupled with working capital grants for resumption of weaving/craft activities	191.8	Value chain studies of handloom and key handicrafts subsectors including stone carving, applique, *patachitra*, *dhokra* bell metal casting to assess gaps and develop action plan for improved competitiveness and resilience	2.5	Developing a comprehensive roadmap and technical specifications for e-Marketplace for supply chain actors including wholesalers, traders, raw material suppliers, equipment manufacturers, business service providers, government institutions etc., with real time price and demand/supply information	3
Debris clearance, repair/rebuilding of damaged WCS, HCS and public infrastructure in line with BBB principles, after detailed structural assessments	13.9	Reform and business process engineering of apex marketing institutions as well as HCS/WCS to incentivise upskilling, innovative product development among weaver/artisan enterprises for improved earning capacities and economic resilience	5	Artisan business education programs to strengthen management/business skills for cooperatives/MSMEs including ancillary units; mentorship programmes to provide handholding support, especially to women entrepreneurs	4
Total (in INR crore)	**332.4**		**10**		**10**
Total (in USD million)	**47.48**		**1.43**		**1.43**

Notes:
1. Recovery estimates for damaged infrastructure include a 10% mark up on estimated damages to facilitate reconstruction based on BBB principles.
2. Recovery estimates for damaged tools and equipment include a 10% mark up on estimated damages to account for inflation, minor technology upgrades etc.
3. Other cost estimates of short-, medium- and long-term needs are based on cost trends of similar initiatives in the region.

Table 4.8: Recovery Needs for Tourism (costs in INR crore)

Short-term needs	Costs	Medium-term needs	Costs	Long-term needs	Costs
Debris clearance, repair/rebuilding of damaged government-owned tourist accommodation and amenities after detailed structural assessments based on BBB principles	26	Capacity building of tourism and hospitality sector for disaster risk management planning and business continuity planning	2	Master Plan development of top five tourist sites in Konark and Puri as 'Smart tourist destinations' comprising resilient dedicated vending zones, ICT-driven integration of tourism and tourism-linked services, digitalisation of consumer experiences, big data feedback loop mechanisms etc.	5
Addressing immediate financial needs of tourist enterprises, particularly in the hospitality industry for reconstruction/ repair activities, through access to insurance claims, soft loans and/or tax relief	30	Capacity building of tourism sector employees including boat operators, transport operators, hospitality sector employees for disaster response	2	Master Plan development for building thematic tourism villages (along the lines of Raghurajpur) in and around the Golden Triangle and other popular tourism circuits, exploring experiential tourism concepts in cuisine, performing arts, traditional wellness, as well as experiences of living with disaster risks	5
'Resurgent Odisha' trust-building marketing campaign centred on high-profile events to bring back tourists	5	Promote enhanced adoption of risk transfer mechanisms (i.e. insurance) among tourist enterprises, particularly in the hospitality industry	2		
Total (in INR crore)	**61**		**6**		**10**
Total (in USD million)	**8.71**		**0.86**		**1.43**

Notes:

1. Recovery estimates for damaged infrastructure include a 10% mark up on estimated damages to facilitate reconstruction based on BBB principles.
2. Recovery estimates for damaged infrastructure for private sector are subsidy estimates to facilitate soft loans.
3. Other cost estimates of short-, medium- and long-term needs are based on cost trends of similar initiatives in the region.

4.5.1 Implementation Strategy

The priority needs such as electricity, housing repair, provision of support for tools and workspaces to artists and artisans, and repair and restoration of monuments and building infrastructure of cultural institutions, need to be addressed on an urgent basis. For long-term solutions, consultation with and participation of all stakeholders in the cultural heritage and tourism sector, such as relevant government departments, communities, NGOs, universities, technical agencies, experts, and private sector is required to develop and execute plans in a collaborative spirit for the recovery and resilience. Partnerships can be explored under the Corporate Social Responsibility (CSR) framework for support. The recovery plans need to be accompanied by robust tracking and monitoring mechanisms to ensure timely progress towards recovery targets, and resolution of the challenges faced.

4.6 Sector Assessment Methodology

The DLNA used primary data collected by the relevant departments—Odia Language, Literature and the Culture Department, Directorate of Culture, Department of Handlooms, Textiles and Handicrafts, and the Department of Tourism. This data was corroborated and qualified with field visits to severely-affected districts of Puri and Khurda, moderately-affected districts such as Cuttack and Jagatsinghpur, and some affected heritage sites. Focused group discussions and individual interviews were conducted with weavers, artisans, weaver and artisan cooperative office bearers, association representatives, performing artist

groups, hotel owners/employees, vendors in tourist sites, tourists, tourist guides, and district-level officials from relevant government departments. The officials of relevant departments were consulted throughout the DLNA process.

Estimates of damage to infrastructure have primarily relied on data collected by the relevant government departments, with suitable qualifications based on the assessment team's judgement informed by field discussions. The economic valuation of damage to and loss of cultural heritage is based on primary data collected by a state-appointed team of engineers and researchers. Estimates of revenue losses have been calculated based on the count of affected members as assessed by the relevant departments, with inputs and references drawn from secondary data published in the public domain, coupled with the assessment team's judgement based on field-level discussions. The proposed recovery strategy is informed by discussions with relevant government officials, institutions, civil society organisations and local experts.

Notes

[1] Handlooms, Textiles and Handicrafts Department, Government of Odisha; https://handloom.odisha.gov.in/pdf/2017/1044.pdf (Accessed on 27 May 2019)

[2] Handlooms, Textiles and Handicrafts Department, Government of Odisha; https://handloom.odisha.gov.in/pdf/overview.pdf (Accessed on 27 May 2019)

[3] Odisha's Industrial Policy Resolution (2015)

[4] Department of Tourism, Government of Odisha has identified 357 tourist centers across 30 districts.

[5] Assessing Tourism Development Potential, 2015, IFC

[6] Ibid.

[7] Ibid.

Productive Sectors

Productive Sectors: Tables and Figures

Tables

5

Agriculture, Fisheries, and Livestock

5.1 Pre-Disaster Context

5.1.1 Agriculture

As per 2018–19 advance estimates at current basic prices by crop sector, the Net State Value Added stood at 12.1% for agriculture, 3.64% for livestock, and 2.46% for fisheries. However, as only 14 districts affected by cyclone Fani were under assessment, the available Net District Domestic Product (NDDP) data for 2011–12 was also analysed to understand the relative importance of the sector on an indicative basis.

As per the Census of India 2011, Odisha has an estimated human population of about 41.97 million as (3.47% of the population of India). Approximately 83% of the population lives in rural areas. In Odisha, 51.57% of the population dependent on agriculture (cultivators and agricultural labourers) is located in the 14 affected districts. It is also observed that the proportion of women farmers (cultivators) in the 14 affected districts was 7.1% as against the state-wide proportion of 10.8%. Similarly, 21.5% of women were engaged as agricultural labourers in the affected districts as against 27.8% in the state as a whole. With very small holdings, 90% of the farmers belong to the small and marginal category. The total area under cultivation in the 14 affected districts is 7.3 lakh ha with 16% of the total farm households in Odisha located here.[1]

The major crops grown in the districts are vegetables, plantation crops, spices, oilseeds, and subsistence crops (Table 5.1). Okra, tomato and brinjal are grown among vegetables; mango, kagzi lime, and cashew among plantation crops; chilli, turmeric, and betel vine, among spices; oil palm and coconut among oilseeds, and banana.

Table 5.1: Area (ha) under Major Crops in 14 Affected Districts

District	Okra	Tomato	Brinjal	Banana	Mango	Key Lime	Betel vine*	Turmeric	Chilli	Oil Palm	Cashew	Coconut
Balasore	4,544	2,610	5,415	1,844	4,648	790	420	720	3,818	697.1	1,400	1,486
Bhadrak	2,500	3,165	7,193	1,102	4,432	860	14	108	2,758	524.5	653	1,073
Cuttack	940	2,764	4,695	510	3,311	474	115	524	3,720	405.5	2,024	5,563
Jagatsinghpur	1,437	3,170	2,830	366	1,482	291	420	198	3,540		642	2,656
Jajpur	4,950	2,300	4,450	420	1,879	214	77	150	3,523	87.74	1,650	2,544
Kendrapara	1,470	4,476	4,066	272	1,111	229	310	267	3,046		361	2,282
Dhenkanal	2,432	2,900	4,633	500	9,335	872		895	390	99.64	10,625	1,127
Angul	2,148	2,770	4,258	1,560	9,406	1,998		360	3,565		6,640	394
Ganjam	3,335	4,287	4,965	792	10,680	2,525	410	140	5,103	156.1	9,540	5,163
Keonjhar	4,031	7,462	10,680	540	10,500	1,472		1,150	4,401		6,662	1,233
Mayurbhanj	3,060	4,926	7,030	1,158	15,800	3,728		500	1,035	2,323	11,166	1,094
Puri	2,663	1,300	2,045	1,808	3,918	461	215	22	316		6,741	9,468
Khurda	2,500	6,168	3,165	988	5,325	433	50	115	580		7,946	3,638
Nayagarh	2,635	2,632	2,460	775	4,583	529		1,960	691	1,075	7,941	4853
Total	**38,645**	**50,930**	**67,885**	**12,635**	**86,410**	**14,876**	**2,031**	**7,109**	**36,486**	**5,369**	**73,991**	**42,574**

Source: Department of Horticulture, Department of Agriculture and Farmers' Empowerment, Government of Odisha

Betel vine*: Unit of 200 square metres (sq m)

The total area cultivated, and production under crop sub-sectors (fruits, vegetables, plantation crops and spices), in the affected districts are given in Table 5.2 below. It may be noted (see last column '% share in Odisha') that more than 50% of vegetables and plantation crops (area and production-wise) fall under the 14 affected districts.

5.1.1 Sub-Sector: Fisheries

Odisha's 480 km-long coastline, with a continental shelf area of 24,000 square kilometres (sq. km) along the Bay of Bengal, showcases the state's rich potential resources in inland, brackish water and marine fisheries. Fisheries and aquaculture are among the most important components of the state economy which supports livelihoods and socio-economic development. An estimated 16.28 lakh people are dependent on fisheries for their livelihood. The state has 813 fishing villages where 1,14,238 fishermen families reside, earning their livelihood from the open sea.

Puri district has the longest coastline of 155 km and Bhadrak the shortest with 50 km among the coastal districts. The state also has 73 marine fish landing centres. There are estimated 8,78,190 inland fishermen and 7,47,606 marine fishermen in Odisha. The state is very keen to double its fish production and increase seafood exports by five times (Fisheries Policy 2015). The total fish production of the state during 2017–18 was 6.85 lakh MTs and export value was over INR 2871.61 crore. Odisha ranks 10th in terms of fish production with a share of almost 4.50% of the total fish production in the country. Of the total fish production, 5.34 lakh MT comes from inland sources including 0.799 lakh MT from brackish water sources. The annual fish production during the last five years is shown below in Table 5.3. In the inland sector, it is estimated that 6.77 lakh ha of freshwater and 4.18 lakh ha of brackish water is available for fish production (Odisha Fisheries Statistics 2014).

According to data provided by the Department of Fisheries and Animal Resource Development, Government of Odisha, during 2017–18, freshwater production was 4,54,189 MT and brackish water production was 79,936 MT inclusive of 58,110 MT of cultured shrimp. There has been significant increase in aquaculture production between 2008 and 2017. Though Odisha has huge aquaculture resources, only a small percentage of the potential resources are utilised, leaving much on the table for further growth. Fresh water aquaculture comprises mainly of major Indian carps—catla, rohu, and mrigal—which contribute to

Table 5.2: Total Area (ha) and Total Production (MT) of Major Crops in 14 Affected Districts

	Fruits (ha)	Fruits (MT)	Veg. (ha)	Veg. (MT)	Plantation crops (ha)	Plantation crops (MT)	Spices (ha)	Spices (MT)
Balasore	8,884	77,689.27	25,894	3,15,559.43	3,615.133	1,055.935	6,620	11,994.16
Bhadrak	8,102	65,098.07	23,066	3,12,640.98	2,278.489	503.377	3,589	4,836.59
Cuttack	5,866	41,170.74	24,636	3,36,395.63	8,049.51	1,467.895	6,419	11,092.88
Jagatsinghpur	3,180	26,502.15	17,660	2,56,387.25	3,341	507.6	5,311	7,566.84
Jajpur	3,851	30,591.66	23,138	3,03,127.48	4,334.735	906.991	4,910	7,319.04
Kendrapara	2,994	26,137.51	19,655	2,85,600.33	2,685	309.96	5,299	7,355.07
Dhenkanal	12,798	85,640.32	25,863	3,70,618.07	11,858.64	7,948.05	3,009	10,209.54
Angul	17,720	1,46,934.08	22,462	3,01,204.39	7,041	3,936.8	7,249	12,737.58
Ganjam	15,627	89,440.75	32,826	4,63,097.91	14,905.06	7,625.305	6,566	11,389.97
Keonjhar	15,190	87,296.96	47,771	6,92,310.98	7,895	3,651.75	8,546	22,787
Mayurbhanj	25,651	1,56,855	33,223	4,59,564.57	14,583.32	7,406.575	4,039	17,062.13
Puri	7,151	65,255.42	14,174	1,94,830.34	16,289	4,469.27	1,164	2,398.24
Khurda	8,054	54,497.43	21,466	3,23,557.2	11,634	6,090.18	1,740	4,469.1
Nayagarh	6,813	43,167.8	16,063	2,12,989.63	13,907.09	4,991.64	3,959	21,790.79
Total 14 Districts	1,41,881	9,96,277.16	3,47,897	48,27,884.2	1,22,416.98	50,871.328	68,420	1,53,008.93
Total Odisha	**3,29,347**	**2,189,540.1**	**6,64,440**	**90,42,508.5**	**2,12,139.13**	**99,153.903**	**1,48,697**	**5,10,327.62**
% share in Odisha	43.1	45.5	52.4	53.4	57.7	51.3	46.0	30.0

Source: Department of Horticulture, Department of Agriculture and Farmers' Empowerment, Government of Odisha

Table 5.3: Annual Fish Production of Odisha: 2013–14 to 2017–18 (MT)

Year	Inland		Total	Marine	Grand Total (MT)
	Freshwater	Brackish water			
2013–14	2,63,862	30,007	2,93,869	1,20,020	4,13,889
2014–15	3,00,964	35,373	3,36,337	1,33,211	4,69,548
2015–16	3,36,216	40,307	3,76,523	1,44,755	5,21,278
2016–17	3,93,730	61,268	4,54,998	1,53,102	6,08,100
2017–18 (P)	4,54,189	79,936	5,34,124	1,50,839	6,84,963

(P): Provisional
Source: Department of Fisheries and Animal Resource Development, Government of Odisha

70%–75% of total aquaculture production. The brackish water sector is largely based on farming of black tiger prawn (Penaeus monodon) and the exotic white leg shrimp (L. vannamei) which has gained significant momentum in recent years. Of the 32,586 ha of area suitable for shrimp farming, 16,385 ha have already been developed. The untapped potential is estimated to be nearly 50.28%. In the year 2016–17 brackish water aquaculture was taken up in about 8,573 ha and the production was 29,293 MT, which, during 2017–18, increased to 58,110 MT. The significant increase in production over the years since 2012–13 was due to the large-scale introduction of white leg shrimp into farming systems. Fishing activities in the open water bodies like rivers, estuaries, and lakes, especially in Chilika Lake is an important source of livelihoods for many inland fishermen. Different types of nets like stake nets, gill nets, dragnets and cast nets are used for fishing. Dugout and plank-built boats and Fiber Reinforced Plastic (FRP) versions of the same are used as fishing craft. Some of them are motorised. The complete statistics of fishers, the craft and gear used in the inland sector is not available. The Draft National Inland Fisheries and Aquaculture Policy (NIFAP) of Government of India circulated to all state governments suggests that such gaps are to be addressed by the states. Baseline data of the fisheries sector as received from the department is given in Table 5.4.

5.1.2 Sub-sector: Livestock and Poultry

Livestock

The animal husbandry sector plays an important role in rural economy of the state. The livestock sector's growth rate is steady, despite low investment. Since the sector has the highest potential for rural self-employment at the lowest possible investment per unit, when it grows, the poor benefit directly. Livestock ownership in the state is more evenly distributed, with landless labourers and marginal farmers owning the majority of livestock. Rural women are directly involved in most of the operations relating to feeding, breeding, management and healthcare of livestock

Table 5.4: Baseline Data on Fishermen, Boats, Aquaculture Ponds, Hatcheries etc. in the Cyclone-Affected Districts

District	Fishermen Population 2018 (projected)	Boats Available	Aquaculture Ponds (estimated)	Government Hatcheries	Private Hatcheries (freshwater)	Private Hatcheries (brackish water)	Fishermen Affected
Balasore	46,265	2,480	39,466	1	7	0	23
Bhadrak	16,437	1,419	18,170	1	2	0	6
Cuttack	57,436	1,340	12,750	0	4	0	477
Jagatsinghpur	23,266	2,101	14,179	1	5	0	45
Jajpur	57,662	400	9,049	1	1	0	53
Kendrapara	59,916	3,135	19,314	0	1	0	111
Khurda	10,1869	2,700	6,731	0	8	0	74
Mayurbhanj	9,363	300	19,356	1	8	0	31
Puri	13,5076	7,259	16,955	2	9	3	14,409
Ganjam	15,9021	3,295	12,203	1	4	18	172
Total	**6,66,312**	**24,429**	**1,68,173**	**8**	**49**	**21**	**15,401**

Source: Department of Fisheries and Animal Resource Development, Government of Odisha

(including poultry). Development of animal husbandry therefore, is critical to the rural prosperity of Odisha.

According to the *Livestock Census, 2012* the state's total cattle and buffalo population stood at 123.47 lakh; small ruminants at 80.94 lakh; pigs at 2.80 lakh; and poultry at 198.90 lakh. The implementation of cross-breeding programmes has led to an increase in the cross-bred population and a decrease in the numbers of unproductive animals.

Poultry

According to the Livestock Census 2012, Odisha's poultry population (mainly fowl) stood at 19.89 million (up from 17.61 million in 2003). There was however a marginal decrease (3.44%), during the inter-census period (2007–2012). In 2017–18, as per the Technical Committee of Direction for Improvement of Animal Husbandry, Dairying Statistics (TCD), Odisha ranked 11th all-India in egg production, 13th in meat production and 16th in milk production. Thus, next to agriculture, animal husbandry has been the most important economic activity in the rural areas of the state.

The Government of India has been supplementing state government's efforts in the development of the animal husbandry, dairying and fisheries sectors and providing assistance to state governments for: control of animal diseases; scientific management and upgrading genetic resources; increasing availability of nutritious feed and fodder; sustainable development of processing and marketing facilities; and enhancement of production and profitability of livestock and fisheries enterprises.

The activities of the animal husbandry sector have been oriented towards health of livestock and increased production of milk, meat, and eggs and to provide adequate bullock power for agricultural operations. Schemes have been formulated in light of well-laid out national policies to:

- improve livestock production;
- fight against protein hunger and improve nutritional standards (of humans);
- provide technical support for the maintenance of livestock and improvement of livestock breeds.

The Directorate of Animal Husbandry and Veterinary Services, Odisha, is thus rendering services to livestock and poultry rearers, in particular those from weaker sections of society.

Institutional Mechanisms

Odisha has 541 veterinary hospitals/ dispensaries and 3,239 livestock aid centres across the state to provide veterinary services. Central clinics of the Odisha Veterinary College have facilities for outdoor treatment, doorstep health checks, and artificial insemination services on payment.

Major Livestock Products in Odisha

The quantum of livestock sector outputs, such as milk, meat and eggs, has appreciably increased in the last decade. Milk production rose steadily from 1,598 thousand metric tonnes (TMT) in 2008–09 to 2,087.5 TMT in 2017–18—mainly due to increased production per animal. In the same period meat production also increased from 62 TMT to 99.88 TMT, and egg production from 1,993 million to 2,062 million. The state has a commercial layer population of 70 lakh in 122 commercial layer farms, producing 64 lakh eggs per day. In addition, Backyard Poultry produces around 7 lakh eggs per day.Annual production and per capita availability of milk, egg and meat is given in Table 5.5.

Table 5.5: Year-wise Production and Per Capita Availability of Milk, Meat and Eggs (2008–09 to 2017–18)

Year	Milk Production (thousand MT)	Milk: Per capita availability (gm/day)	Meat Production (thousand MT)	Meat: Per capita availability (kg/annum)	Egg Production (million)	Egg: Per capita availability (no./annum)
2008–09	1,598	112	62	1.58	1,993	51
2009–10	1,651	109	69	1.67	2,319	56
2010–11	1,670	109	74	1.76	2,357	56
2011–12	1,718	112	76	1.81	2,301	55
2012–13	1,784	113	76.72	1.83	2,323	54
2013–14	1,861	117	81.26	1.86	2,361	54
2014–15	1,903	118	88.71	2.00	1,924	43
2015–16	1,938	118	92	2.04	1,927	43
2016–17	2,002	120	94	2.06	1,974	46
2017–18	2,087.5	124	98.83	2.16	2,062	48

Source: Department of Fisheries and Animal Resource Development, Government of Odisha

State Schemes in Animal Husbandry and Poultry

- **Strengthening Dairy Organisation:** The scheme envisages supply of breeding inputs to Frozen Semen Artificial Insemination (FSAI) Centres for the production of high pedigree females to augment milk production in the state. It includes logistics of supplying cryo-containers, artificial insemination (AI) gun, equipment, spares, annual maintenance cost, infrastructure repair and renovation in the semen station, processing units and field institutions for uninterrupted services to the farmers.
- Small Ruminants Development: Interventions include genetic upgrade with supply of improved bucks and rams; and healthcare measures, including routine de-worming and vaccination.
- Fodder Development: Odisha faces a wide gap between demand and supply of fodder. In order to reduce this gap and create awareness among those who rear livestock, various fodder development programmes have been initiated by the Department. These include the following:
    - Seasonal and Perennial Fodder Cultivation Programme
    - Programme for Distribution of Hand-operated Chaff Cutters
    - Fodder Seed Production Programme
    - Fodder Production and Demonstration Programme
- Livestock Healthcare Service Delivery: The Department of Fisheries and Animal Resource Development, with its strong service delivery network in the form of livestock aid centres, veterinary hospitals and dispensaries, renders desired services to the livestock farmers. In addition, there are institutions like the Animal Disease Research Institute (ADRI), State Veterinary Laboratory (SVL), 26 Disease Diagnostic Laboratories (DDL) and 3 Clinical Investigation Laboratories (CIL). Other support includes:
    - Mobile Veterinary Units in all blocks
    - Assistance to State for Control of Animal Diseases for preventive vaccination of livestock and poultry.
    - Innovative Poultry Productivity Project
    - Rural Backyard Sheep Development Programme
    - Rural Backyard Goat Development Programme
    - Sub-Mission on Skill Development, Technology Transfer and Extension Training and Capacity Building to Farmers and training for other Stakeholders on Animal Husbandry schemes and programmes, including in-service training for Veterinary Officers on Small Animal Poultry Management.

5.2 Disaster Effects: Damages and Losses

5.2.1 Agriculture

Post-Fani, the major damage to perennial crops estimated at INR 301.72 crore, representing 83% of the damage to all crops, was caused by high-speed cyclonic winds (approximately 175 to 185 km per hour), uprooting trees, breaking trunks, branches, etc.

Other physical infrastructure worth INR 61.82 crore was also damaged, with total damage working out to INR 363.54 crore. Severe damage was caused in the affected districts to crops like the betel vine (26.99% cultivated area needed restoration); coconut (19.15% cultivated area affected). In all, 19,734 ha of perennial crops in the 14 affected districts were damaged. The disaster has left behind a large quantity of broken wood, fallen trees and other debris. The severely damaged, crown/trunk broken trees will have to be uprooted and removed, adding to the replanting costs.

As shown in Table 5.6, 43.84% of the total farmers in the affected districts suffered damage to crops; 6.86% of all farmers in Odisha, were impacted by Fani.

The timing of the storm caused serious disruption to the pollination of summer paddy, which usually self-pollinates

Table 5.6: Details of Affected Farmers

Particulars	Unit	Value
Total farmer households in the state	In lakh	46.67
Total farmers in 14 affected districts	In lakh	7.3
Total farmers affected by Fani	In lakh	3.2
% farmers in affected districts to state total	%	15.64
% farmers affected to state total	%	6.86
% farmers affected to total farmers in 14 affected districts	%	43.84

Source: *Status of Agriculture in Odisha 2014–15*, Directorate of Agriculture & Food Production, Government of Odisha, Bhubaneswar: Data relating to 2011.

Table 5.7: Assessment of Total Damage to Crops and Infrastructure

District	Damage to Crops (INR crore)	Damage to Infrastructure (INR crore)	Total Damage (INR crore)
Angul	0.01		0.01
Balasore	0.21		0.21
Dhenkanal	8.55	1.01	9.56
Keonjhar	0.00		0.00
Nayagarh	1.30	0.01	1.31
Bhadrak	0.00		0
Cuttack	13.43	11.33	24.76
Ganjam	0.00		0.00
Jagatsinghpur	0.90	3.57	4.47
Jajpur	1.45	1.94	3.39
Kendrapara	0.74	1.29	2.04
Khurda	35.60	31.62	67.22
Mayurbhanj	0.00		0
Puri	239.51	11.05	250.56
Total	**301.72**	**61.82**	**363.54**
% Share	83	17	100

Source: Department of Agriculture and Farmers' Empowerment, Government of Odisha

from 8 a.m. to 11 a.m. Fani blew away the pollen and rendered large areas of crop sterile. Thus 30% of the sown area of summer paddy was damaged in the affected districts. The standing paddy crop had 60% to 80% unfilled chaff/husk with only 20% to 40% grains.

The second most damaged crop was mung (12% of sown area affected), contributing to 50% of the total damaged area in the 14 districts. The pods in the fallen and standing crop were severely affected by a fungal attack caused due to inundation by heavy rain that followed in the wake of the cyclone and went on for two to three days.

In both these cases (summer paddy and mung), as well as in other crops, farmers reported that it was uneconomical to harvest the crops and the crops needed to be removed or ploughed back into the soil.

In the case of the plantation crops, extensive damage was noticed in fruit trees and spices which are perennial in nature (Table 5.8). Broadly, the types of damage include broken trunks and severe bending, uprooting of trees/palms, severe to moderate crown damage to coconut trees, severe to partial damage to canopy, and tilting of trees.

The primary assessment has been done on the basis of severity of damage (i.e. above 33% crop damage) and not based on the type of damage. In view of this, the damage has been quantified based on the replanting cost, though other means of restoration are possible as discussed in the chapter on recovery strategy. As the unreported less-than-33%-damaged crops will also require restoration, the total estimate is likely to remain true.

Crop sector damage (ownership and district-wise) is shown in Table 5.9. Damage to public infrastructure occurred mainly to office buildings and various structures, including boundary walls and poly-houses, nurseries, etc. Major damage was reported to the Centre of Excellence of the Horticulture Department located at Deras, Bhubaneswar. Damage reported to structures in the private sector was mainly to shade-net structures and poly-houses.

Estimated production losses in the crop sub-sector stand at INR 1,304.58 crore. Cyclone Fani affected 88,486 ha of annual crop area and 19,734 ha of perennial crop area (1,08,220 ha in all) (Table 5.10). This works out to 9% of the sown area of the affected crops.

Table 5.8: Assessment of Damages to Perennials

Permanent Crops	Total Area Pre-Disaster (ha)	Affected Area (ha)	Number of Trees Severely Damaged	Total Damages (INR crore)
Mango	65,482	3,746.57	3,74,657	80.36
Jackfruit	3,519	85.40	8,540	0.70
Key lime	13,538	427.00	1,70,800	7.77
Other fruits	6,860	694.00	69,400	5.21
Betel vine*	2,031	548.12	NA	1.10
Cashew	60,830	7,172.26	14,34,452	98.62
Arecanut	406	21.00	28,875	0.26
Coconut	36,767	7,039.86	12,31,976	98.52
Mushroom**	15,321	1,312	NA	9.18
Total	**1,89,433**	**19,734.21**	**33,18,700**	**301.72**

Betel vine* in unit: 200 sq m
Mushroom** in unit: 300 sq m
Source: Department of Agriculture and Farmers' Empowerment, Government of Odisha

Table 5.9: Assessment of Total Damage by Ownership (INR crore)

District	Damage		Total
	Private	Public	
Angul	0.01		0.01
Balasore	0.21		0.21
Dhenkanal	8.86	0.70	9.56
Keonjhar	0.00		0.00
Nayagarh	1.31	0.01	1.32
Bhadrak	0.00		0.00
Cuttack	14.83	9.93	24.76
Ganjam	0.00		0.00
Jagatsinghpur	0.90	3.57	4.47
Jajpur	2.85	0.54	3.39
Kendrapara	1.95	0.09	2.04
Khurda	35.60	31.62	67.22
Mayurbhanj	0.00		0.00
Puri	239.51	11.05	250.56
Total	**306.03**	**57.51**	**363.54**

Source: Department of Agriculture and Farmers' Empowerment, Government of Odisha

Crop production losses by district are presented in Table 5.11.

The five districts of Puri, Khurda, Jajpur, Cuttack, and Jagatsinghpur accounted for 92% of area damaged and 94% of crop production losses. In the computation of the production losses, one year of loss of yield is computed for perennial crops (other than betel vine, in which case 40% of annual yield has been considered lost) to compute current losses. The loss during crop-wise gestation period is taken as future losses.

Table 5.10: Annual and Perennial Crop Production Loss (Area in ha)

Crop	Cropped Area	Area Damaged	% to Crop Area	% to total Damage Area	Production Loss (INR crore)
Summer Paddy	62,510	18,560	30	17	156.69
Pulses- Mung	4,50,090	54,185	12	50	124.10
Oilseeds-Annual	1,14,130	2,001	2	2	12.39
Sugarcane	98,110	2,725	3	3	1.62
Vegetables	2,46,210	7,619	3	7	173.00
Fruits	20,137	2,083	10	2	81.91
Mushroom**	15,321	1,312	9	1	0.20
Sub Total Seasonal	10,06,508	88,486	9	82	549.92
Perennials Current	1,89,433	19,734	10	18	295.09
Perennials Future					459.58
Total	**11,95,941**	**1,08,220**	**9**	**100**	**1,304.58**

Source: Department of Agriculture and Farmers' Empowerment, Government of Odisha

Table 5.11: District-wise Crop Production Losses

District	Summer paddy, pulses, oilseeds, sugarcane		Veg./fruit/ mushroom		Perennial crops current losses (INR crore)		Perennial crops computed future losses (INR crore)	All affected crops		% share to total	
	Damaged area (ha)	Total loss (INR crore)	Damaged area (ha)	Total loss (INR crore)	Damaged area (ha)	Total loss (INR crore)	Total loss (INR crore)	Damaged area (more than 33%)	Total loss (INR crore)	% Area to total damaged area	% Loss to total loss
Angul	0	0	12	0	1	0	0	13	0	0	0
Balasore	0	0	29	1	10	0	1	39	2	0	0
Dhenkanal	0	0	170	6	622	5	15	797	25	1	2
Keonjhar	0	0	0	0	0	0	0	0	0	0	0
Nayagarh	0	0	21	1	94	1	2	116	4	0	0
Bhadrak	3,663	20	1	0	1	0	0	3,665	20	3	2
Cuttack	15,089	37	1706	54	981	34	24	17,809	148	16	11
Ganjam	49	0	0	0	0	0	0	49	0	0	0
Jagatsinghpur	20,889	49	55	1	86	7	3	21,038	60	19	5
Jajpur	7,336	25	2,556	50	85	1	3	9,977	79	9	6
Kendrapara	4301	17	79	2	42	2	1	4,424	22	4	2
Khurda	6,090	24	860	20	2,174	27	73	9,151	143	8	11
Mayurbhanj	49	0	0	0	0	0	0	49	0	0	0
Puri	20,005	124	5,526	120	15,639	219	339	41,388	801	38	62
Total	**77,471**	**295**	**11,015**	**255**	**19,734**	**295**	**460**	**1,08,515**	**1,304**	**98**	**101**

Notes:
- Betel vine: Loss is estimated only for four months till rejuvenation
- Mushroom (P) income is taken at INR 50,000 per ha
- Coconut yield is taken at 60.5 nuts per tree, 175 trees per ha

Source: Estimates made by the assessment team based on the data available from Department of Agriculture and Farmers' Empowerment, Government of Odisha

5.2.2 Fisheries

Through advance warning, over 2 lakh fishermen in coastal villages of the seven coastal districts were safely evacuated resulting in zero casualties. After the landfall of the cyclone, massive damage and loss was suffered by fishing boats, nets, houses, and other household assets of fishermen in nine districts; Puri, Khurda, Cuttack, Jagatsinghpur, and Kendrapara were the worst hit.

Loss/Damage to Fishing Boats/Nets: Marine Sector, including Chilika

The maximum damage and loss occurred at fish landing centres located at Pentakota, Arakhkud (Telengapentha), Chandrabhaga, Satapada, and Jaguleipadar of Puri district. About 50 fishing settlements in Odisha, comprising about 1,50,000 traditional fishermen who have no alternate source of livelihood, were severely affected.

Loss/Damage to Fishing Boats/Nets: Inland Sector

The details of the district-wise loss and damage (fully/ partially) to fishing boats nets are given in Table 5.16. The districts of Puri and Kendrapara also saw damage/ loss to aquaculture bodies such as ponds and hatcheries by way of breaches/ damage to dykes/ tanks, loss of fish and shrimp seeds in growing ponds etc. The ecosystem of many aquaculture ponds and community tanks/ Gram Panchayat tanks used for freshwater aquaculture was destroyed due to deterioration in water quality owed to decomposition of organic debris within.

Loss/Damage to Fishing Harbours and Fish Landing Centres

The state has 73 fish landing centres of which four are fishing harbours. Of the fishing harbours those at Paradeep, Nuagarh (Astarang) and Dhamara were partially damaged, as were six fish landing centres. These require repair and renovation in addition to hand holding support for the associated fisherfolk.

A few state government fish farms, fish hatcheries and cage farming units, staff quarters, and assets of the Odisha Pisciculture Development Corporation (OPDC) and Odisha Fisheries Cooperative Corporation Ltd (FISHFED) have been partially damaged.

Assessment of Damage and Loss

The Odisha Government has imposed an annual ban on mechanised fishing during the fish breeding season from April to June, as a conservation measure and on fishing in general during the nesting period of the Olive Ridely Turtle. Owed to these bans, fisherfolk find it difficult to make a decent living even at the best of times. Despite state support during ban periods, they migrate to other states seasonally in search of alternate livelihoods. Furthermore, the dominance of mechanised fishing and companies (with better technology and resources) has greatly contributed to the marginalisation of small fishermen in recent times. Fani has not improved matters.

According to government estimates, about 6,416 traditional fishing boats, 8,828 nets, 2,524 fish ponds, 157 aquaculture ponds covering an area of 77 ha, three fishing harbours, six fish landing centres and five fish farms have been damaged.

The total damage and loss for fisheries and the aquaculture activities is calculated at INR 158.35 crore, of which, the damage is to the extent of INR 72.92 crore and loss is INR 85.43 crore respectively (Table 5.12).

Damage to boats and nets has been calculated based on assumptions highlighted in the methodology section at the end of this chapter. Damage and loss estimates separately for marine, brackish, inland freshwater fisheries, and provate aquaculture are presented in Tables 5.13–5.16.

Table 5.12: Overview of Total Damage and Loss to Fisheries (INR crore)

Fisheries sub-sectors	Damage	Loss	Total
Coastal/marine fishery	27.30	58.10	**85.40**
Chilika fishery	27.74	19.19	**46.93**
Inland fishery, including aquaculture	7.08	7.77	**14.85**
Aquaculture hatcheries	0.26	0.37	**0.63**
Public properties, including buildings and other infrastructure	10.54	-	
Total	**72.92**	**85.43**	**158.35**

Source: Estimates made by the sector teams based on the data available from Department of Fisheries and Animal Resource Development, Government of Odisha

It is assessed that the combined total damage to fishing boats and nets of marine and Chilika fishermen is about INR 55.04 crore (see Tables 5.13 and 5.14), of which INR 27.31 lakh stems from losses marine fishing boats and nets and the rest from the damage to boats and nets of the fishermen in the Chilika area.

In the inland freshwater sector, a total of 856 fishing craft were reported as damaged or lost. The maximum loss of fishing craft (533) was reported from the district of Puri followed by Cuttack (209) (Table 15.5).The loss in this sector has been calculated based on the assumed loss of four months of fishing for each lost fishing craft/net.

Of the many new private investments by small and marginal farmers in the aquaculture sector, such as in shrimp and fish farming activities, hatcheries, feed mills etc., some were hit by damage to electric supply, aeration facilities, watch and ward sheds and pond dykes and cracks in concrete tanks (hatcheries) (Table 5.16).

Freshwater carp culture was affected as were some shrimp culture units in the brackish water sector. The loss to carp culture units was greater because most of the farms had been stocked just a couple of months prior to the disaster or had a 'standing crop' as it was the right season for carps. Shrimp farms suffered fewer losses as there was little 'standing crop' and also the season had yet to begin.

The loss to hatcheries has been estimated as INR 0.63 crore. The maximum damage and loss occurred in Puri district to an extent of INR 0.223 crore as given above, followed by Khurda and Cuttack respectively. Departmental buildings and other infrastructure related to fisheries were also damaged during the cyclone (Table 5.17). As per estimates this damage and loss is to the extent of INR 10.54 crore. This includes damage to government farms, fish landing centres, minor fishing harbour office buildings etc.

Despite good institutional structure, substantial resources, and effective peripheral institutional support mechanisms, preparedness for Fani was found wanting in the sector due to:

- Inadequate database on the inland fishery practices and fishery resources
- Limited capacity and skill among stakeholders
- Lack of institutional support by way of finance and insurance to stakeholders
- Lack of micro-level database at the farm or fisher level for insurance denied with reason for denial

Table 5.13: Damage and Loss Estimates in the Coastal /Marine fishery sector in Balasore, Bhadrak, Puri, Jagatsinghpur, Kendrapara and Pur.

Districts	No. of boats partially damaged	No. of boats fully damaged	No. of nets partially damaged	No. of nets fully damaged	Total damage (including boats and nets in INR crore)	Total loss (INR crore)
Balasore	21	2	0	0	0.11	0.36
Bhadrak	6	9	0	0	0.13	0.31
Jagatsinghpur	8	6	0	4	0.12	0.26
Kendrapara	22	5	0	0	0.15	0.45
Puri	1,445	1,460	1,397	0	26.79	56.72
Total	**1,502**	**1,482**	**1,397**	**4**	**27.30**	**58.10**

Source: Department of Fisheries and Animal Resource Development, Government of Odisha

Table 5.14: Damage and Loss Estimates in the Brackish Water (Chilika Lake) Sector in Ganjam, Khurda, and Puri

Districts	No. of boats partially damaged	No. of boats fully damaged	No. of nets partially damaged	No. of nets fully damaged	Total damage (including boats and nets in INR crore)	Total loss (INR crore)
Ganjam (Chilika)	117	30	25	0	**0.62**	**1.00**
Khurda (Chilika)	71	3	0	0	**0.21**	**0.45**
Puri (Chilika)	1,376	988	2,995	3,535	**26.92**	**17.74**
Total	**1,564**	**1,021**	**3,020**	**3,535**	**27.74**	**19.19**

Source: Department of Fisheries and Animal Resource Development, Government of Odisha

Table 5.15: Damage and Loss Estimates in Inland Freshwater Sector (including aquaculture)

A. Damage Estimates in Inland Freshwater Sector (including aquaculture)									
Districts	No. of boats partially damaged	No. of boats fully damaged	No. of nets partially damaged	No. of nets fully damaged	Fish ponds damaged (no.)	Fish ponds damaged (ha)	Fish seed farm damage (no.)	Fish seed farm damage (ha)	Total damage (INR crore)
Cuttack	120	89	168	100	0	0	0	0	1.56
Jagatsinghpur	19	4	0	4	0	0	0	0	0.12
Jajpur	36	4	13	0	0	0	0	0	**0.19**
Kendrapara	14	17	1	10	10	2.995	32	12.71	**0.29**
Mayurbhanj	16	4	10	0	1	0.2	0	0	**0.11**
Puri	188	345	56	510	57	30.64	57	30.6	**4.81**
Total	**393**	**463**	**248**	**624**	**68**	**33.835**	**89**	**43.31**	**7.08**

B. Loss Estimates in Inland Freshwater Sector (including aquaculture)				
Districts	Riverine fishery loss		Aquaculture sector loss	
	Boats: partially damaged	Boats: fully damaged	Fishponds damaged (ha)	Total loss (INR crore)
Cuttack	120	89	0	**1.62**
Jagatsinghpur	19	4	0	**0.16**
Jajpur	36	4	0	**0.27**
Kendrapara	14	17	2.995	**0.32**
Mayurbhanj	16	4	0.2	**0.15**
Puri	188	345	30.64	**5.25**
Total	**393**	**463**	**33.835**	**7.77**

Source: Estimates made by the sector teams based on the data available from Department of Fisheries and Animal Resource Development, Government of Odisha.

Table 5.16: Damage and Loss Estimates for Private Aquaculture Hatcheries

Hatchery damage			
District	Damaged freshwater aquaculture hatchery	Damaged brackish water shrimp hatchery	Total damage (INR crore)
Jajpur	1	0	**0.02**
Khurda	6	0	**0.09**
Mayurbhanj	3	0	**0.05**
Puri	7	1	**0.011**
Total	**17**	**1**	**0.26**
Hatchery loss			
District	Damaged freshwater aquaculture hatchery	Damaged brackish water shrimp hatchery	Total loss (INR crore)
Jajpur	1	0	**0.016**
Khurda	6	0	**0.096**
Mayurbhanj	3	0	**0.048**
Puri	7	1	**0.212**
Total	**17**	**1**	**0.37**

Table 5.17: Loss and Damage to Public Property Related to Fisheries

District	Property type	Damage value (INR crore)
Angul	Angul Fish Farm: partial damage	0.01
Balasore	Bahabalpur Fish Landing Centre: partial damage	0.25
Bhadrak	Saramanga Fish Farm and Dhamara Fishing Harbour: partial damage	0.46
Cuttack	Directorate as well as DFO office: partial damage Nuapatna Fish Farm Office: partial damage	2.06
Ganjam	Office of Add F.O (Marine); Cage Culture in Salia Reservoir and Markandi Fish Landing Centre: partial damage	70.0
Jagatsinghpur	Paradeep Fishing harbour and Nandara Fish Landing Centre: partial damage	0.63
Jajpur	Kalakala Fish Farm: partial damage	0.10
Kendrapara	DFO Office and Fish Landing Centres at Talachua, Kharinasi and Jumboo: partial damage	1.19
Khurda	District Fishery Office; 'Chilika Fresh' of FISHFED: partial damage	0.20
Mayurbhanj	Kathapal and Badajore Fish Farms: partial damage	0.04
Puri	Kausalyaganga Fish Farm and Brick Field Fish Farm (ponds, hatching unit, etc.): partial damage DFO Office (including staff quarters and electrical installation); Fishing Harbour at Astaranga: Completely damaged	4.90
Total		**10.54**

Source: Estimates made by the sector teams based on the data available from Department of Fisheries and Animal Resource Development, Government of Odisha

- Lack of advance warning system on intensity of storm, floods etc., based on which fishfarmers could have done an emergency harvest of existing stock.

5.2.3 Livestock and Poultry

Around 24.5 lakh of large animals, 10 lakh small animals and 54 lakh poultry birds were affected due to cyclone Fani (Table 5.18).

Estimated Damage of Livestock by District

Fani resulted in the death of 2,499 cows and buffaloes, 139 bullocks, 695 calves, 2,924 sheep and goats, and 53 lakh chickens (Table 5.19).

A total of 2,584 commercial broiler farms were damaged. District-wise details are given below in Table 5.20.

A total of 1,23,641 cattle sheds were totally damaged, with the districts of Puri (59,549 sheds), Cuttack (26,816

Table 5.18: Livestock and Poultry Affected by Cyclone Fani

District	No. of livestock and poultry impacted			
	Large animals	Small animals	Poultry	Total
Cuttack	3,26,659	1,51,669	11,95,462	**16,73,790**
Puri	3,98,521	1,76,054	24,08,000	**29,82,575**
Bhadrak	2,762	1,995	1,488	**6,245**
Nayagarh	66,869	25,287	3,74,611	**4,66,767**
Khurda	3,59,440	1,16,749	6,50,787	**11,26,976**
Ganjam	64,715	56,224	52,770	**1,73,709**
Balasore	46,355	15,913	0	**62,268**
Jagatsinghpur	3,02,800	1,30,466	4,26,016	**8,59,282**
Jajpur	5,08,600	1,97,050	1,96,166	**9,01,816**
Kendrapada	3,65,590	1,23,587	61,023	**5,50,200**
Total	**24,42,311**	**9,94,994**	**53,66,323**	**88,03,628**

Source: Department of Fisheries and Animal Resource Development, Government of Odisha

Table 5.19: Death of Livestock and Poultry (district-wise)

District	Cows/Buffaloes	Sheep/Goats	Bullocks	Calves	Poultry (chicken)
Cuttack	253	773	10	64	1,186,303
Puri	1,796	1,400	103	406	26,67,669
Bhadrak	9	12	0	7	1,502
Nayagarh	3	5	1	4	20,000
Khurda	354	669	21	170	13,25,639
Ganjam	13	21	3	20	4,897
Balasore	3	12	1	1	15
Jagatsinghpur	18	8	0	8	83,142
Jajpur	9	9	0	8	18,435
Kendrapada	41	15	0	7	14,248
Mayurbhanj	0	0	0	0	0
Anugul	0	0	0	0	0
Dhenkanal	0	0	0	0	0
Gajapati	0	0	0	0	0
Total	**2,499**	**2,924**	**139**	**695**	**53,21,850**

Source: Department of Fisheries and Animal Resource Development, Government of Odisha

Table 5.20: District-wise List of Totally Damaged Poultry Farms/Sheds

District	Capacity					Total
	(below 1,000)	(1,000–2,000)	(2,000–3,000)	(3,000– 4,000)	(> 4,000)	
Puri	39	359	416	222	457	**1,493**
Khurda	02	49	99	87	269	**506**
Cuttack	01	60	96	58	211	**426**
Bhadrak	2					**2**
Nayagarh	7	2				**9**
Ganjam	6	2				**8**
Balasore	1					**1**
Jagatsinghpur	43	62				**105**
Jajpur	12	6				**18**
Kendrapada	10	6				**16**
Total	**123**	**546**	**611**	**367**	**937**	**2,584**

Source: Department of Fisheries and Animal Resource Development, Government of Odisha

sheds), Khurda (16,915 sheds) and Jagatsinghpur (17,915 sheds) being affected the most (Table 5.21). Though, there is no data available on the damage to the sheep and goat population, during field visits it was found that quite a few sheep and goat sheds were damaged. Assuming that 40% of the cattle shed damage was to sheep and goat sheds in different districts, it has been estimated that there were a total of 49,456 sheep and goat sheds. District-wise damage to sheds is shown in Table 5.21.

Losses to the livestock and poultry (due to death) were estimated at INR 146.50 crore, representing around 12.9% total losses to the sector, which includes production losses, death of animals, and decline in egg and milk production (Table 5.22). The estimates show that loss of

Table 5.21: List of Damaged Cattle and Sheep/ Goat Sheds

District	Cattle sheds	Sheep/ Goat sheds
Cuttack	26,816	10,726
Puri	59,549	23,820
Bhadrak	5	2
Nayagarh	0	0
Khurda	16,915	10,726
Ganjam	86	34
Balasore	0	0
Jagatsinghpur	17,594	7,038
Jajpur	0	0
Kendrapara	2,676	1,070
Mayurbhanj	0	0
Anugul	0	0
Dhenkanal	0	0
Gajapati	0	0
Total	**1,23,641**	**49,456**

Source: Department of Fisheries and Animal Resource Development Government of Odisha

Table 5.22: Total Damage and Loss to Livestock/Poultry/Infrastructure and Assets (value in INR crore)

District	Death of livestock/ poultry	Infrastructure/ assets loss	Veterinary infrastructure loss (public/ coop. sector)	Production loss (milk)	Production loss (eggs)	Total damage and loss
Cuttack	25.6	203.0	4.3	8.5	0.0	241.5
Puri	64.8	496.5	7.3	5.7	0.0	574.4
Bhadrak	23.8	0.1	3.4	2.1	0.0	29.4
Nayagarh	0.0	0.3	0.3	1.1	0.0	1.8
Khurda	29.1	166.8	4.6	4.4	1.9	206.8
Ganjam	0.2	0.8	0.4	5.0	0.0	6.4
Balasore	0.1	0.0	0.9	6.0	0.0	7.1
Jagatsinghpur	1.8	96.6	0.8	5.5	0.0	104.7
Jajpur	0.4	0.7	0.3	4.0	0.0	5.5
Kendrapada	0.5	14.6	0.3	3.6	0.0	19.1
Mayurbhanj	0.0	0.0	0.0	4.0	0.0	4.0
Anugul	0.0	0.0	0.0	2.0	0.0	2.0
Dhenkanal	0.0	0.0	0.0	2.9	0.0	2.9
Gajapati	0.0	0.0	0.0	1.3	0.0	1.3
Total	**146.5**	**979.5**	**22.7**	**56.2**	**1.9**	**1,206.8**

Source: Department of Fisheries and Animal Resource Development Government of Odisha

infrastructure and assets at village level, amounts to INR 979.51 crore. The loss of milk and eggs and loss due to poor productivity of remaining animals is estimated at INR 58.1 crore. Damage to the veterinary and dairy sectors was estimated at INR 22.7 crore.

Distribution of Loss and Damage in Public and Private sector

Out of the total loss and damage of INR 1,206.8 crore, the damage in private and public sector was INR 1,126.01 crore and INR 22.7 crore respectively (Table 5.23).

Table 5.23: Value of Total Losses and Damage to Livestock by District and Ownership (INR in crore)

District	Loss	Damage		Total
	Private	Private	Public	
Cuttack	8.53	228.63	4.32	**241.48**
Puri	5.71	561.36	7.34	**574.41**
Bhadrak	2.14	23.88	3.36	**29.38**
Nayagarh	1.13	0.37	0.28	**1.79**
Khurda	6.28	195.96	4.61	**206.84**
Ganjam	4.97	0.98	0.42	**6.37**
Balasore	6.02	0.16	0.94	**7.12**
Jagatsinghpur	5.48	98.36	0.84	**104.68**
Jajpur	4.04	1.18	0.28	**5.50**
Kendrapara	3.63	15.13	0.33	**19.08**
Mayurbhanj	4.00	0	0	**4.00**
Anugul	1.95	0	0	**1.96**
Dhenkanal	2.91	0	0	**2.91**
Gajapati	1.30	0	0	**1.30**
Total	**58.09**	**1126.01**	**22.71**	**1206.81**

Source: Estimation made by the sector team on the basis of government data and field visits

Table 5.24: Assessment of Disaster Effects on the Livestock and Poultry Sector (INR crore)

Sub-sector	Damage	Losses	Total effects	Ownership		Recovery needs (INR crore)
				Private	Public	
Livestock						
Components of damage	1,148.72			1,126.01	22.71	
Components of losses		58.09		58.09		
Total			**1,206.81**	**1,184.10**	**22.71**	**1,254.16**
Recovery needs (INR crore)						1,254.16

Source: Estimation made by the sector team on the basis of government data and field visits

5.3 Recovery Costs and Strategies

This section provides sub-sectorwise recovery costs and strategies. Table 5.25 provides an overview of the damage, loss, and recovery needs across agriculture, fisheries, and livestock.

5.3.1 Agriculture

Short-term activities to address immediate needs include restoration of crop production through land clearing, preparing the paddy land and sowing, treating soil salinity issues in the coastal lowlands, removal of uprooted, broken trees/palms, pruning partially damaged trees, removal of debris, distribution of good quality planting materials (preferably seedlings/tissue culture materials), restoration of betel vines, provision of critical moisture support on an emergency basis to save standing crops suffering from lack of irrigation due to the ongoing restoration of power supply, and making rotavators available in sufficient numbers to plough the fallen crops/crop residue into the soil on an urgent basis. The use of bio control agents like Pseudomonas and Trichoderma etc., may be promoted.

The Odisha Livelihoods Mission can lead the quality planting material (QPM) supply by involving SHGs in each district. The members can be trained and provided with

Table 5.25: Overview of damage loss and recovery needs in Agriculture, Fisheries, and Livestocks (INR crore)

	Damage	Loss	Disaster Effects	Recovery Needs			Total
				Short term	Medium term	Long Term	
Agriculture, Fisheries, and Livestock	1,585.18	1,447.52	3,032.70	1,641.38	472.78	500.50	**2,614.66**
Fisheries	72.92	85.43	158.35	99.50	165.50	125.50	**390.50**
Crops	363.54	1304	1,667.54	440.00	155.00	375.00	**970.00**
Livestock	1,148.72	58.09	1,206.81	1,101.88	152.28	0	**1,254.16**

Source: Estimation made by the sector team on the basis of government data and field visits

adequate infrastructure (tunnel nursery, shade-nets, etc.) to raise nurseries entrepreneurially. The QPM can be sold to both public agencies and private players. This approach is consistent with the policy of the Government of Odisha wherein SHGs play a critical role in both service delivery as well as in sourcing of material.

Further, urgent initiatives are required to maintain supply chain of seeds for the upcoming kharif and subsequent rabi seasons. Arrangements for procurement and safe storage of adequate quantity of QPM need to be made, including sourcing from other districts or from nearby states.

Several strategies are suggested for the medium term. The Backyard Farming Initiative may be strengthened and local varieties of fresh and safe vegetables may be promoted so that households have access to vegetables round the year. The Odisha Livelihoods Mission community infrastructure and community professionals could be leveraged for this purpose.

Rebuilding public infrastructure relating to the agriculture and horticulture departments must be taken up on priority basis, to ensure that there is minimal disruption of services to farmers. The possibility of restoration of fallen/partially damaged trees, with the help of heavy equipment also should be explored and attempted before the roots are further damaged by the excessive heat. Hydration of the root and root zone of the fallen trees may also be carried out as a plant life saving measure. It is observed that several protected agricultural infrastructure have been damaged. Given that the coastal zone of the state is prone to frequent wind-related disaster, such structures may be popularised with care and caution. It is suggested that the Centre of Excellence in Horticulture, the Gene Bank and such advanced scientific facilities may be considered for relocation to the least disaster-prone areas. Such institutions may be built/reinforced with robust, disaster-resistant structures. Increasing mangrove area in the coastal zone is recommended in the wake of frequent sea water surges into agricultural low lands.

In the long term studies on climate change, and close observation of empirical impact of the same, need to be taken up. More research is required for developing drought/flood resistant crops as well as crops that are adaptive to various soil chemistry statuses, particularly in the coastal zones.

Land-use patterns in the state may be studied to ensure climate and disaster resilience, modernise the agriculture sector for adoption of climate smart agriculture, and to increase the output and value per unit of land and produce. Such a study may be undertaken in collaboration with internationally renowned institutions in India and abroad. The state may pilot climate resilient agriculture in selected pockets with the help of competent agencies.

Key issues to be addressed include increasing the capacity of stakeholders and enhancing inter- ministerial and interdepartmental coordination towards strengthening agriculture and allied sectors namely fisheries, agriculture, agroforestry, livestock, and poultry. In this connection there is a need for mainstreaming biodiversity conservation into agriculture and its allied sectors namely, forestry, horticulture, sericulture, animal husbandry, and agriculture- based and agriculture-supporting industries namely fertiliser, pesticide, seed industries, etc.

There is a great opportunity to pursue multiple cropping and mixed cropping in rainfed agriculture areas. Integrated farming with diverse crops for enhancing food security should be considered. Agroforestry and home gardens with perennial native species should be strengthened as many trees were damaged in the cyclone. Wastelands may be used for developing agroforestry as well as multiple cropping through all-women SHGs and federations at the level of Gram Panchayats, which can address the twin goals of agro-biodiversity conservation and livelihood enhancement of rural and tribal people.

Linkages may be established with NABARD and other national and international agencies for financial and technical support to promote multiple and mixed cropping

Table 5.26: Recovery Needs for the Crop Sector (Agriculture and Horticulture)

Activity	Responsible agency	Cost (INR crore)
Short-term recovery needs (up to 12 months)		
Crops		440
Provision of seeds, seedlings for replanting of seasonal and annual crops.	Odisha Livelihood Mission, Department of Horticulture, State Horticulture Mission in collaboration with local self-government department like Grama, Block and District panchayats, Odisha University for Agriculture and Technology (OUAT)	10
Clearance of land and restoration/ replanting of damaged crops. For replanting of perennial crops, the SHG network of OLM to be used for fruit tree nursery preparation as an enterprise activity	State Agriculture and Horticulture departments; State Horticulture Mission in collaboration with local self-government department like Grama, Block and District panchayats, OUAT	335
Provision agricultural inputs (other than planting material) for replanting seasonal and annual crops. Soil amendments with fertilisers (both organic and inorganic) and liming materials/ dolomite etc., for acidic soils and gypsum or other neutralising agents for saline soils, prepare package of practices and capacity building for replanting etc.	State Agriculture and Horticulture departments; State Horticulture Mission in collaboration with local self-government department like Grama, Block and District panchayats, OUAT	15
Support to small and marginal farmers and sharecroppers: A process to enumerate and register share croppers at the Agriculture/ Horticulture departments will help plan a response, include them in the compensation process, provide insurance and services etc., while also enabling access to financial institutions.	Government of Odisha, State Agriculture and Horticulture departments; State Horticulture Mission in collaboration with local self-government department like Grama, Block, and District panchayats	10
Rebuilding and repairing of damaged structures like office buildings, poly-houses, nurseries, compound walls, etc., on a build back better (BBB) basis	State Agriculture and Horticulture departments; State Horticulture Mission in collaboration with local self-government department like Grama, Block, and District panchayats	70
Medium-term recovery needs (12–36 months)		
Crops		155
Strengthening the backyard farming initiative in the districts. Local variety of fresh and safe vegetables to be promoted so that households have access to vegetables round the year	Odisha Livelihood Mission, Department of Horticulture, State Horticulture Mission in collaboration with local self-government department like Grama, Block and District panchayats, OUAT	50
Conducting soil testing for land areas inundated by sea surge and heavy rainfall immediately following cyclone Fani	Department of Soil conservation and Soil Survey, OUAT and other central Government institutions	50
Provision of disaster resilient crops, strengthening plant health clinics, developing technology to provide critical irrigation to avoid moisture stress	OUAT, Indian Council of Agricultural Research (ICAR)	40
Study sustainable disaster mitigation oriented land management practices such as developing drainage and promoting mangroves in coastal zones	Department of Agriculture, and Department of Soil Conservation and Soil Survey, OUAT, ICAR	5
Further strengthen disaster communication systems, build capacity of field level officials of the Department of Horticulture and Agriculture to respond to disasters, conduct quick scientific assessment etc.	Department of Agriculture, Department of Horticulture and Department of Soil Conservation and Soil Survey, OUAT, ICAR, Odisha State Disaster Management Authority (OSDMA), National Disaster management Authority (NDMA)	10

Long-term recovery needs (36–60 months)		
Crops		375
Provide resilient power supply to agriculture, irrigation activities with focus on small and marginal farmers and vulnerable sections including solar/alternate energy solutions	Government of Odisha	90
Develop value addition chains for coconut, cashew, arecanut, spices, fruits etc. in PPP mode; promote community engagement to increase investments in post-harvest technologies and infrastructure for market oriented, sustainable agriculture. The various components shall include: • development of farmer organisations and farmers' markets; • modernising and building extension capacity; and • development of market infrastructure, common facility structures, agro-processing and value addition, and market intelligence.	Department of Agriculture, Department of Horticulture, and Department of Soil Conservation and Soil Survey, OUAT, ICAR	225
Launch local scented and other varieties of paddy which are adaptive to local soil and climatic conditions and are naturally resilient	Department of Agriculture, Department of Horticulture and Department of Soil Conservation and Soil Survey, OUAT, ICAR	10
Study the risks to high-end institutions and relocate the same to safe zones		
Institute an internationally supported study on land-use patterns in the state with an aim to increase the output and value per unit of land and produce	Department of Agriculture, Department of Horticulture and Department of Soil Conservation and Soil Survey, OUAT, ICAR, Food and Agriculture Organisation (FAO), other international/ multilateral agencies	20
Pilot climate resilient agriculture in selected pockets of the state with the help of competent agencies	Government of Odisha, ODSMA, OAUT, Departments of Agriculture and Horticulture	30
Total recovery and reconstruction needs		**970**

Source: Estimation made by the sector team on the basis of government data and field visits

agriculture, horticulture, agroforestry, home gardens, and fish culture. Microenterprises may be promoted in coastal areas to market agriculture, fisheries and dairy produce for better livelihoods. A coordination committee consisting of agriculture, horticulture, fisheries and livestock agencies could be established to improve collaboration and coordination for effective implementation of the recovery strategy. Appropriate insurance products could be developed for the sector along with efforts to improve engagement between sector players and financial institutions and products.

5.3.2 Fisheries

Short Term

- Repair and replacement of the lost and damaged fishing assets such as boats, nets, and aquaculture ponds may be prioritised for the revival of livelihoods. It may be difficult to mobilise credit from the banking sector and other financial institutions immediately, since banks require collateral or other types of security. Many fish hatcheries in cyclone-affected areas need brood stock and spawn or seed supply from other regions/ states and should be encouraged to procure these by following quarantine and bio-security protocols.
- The replacement of lost craft and gear to be taken up strategically by replacing with more eco-friendly gears (square mesh) and craft, as per the actual carrying capacity for the fishing body and to be discouraged if over fishing is already indicated. Fishermen need to be supported to go up in the value chain of fisheries by forming SHGs/ producer companies or to take up most appropriate alternative livelihoods, either in the emerging areas of diversified aquaculture or in other similar sectors.

- Repair and rehabilitation work such as the removal of silt, etc. may be considered by effective implementation of the government employment guarantee schemes of the National Rural Employment Guarantee Act (NREGA) that could help alleviate the troubles of the fishing community to a great extent.

Medium Term

- The management of marine capture fisheries is as per the Odisha Marine Fisheries Regulation (OMFRA) Act. There is a need to convince fishermen to register all fishing boats and major gears. For sustainable management of resources, the ecosystem approach to fisheries must be followed at different levels, and a co-management mechanism built.
- A planned aquaculture calendar may be promoted and early warning on floods/cyclones may be ensured so the farmers have an opportunity to harvest and sell the stock in time.
- Aquafarmers need to develop a system of data and aquaculture operations management directly. All such farms should be registered with the Department of Fisheries. This could facilitate access for aquafarms or aquaunits to formal credit and insurance.
- Common water bodies may be revived by removing silt and strengthening bunds wherever applicable. The local labour whose employment has been affected by the flood could be engaged under the government employment guarantee scheme wherever applicable.

Long Term

- Currently marine capture fisheries and aquaculture are being managed by the Department of Fisheries under the revenue administration in the district divisions. Such natural resource-based livelihoods activities need to be managed within an ecosystem-based framework with greater flexibility and streamlining.
- Capacity building on Ecosystem Approach to Fisheries Management (EAFM) is recommended for senior, middle level, and grassroots officers, civil society, local self-government departments (LSGDs), and fishermen/ farmer cooperatives. External technical support from agencies like the Food and Agriculture Organisation (FAO) of the United Nations, CGIAR or other organisations may be sought in this regard.
- The loss of biodiversity of fishes (reported by ATREE) and fall in catch due to over fishing are reported. Co-management of fisheries within the provisions of the (proposed amended) Inland Fisheries and Aquaculture Act and within the larger ambit of the EAFM may be taken up.
- To meet the need for stock enhancement in the coastal areas including the Chilika Lake, appropriate mechanisms and hatcheries may be established. EAFM

Table 5.27: Recovery and Reconstruction Needs and Costs

Activity	12 Months	12–36 months	36–60 months	Total amount	Calculation assumption
Short Term (INR crore)					
1. Immediate restoration of all public infrastructure	12.00				Damage value +15% addition
2. Immediate repair/ replacement of all damaged boats and nets for revival and restoration of coastal fisheries and fishing in Chilika to pre-flood situation. In freshwater fisheries, immediate repair/ replacement of all damaged boats and nets and aquaculture ponds.	68.00				120% of damage value
3. Negotiating with financial institutions to mobilise and arrange credit, restructuring existing outstanding loans and issuing fresh credit to private aqua-hatchery entrepreneurs	1.00				
4. Training of local youth in boat building and repairing, with more efficient eco-friendly craft and gears. And also promoting the stakeholder to establish such units	10.00				
5. Immediate reconstruction of all damaged fish seed ponds. Support to fishers/farmers go up in the value chain of fisheries by forming SHGs/ producer companies or to take up most appropriate alternative livelihoods either in the emerging areas of diversified aquaculture or in other similar sectors	8.50				Damage cost plus 15% of

Medium term (INR crore)				
1. Registration of all aquaculture, shrimp/ prawn culture enterprises. Registration of all riverine fishing boats and major gears.		40.00		
2. Promoting ecosystem approach to fisheries for sustainable management of resources in order to build up a co-management mechanism in fisheries		5.00		
3. Promoting adherence to a preplanned aquaculture calendar and providing early warning of imminent floods		0.50		
4. Awareness building among private aqua-hatchery owners to develop systematic processes and insure assets. Capacity building of aqua-farmers towards database maintenance and aquaculture operations management.		10.00		
5. Coordination across OLM, Department of Fisheries, and technical partners to promote value chain initiatives and producer collectives in inland and riverine fisheries. Both have great production and market potential.		100.00		
Long term (INR crore)				
1. Capacity building of senior, middle and grassroots level officers, civil society, LSGDs and fisher/farmer cooperatives etc.			0.50	
2. Fisheries co-management within the provisions of the (proposed) Inland Fisheries and Aquaculture Act and within the larger ambit of the Ecosystem Approach to Fisheries Management (EAFM).			100.00	
3. Stock enhancement in the coastal areas including the Chilika Lake with appropriate mechanisms and hatcheries			10.00	
4. Development of more resilient infrastructure and systems to overcome the recurring climate-related disasters and encouraging Odisha fishermen to move to deep sea fishing			25.00	
Total amount required	**99.50**	**165.5**	**125.50**	**390.5**

Source: Estimation made by the sector team on the basis of government data and field visits

plans for each fishery ecosystem may be developed involving all stakeholders and implementation may be envisaged within a co-management framework.

- An Ecosystem Approach to Aquaculture (EAA) may be promoted. A master plan-based aquaculture system may be built on a co-management platform for each aquaculture ecosystem/zone.
- More resilient infrastructure and systems may be developed to overcome the recurring issues of climate-related disasters. Examples of other countries may be studied; Bangladesh has developed such infrastructure with the help of the World Fish Centre. The fisheryouth of Odisha may be supported in deep sea fishing ventures.

Implementation Strategy for Recovery

- The Directorate of Fisheries in the Department of Fisheries and Animal Resource Development, Odisha is both robust and highly resourceful. The department will play a lead role in the recovery process.
- The local level fisher/ farmer community represented by cooperatives/SHGs and associations will be the active grassroots partners. Other government agencies like Orissa Pisciculture Development Corporation and Fish-Fed will support the Directorate of Fisheries in the works.
- There is a need to develop contingency plans for fisheries and aquaculture activities on the lines of agriculture. Further, perhaps establishment of one FRP boat

manufacturing and repairing unit immediately to meet the present crisis and to maintain boats in future would be useful. Also, it would be better if skilling of fisher youth from Odisha in boat building is commenced with expertise from Central Institute of Fisheries Technology (CIFT) or neighbouring states. Training could begin with overhauling of In Board Motors (IBM) and Out Board Motors (OBM) to revive the sand laden engines that were retrieved.

- The technical support and back up may be provided by the fisheries institutes under the Indian Council of Agriculture Research (ICAR), Department of Fisheries under Ministry of Agriculture and Farmers' Welfare, The Marine Products Export Development Authority (MPEDA) and the FAO. Relevant NGOs may also play partner and facilitate handholding roles.

Additional Suggestions

- There is a need to strictly adhere to CRZ regulations and prevent people from living very close to hazard line.
- Support for alternative livelihoods could reduce the pressure on sensitive eco zones suitable for the region.
- Fishermen are migrating to other areas. In order to discourage and attract them back into fisheries-related activities, skill development and capacity building in various emerging technologies should be undertaken.
- Lack of adequate infrastructure in the state, such as fish landing centres and fishing harbours, is an issue. Catch services are also limited. These should be addressed. Two types of investment therefore would be required. One to build infrastructure and the second to maintain ecosystem services.
- Distress selling is common, as fish is highly perishable. Fishermen mainly depend on middlemen and sell the produce for lower price. Marketing support, provision of connectivity to the markets, services such as cold chain, ice plants, refrigerated vehicles are need of the hour.
- Value addition of fish catch would increase income and create additional job opportunities. Adequate technical support and training with learner friendly methods for the new livelihoods introduced will be very important.
- Promotion of sustainable brackish water aquaculture and inland fisheries and promotion of deep-sea fishing could enhance catch and improve livelihoods of the fishing communities.
- Fishermen cooperatives do not extend credit to the fishermen. Rural banks too avoid loans to them due to a very high default rate. As a result fisherfolk fall back upon private moneylenders for advances at exorbitant rates of interest for repairing boats and nets. Input delivery system for crops could be strengthened and co-operative credit system broadened to include fisheries and farm labourers also.
- Insurance for climate risks faced by the coastal communities, especially fishers, could be developed.
- The important recovery strategies in the fisheries sector are ecosystem approach to fisheries and aquaculture management, based on a strong foundation of co-management and integrated development of the sector.
- Building of a strong fisheries and aquaculture database and fisheries and aquaculture census at regular intervals needs to be undertaken to obtain comprehensive picture of production including resource usage and users.
- Resilient shore infrastructure facilities could include warehouses for storing /harbouring boats and nets safely during disasters
- Biosecurity protocols could be developed to control disease outbreaks and health risks in affected areas.
- The Fisheries Disaster Management plan of Odisha developed and revised during 2014–15 should be updated and circulated for more publicity and necessary action in the field.

5.3.3 Livestock and Poultry

The most important recovery strategy for the livestock sector is formulation of an area-specific action plan for natural calamities including rescue, rehabilitation, development of designer sheds, and a common cyclone resilient facility in each and every village/Panchayat. This will be a one time and long-term investment to prevent damage/ losses of infrastructure and livestock, including poultry, due to calamities.

Cattle sheds (including goat sheds) should be an intrinsic part of the housing infrastructure. Thus every housing design should include a designated space for disaster resilient shed (just like toilets/ bathrooms are included later with housing).

Grassroot support to dairy and goat rearing may be strengthened through capacity building and incentivising of OLM's Pashu Sakhis at a cost of INR 350 crore over a period of three years.

A corpus worth INR 60 crore could be instituted as a revolving fund at the Cluster Level Forum (CLF) of OLM to support disaster-vulnerable households.

A subsidy mechanism needs to be devised to kickstart the insurance of all cattle for a period of three years where in the fund required is 70% of the total premium cost. Studies are also needed to understand how the backyard poultry and goat rearing can be enhanced in collaboration with OLM. In order to achieve these needs, alternative sources of finance need to be found.

Short Term (0–12 months)

- Immediate feed supply/ subsidy on feed for the surviving animals
- Renovation/ re-construction of animal/poultry sheds
- Restocking/replacement of dead livestock and poultry and provision for compensation/subsidy
- Moratorium for bank loans
- Provision of working capital
- Restructuring of loan
- Interest free loans and easy access to credit
- Provision of credit through MUDRA Scheme
- Special revival package for cyclone affected commercial farms (government and private) and milk societies
- Formulation of area-specific action plans for natural calamities including rescue, rehabilitation and construction of designer sheds
- Training to Veterinary Officers/ para-vets on veterinary epidemiology, animal disease surveillance and monitoring, biosecurity and bio-safety
- Farmers and volunteers training on biosecurity and bio-safety, carcass disposal, use of mastitis kits at household level with provision of extension material on animal husbandry practices and disease reporting, investigation and control, especially in the event of unusual mortality.

Medium- and Long-Term Strategy (1 to 5 years)

The following long-term interventions are recommended to improve resilience of households dependent on animal husbandry:

- **Livestock insurance** may be extended to 10 lakh graded or cross-bred milch animal @ INR 500 premium subsidy per animal annually.
- Interest subvention (10%) on term loans (up to a cumulative maximum of INR 20 crore) may be provided to farmers at a subsidy cost of INR 2 crore.
- Ten **fodder block units** could be set up @ INR 50 lakh per unit to reduce fodder scarcity during lean season
- **Solar power backup supply for cold chain management** could be extended to 541 veterinary dispensaries, 30 disease diagnostic centres, and 2,000 livestock aid centres for storing vaccines.
- A **calf rearing scheme** could be envisaged for raising female calves from the age of 4 months to 28 months to benefit 15,000 farmers @ INR 5,000 per calf for 7 quintals of feed.
- **Disaster preparedness** could be improved through better disaster communication systems and capacity building of field-level officials of the Department of Fisheries and Animal Resource Development.
- **Disaster resilient animal sheds** could be built using local material to the extent possible. This could be provided for both financially and in terms of floor plan within the overall housing policy for farmer households.
- **Promote integrated/ farm family approach** towards combining animal husbandry with crop cultivation to diversify household income, improve resilience for smallholder households and realise synergies through complementarities of the two activities. This translates to building greater awareness of animal husbandry activities among households engaged solely in crop cultivation, greater coordination between agriculture and animal husbandry departments, and bundling of schemes. Creation of marketing infrastructure with backward and forward linkages is also recommended.

Table 5.28: Recovery Needs for the Animal Husbandry Sector

Part A

Activity	Responsible agency	Cost (INR crore)
Short-term recovery needs (up to 12 months)		1,101.88
Provision for immediate feed supply	Fisheries and Animal Resources Development Department of Government of Odisha	0.5
Restocking of 2,499 cows and buffaloes @ INR 65,000 per animal (cost of animal @ INR 55,000/- + transportation insurance and veterinary services and feed for two months @ INR 10,000/-)	Fisheries and Animal Resources Development Department of Government of Odisha	16.24
Restocking of 695 calves @ INR 16,500 per animal (cost of animal @ INR 16,000/- + insurance and veterinary services @ INR 500/-)	Fisheries and Animal Resources Development Department of Government of Odisha	1.15
Restocking of 139 bullocks @ INR 26,500 per animal (cost of animal @ INR 25,000/- + insurance and veterinary services @ INR 1,500/-)	Fisheries and Animal Resources Development Department of Government of Odisha	0.37

Restocking of 2,924 sheep and goats @ INR 5,500 per animal (cost of animal @ INR 5,000/- + insurance and vet. services @ INR 500/-)	Fisheries and Animal Resources Development Department of Government of Odisha	1.61
Renovation/reconstruction of cattle sheds (1,23,641) @ INR 50,000/- per shed	Fisheries and Animal Resources Development Department of Government of Odisha	618.2
Renovation/ reconstruction of goat sheds @ INR 5000/- per shed	Fisheries and Animal Resources Development Department of Government of Odisha	24.73
Renovation / re-construction of poultry sheds	Fisheries and Animal Resources Development Department of Government of Odisha	336.58
Assumption 1: For capacity below 1,000, the no. of birds is assumed to be 800, for capacity 1,000–2,000, the no. of birds is assumed to be 1,500; for capacity 2,000–3,000, the no. of birds is assumed to be 2,500; for capacity 3,000–4,000, the no. of birds is assumed to be 3,500 and for capacity more than 4,000, the no. of birds is assumed to be 5,000		
Assumption 2: 1 sq ft area per bird for construction of shed and cost of construction @ INR 400 per sq ft		
Building/ reconstruction of disaster resilient service institution infrastructure	Fisheries and Animal Resources Development Department of Government of Odisha	30
Capacity building, study and IEC activities	Fisheries and Animal Resources Development Department of Government of Odisha	1.5
Organisation of animal health camps and oestrus synchronisation of bovines (3,000 camps @ INR 30,000/ -per camp	Fisheries and Animal Resources Development Department of Government of Odisha	9
Alternative livelihood through:	Fisheries and Animal Resources Development Department of Government of Odisha	
Backyard poultry: A unit of 50 birds @ INR 4,000 per unit, including cost and housing for 30,000 farmers/households		12
Goat farming activity: Unit of 1 buck and 10 does @ INR 50,000/ unit for 10,000 farmers to be implemented in collaboration with OLM		50
Medium- and long-term recovery needs (12–36/ 60 months)		152.28
Total funds	Fisheries and Animal Resources Development Department of Government of Odisha	
Livestock Insurance: 10 lakh graded/ CB milch animal @ INR 500/- premium subsidy per animal	Fisheries and Animal Resources Development Department of Government of Odisha	50
Interest subvention on term loan (farmer will be provided 10% subvention on term loan of INR 20 crore)	Fisheries and Animal Resources Development Department of Government of Odisha	2
Provision of Fodder Block unit – 10 nos. @ INR 50 lakh per unit	Fisheries and Animal Resources Development Department of Government of Odisha	5
Solar Power backup supply in all service institutions – 541 veterinary dispensaries, 30 disease diagnostic centres, 2,000 livestock aid centres	Fisheries and Animal Resources Development Department of Government of Odisha	10.28
Strengthen disaster communication system, build capacity of field-level officials of the Department of Animal Husbandry Department etc.	Fisheries and Animal Resources Development Department of Government of Odisha	10
Calf Rearing Scheme: Raising of female calves from 4–28 month for which provision is needed for feed of about 7 quintals per calf (unit cost INR 5,000 for 15,000 farmers)	Fisheries and Animal Resources Development Department of Government of Odisha	75
Total recovery and reconstruction needs		**1,254.16**

- **Develop essential infrastructure to strengthen value chain** including veterinary healthcare centres, bulk coolers, milk collection centres, fodder banks and other infrastructure for improve access to inputs and essential services.
- **Improve awareness of livestock insurance** improved resilience. Premium subsidy to all the farmers involved in livestock farming should be provisioned for.
- **Assessments/ studies to improve knowledge-base and planning** including disease mapping in a GIS framework needs to be undertaken. Fodder requirements need to be assessed and mapped, and block level fodder development plans developed
- The **genetic potential of livestock (especially of exotic and crossbreeds) may be leveraged** by promoting better animal management techniques including care, improved nutrition including protein supplements and disease management through prevention, control, and containment of diseases to augment yield and increase income
- **Extending fresh bank loans and restructuring existing loans** could provide the support needed to rebuild sheds.

5.4 Sector Assessment Methodology

5.4.1 Agriculture

Data Collection Process and Sources

- The damage and loss data and related information was sourced from the Department of Agriculture and the Department Of Horticulture, Odisha State Cashew Development Corporation and Odisha University for Agriculture and Technology.
- Directorate of Economics and Statistics of Odisha was consulted for data on Net District Domestic Product, GVA etc. Gaps in data were discussed with state and district officials.ehensive data collection sheet was circulated to the Director of Agriculture and Director of Horticulture to obtain district-wise, ownership-wise, crop-wise updated data on crop losses, crop damages, damages to physical infrastructure, farm equipment, machinery, etc. The departments deputed nodal officers to facilitate the work of the DLNA team.
- Field visits were undertaken in three of the worst hit districts of Puri, Cuttack, and Bhubaneswar. Valuable inputs were received from the District Collector of Puri; Deputy Director Horticulture, Cuttack; Deputy Director Agriculture, Puri; Joint Secretary, Agriculture; Joint Secretary, Horticulture; and officers in the two departments.

Assumptions Made for Estimating Costs

- Immediate losses in perennial crops were calculated by multiplying productivity (kg/ha) for each crop (provided by the Departments of Agriculture and Horticulture for each affected district) with farm gate price and number of hectares damaged. The long-term loss was calculated assuming that production would be lost up to fruit bearing time using the same criteria.
- Damage to perennial crops and cost for replanting was calculated by multiplying the number of units damaged with the unit cost for replanting per hectare (including inputs, labour, and seedlings); the cost varied by district.

Table 5.29: Unit Cost for Assessment of Damage to Perennial Crops

Crop	Unit Cost INR	Additional Expenses* INR	Total Unit Cost INR	Planting Density/ha	Time for Fruit Bearing-Years
Mango	2,04,500	10,000	**2,14,500**	125	3
Jackfruit	72,000	10,000	**82,000**	100	4
K Lime	1,81,900		**1,81,900**	400	4
Other Fruits	75,000		**75,000**	100	4
Betel vine**	20,000		20,000		
Cashew	1,27,500	10,000	**1,37,500**	200	3
Areca nut	1,16,000	10,000	**1,26,000**	1,375	5
Coconut	1,29,925	10,000	**1,39,925**	150	6

*Expenses for debris clearance/uprooting removal etc. (estimate)
**Betel vine: 25% of the unit cost for fresh planting is taken for restoration and repairs to damaged paan borjoras. Borjoras are bamboo ply scaffoldings erected at regular intervals for the vine/creeper to grow on.

The unit cost prepared under the guidance of NABARD was used for computing the damage to perennial crops. The Cost of Cultivation prepared by OUAT was used wherever required.

5.4.2 Fisheries

The damage and loss data on fisheries and aquaculture was sourced from the Department of Fisheries and Animal Resources. Clarifications on gaps were sought from officials of Directorate of Fisheries (DoF) and the details collected to satisfy the DLNA requirements. Some additional data were also obtained from other agencies working in the field like the MPEDA. The basis of the data collection was discussed with the DoF officers and gaps were filled in by directly contacting the district officers. In other gap areas such as loss in capture fisheries and labour loss in fisheries and aquaculture, convincing formulas for extrapolation was discussed and worked on.

Field visits were made to the districts of Puri, Khurda, Cuttack, and Jagatsinghpur where fishery and aquaculture sector was severely affected. In these districts, apart from meeting the District Collector, visits were made to the worst-affected villages for one-on-one interaction with fisherfolk and farmers. Direct interactions and telephonic discussions were held with developmental workers and farmers and fishers to get additional information. Within the DLNA team, discussions were held with other sectoral experts to better understand the cross-cutting areas.

5.4.3 Livestock

Data Collection Process and Sources

- *Report on Integrated Sample Survey (2018–19)*, Animal Husbandry and Dairy Department, Goverment of India
- Animal Husbandry and Dairy Department, Goverment of India
- Contact with dairy and poultry farmers during field visit
- Interaction with state government officers.

Assumptions Made for Estimating Costs

Cows and Buffaloes

- Replacement/restocking of animals = 180 days
- Regain production loss of the surviving animals = 15 days
- Production loss of the surviving cows = 30%
- Average milk production: Cows = Range between 1.77 to 5.00 litres in different districts. Calculations made on the basis of the average milk production of the district (1.7 litres in Jajpur and 4.1 litre in Cuttack).
- Price of milk = INR 30 per litre

Poultry - Chicken

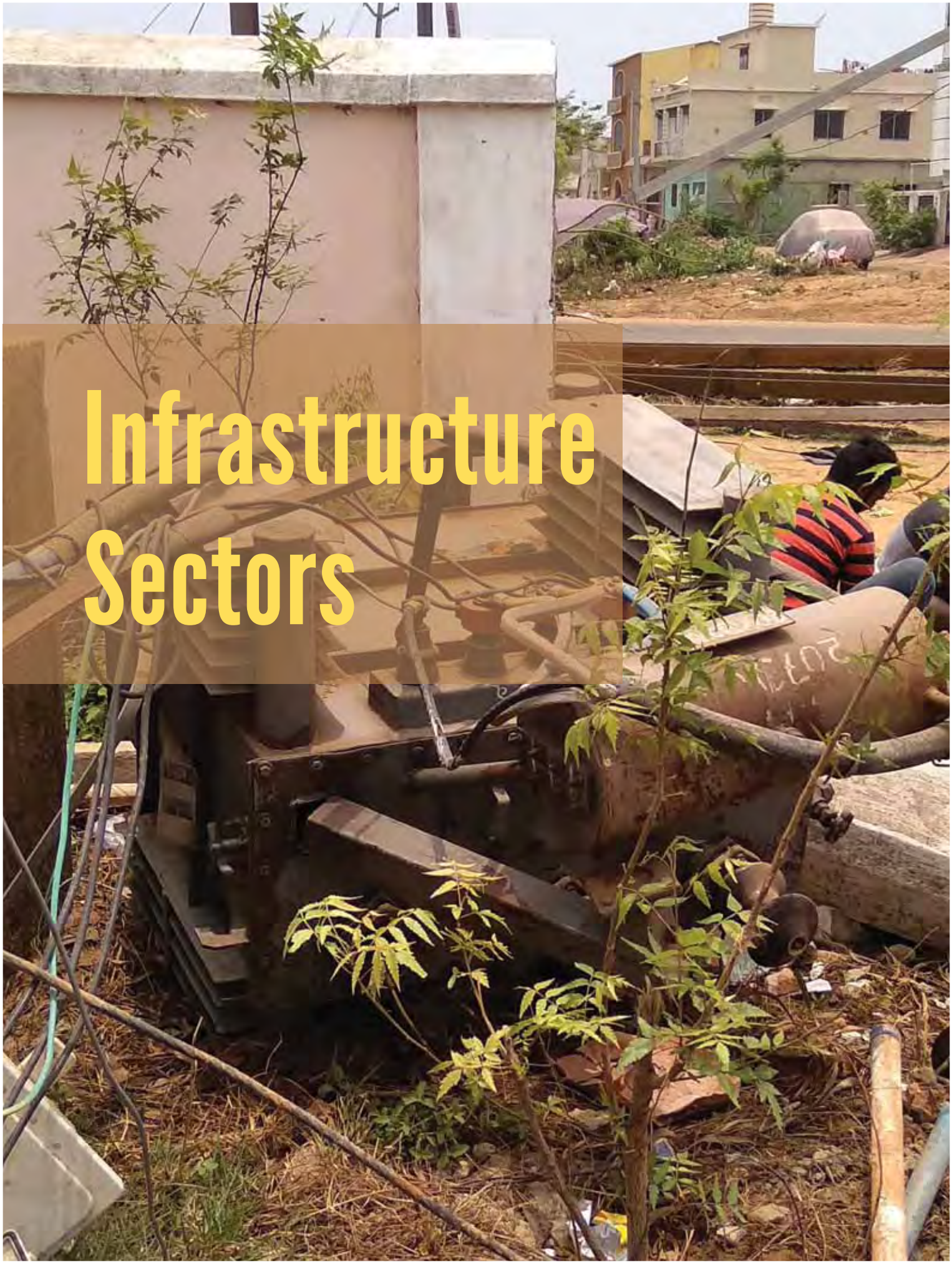
- No of eggs per year = 320 in commercial farms
- Total layer population laying eggs = 30%
- Out of total layers 80% laying
- Cost of egg = INR 5 per egg
- Egg lost from the layers: 60 days
- Unit Cost: Based on NABARD/NDRF cost for livestock/ poultry

Assumptions for Construction of Cattle, Sheep, Goat, and Poultry Sheds

- Assumption 1: For capacity below 1,000 birds, the bird size is assumed to be 800 g, for capacity 1,000–2,000 birds, the bird size is assumed to be 1,500 g; for capacity 2,000–3,000, the bird size is assumed to be 2,500 g; for capacity 3,000-4,000, the bird size is assumed to be 3,500 g and for capacity more than 4,000, the bird size is assumed to be 5,000 g.
- Assumption 2: 1 sq ft area is considered per bird for construction of shed and cost of construction is INR 400 per sq ft.
- Assumption 3: INR 50,000 for construction of one cattle shed
- Assumption 4: INR 5,000 for construction of one sheep and goat shed

Note

[1] *Census of India 2011,* Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.



Infrastructure Sectors

Infrastructure Sectors: Tables and Figures

Tables

Figures

6

Power

6.1 Pre-Disaster Context

6.1.1 Baseline Data

Power in Odisha (5,487 megawatts (MW) in all) is either generated in the state or supplied by central generating stations (CGS). Power generated within the state is classified into three sub-categories: (i) hydel generation: 2008 MW (36.6%); (ii) thermal generation: 862 MW (15.7%); and (iii) renewable energy like small hydro, solar, wind, and biomass: 539 MW (9.8%). The remaining power, around 2,077.5 MW (37.8%), is received from the CGS.[1] The state has a peak demand of 4,582 MW and an average demand of 3,850 MW.

The power network in Odisha can be classified largely into four categories: (i) Extra High Voltage (EHV) lines from 400 kilovolts (kV) to 132 kV, (ii) 33 kV network, (iii) 11kV network, and (iv) 415 volts (V) low tension network. The present network of 400 kV, 220 kV, and 132kV overhead lines with towers is maintained by the Odisha Power Transmission Corporation Limited (OPTCL) while the lower voltage overhead line network, spanning around 13,995 km,[2] is maintained by four distribution companies (DISCOMs)[3] in Odisha.

Table 6.1 presents the baseline data for the power systems in the 14 districts affected by cyclone Fani. Most of the lines from 400 kV to 415 V are overhead with towers, mild steel (MS), and reinforced concrete cement (RCC) poles. Only certain areas in the cities of Bhubaneswar and Puri have 33 kV and 11 kV underground cable networks. The underground networks have not suffered any damage. As a result, these areas had their power supply restored within 1–2 days of the disaster.

Table 6.1: Baseline Data for 14 Affected Districts Prior to Cyclone Fani

District	400 kV, 220 kV, 132 kV (km)	33 kV feeders (km)	33 kV/11 kV substations (no.)	11 kV feeders (km)	11 kV/ 415 V distribution transformers (no.)	415 V distribution lines (km)	Consumers (no.)
Angul		542	28	5475	5356	6100	224,680
Dhenkanal		353	22	3338	3301	3773	198,132
Cuttack		716	61	5657	8305	10547	490,532
Puri		418	26	4344	5550	6746	302,898
Khurda		796	65	5363	3805	3636	566,923
Nayagarh		305	21	3467	8170	9750	213,310
Jagatsinghpur	13,995	253	22	3807	3536	5983	217,443
Balasore		542	51	7462	16996	11776	454,018
Bhadrak		358	26	3746	11306	6543	239,026
Ganjam		1396	61	13987	18814	12993	827,054
Mayurbhanj		350	47	4262	12166	17281	451,125
Jeypore		54	4	563	665	872	42,193
Kendrapara		267	26	3555	4140	5397	256,747
Keonjhar		453	36	6726	10314	8582	264,593
Total	**13,995**	**6,803**	**496**	**71,752**	**112,424**	**109,979**	**4,748,674**

6.1.2 Sector Preparedness

As a precautionary measure, power was switched off on 2 May 2019, a day before the cyclone was expected to make landfall. The Disaster Response Centre set up in 2016–17 by the Energy Department of the Government of Odisha, was operational during the event. Once it was certain that the landfall of the cyclone would take place near Puri, the response centre in Bhubaneswar ensured that various DISCOMs received the following on a priority basis:

a. Materials like RCC poles, steel poles, wires, conductors and transformers, mobilised from different stores
b. Local manpower, including unskilled, semi-skilled, skilled and other technicians, supervisors and engineers, mobilised at various locations
c. Staff member from unaffected districts were advised to be ready to move in for restoration work
d. Machinery like cranes, hydra (to straighten tilted poles), pole master (tractor mounted auger drilling machine with a crane to position the pole), mobilised at various sites
e. Some machines, along with operators, were also mobilised from other states like Haryana

6.2 Post-Disaster Context

6.2.1 Damage Assessment

During field visits it was observed that many of the poles had not been secured with adequate foundations as per code standards. While the spans and poles may have been as per required standards, due to periodical high wind speeds and heavy rains, the poles may have undergone substantial deterioration over time. Some of the MS poles had no base plates.

Due to the tension caused by heavy winds, poles, conductors, and transformers were damaged or uprooted. There were cases of EHV towers falling over other EHV or High Voltage (HV) towers.

Odisha suffered losses in revenue due to disruptions in power supply in 14 districts. Due to high wind speeds, many poles from 220 kV to 415 V were damaged or uprooted. This caused the snapping of overhead lines, transformers and accessories and, in most cases, the entire equipment was damaged. Five districts, namely Puri, Cuttack, Khurda, Ganjam, and Dhenkanal, were severely affected. Nine other districts suffered extensive damage (Table 6.2).

Buildings belonging to DISCOMs have suffered minor damage. At a few locations, boundary walls have collapsed, and restoration work has already started. Some old and unused small buildings have been damaged.

Table 6.2: Damage in the Affected Districts

District	400 kV, 220 kV, 132 kV (km)	33 kV feeders (km)	33 kV/11 kV substations (no.)	11 kV feeders (km)	11 kV/ 415 V distribution transformers (no.)	415 V distribution lines (km)	Consumers (no.)
Angul	5 towers of 400 kV 111 towers of 220 kV and 132 kV	10	0	75	18	980	224,680
Dhenkanal		26	0	110	15	755	198,132
Cuttack		418	2	2200	1911	2620	490,532
Puri		360	6	4731	5641	1287.5	302,898
Khurda		493	1	2690	1152	952	566,923
Nayagarh		55	0	175	32	290	213,310
Jagatsinghpur		253	22	3806	3536	5982.5	217,443
Balasore		285	36	3345	148	2941	454,018
Bhadrak		357	26	2589	280	3598	239,026
Ganjam		1,396	61	13,987	18,814	12993	827,054
Mayurbhanj		350	47	4262	50	8122	451,125
Jeypore		485	24	8666	415	9186	42,193
Kendrapara		45	2	485	165	327	256,747
Keonjhar		453	36	5576	30	1288	264,593
Total		**4,986**	**263**	**52,697**	**32,207**	**51,322**	**4,748,674**

Figure 6.1: Damaged 33 kV Panel and Substation

Figure 6.2: Damaged Steel H-Pole

6.2.2 Increased Sector Risk

During the reconstruction of the power network, the following issues were observed that potentially increase the risks to the network in future disaster events:

- Steel poles, RCC poles, and transformer structures are being erected in the same or nearby locations. Without proper checks, this could cause the poles or structures to fall again, since the soil around them could have become loose or may have existing concrete.
- Span lengths between the new poles being erected are the same as earlier.
- Base plates are not being used as per standards and the portion of the steel pole that goes into the ground is not being painted with epoxy.
- The pits/foundation requirement is being backfilled with excavated soil. No concreting of the foundation or compaction of backfilled soil is being done.
- In case of heavy rains, wind or the forthcoming southwest monsoon setting in early, the backfilled soil will not be able to support the poles or equipment, which could lead to significant damage.

6.3 Damage and Loss Estimate

Table 6.3 provides the estimate of losses based on field assessment by the joint team. These figures pertain to all 14 districts and both transmission and DISCOMs. This data, along with the detailed estimates in Annex 6.1, was discussed on 2 June 2019 with the Energy Department and DISCOM officials and agreed upon.

6.3.1 Estimate of Revenue Losses

Revenue losses are classified into two categories, namely, revenue loss to DISCOMs due to non-supply of power and income loss to meter readers and bill collectors (since DISCOMS outsource these activities to third parties).

- Revenue loss to DISCOMs: INR 250 crore (USD 35.7 million)
- Loss in earnings of meter readers/bill collectors: INR 3.5 crore (USD 0.5 million)
- Total losses = INR 253.5 crore (USD 36.2 million)

6.4 Recovery Needs

For power systems to be resilient and withstand high wind speeds and heavy rains, three approaches to network recovery could be adopted. The first is to use the existing design systems with proper foundations and reduced spans. This may be cost efficient but may not be long lasting. The second is to use a combination of spun concrete poles and H-poles, which can withstand wind speeds of up to 250 kilometers per hour (kmph). The last—and most resilient and robust—method is to shift from overhead lines to underground cables. Annex 6.1 lists the assumptions for the costing of these approaches.

Table 6.4 provides the costs involved in reconstructing the damaged network using different resilient options. The costs for the transmission network would not vary much. However, the costs for the distribution network would vary considerably based on the types of poles and foundations used for overhead networks as well as for underground cable networks.

Table 6.3: Estimate of Damage Incurred

District	400 kV/ 220 kV and 132 kV (INR crore)	33 kV lines (INR crore)	33 kV/11 kV substations (INR crore)	Cost of 11 kV lines (INR crore)	11 kV/ 415 V DTR transformers (INR crore)	415 V lines (INR crore)	Total cost per district (INR crore)	Total cost per district (USD million)
Angul	93.5	1.7	0.0	5.6	0.5	39.2	47.1	6.7
Dhenkanal		4.4	0.0	8.3	0.5	30.2	43.4	6.2
Cuttack		71.1	1.6	165.7	57.3	104.8	400.5	57.2
Puri		61.2	4.8	356.2	169.2	51.5	643.0	91.9
Khurda		83.8	0.8	202.6	34.6	38.1	359.8	51.4
Nayagarh		9.4	0.0	13.2	1.0	11.6	35.1	5.0
Jagatsinghpur		43.0	17.6	286.6	106.1	239.3	692.6	98.9
Balasore		48.5	28.8	251.9	4.4	117.6	451.2	64.5
Bhadrak		60.7	20.8	195.0	8.4	143.9	428.8	61.3
Ganjam		237.3	48.8	1053.2	564.4	519.7	2423.5	346.2
Mayurbhanj		59.5	37.6	320.9	1.5	324.9	744.4	106.3
Jeypore		82.5	19.2	652.5	12.5	367.4	1134.1	162.0
Kendrapara		7.7	1.6	36.5	5.0	13.1	63.8	9.1
Keonjhar		77.0	28.8	419.9	0.9	51.5	578.1	82.6
Total (sans 400/220 kV and 132 kV)		847.6	210.4	3,968.1	966.2	2052.9	8,045.2	1,149.3
Total (including 400/220 kV and 132 kV)							**8,138.7**	**1,162.7**

Table 6.4: Recovery Needs for a Resilient Network

Option 1		Option 2		Option 3	
Existing system with improved specifications and quality control		Existing system, but with spun poles and H-poles along with improved specifications and quality control		Complete system, using an underground cable network along with improved specifications and quality control	
Total cost in INR (crore)	Total cost in USD (million)	Total cost in INR (crore)	Total cost in USD (million)	Total cost in INR (crore)	Total cost in USD (million)
9,747.7	**1,392.5**	**11,356.8**	**1,622.4**	**25,920.2**	**3,702.9**

Based on the estimated costs in Table 6.4, and considering the need for the entire network to be reconstructed, the estimated costs for the three options are detailed as follows:

- Option 1: Overhead system with existing equipment and improved specifications for the installation of equipment, poles, and quality control: INR 9,747 crore (USD 1,393 million)
- Option 2: Overhead system with spun poles, H-poles, and improved quality control: INR 11,357 crore (USD 1,622 million)
- Option 3: Completely underground cable system for distribution network: INR 25,920 crore (USD 3,703 million)

6.5 Impact Analysis on Development Goals

Robust electrical networks ensure uninterrupted power supply and improve the government's ability to recover from disasters in a faster and stronger manner. The impact on households and communities and on vital systems like health, water supply, small and large enterprises and industry, and most livelihoods is immediate and long lasting.

As a result, investing in a robust electrical network is central to ensuring the social and economic health of communities within the state.

6.6 Sector Recovery Strategy, Policy Recommendations and Broad Strategy for the Sector

6.6.1 Investing in Resilient Infrastructure

Odisha has long been prone to natural and man-made calamities. Floods, droughts and cyclones are regular features in the state. In the past 50 years, the state has witnessed more than 17 floods and over seven cyclones. While the Government of Odisha has managed the aftermath of cyclone Fani very well, the immediate need is to build a resilient power infrastructure that can sustain the impact of extremely strong winds.

As the state focuses on minimising losses and damage in case of a natural calamity like a cyclone, and on ensuring continuous supply to critical installations, the Government of Odisha should identify vulnerable locations. Resilient infrastructure should be put in place and critical installations should be provided with reliable power supply on continuous basis.

To build a resilient network, the state might want to consider expanding its underground cable network in the coastal areas. Since underground cabling is much more expensive, supplementary studies on economic and cost–benefit analysis should be undertaken. This requires in-depth study of the existing system, understanding the gaps in the current system and drawing up of a plan for resilient infrastructure in the coastal areas. Judicious combinations of overhead lines, air bunch cables, spun and H-poles, underground cables, ring main units and auto reclosures should be evaluated by considering factors like estimated cost and 'right-of-way' issues that may arise while laying of lines through agricultural lands, other private lands, and through areas with shops which may need to be relocated. This is likely to ensure higher availability of systems that are reliable.

Connecting up consumer metre boards with underground cable will make the system completely robust, especially in high density urban areas. Subject to the availability of funds, smart meters can also be used.

Annex 6.1 provides the estimated costs of an underground cable network, overhead lines, and major equipment. These are based on actual costs from projects under execution in various parts of the country. The equipment being used is designed for wind speeds of up to 250 kmph and for corrosive weather conditions. These estimates can be used for further detailed study to arrive at the required costs.

The Energy Department of the Government of Odisha should identify the areas to be covered by underground cables or overhead lines, or a combination. Areas that are most vulnerable, based on past data, should be taken up on priority basis.

6.7 Sector Assessment Methodology

- **Data collection process:** Data was collected by various DISCOMs and shared with the assessment team.
- **Extrapolation of data:** The data provided on damages in Table 6.3 is based on the inputs provided by the GRIDCO and may vary from the actual cost.
- **Field visits:** The assessment team, along with the nodal officers of DISCOMs, visited the districts of Puri, Cuttack, and Khurdha during 24–27 May 2019.
- **Assumptions made for cost estimates:** Costs for most of the items have been provided by DISCOMs. For some of the items for which costs were not available, the latest prices have been taken from other contracts or market rates being executed under similar projects.

Notes

[1] The data, as on 31 March 2019, is based on details furnished by GRIDCO Ltd.

[2] 33 kV: 13,914 km; 11 kV: 140,862 km; and 415 V: 197,722 km

[3] Central Electricity Supply Utility (CESU), WESCO Utility, NESCO Utility, SOUTHCO Utility

7

Telecommunications

7.1 Pre-Disaster Context

The telecommunications sector has registered strong growth in Odisha in the past two decades and forms an integral part of the economy. The state of Odisha has a subscriber base of 3.26 crore spread over five mobile service providers, namely: Airtel, Vodafone/Idea, Tata Teleservices, Bharat Sanchar Nigam Limited (BSNL) and Reliance Jio. BSNL, a Public Sector Undertaking (PSU), has a market share of 18%, while 81% of the market is controlled by three private companies—Airtel (37%), Vodafone/Idea (16%) and Reliance Jio (28%) (Table 7.1).

Table 7.1: Subscriber Base and Market Share per Service Provider in Odisha

Service Provider	Number of Subscribers	Market Share (Subscriber Base)	Total Subscriber Base in Odisha
Airtel	12,178,352	37%	**32,694,369**
Vodafone/Idea	5,161,435	16%	
Tata Teleservices	427,153	1%	
BSNL	5,747,860	18%	
Reliance Jio	9,179,431	28%	

Source: Telecom Regulatory Authority of India (TRAI), Highlights of Telecom Subscription Data as on 31 March 2019

Spread over the 30 districts of the state, the wireless network in the state is supported by approximately 18,000 towers that house over 49,000 Base Transceiver Stations (BTS). These BTS provide a mix of The Global System for Mobile Communications (GSM), 3G and 4G-LTE coverage to the users in the state. As per the TRAI, Odisha has an overall teledensity (subscribers per 100 inhabitants) of 80.24 in the state (urban areas reported a teledensity of 163.17 and the rural areas reported a teledensity of 61.81) (Table 7.2).

For a sector that has shown immense promise and a steady growth in the subscriber base over the past decade,

Table 7.2: Number of BTS Towers in Odisha

Type of BTS Tower	Number	% of Network Type	Total
GSM	18,951	38%	**49,406**
3G	7,115	14%	
4G-LTE	23,340	47%	

Source: Department of Telecommunications (DoT), *Telecom Statistics of India—2018*, data as of 1 July 2018

the recent financial health has not been very encouraging, primarily driven by the high capital investments and licensing costs and low returns stemming from low Average Revenue per User (ARPU). In addition, the state also has 2.3 million subscriptions of wireline services.[1] Furthermore, it has a subscriber base of 12.2 million internet connections of which 9.1 million connections are supported on the broadband network and another 11.6 million users access the internet wirelessly.[2]

Sustainable Development Goal 9 (SDG 9) on Industry, Innovation and Infrastructure clearly highlights the importance of communication networks for societies as it provides them an opportunity to leapfrog in their development. Moreover, as the dependence on telecommunications increases, it becomes a vital conduit for service delivery and transforms into a critical infrastructure.

In view of this, any investment in the sector must focus on designing resilient systems that can withstand climate-induced extreme events and natural disasters. As the state and the central governments promote an ambitious agenda to deliver a range of citizen services over digital platforms, the sustainability and robustness of these platforms must be ensured. A resilient telecom network will contribute to economic growth, and in times of disasters, it will become the backbone of the response and recovery. Alternatively, a failure to do so may have a cascading effect on the development trajectories of many interlinked sectors.

7.2 Post-Disaster Context

As an infrastructure heavy sector, the damage accrued by the sector has been quite significant. In the immediate aftermath of the cyclone, 52% of the 11,727 BTS deployed across 11 districts became dysfunctional. Of these 11 districts, the most severely impacted were the districts of Puri, Khurda and Cuttack, where 83% of the 5107 BTS stopped working[3] (Table 7.3).

Table 7.3: Affected Base Transceiver Stations in the 11 Districts on 4 May 2019

District	Total BTS	Functional BTS on 4 May 2019	% of Non-functional BTS
Balasore	1,216	966	21%
Bhadrak	802	625	22%
Nayagarh	292	148	49%
Gajapati	90	76	16%
Ganjam	1,738	1,486	14%
Jagatsinghpur	747	389	48%
Jajpur	984	584	41%
Kendrapara	751	428	43%
Khurda	2,388	334	86%
Puri	971	173	82%
Cuttack	1,748	380	78%
Total for the 11 districts	**11,727**	**5,589**	**52%**

Analysis suggested that the cities in these districts, namely, Puri, Bhubaneswar, and Cuttack were disproportionately impacted, with an average outage of 80% across the three cities. In fact, in Puri only 4 of the 204 BTS were working. Thus, the immediate impact of cyclone Fani resulted in disconnecting millions of users—citizens, government officials and first responders. This made relief and rescue efforts more challenging and constrained the ability of the impacted populations to reach out for help or to communicate with their friends and families (Table 7.4).

Table 7.4: Affected Base Transceiver Stations in the Three Cities

City	Total BTS	Functional BTS on 4 May 2019	% of Non-functional BTS
Bhubaneswar city	1503	287	81%
Puri city	204	4	98%
Cuttack city	704	184	74%
Total for the 3 cities	**2411**	**475**	**80%**

Source: BSNL, Odisha

The assessment found that the disruption in mobile services was mainly due to the following causes:

7.2.1 Damaged or Collapsed Mobile Tower and Ancillary Equipment

The mobile towers are typically designed to withstand wind speeds of 175–180 kilometre per hour (kmph) with a gusting wind speed of up to 205 kmph. However, the wind speeds experienced during the cyclone were in the range of 220–250 kmph, which led to severe damages in few mobile tower installations. Another plausible reason for the damage to the towers could be the overloading of mobile towers since these towers are routinely shared by several mobile service providers. Such overloading beyond the design specifications, corresponding increase in the wind drag factor, the age of the mobile towers, and their weak foundations can make the towers vulnerable to high sustained wind speeds.

7.2.2 Disrupted Power Supply to Mobile Tower Stations

The failure resulted from the snapping of electrical wires providing electricity to the mobile tower or because of the failure of the other ancillary equipment, like mini-links, in-situ and damage to equipment shelters.

7.2.3 Inadequate Power Backup Arrangements

This may be attributed to the non-provision of power backup infrastructure like generator sets at the site, usually the case with private mobile operators.

In other damages, BSNL's Optical Fibre Cable (OFC) network was damaged in certain instances where the sections of OFC and accessories were kept functional through above the ground connections—to avoid damage due to excavations conducted for other development projects. These sections of OFC and accessories got damaged during the cyclone and will necessitate re-laying of approximately 400 kilometres (kms) of this network.

Odisha State Wide Area Network (OSWAN), which was set up to connect the state with 30 district headquarters and 284 block headquarters and 61 horizontal offices through data, video and voice communications also failed. The very-high-frequency (VHF) communication being used by the police administration had very limited reach during the disaster.

The communications sector is central to ensuring that the government can communicate and manage its disaster response, relief and rehabilitation efforts. While initial network failure followed by slow restoration was experienced, apparently no adverse effect was observed of this failure on governance and decision-making processes at the key government decision makers, except for the first

48–72 hours. This was mainly due to BSNL landlines being operational to a fair extent. BSNL mobile services were also disrupted to a lesser extent, compared to the other mobile operators, due to their provision of Diesel Generator (DG) sets at mobile tower stations and pre-positioning of generator fuel. If the connectivity had failed completely and not restored within a few days, the government functions would have been very adversely affected.

Majority of the worst affected people by the cyclone are in the rural coastal communities and have faced challenges in accessing social and economic services. Also, a large number of subscribers were out of reach as they were unable to charge their mobile phones or use their computers due to the lack of power.

Information and Communications Technology (ICT) and telecommunications are a crucial economic infrastructure and its complete recovery and strengthening is important to support economic and public service delivery activities. Post-disaster relief and recovery efforts will continue to rely heavily on telecommunications and internet. Moreover, Government of Odisha's disaster preparedness strategy includes the use of monitoring and early warning systems that rely on telecommunications networks.

The damage and losses accrued in the sector as reported by BSNL is tabled below. The numbers have been qualified and extrapolated to give an overall understanding of the impact of the cyclone on the sector (Table 7.5).

7.3 Damages and Loss Estimation

Table 7.5: Damage and Loss Assessment for the Telecom Sector

Item	BSNL				Private Operator estimates			
	Quantity/ Measure	Approx. Unit Rate (INR)	Amount (in INR crore)	Amount (in USD million)	Quantity/ Measure	Approx. Unit Rate	Amount (in INR crore)	Amount (in USD million)
Optical fibre cable	400 km	75,000/km	3.00	0.43	50 km	9,00,000/km	4.50	0.64
Laying cost/Labour cost	400 km	3,50,000/km	14.00	2.00				
Joint closure and accessories	500 no.	5,000/unit	0.25	0.04				
Towers and equipment	57	35,00,000	19.95	2.85	324	52,00,000	168.68	24.10
Loss due to running network through diesel	14 days	25,000 ltr @INR 71	2.49	0.36	NA	NA	7.98	1.14
Anticipated revenue loss			5	5			20.50	2.93
Battery and power plant and shelter	45 no.	7,50,000/ unit	3.38	0.48	NA	NA	NA	NA
Mini-link	48 no.	25,000/unit	0.12	0.02	NA	NA	NA	NA
Cell on Wheels BTS (mobile cell towers)	8	20,00,000	1.60	0.23	50	30,00,000	15.06	2.15
Antenna and feeder cable	70	2,00,000	1.40	0.20	NA	NA	70	10.00
Transmission equipment	lump sum		12	1.71				
Switching equipment	lump sum		11	1.57				
Building damage	lump sum		20	2.86	NA	NA	62.05	9
AC unit	15	1,00,000	0.15	0.02				
DG set	18	4,00,000	0.72	0.10				
Electrical transformer	22	4,00,000	0.88	0.13				
Approx. effects for BSNL			95.93	13.70	Estimated effects by private sector		348.81	49.83
Total effect (damage and losses)							**447.4**	**63.5**

Note: Estimates are calculated based on the information accessed from BSNL and extrapolating it for the relative market share of private mobile operators active in affected areas. The damage and disruption data from private operators could not be accessed during the assessment.

7.4 Recovery Needs

The recovery needs have been estimated based on the actual damages reported by BSNL and assuming higher design specification for the replacement infrastructure and assets, such as the mobile tower station and equipment shelters with higher wind resistance. While there's a need for upgrading the design specification and providing reliable power back-up systems for the network assets in the coastal areas vulnerable to cyclones, floods and storm surges, the associated costs have not been worked out in the current assessment (Table 7.6).

Table 7.6: Recovery Needs for the Telecom Sector

Item	Quantity/Measure	Approx. Unit Rate	Amount (in INR crore)	Amount (in USD million)
Optical fibre cable	450 km	10,00,000	45.00	6.43
Towers	381 no.	62,42,143	238.00	34.00
Replacing lost equipment			96.18	13.74
Buildings			98	14.07
Battery/power plant shelter	45 no.	10,00,000	4.50	0.64
Total recovery needs			**482.14**	**68.88**

The basis for the recovery cost estimates is as below:

- For relaying of damaged OFC, the trenches need to be deeper and away from the trenches used for other utility services, hence, a cost escalation of about 33% over and above the costs shared by BSNL has been prescribed.
- For the towers and the buildings that need to be restored, an additional 20% of the total cost is recommended so that the resilience factors may be incorporated into the design and construction for withstanding higher wind speeds and inundation levels.
- For the equipment damaged or destroyed during the cyclone, the needs reflect a one-to-one replacement cost.

7.5 Recovery Strategy

Cyclone Fani's impact on the telecom services in the state has exposed the vulnerabilities in the telecom network and the critical need for improving its resilience to natural disasters. While the government authorities have quickly mobilised manpower, material and machinery to restore the telecom services in the affected areas to a large extent, there remains a need to future-proof the telecom infrastructure and services. When investing in a resilient network and services, it is recommended that the network is designed in a manner that it supports the state's development objective of achieving equitable growth, which will stem from a well-functioning digital economy in the state.

In the principle of 'building back better', the Government of Odisha and private operators should jointly invest in a telecommunications network that includes the following measures:

1. Improve the resilience of BTSs by:
   a. Making provisions for vehicles with microwave transceivers, combined with the function of a base station as well as a satellite ground station. These could be shared among operators.
   b. Adjusting the output power and reconfiguring base station antennas to cover more ground, to serve low population density and low network traffic areas better.
   c. Increasing backup power at base stations and all other communication facilities to counter electricity outages. BTSs identified as crucial to be earmarked to also receive reliable fuel supply.
2. Adopt designs for buildings and mobile towers that can sustain wind speeds of up to 250 kmph.
3. Strengthen the resilience of telecommunication infrastructure by promoting the underground cabling ducts rather than aerial cables.
4. Ensure multiple route redundancies for the backhaul network to ensure that Odisha's telecommunications and internet connectivity is not compromised in the future cyclone events.
5. Take measures to mitigate traffic congestion on the network, such as call restriction, call prioritisation and appropriate disclosure of network capacity by operators through a pre-determined process.
6. Adopt a policy, legal and regulatory framework for infrastructure sharing across utilities and sectors (roads, urban, power).

7. Improve the redundancy and reliability within telecom services and ensure last-mile connectivity, by deploying alternative communication systems for emergencies and testing it frequently with a standard operating procedure (SOP) at community, block and district levels.
8. Assess the mobile networks, their possible interoperability and the shortcomings in the current service delivery model. This will enable the policymakers to identify the gaps in the sector and act in advance.
9. Review telecommunications sector policy and regulatory framework to ensure that infrastructure investments are future proofed.

Notes

[1] TRAI Press Release, Highlights of Telecom Subscription Data as on 31 March 2019.

[2] Source: DoT, *Telecom Statistics of India – 2018*, Data as of 1 July 2018

[3] BSNL Odisha and Department of Electronics and IT, Odisha

8

Roads

8.1 Pre-Disaster Context

Roads are the dominant mode of transport in the state of Odisha for both passenger and freight transport. The total road network in the state is of 2,56,40 km and comprises National Highways (NH): 4,856 km, Express Highways: 38 km, State Highways (SH): 4,101 km, Major District Roads (MDR): 2817 km, Other District Roads (ODR): 13,454 km, Rural Roads (RR): 36,128 km, Gram Panchayat/Panchayat Samiti (GP/PS Roads): 1,62,477 km, Forest Roads: 7574 km, Irrigation Roads: 6277 km, Grid Corporation of Odisha (GRIDCO) Roads: 88 km and ULB Roads: 18,591 km.

The NHs are jointly managed by the National Highway Authority of India and the NH wing of Works Department (it manages 3811 km of NH). The SH, MDR and ODRs are managed by the Works Department, RR by Rural Development, ULB Roads by Municipal Corporations/ Municipalities and partly by the Works Department, GP/PS roads by Panchayati Raj and the Drinking Water Department, irrigation roads by the Water Resources (WR) Department, forest roads by the Forest Department, and GRIDCO roads by GRIDCO.

Due to its sub-tropical littoral location, the state is vulnerable to various natural disasters such as cyclones, floods, storm surges, lightning, tsunami, whirlwinds, etc. The coastline of the state is 480 km. Generally, two cyclone seasons i.e., one during the pre-monsoon period (April, May and June up to the onset of monsoon) and another post monsoon (October to December) prevail over the state. The Odisha State Disaster Management Authority (OSDMA) has carried out hazard mapping for the wind and cyclone zones of Odisha and has identified very high damage risk zones with wind velocities up to metres per second (50m/s) (180 kilometres per hour [kmph]).

The state has a State Disaster Management Plan (SDMP), that provides a framework for all phases of disaster management including, disaster risk reduction, mitigation, preparedness, response, recovery and better reconstruction. It prescribes standard operating procedures to be followed during disasters. Districts have their own detailed District Disaster Action Plans (DDAP). The preparedness for roads included: keeping in-readiness machines (JCBs, tractors with trolleys), material (cutters, fuel, lubricants, etc.) and manpower (operators, cutters, labour) at identified locations along the road network to deal with the extremely severe cyclone Fani, in the state.

This section covers the impact on NH, SH, MDR, ODR, RR and ULB roads. The damage to GP/PS is very minimal and is not reported.

8.2 Post Disaster Effects

Cyclone Fani crossed the Odisha coast close to Puri at 0800 hours on 3 May 2019 and as reported by the Indian Meteorological Department (IMD), maximum sustained surface wind speed of 170–180 kmph, gusting to 205 kmph was observed during landfall. Heavy rainfall occurred in some parts of the state during 3–4 May 2019. Nine districts recorded an average rainfall of more than 100 millimetres (mm), highest being in Khurda (187.8 mm) followed by Cuttack (171.1 mm), Jajpur (143.9 mm) and Nayagarh (141.7 mm).

As reported by the Government of Odisha, 272 km of NH (5.6%), 529 km of SH (12.9%), 735 km of MDR (26%), 3,976 km of ODR (29.6%), 6,251 km of rural roads (17.3%), 750 km of ULB roads (4%) were affected and have suffered varying degrees of damages during Fani in 14 districts of Odisha. Of the 14 affected districts, damages were high in Khurda, Puri, Cuttack and Jagatsinghpur, and moderate in Kendrapara, Ganjam, Balasore and Nayagarh districts. A total of 583 roads of the state (SH, MDR, ODR) and 1,977 rural roads were blocked due to uprooting of trees, electric poles and snapping of electric wires and cyclone debris.

Damages to road infrastructure caused by the cyclone was mainly due to high wind speeds leading to: (a) uprooting of lakhs of trees that blocked roads and damaged berms, drains, footpaths, medians, collapse of compound walls; (b) damaged road furniture such as signage gantries, traffic

signals, street lights, towers, poles, road signs, hoardings, etc.; (c) collapse of parapet walls at Puri Beach; and (d) damaged road embankments, causing breaches at some places. Associated rainfall damaged culverts at a few isolated locations, primarily owing to the lack of maintenance and adequate protection works.

8.3 Assessment of Disaster Impact

About 272 km of the NH were affected, and sustained damages, primarily to roadside infrastructure in terms of (a) uprooting of signage gantries and other signages; (b) minor damages to carriageway and berms; and (c) damage

Figure 8.1: Typical Damages to Roads caused by Fani

Tree uprooting and damages to berms

Sand accumulation on a coastal road

Road breaches

Culvert/embankment damages

Road signs/gantry dislodging on urban roads

Fallen gantry signs

to six culverts. This would require gantries and signs which are designed to withstand cyclonic wind speeds in Odisha, repair and maintenance of shoulders, carriageway and repair/replacement of culverts. A total damage of INR 6.92 crore (USD 0.98 million) has been reported. Based on field visits, it is assessed that this assessment is reasonable.

About 5,240 km of state roads (SH, MDR and ODR) were affected, which included: (a) damage to carriageway and berms due to falling of uprooted trees, towers, electric and other poles; (b) damaged embankment and breaches at some places; (c) uprooting/dislodging of gantries and traffic signs; and (d) damages to culverts at some places. Based on field visits and site assessments, a total damage of INR 131.47 crore (USD 18.78 million) has been assessed. State highways would require repairs of berms, surface, limited repair/replacement of cross drainage and protection works, and replacement of gantries/signs (Table 8.1).

Table 8.1: Damage Estimate for State Roads under Works Department

District	Road Length Affected (km)			Damage Estimate*	
	SH	MDR	ODR	Total (INR crore)	Total (USD million)
Angul	0.00	0.00	0.00	–	–
Balasore	50.69	62.58	214.21	**6.80**	**0.97**
Bhadrak	24.30	29.71	41.81	**2.16**	**0.31**
Cuttack	103.92	93.17	430.34	**19.42**	**2.77**
Dhenkanal	0.00	0.00	253.89	**4.48**	**0.64**
Ganjam	105.68	45.12	361.27	**10.91**	**1.56**
Jagatsinghpur	13.46	15.45	187.39	**6.31**	**0.90**
Jajpur	7.32	28.17	522.48	**10.35**	**1.48**
Kendrapara	30.16	22.45	259.55	**9.18**	**1.31**
Keonjhar	0.00	0.00	60.90	**1.08**	**0.15**
Khurda	33.69	206.71	746.33	**28.89**	**4.13**
Mayurbhanj	44.064	49.600	225.649	**6.47**	**0.92**
Nayagarh	44.666	66.410	290.011	**7.98**	**1.14**
Puri	71.38	115.83	382.35	**17.44**	**2.49**
Total	**529.319**	**735**	**3,976**	**131.47**	**18.78**

*Assumptions presented in sector assessment methodology (Section 8.6).
Source: Works Department, Government of Odisha, site assessments and discussions

A monetary loss of INR 12.27 crore (USD 1.75 million) was reported for clearing of obstructions to make the state highways roads operational.

About 6,251 km of rural roads were affected, which includes minor damages to carriageways and berms due to the uprooting of trees, towers, electric and other poles; breaches and damages to culverts at some places. Based on field visits and site visits, a damage of INR 107.51 crore (USD 15.36 million (Table 8.2) is assessed. Rural roads would require repairs of berms, surface, limited repair/replacement of cross drainage and protection works, and other minor works.

A monetary loss of INR 9.27 crore (USD 1.32 million) was reported for clearing of trees and debris in order to make the rural roads operational.

Table 8.2: Damage Estimate for Rural Roads under the Rural Development Department

District	Road Length Affected (km)	Damage Estimate*	
		Total (INR crore)	Total (USD million)
Angul	–	**0.002**	**0.000**
Balasore	368.41	**6.459**	**0.923**
Bhadrak	204.97	**3.626**	**0.518**
Cuttack	352.17	**6.358**	**0.908**
Dhenkanal	105.92	**1.860**	**0.266**
Ganjam	88.72	**1.562**	**0.223**
Jagatsinghpur	855.97	**12.555**	**1.794**
Jajpur	202.98	**3.711**	**0.530**
Kendrapara	397.20	**6.996**	**0.999**
Keonjhar	175.71	**3.078**	**0.440**
Khurda	320.21	**5.649**	**0.807**
Mayurbhanj	–	–	–
Nayagarh	84.95	**1.487**	**0.212**
Puri	3,094.09	**54.168**	**7.738**
Total	**6,251.281**	**107.51**	**15.358**

*Note: Assumptions presented in sector assessment methodology (Section 8.6)
Source: RDD-Government of Odisha, site assessment and discussions

Of 57 ULBs in 14 districts, 27 were affected, affecting about 750 km of roads and 291 km of drains. The damages included (a) damage to carriageways, footpaths and drains because of falling of uprooted trees, electric and other poles; (b) damages to culverts; and (c) uprooting/dislodging of gantries and traffic signs. Based on field visits and site assessments, a damage of INR 80.30 crore (USD 11.5 million) (Table 8.3) is assessed in the ULBs.

A total damage of INR 326.2 crore (USD 46.6 million) was assessed for NH, SH, MDR and ODR, Rural and ULB roads.

Table 8.3: Damage Estimate for Urban Roads under Housing and Urban Development Department

District	Total Nos. of ULBs/ (ULBs Affected)	Length of Drain Damaged (km)	Road Length Affected (km)	Damage Estimate*	
				Total (INR crore)	Total (USD million)
Angul	–	–	–	–	–
Balasore	4 (2)	0.23	0.52	**0.78**	**0.11**
Bhadrak	4 (0)	–	–	–	–
Cuttack	4 (3)	5.53	3.35	**9.62**	**1.37**
Dhenkanal	4 (2)	1.20	0.63	**1.85**	**0.26**
Ganjam	12 (5)	0.26	1.37	**1.65**	**0.24**
Jagatsinghpur	2 (1)	0.06	0.55	**0.62**	**0.09**
Jajpur	2 (2)	–	0.33	**0.33**	**0.05**
Kendrapara	2 (1)	–	0.05	**0.05**	**0.01**
Keonjhar	1 (1)	0.02	0.18	**0.20**	**0.03**
Khurda	5 (4)	15.04	47.52	**63.68**	**9.10**
Mayurbhanj	4 (1)	0.01	0.08	**0.09**	**0.01**
Nayagarh	5 (2)	0.05	–	**0.07**	**0.01**
Puri	4 (3)	0.58	0.71	**1.38**	**0.20**
Total	**53 (27)**	**22.98**	**55.28**	**80.30**	**11.47**

*Note: Assumptions presented in sector assessment methodology (Section 8.6). Includes costs of culvert, roadside furniture
Source: H&UDD-Government of Odisha, site assessment and discussions

8.4 Impact on Development Goals

A well-knit road network plays as a base of the infrastructure, growth and development of the state which increases the economic efficiency. During cyclone Fani, most of the major roads were restored for traffic within the first 24 hours. This included major highways and city roads. The balance roads, mostly the rural roads, were opened and traffic restored within 72 hours. Since road connectivity was restored very quickly and majority of truck and bus services restarted within first 24 hours, no additional economic loss is being calculated on account of loss of connectivity. As the state is vulnerable to various natural disasters, identification of a core climate resilient road network is recommended, which will withstand cyclone-related risks to road infrastructure and help in agile post-emergency rescue and relief operations.

8.5 Sector Recovery Needs and Broad Recovery Strategy for the Sector

8.5.1 Sector Recovery Needs

The sector recovery needs analysis was carried out for all 14 districts impacted by Fani under state highways (SH, MDR & ODRs), Rural roads and ULB roads, and is summarised in Tables 8.4, 8.5, and 8.6. The overall recovery need is estimated at INR 424.95 crore (USD 60.7 million). For the National Highways managed by the NH wing of the state, an additional need of INR 6.92 crore (USD 0.98) million has been assessed.

8.5.2 Short-Term Response

The Government of Odisha, using its own resources, has started immediate short-term repairs of pavements and cross drainage structures, clearance of debris and temporary protection works to restore access and keep the roads trafficable. The damages to roads are therefore recoverable in the short term. It is estimated that about INR 368.86 crore (USD 52.7 million)—Works Department: INR 124.24 crore (USD 17.7 million); RD: INR 101.6 crore (USD 14.5 million); H&UDD INR 143.02 crore (USD 20.4 million)—would be required for short term needs (0–12 months).

8.5.3 Recovery and Resilience Building Needs

In the medium term (12–36 month) INR 56.1 crore (USD 8.0 million) is needed for roads: Works Department: INR 21.74 crore (USD 3.1 million), RD: INR 17.78 crore (USD 2.5 million), H&UDD: INR16.58 crore (USD 2.4 million).

Table 8.4: Recovery Estimate for State Roads (SH, MDR, ODR) under Works Department

District	Recovery Needs (in INR crore, except where mentioned)				
	Short Term (0–12 Months)	Medium Term (12–36 Months)	Long Term (36–60 Months)	Total Cost	Total Cost in (USD million)
Angul	–	–	–	–	–
Balasore	6.42	1.12		**7.55**	**1.08**
Bhadrak	2.04	0.36		**2.40**	**0.34**
Cuttack	18.35	3.21		**21.56**	**3.08**
Dhenkanal	4.24	0.74		**4.98**	**0.71**
Ganjam	10.31	1.80		**12.11**	**1.73**
Jagatsinghpur	5.96	1.04		**7.00**	**1.00**
Jajpur	9.79	1.71		**11.50**	**1.64**
Kendrapara	8.68	1.52		**10.19**	**1.46**
Keonjhar	1.02	0.18		**1.20**	**0.17**
Khurda	27.30	4.78		**32.08**	**4.58**
Mayurbhanj	6.11	1.07		**7.18**	**1.03**
Nayagarh	7.54	1.32		**8.86**	**1.27**
Puri	16.48	2.88		**19.37**	**2.77**
Total	**124.24**	**21.74**	–	**145.98**	**20.85**

Source: Estimates

Table 8.5: Recovery Estimate for Rural Roads under Rural Development Department

District	Recovery Needs (in INR crore, except where mentioned)				
	Short Term (0–12 Months)	Medium Term (12–36 Months)	Long Term (36–60 Months)	Total Cost	Total Cost in (USD million)
Angul	0.00	0.00		**0.00**	**0.00**
Balasore	6.10	1.07		**7.17**	**1.02**
Bhadrak	3.43	0.60		**4.03**	**0.58**
Cuttack	6.01	1.05		**7.06**	**1.01**
Dhenkanal	1.76	0.31		**2.06**	**0.29**
Ganjam	1.48	0.26		**1.73**	**0.25**
Jagatsinghpur	11.86	2.08		**13.94**	**1.99**
Jajpur	3.51	0.61		**4.12**	**0.59**
Kendrapara	6.61	1.16		**7.77**	**1.11**
Keonjhar	2.91	0.51		**3.42**	**0.49**
Khurda	5.34	0.93		**6.27**	**0.90**
Mayurbhanj	–	–		–	–
Nayagarh	1.40	0.25		**1.65**	**0.24**
Puri	51.19	8.96		**60.15**	**69.10**
Total	**101.60**	**17.78**	–	**119.37**	77.57

Source: Estimates

Table 8.6: Recovery Estimate for Urban Roads under Housing and Urban Development Department

District	Recovery Needs (in INR crore, except where mentioned)				
	Short Term (0–12 Months)	Medium Term (12–36 Months)	Long Term (36–60 Months)	Total Cost	Total Cost in (USD million)
Angul	–	–		–	–
Balasore	1.37	0.16		**1.53**	**0.22**
Bhadrak	–	–		–	–
Cuttack	12.99	1.52		**14.51**	**2.07**
Dhenkanal	2.49	0.29		**2.78**	**0.40**
Ganjam	3.23	0.38		**3.60**	**0.51**
Jagatsinghpur	1.26	0.15		**1.41**	**0.20**
Jajpur	0.72	0.08		**0.81**	**0.12**
Kendrapara	0.10	0.01		**0.11**	**0.02**
Keonjhar	0.40	0.05		**0.45**	**0.06**
Khurda	118.06	13.67		**131.73**	**18.82**
Mayurbhanj	0.18	0.02		**0.21**	**0.03**
Nayagarh	0.07	0.01		**0.07**	**0.01**
Puri	2.16	0.25		**2.41**	**0.34**
Total	**143.02**	**16.58**	–	**159.60**	**22.80**

Source: Estimates

8.5.4 Recovery and Resilience Building Strategy

- OSDMA has done hazard mapping for the wind and cyclone zones of Odisha and has identified very high damage risk zones with wind velocities up to 50m/s (180 kmph). The observed wind speed during cyclones in Odisha has been higher. Therefore, the relevant codes for traffic signs, gantries, and other structures should be updated to incorporate higher wind design speeds. The State Works department may coordinate with relevant authorities for developing these specifications.
- In addition, a climate and disaster vulnerability assessment of the state road network should be undertaken to identify cyclone related risks to infrastructure i.e. high coastal wind speeds, post-cyclonic flooding events. Based on the assessment, a core climate resilient network can be identified, which will withstand cyclone-related risks to infrastructure and help in agile post-emergency rescue and relief operations.
- The Probable Maximum Precipitation (PMP) Atlas produced by the Central Water Commission (CWC) of India in 2015, provides a reasonable maximisation of event precipitation. This can be used for design inputs in the estimation of design floods for hydraulic/cross drainage (CD) structures and the need for protection works during recovery. A regional frequency approach in extreme rainfall analysis should be undertaken for determining PMP for the designing of various hydraulic/CD structures for high intensity cyclonic floods.
- Road tree plantation strategy to incorporate (a) Cyclone resistant species, (b) Configuration of the plantation to reduce wind speed or to have less damage; (c) Lateral stiffening of plantation blocks and (d) Pre-cyclone pruning to reduce the damages.
- Urban road resilience building should be targeted forcoastal cities against cyclone-related hazards/risks. It should incorporate climate-friendly road designs and construction with adequate storm water drainages and resilience against multi-hazards. Underground utilities and cyclone-resistance tree plantation and maintenance strategies should be adopted. A multi-sectoral approach is needed.
- Institutional capacity building of all relevant stakeholder departments towards road infrastructure climate resilience building is also needed.

8.6 Sector Assessment Methodology

The data on road and drain length, number of culverts damaged and breaches owing to the cyclone was collected from the respective departments. The assessment utilised a combination of qualitative and quantitative assessment tools for ascertaining the data and making rational assumptions for damage estimates. Field visits to the representative damaged roads in the districts of Puri, Khurda, Cuttack, Kendrapara and Jagatsinghpur was conducted from 25–27 May 2019 covering different categories of roads to assess extent of damage. This was followed by discussions with various state stakeholders to interpret the data and rationalise the damage estimate. The nature of damage from high speed cyclonic winds of Fani, was primarily uprooting of trees, falling of gantries, street lights, utility towers on account of which road surfaces and berms got damaged in rural areas (SH, MDR, ODR, RR), while urban roads were affected by damages to drains, medians, footpaths by fallen trees, uprooting of traffic signs and gantries. The road length damaged as reported by the department has been considered for damage estimates.

However, considering the rainfall intensity, the incidents of breaches and CD damages from flooding were limited and such incidents that might have happened during the recent cyclone were also not witnessed during the site visits. For all categories of road network, in the districts of Khurda and Cuttack, which witnessed a combined rainfall of over 150 mm on 3 and 4 May 2019, 50% of the reported damages to CD have been considered, while for the rest of the districts, 10% of the reported damages to CD structures were considered. The length of lined drains reported as damaged in urban roads have been considered.

For damage assessment, market rates were discussed with department engineers for various types of road works envisaged for recovery across different categories of roads i.e. replantation of road-side trees uprooted, routine pavement surface repairs, repairs of earthen shoulders/berms, reinstallation of gantries and traffic signs, lined drains, footpath and median repair works. For the different road categories, a judicious combination of all these items for roadworks was considered to work out the market rates per kilometre. The assumed market rates for roadworks used in damage estimates, discussed and agreed with the departments, was INR 3 lakh per km (SH), INR 2.3 lakh per km (MDR), INR 1.75 lakh per km (ODR and RR) and INR 9 lakh per km for urban roads. For CD works, a blended market rate per unit was used to estimate damage to protection works. For urban road drains, a market rate of INR 10 lakh per km was assumed. For the recovery estimate, 5% project monitoring and supervision cost has been added to the damage estimates and 5% cost towards resilience building, particularly in the context of tree plantation,

(overall strategy covering types of species, location and maintenance), improved foundation and structure design, specifications for gantries and other traffic signs has been added. For urban roads, resilience recovery estimates include upgraded urban design considerations i.e. replacing laterite stone masonry drains with Reinforced Cement Concrete (RCC) drains, strong foundations for gantry signs, traffic signs and signals for withstanding higher wind speed and better road-side replantation strategy and footpath designs. Thus, for recovery estimates of urban roads the per kilometre rates as provided by the Urban Development Department has been assumed.

9

Water, Sanitation, and Hygiene

9.1 Pre-Disaster Context

As per the reports of the Special Relief Commissioner (SRC), Government of Odisha, 13 districts in rural Odisha and 53 ULBs in urban Odisha were affected by the cyclone Fani. However, the Damage, Loss, and Needs Assessment (DLNA) was conducted for only seven rural districts and 17 ULBs.

This assessment, therefore, primarily looks into the pre- and post-cyclone Fani status of rural and urban water supply and sanitation systems in seven Fani-affected districts (Bhadrak, Cuttack, Jagatsinghpur, Jajpur, Kendrapara, Khurda, and Puri). While quantitative data sets are available for water supply and excreta disposal, WASH sub-sectors like solid waste management and drainage have not been considered in this assessment due to lack of available data. Only qualitative data through direct observations was available for hygiene-related issues.

Assessment of WASH facilities in institutions (schools, anganwadis and health facilities) are included in chapters on the education and the health and nutrition sectors. Urban and rural WASH data has been analysed separately, given the different nodal departments in charge.

9.1.1 Water Supply

As per census 2011, only 22% households had Drinking Water Facility (DWF) within the premises in Odisha, while 7.5 million households did not. Of the 22% households that did have DWF within the premises, 57% households were in urban areas, and 16% HHs in rural areas—a significant disparity between rural and urban, with regard to DWF within premises.

Rural Water Supply

The Panchayati Raj and Drinking Water Department's (PR&DWD), Rural Water Supply and Sanitation wing is the nodal department for rural water supply. As per PR&DW pre-cyclone data, there are 2,229 functional piped water schemes and 1,12,512 public tube wells supplying water to households and institutions in rural areas in the seven most-affected districts.

Most piped water schemes are largely dependent on electricity, only 567 schemes are operated through solar energy. The 989 piped water schemes in seven affected districts have Elevated Storage Reservoirs (ESR) with cumulative capacity of more than 84.3 million litres. The delivery points include 40,290 stand posts within the reach of households. Drinking water supply is through the ESRs, or in many cases it is directly pumped to the delivery points within habitations. Each village has one self-employed mechanic (SEM) or more as the functionary who ensures regular supply of drinking water to the village/ habitations, carries out water quality monitoring, sanitary survey, and the disinfection of handpumps.

Urban Water Supply

The Public Health and Engineering Organisation (PHEO) is the nodal agency for urban water supply in Odisha. Prior to cyclone Fani about 914.18 million litres per day (MLD) of drinking water (90% of total demand) was being supplied daily to 114 ULBs, benefiting an estimated population of 64.78 lakh. Of this population, about 25.52 lakh people benefited through 3,77,357 house connections and the remaining 39.26 lakh were served through 26,212 public stand posts. Besides, there are 31,881 handpumps/tube wells functional in different ULBs and Census Towns to cater to the water demand during non-supply hours and to the demands of the population residing in areas not covered by piped water supply systems.

9.1.2 Sanitation

Sanitation is categorised into provisions for household toilets and disposal of human excreta disposal, solid waste management, and drainage disposal.

Household Toilets (Rural)

As per census 2011, 85% of rural Odisha practices open defecation. Till 2016–17, the rural sanitation coverage in Odisha was pegged at 45.06%.[1] However under the Swachh Bharat Mission, a rigour and commitment shown by the state officials ensured that the rural sanitation coverage extended to 87.21%, reaching out to 67,38,000 households[2] by April 2019. The most promoted toilet technology in rural areas is the leach pit toilet, and a draft report from the PR&DWD shows only 0.54% toilets have septic tank technology. While leach pit is a preferred option in areas with a high-water table and prone to water-logging, there are no existing mechanisms yet for faecal sludge management for emptying leach pits or septic tanks.

Household Toilets (Urban)

In all, 114 ULBs were declared as Open Defecation Free (ODF) by March 2019 in Odisha. The progress of providing sanitation access to urban households and communities has been very impressive, thereby benefitting a population of 6.62 lakh.

Sewerage Management in Urban Areas

Odisha Water Supply and Sewerage Board (OWS&SB) is the nodal agency in the state to implement the projects related to urban sewerage. There are only four Sewerage Treatment Plants (STPs) in Odisha, located in Puri, Bhubaneswar, Cuttack and Berhampur. Of these four STPs, three (in Puri, Bhubaneswar and Cuttack respectively) have been severely affected by the cyclone. These three STPs served 51,973 households and a population of 2.07 lakh.

9.1.3 Hygiene

Odisha has been carrying out various Social and Behaviour Change Communication (SBCC) initiatives as part of the ongoing rural WASH programmes to ensure safe hygiene practices. Prior to cyclone Fani, efforts focused on promoting hygiene practices in communities, schools, anganwadi centres and healthcare facilities. According to the *Rapid Survey on Children* (RSOC) *2013–14*, though 93% households had a designated place for washing hands, only 59% also had water available right there (and not elsewhere on the premises) to do so, and only 47% had soap, detergent, ash or mud/sand at the hand-washing facility. Due to lack of data, the DLNA does not cover hygiene.

9.2 Disaster Preparedness in the WASH Sector

The Odisha State Disaster Management Authority (OSDMA) has focused on development of thematic sectoral SOPs and contingency plans for emergency preparedness.

For rural areas, the PR&DWD had issued advisories as a part of the preparedness strategy to ensure storage of adequate water and bleaching powder, and diesel generator sets for pumping drinking water to habitations where water supply schemes could become partially or fully non-functional due to power-cuts during and after a cyclone. As a result:

- Provisions for water supply were checked and arranged for all cyclone shelters.
- Functionality of all piped water supply schemes and tube wells was verified by the monitoring team. Block-level procurement committees were formed in advance, for procurement of an adequate amount of spare parts.
- Preparatory arrangements for tanker mobilisation to water-scarce pockets were made.
- Mobile water treatment units (including capacity to produce water pouches) were made ready for deployment.
- Around 600 overhead tanks were filled before the cyclone in seven districts (Puri, Khurda, Kendrapara, Jagatsinghpur, Cuttack, Bhadrak and Jajpur).

For urban areas, the Housing & Urban Development Department (H&UDD) prepared for cyclone Fani based on earlier cyclone/ flood events (Phailin, Hudhud and Titli). Preparation included the following:

- Readying 24x7 control rooms at district- and ULB-level for coordinating with staff, deployment of tankers and supplies, and receiving complaints. Generators for power back-up were arranged.
- Mapping was undertaken, and water tankers reserved for deployment, as were truck-mounted generators/ trolley-mounted generators /mobile generators etc.
- Circulars were issued to staff/ officers not to leave the headquarters, and nodal officers were appointed in different ULBs.
- Adequate chemicals were stored for regular disinfection of submerged areas and water sources.

9.3 Post Disaster Effects: Damages and Losses

9.3.1 Damage to Infrastructure and Physical Assets

Water Supply (Rural)

Cyclone Fani affected about 49% (1,088) of total 2,229 piped water schemes and almost 10 million (1 crore people) in the rural areas of the seven assessed districts. Damage to infrastructure was mainly caused by uprooted trees falling on pump houses, panels or compound walls and (mainly) bringing down the low-tension substation and transformers within or nearby the premises. Disruption of power supply led to piped water systems becoming non-functional. Many handpumps[3], were partially damaged, mostly due to falling

trees. The damage to rural water supply infrastructure in the seven districts is estimated at about INR 39.32 crore (USD 56.17 million).

Water Supply (Urban)

The cyclone caused much damage to water supply schemes in different ULBs, with 337 urban water systems being affected. The damage was predominantly to peripheral structures such as boundary walls. In addition, disruption of power supply resulted in shut down of piped water systems, requiring quick repairs and alternative water supply until power was restored. Temporary power supply took two to three days to get fully stabilised and urban water supply suffered during that period. Water supply was ensured through tankers in a staggered approach, prioritising the most vulnerable populations. Damage to urban water supply infrastructure in 17 ULBs is estimated at about INR 89.41 crore (USD 12.88 million).

Household Toilets (Rural)

Damage to individual household toilets has been assessed only in three districts (Bhadrak, Khurda and Puri), out of the seven districts where the DLNA was conducted. Figures indicate that about 18.9% of the total 5,34,125 assessed toilets were partially damaged and 1.4% completely damaged. Damage was greater in Puri, where 36.43% of the total toilets were partially damaged and 2.79% completely damaged.

Partial damage indicates damage to roof and doors, and recovery cost is estimated at INR 50.46 crore; total or complete damage refers to destruction of the entire superstructure along with damage to the pits, due to falling trees etc., with recovery cost estimated at INR 9.34 crore.

Household Toilets (Urban)

Some houses have toilets within the premises, while some house the toilet in a separate block. Toilets were found to have been totally damaged (along with the house), or partially damaged. Damage was assessed based on the DLNA report of the housing sector, which describes houses that are completely damaged. It is inferred that toilets of these houses are also damaged. The cost of the damage is extrapolated from the rationale that building an urban house, supported by the government (PMAY-U), costs INR 2 lakh for 30 sq m of plinth area, with approximately 2.71 sq m of toilet area. Accordingly, a toilet in the destroyed house would cost approximately INR 16,000.

The repairs and recovery needs for both rural and urban toilets are covered in the chapter on the housing sector in this DLNA report. The data above is included to emphasise that household latrines have been damaged and should be considered as a priority in reconstruction efforts by the housing sector.

Sewerage Systems (Urban)

Even though sewers were choked by debris, access to latrines was not compromised as the debris was cleared from pits/sewer lines within two to three days. About 51,973 households are connected to the sewage treatment plants (STPs) located in the three cities namely Puri, Bhubaneswar and Cuttack. Puri STP suffered severe damage to its sludge drying sheds. No major damage was reported to piped sewage treatment systems. The other two STPs (at Cuttack and Bhubaneswar respectively) also suffered damage to pumping stations and adjoining office buildings. Damage to the STPs in the three cities is estimated at about INR 5 crore (USD 0.72 million).

9.3.2 Losses Due to Disruption of Access to Goods and Services

Water Supply (Rural)

The Rural Water Supply and Sanitation (RWSS) divisions and sub-divisions under PR&DWD undertook prompt measures to ensure supply of drinking water to affected habitations and displaced population, and to restore water supply soon after the cyclone. The measures included:

- Ensuring 100% staff presence at headquarters
- Pooling emergency-response-experienced personnel from nearby districts
- Mobilising diesel generator sets; 264 such sets of varied capacities (10 KVA to 82.5 KVA) were deployed in all
- Requisitioning TATA Hi Ace vehicles as water tankers for transportation of water
- Procuring high-density polyethylene (HDPE) water storage tanks of 1000 and 2000 litre capacity, for mounting on vehicles
- Distributing drinking water pouches
- Stationing 11 Mobile Water Treatment Plants (WTPs) at specific locations in Puri district; local WTPs mobilised, and others solicited from neighbouring states
- Mobilising mobile maintenance teams comprising SEMs and plumbers under guidance of Junior Engineers and armed with spares and supplies; 55 teams from 11 district RWSS' were deployed for disinfection of all sources in Puri district, including 13,555 spot sources

The losses have been calculated based on the measures mentioned above taken to restore and ensure rural water supply. Considering variability in power restoration within different districts, emergency water provision measures might remain in place until the end of June 2019.

Gradual reduction in recurring costs is expected in Puri, as power is being restored incrementally. Therefore, based on estimates by different RWSS', cumulative expenditure for continuation of water supply has been calculated. The total losses for a period of 1.5 months (until mid-June) were estimated by the RWSS at INR 100.43 crore or USD 14.35 million. The power cost estimates for Puri might go higher, as power restoration may continue until June end.

Water Supply and Sewerage Network (Urban)

Losses to the sector are due to higher operating costs than normal. As in rural areas, power generators were mobilised to operate pumping stations where possible; elsewhere, water tankers were deployed until water supply systems were operational again. Losses estimated by H&UDD stood at INR 25.64 crore (USD 3.69 million) and were derived from emergency purchase of generators, hiring water trucks, and paying staff labour charges.

Sewer pipelines were blocked with debris and sand. The OWS&SB incurred losses worth INR 3.01 crore (USD 0.43 million) in cleaning sewer pipelines, debris from manholes, hiring labourers, and hiring generators for pumping stations etc.

9.3.3 Estimates of Damage and Loss

Table 9.1: Damage to WASH Infrastructure (Rural and Urban)

Sector / Components	Bhadrak	Cuttack	Jagatsinghpur	Jajapur	Kendrapara	Khurda	Puri	Total
Rural WASH								
No. of piped water schemes affected	29	381	55	29	54	252	288	**1,088**
Restoration cost of piped water schemes (INR crore)	0.43	10.11	1.48	0.48	1.92	7.59	12.12	**34.13**
Tubewell damage repairing cost (INR crore)	0	0.2	0.15	0	0.19	0.53	0	**1.07**
Restoration cost of solar piped water scheme (INR crore)	0.04	0	0	0.07	0	0.04	0	**0.15**
Office building repairing cost (INR crore)	0	0.34	0.22	0	0	0.69	2.7	**3.95**
No. of partially damaged toilets (individual household latrine [IHHL])	60					2,187	98,679	**1,00,926**
Repair cost of partially damaged toilets @ INR 5,000/ toilet; (INR crore)	0.03					1.09	49.34	**50.46**
No. of completely damaged toilets (IHHL)	4					197	7557	**7758**
Repair cost of completely damaged toilets	0.05					0.23	9.06	**9.34**
Rural sub-total damage cost (INR crore)	0.55	10.65	1.85	0.55	2.11	10.17	73.16	**99.04**
Rural sub-total damage cost (USD million)	0.08	1.52	0.26	0.78	0.3	1.47	10.56	**14.3**
Urban WASH								
No. of water treatment plants affected					1	3	1	**5**
No. of house connections damaged		173	60			5,800	723	**6,756**
No. of handpumps affected		80				44	237	**361**

No. of household toilets damaged		1,228	166		18	6,158	68,516	**76,086**
Restoration cost of piped water schemes (INR crore)		9.44	0.49		1.87	32.96	44.65	**89.41**
Sewerage restoration cost (INR crore)		1.99	0		0	0.5	2.51	**5**
Sanitation – household toilets (INR crore)		1.12	0.16		0.2	5.52	66.06	**73.06**
Urban sub-total cost (INR crore)		12.55	0.65		2.07	38.98	113.22	**167.47**
Urban sub-total cost (in USD million)		1.81	0.09		0.02	5.62	16.34	**24.18**
Grand total (Rural+Urban) (INR crore)	**0.55**	**23.2**	**2.5**	**0.55**	**4.18**	**49.15**	**186.38**	**266.51**
Grand total (Rural+Urban) (USD million)	**0.08**	**3.33**	**0.35**	**0.78**	**0.32**	**7.09**	**26.9**	**38.48**

Notes: Household toilet damage cost for rural and urban areas is not included in the total cost estimate for the WASH chapter, and instead is included in the housing sector.
Household toilet damage is calculated based on the housing estimate of INR 2 lakh, with a toilet space of 2.71 sq m, by the Pradhan Mantri Awas Yojana-Urban (PMAY-U).

Table 9.2: Losses–Water and Sanitation (Rural and Urban)

Sector / Components	Bhadrak	Cuttack	Jagatsinghpur	Jajapur	Kendrapara	Khurda	Puri	Total
Rural WASH								
Piped water scheme losses (INR crore)	4.18	12.55	12.55	8.36	8.36	12.55	41.84	100.39
Total cost (INR crore)	**4.18**	**12.55**	**12.55**	**8.36**	**8.36**	**12.55**	**41.84**	**100.39**
Total cost (USD million)	**0.6**	**1.79**	**1.79**	**1.2**	**1.2**	**1.79**	**5.97**	**14.34**
Urban WASH								
Piped water scheme losses (INR crore)		5.89	0.16		0.14	12.25	7.2	25.64
Sewerage losses (INR crore)		0.41				1.8	0.8	3.01
Total cost (INR crore)		**6.3**	**0.16**	**0**	**0.14**	**14.05**	**8**	**28.65**
Total cost (USD million)		**0.9**	**0.023**		**0.02**	**2.02**	**1.15**	**4.13**

9.4 Impact on Sector Development Goals, including Potential Social Impact

Odisha has witnessed major cyclones like Phailin, Hudhud, Titli, and most recently Fani, in the last four years. The damages tend to set back the development gains made over the period, including household toilets built under the government flagships and efforts to provide improved drinking water supply.

While some districts indicated compilation and dissemination of SOPs prior to the event, these did not result in a full-fledged contingency plan with delineated responsibilities, authorisation for expenditure, long-term agreements with suppliers for stocking and delivering essential supplies etc. Lack of capacities for detailed risk assessment may have led to limited prepositioning of staff, materials and equipment necessary for a rapid response.

Districts were affected moderately or severely, with Puri being the worst affected district. In some cases, water supply could be restored to pre-cyclone levels quickly, while in others this took time and water supply was severely hindered for the initial two to three days. The

disruption of water and sanitation services impacted livelihoods and disrupted production and tourism activities, particularly in Puri. It also impacted the habits and consumption patterns of the affected population in different ways.

Damage to latrines and septic tanks may induce households to switch back to unsafe sanitation options and open defecation at least for a considerable time till repairs are taken up. Presence of leach pit toilets in the low-lying flood-prone and/or coastal areas, as well as lack of faecal sludge management options at block level, further aggravate the risk of pathogen contamination and waterborne diseases, given that monsoons are around the corner.

Restoring access to water supply and sanitation services is critical to reduce public health and safety risks, particularly for women and girls. Damage to household toilets and relative shortage of, or lack of access to, essential personal hygiene supplies such as soap and menstrual absorbents, would mean a compromise on space and dignity in terms of menstrual hygiene management for women and adolescent girls. Women and girls also spent more time fetching clean water, especially in the days immediately following the cyclone.

Water quality was temporarily affected. Tube wells were disinfected by the RWSS Division and mobile water treatment units deployed to ensure safe drinking water up to the extent possible. Private wells were disinfected by the frontline Health and Family Welfare functionaries. No significant WASH-related diseases were reported after the cyclone.

Solid waste was piling up in the streets due to challenges in collecting waste due to blocked roads, and other priorities for the sanitation workers. Debris caused by the cyclone was blocking sewage systems and polluting ponds that could have potentially been used as back-up water sources (in case of failing piped water schemes). This resulted in unsafe practices such as burning of uncollected solid waste and debris.

Environmental damage and degradation associated with the cyclone can further result in compromising water safety in the rural areas. The increased turbidity and darkened colour of water bodies, as well as their odour, indicates a rise in levels of microbial contaminants due to excess sewage in surface water as well as due to uprooted trees and cadavers floating in these water bodies.

The worst impact was offset by a substantial response that restored water supply services as quickly as possible. Still, in urban areas not covered by piped water schemes, residents incurred huge costs in hiring generators and tankers to access drinking water.

9.5 Sector Recovery Needs and Broad Recovery Strategy

Recovery needs were assessed in consultation with PR&DWD, H&UDD and OWS&SB. The strategy for rural and urban WASH is aligned with the development vision adopted by the Government of Odisha, which builds upon existing systems and mechanisms and enables the strengthening of community ownership and sustainability. The strategy also integrates preparedness and resilience components, ensuring BBB is built into rural WASH systems and facilities. The strategy and activities are broadly categorised as short-, medium- and long-term (designed for periods of less than one year, one to three years and up to five years, respectively).

9.5.1 Recovery in the Short Term (within one year)

This phase includes lifesaving activities and restoring access to services to those previously reached. Both nodal departments have skilled technical teams to monitor and undertake repairs and reconstruction of the piped water supply systems. Capacity expansion for better emergency response and preparedness activities is also being considered in this phase, with real-time training of technical teams, village functionaries and RWSS, PHEO, OWSSB, and ULB personnel.

9.5.2 Recovery in the Medium Term (one to three years)

This phase focuses on most critical recovery activities, which will include resilience and BBB concepts, such as promoting resilient toilet design (to withstand wind and flood) and ESRs/ water supply structures. Risk-informed and resilient planning for widening WASH service delivery will also be integrated in regular development works.

9.5.3 Recovery in the Long Term (up to five years)

This phase will focus on the expansion of WASH services to new areas, including hitherto not covered population in 20 saline affected blocks (estimated 0.3 crore population @ INR 10,000 per capita) with piped water supply.

The investment, INR 3,350 crore (USD 478.5 million), needs to be implemented through: regular development programming, solar powered spot sources fitted with IRP/ RO (INR 0.06 crore for 1,677 spot sources, amounting to INR 2,004 crore or USD 286.2 million) as per requirement, with provision of storage tankers promotion of community ownership and management of assets, and strengthening governance and preparedness capacity at local and district level WASH institutions. This also includes setting up a system for Faecal Sludge Management in rural areas.

Planning for further long-term recovery activities should start immediately to ensure sustainable capacity development and strengthening of systems, as actual implementation will take several years. Alternative power supply for resilient piped water systems, with pre-positioning of diesel generators and WTPs at block level, are other measures to improve preparedness and reduce risks.

9.5.4 Total Recovery and Reconstruction Cost for Rural WASH Sector

The total recovery and reconstruction cost for the rural WASH sector for the first year (short-term) is estimated at INR 135.02 crore, (USD 19.45 million) with a focus on the water supply sub-sector. Recovery estimations over subsequent phases (mid and long term), will cost INR 321.13 crore (USD 46.26 million) and INR 141.46 crore (USD 20.38 million), respectively. Overall recovery costs are estimated at about INR 599.65 crore (USD 86.39 million).

9.5.5 Total Recovery and Reconstruction Cost for Urban WASH Sector

For urban WASH, approximately INR 218.96 crore (USD 31.2 million) will be needed to fully restore the water supply infrastructure and resume full service delivery at an improved standard and quality.

The estimated cost for short-, medium- and long-term reconstruction and recovery for Urban WASH are INR 132.66 crore, (USD 19.11 million), INR 16.3 crore (USD 2.34 million) and INR 70 crore (USD 10.08 million) respectively. The total WASH recovery needs are INR 819 or USD 117m.

The future development and augmentation of the rural and urban WASH systems should be based on comprehensive multi-hazard risk analysis, with particular focus on cyclones and floods to which Odisha is very susceptible. Needs assessment should take into account the following: (i) restoring service to pre-cyclone conditions; and (ii) upgrading reconstruction to address future similar events. Reconstruction needs for damaged water supply and sanitation systems are summarised in Table 9.3 below. Reconstruction needs facing the water supply and sanitation sector are also estimated below.

9.6 Key Policy Recommendations

- Restoration of power at the water points/ pumping stations must be prioritised. This should be accompanied by repair of damage to piped water systems. As a second step, appropriately safeguarded solar installations, able to withstand high wind speeds, should be constructed for pumping stations to reduce dependence on electricity or diesel power.
- Adequate quantity of safe drinking water should be provided to households and shelters as per the need in emergency. As a solution, production wells of piped water systems can be fitted with online chlorinators, to avoid manual errors in disinfection. Besides new ESRs will be constructed as part of disaster preparedness.
- Contingency plans following existing SOPs must be finalised at ULB and block level, through training and skill development of block- and district-level functionaries, with appropriate arrangements for prepositioning of materials, supplies and staff. This should cover:
    - Availability of at least one diesel generator set, one portable water testing kit (with consumables) at Junior Engineer level
    - Availability of at least one mobile water treatment unit and water treatment chemicals at Sub Division Office (SDO) level (this will remove the need to solicit water treatment units from nearby states).
    - Pre-positioning of spares and supplies for solar installations, along with the usual handpump, pipe network and pump spares at sub-division level.
    - Longer term agreements with suppliers for storage and supply of basic non-perishable hygiene items including menstrual absorbents, following minimum standards in emergencies. This is to ensure access to personal hygiene and dignity items for women and adolescent girls during the emergency.
    - Develop and formalise a surge roster to mobilise additional technical staff from nearby (non-affected) districts, including drivers, technicians, SEMs.
- Capacity building of SEMs to carry out emergency repairs to be undertaken at regular intervals. SEMs should be equipped with the necessary tools to carry out operation and maintenance of piped water systems, handpumps and tube wells.
- Capacity building of frontline functionaries on hygiene promotion during emergencies, must be undertaken.
- Inter-departmental and inter-sectoral coordination should be ensured at the district level and should be acted upon under the guidance of District Magistrate. This should include:
    - Coordination with health: regular analysis of line lists to detect spike in diarrhoeal diseases, this should inform increased water quality monitoring

Table 9.3: Recovery Cost Estimates for Rural and Urban WASH efforts

	Components	Bhadrak		Cuttack		Jagatsinghpur		Jajpur		Kendrapara		Khurda		Puri		Total		Grand Total	
		R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	INR crore	USD million
Short-Term Recovery	Recurring costs-Losses (as reported and estimated by state government)	4.18	0	12.55	6.3	12.55	0.16	8.36	0	8.36	0.14	12.55	14.05	41.84	8	**100.43**	**28.65**	**129.08**	**18.44**
	Real-time training of technical teams and village functionaries and RWSS, PHEO, OWSSB, ULBs personnel on emergency preparedness and response (@ INR 60,000 per block /ULB)	0.05		0.09	3.1	0.05	0.5	0.08		0.06	1.5	0.05	2.5	0.07	2	**0.45**	**9.6**	**10.05**	**1.44**
	Repairing damages to piped water schemes (as reported and estimated by state government)	0.43	0	10.11	9.44	1.48	0.49	0.48	0	1.92	1.87	7.59	32.96	12.12	44.65	**34.14**	**89.41**	**123.55**	**17.65**
	Repairing damages to sewage systems (as reported and estimated by state government)	0	0	0	1.99		0		0		0		0.5		2.51		**5**	**5**	**0.71**
	Sub-Total	**4.66**	**0**	**22.75**	**20.83**	**14.08**	**1.15**	**8.92**	**0**	**10.34**	**3.51**	**20.19**	**50.01**	**54.03**	**57.16**	**135.02**	**132.66**	**267.68**	**38.24**
Mid-Term Recovery	Constructing new ESRs, online chlorinator (estimated @ INR 0.24 crore per ESR)	33.25	0	88.75		27		56.5		34.25		31.25		39		**310**	**0**	**310**	**44.29**
	Desludging equipment (estimated @ INR 0.06 crore per block for rural and INR 0.27 crore per ULB in urban)	1.05	0	0	1.5	0	0	0	0	0	0	1.5	1.5	1.65	1.5	**4.2**	**4.5**	**8.7**	**1.24**
	Awareness generation of PRI functionaries, community leaders on preparedness and O&M of assets (estimated @ INR 0.012 crore per block [rural] and INR 0.7 crore per ULB [urban])	0.05	0	0.09	3.7	0.1	0.5	0.147	0	0.12	1.5	0.098	3.1	0.127	2.7	**0.881**	**11.8**	**12.681**	**1.82**
	Capacity building of technical staff at different levels on risk assessment and planning, DRR, emergency preparedness, response planning contingency planning etc. (estimated @ INR 0.002 crore per block [rural])	0.01	0	0.021	0	0.012	0	0.015	0	0.0135	0	0.015	0	0.02	0	**0.1**	**0**	**0.1**	**0.01**
	Procurement and pre-positioning of diesel generator sets, water treatment plants (estimated @ INR 0.84 crore per district [rural])	0.65	0	0.9	0	0.7	0	0.8	0	0.75	0	0.8	0	1.35	0	**5.95**	**0**	**5.95**	**0.85**
	Sub-Total	**35.01**	**0**	**89.761**	**5.2**	**27.812**	**0.5**	**57.5**	**0**	**35.13**	**1.5**	**33.66**	**4.6**	**42.15**	**4.2**	**321.13**	**16.3**	**337.43**	**48.21**

	Components	Bhadrak		Cuttack		Jagatsinghpur		Jajpur		Kendrapara		Khurda		Puri		Total		Grand Total	
		R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	INR crore	USD million
Long-Term Recovery	DEWATS Pilots (estimated @ INR 0.05 crore per block [rural])	0.87	0	0	0	0	0	0	0	0	0	1.25	0	1.37	0	**3.5**	**0**	**3.5**	**0.5**
	Planning and implementation of solid and liquid waste management options, including sewage recycling (including stormwater drainage in slums), (estimated @ INR 0.004 crore per Gram Panchayat [rural], and @ INR 2.4 crore per ULB [urban])	1.75	0	0	10	0	5	0	0	0	5	2.5	10	2.75	10	**7**	**40**	**47**	**6.71**
	Solarisation of piped water schemes (estimated @ INR 0.073 crore per unsolarised piped water scheme [rural], and @ INR 1.8 crore per ULB [urban])	8.48		39.76	10	13.28		5.68		20.48		30.42	10	18.16	10	**132.96**	**30**	**162.96**	**23.28**
	Sub-Total	**11.1**	**0**	**39.76**	**20**	**13.28**	**5**	**5.68**	**0**	**20.48**	**5**	**34.17**	**20**	**22.28**	**20**	**143.46**	**70**	**213.46**	**30.49**
	Grand Total	**50.77**	**0.00**	**152.27**	**46.03**	**55.17**	**6.65**	**72.06**	**0.00**	**65.95**	**10.01**	**88.02**	**74.61**	**118.46**	**81.36**	**599.61**	**218.96**	**818.57**	**116.94**

and treatment along with key hygiene promotion messages.
    - Coordination with housing: reconstruction, repair and retrofitting of toilets, which include resilience measures, should be coordinated closely with the housing sector.
    - Coordination with education and health: assessment of WASH in institutions (schools, anganwadis, health centres) should be jointly assessed and recovery needs prioritised, to prevent: (i) students from dropping out of school; and (ii) increase in infections in hospitals.
    - Coordination with shelter: Assessment of shelter damages must include adequate repair of water supply, toilets and retrofitting of septic tanks or leach pits so as to avoid contamination of ground and surface water sources.
    - Coordination with water resources: Cleaning, disinfection and maintenance of village ponds should be taken up jointly to ensure that the ponds serve as emergency water sources and not turn into waste dumping areas.
- The nodal WASH departments (rural and urban) should assess the Human Resource requirement against the overall standard of the Department and recruit accordingly. Skill gaps exist among engineers, field functionaries and agencies on Disaster Risk Reduction (DRR). Hence, it is proposed to undertake skill building of all officers and field functionaries on DRR.
- Two ESRs collapsed in Puri, which implies that these were not designed to withstand severe wind speeds. Design specifications for ESRs should be reviewed and should be informed by future hazards (floods, cyclones, etc). Future construction of ESRs should follow these revised standards and this should be reinforced.
- Establishment of off-site, decentralised grey and black water treatment must be promoted in flood prone areas, supporting construction of toilets with raised pits and platforms. Decentralised solid waste management systems should be taken up through public-private partnership leading to resource reuse and recovery as elements of income generation for the rural poor embedded within.
- The H&UDD has initiated the Odisha Liveable Habitat Mission to transform slums to liveable habitats by upgrading slums with components of water supply, drainage, sanitation and solid waste management, among a host of other infrastructure and capacity building components. This programme should ensure appropriate resilience measures so that the WASH services will continue during a future disaster.

9.7 Sector Assessment Methodology

- The DLNA WASH team consisted of officials from PR&DWD, H&UDD and OWS&SB, the UNICEF WASH team, and consultants.
- Quantitative data used for this assessment was collected by the Project Monitoring Unit (PMU) of RWSS in Bhubaneswar and PHEO. Qualitative data was generated through district- and block-level meetings, key informant interviews, group discussions and informal talks with civil service organisations (CSOs) during the field visits. Transect walk and observations helped in corroborating and grossly validating the data sets.
- Estimations provided by the RWSS Division and H&UDD were checked and edited as required. It was assumed that the emergency response operations (incurring daily losses) would continue until end of June 2019. Cost estimates for losses were accordingly extrapolated to cover this period.
- The assessment was carried out in the immediate weeks following the cyclone. Some cost estimates are not yet finalised, and costs for damages and losses and recovery needs may change after the finalisation of the report.

Notes

[1] *Annual Report 2017–18*, Ministry of Drinking Water and Sanitation, Government of India.

[2] https://sbm.gov.in/sbmreport/report/physical/sbm_TargetVsAchievementWithout1314.aspx

[3] The number of handpumps damaged, is yet to be quantified.

10

Public Buildings

10.1 Pre-Disaster Context

Public buildings, irrespective of the line departments they serve, fall largely under the purview, care and maintenance of the following departments: Works; Panchayati Raj and Drinking Water; Rural Works; and Housing and Urban Development.

Public buildings in the affected districts, including urban and rural areas are of two types: (i) framed and load-bearing buildings with RCC slabs (and are described as 'RCC roof building'); and (ii) older masonry buildings with AC roofs (described as 'AC sheet roof building').

In most cases both building types were found to occupy the same compound/ campus and were not in a good state of maintenance, especially the 'AC sheet roof buildings'. The 'AC sheet roof buildings' were in regular or partial use, being used for storage or for other broadly similar ancillary-/ secondary-use purposes.

10.2 Post-Disaster Context

Cyclone Fani damaged many public buildings, disrupting the routine functioning of these facilities. While very few were rendered non-functional, most were partially damaged, and their equipment destroyed. In all 6,441 public buildings were partially or completely damaged, with the cost of damage estimated at about INR 540 crore (USD 77 million), as per data compiled by the Government of Odisha. The damage to public buildings is categorised and shown in Table 10.1.

Based on field work in the five worst affected districts, and on discussions with the concerned line departments, the following district-wise conclusions were reached: nearly 100% public buildings were affected in Puri; close to 50% were affected in Khurda and Cuttack; and about 25% were affected in Kendrapara and Jagatsinghpur.

Public buildings suffered both structural and non-structural damage, and damage of the following types was seen:

- Main damage suffered by buildings with sloping roofs due to AC roofing sheets (including a marginal number of galvanised iron sheets) flying off, and displacement and damage to the supporting structure of rafters and purlins
- Damage to doors/windows/shutters; damage at joints where shutters were affixed to the frames and where frames were attached to the wall, and damage to the frame itself
- Damage to equipment, furniture and false ceilings caused by entry of high-speed winds through open roofs and through damaged doors and windows
- Severe damage to PVC overhead water tanks and associated plumbing infrastructure such as uptake and down-take pipes, and to other external exposed plumbing which was broken, displaced and became non-functional
- Uniform damage to air-conditioning units, antennas, other external light fittings, wiring and associated infrastructure in all affected buildings
- Extensive direct damage to masonry compound walls due to high winds and falling trees
- Damage to trees, an integral and essential part of building compounds, in varying magnitude: many had completely toppled over, others had damage to branches, or partial tilting, some remained barely touched

Public buildings are critical for the functioning of the State. They play an important role in providing essential services to the population, are vital to the continuous delivery of services to local communities, including the more marginalised groups, and play an important role in increasing economic growth and productivity. Therefore, damage to the buildings and to the equipment and materials therein, impaired service delivery and the functioning of the government.

Cyclone Fani made landfall in a period well before the annual cyclone season and would have thus posed challenges to preparedness. Nevertheless, key gaps in preparedness related to infrastructure and related services rendered public buildings vulnerable to the cyclone. The most important of these gaps were:

- Nature of the building stock

- Inadequate maintenance
- Inadequate adherence to code requirements, especially when it came to the details
- Absence of a workable disaster contingency plan
- Inadequate preparation through mock-drills and other similar simulation exercises

Cyclone Fani and its aftermath also highlights the need for gender and disability inclusive buildings, facilities, and assets—for instance, ensuring separate toilets for female staff and visitors in government buildings and integrating disabled-friendly access features. The recovery process thus presents an opportunity to redress such inequalities. This may be done through allocation of financial and human resources, and by ensuring that the specific needs of women, the disabled, the elderly and other disadvantaged groups are identified and addressed in a coordinated and comprehensive manner. The capacity of the Government of Odisha needs to be strengthened to better address the inclusion of women, youth, historically marginalised communities and vulnerable groups in decision making, especially those adversely affected by the cyclone.

In terms of environmental concerns, a significant amount of the building debris can be safely collected, cleaned, stacked and put back to use. Debris that cannot be reused must be safely removed in an environmentally friendly manner and stacked in a dedicated landfill. In absence of the above, the debris will:

- Choke waterways, ponds, tanks and drains
- Render soil infertile
- Pollute the environment

As noted earlier, a large number of trees were also badly damaged. Trees, in public building compounds serve as public assets providing shade, maintaining bearable temperature and moisture levels, shielding buildings and visitors from the elements, bearing fruit and providing a number of other eco-system services.

Some initial analysis has shown which native tree species fared better in the cyclone and how, with some minor treatment, a large number of partly damaged trees can be safely revived. Replanting using these native species and the appropriate treatment of partially damaged trees to ensure their safe revival should be taken up for disaster-resilient public building compounds.

Many public buildings are used as evacuation shelters during cyclones and other disasters. This calls for laying out standardised evacuation procedures for people to get those public buildings that also serve as evacuation shelters.

For disaster risk reduction going forward, the following need to be prioritised:

- Physical resilience of public buildings
- Their accessibility to ensure speed and inclusivity of evacuation
- Timely delivery of goods and services

Finally, when evacuation is prolonged for people who have experienced substantial damages to housing, the medium- to long-term needs of these populations, particularly with regard to education and human development, should be identified and addressed in future disaster planning processes.

10.3 Estimates of Damage and Loss

The following damage estimates are based on data provided by the concerned departments of the Government of Odisha. (please refer to Annexes A10.1 to A10.5 for more information).

Based on site observations, discussions with department engineers, data provided by respective divisions of the Works Department and some assumptions, the damage break-up numbers for 'RCC roof' (load-bearing or framed structure with RCC roof) and 'AC sheet roof' (load-bearing or framed structure with AC sheet roof) public buildings were derived. The 'RCC roof' buildings suffered damage mainly to doors, windows and masonry (mainly compound wall masonry), as did the 'AC sheet roof buildings'. In addition, these buildings suffered damage to the AC sheet roofing as well. It was broadly worked out that 'AC sheet roof' buildings suffered twice the damage suffered by the 'RCC roof' buildings; 50% of the damage value stemming from damage to the AC sheet roofing and 25% from the damage to the doors, windows and masonry respectively. In the case of 'RCC roof' buildings, 50% of the damage value was attributed to damage to doors, windows and masonry respectively. Using this break-up and the market rates, the damage value presented by the government was verified and confirmed. (refer to Annexes A10.3, A10.4, and A10.5).

10.4 Recovery Costs

While calculating Build Back Better (BBB) costs, guidance was taken from *Guidelines. Improving Wind/Cyclone Resistance of Housing* (Arya 2010). For AC sheet roofing, doors and windows, the BBB cost was taken at 120% of prevalent market costs, for masonry at 150% of the current market value, especially considering that the work would involve demolishing and excavating existing foundations and rebuilding these walls from the foundation up.

Accounting for the above and including other short-term measures like rapid visual survey, structural audit of select buildings etc., an additional 20% of damage cost was estimated for recovery. Hence for damage valued at INR 540 crore, the BBB cost was estimated at INR 647crore. District-wise recovery cost is provided in Table 10.2.

Table 10.1: District-wise Consolidated Numbers for Buildings Damaged and Damage Value (in INR crore unless mentioned otherwise)

District	Works Department		Rural Works Department		PR & DW		Urban Local Bodies		Total		
	Number	Damage	Number	Damage	Number	Damage	Number	Damage	Number	Damage (INR crore)	Damage (USD million)
Angul	0	0.0	0	0.0	14	0.3	0	0.0	14	0.3	0.0
Balasore	67	2.0	68	3.3	891	13.9	26	2.0	1052	21.1	3.0
Bhadrak	2	0.0	44	1.4	11	0.2	16	1.0	73	2.6	0.4
Cuttack	620	30.9	181	6.3	215	4.3	38	6.2	1054	47.7	6.8
Dhenkanal	9	0.4	23	0.7	91	1.8	15	0.8	138	3.7	0.5
Ganjam	153	6.6	5	0.1	183	2.7	41	0.2	382	9.7	1.4
Jagatsinghpur	82	2.2	91	4.0	415	8.3	368	1.6	956	16.1	2.3
Jajpur	67	5.0	21	0.9	304	6.1	8	3.5	400	15.6	2.2
Kendrapara	88	4.2	70	2.3	72	1.1	0	0.0	230	7.6	1.1
Keonjhar	0	0.0	7	0.2	22	0.4	0	0.0	29	0.7	0.1
Khurda	798	264.7	134	4.5	186	3.7	0	14.9	1,118	287.8	41.1
Mayurbhanj	3	0.1	0	0.0	34	0.7	0	0.0	37	0.8	0.1
Nayagarh	10	0.1	19	1.1	0	0.0	0	0.0	29	1.1	0.2
Puri	317	63.7	251	19.1	283	10.1	78	31.6	929	124.5	17.8
Total	**2,216**	**379.9**	**914**	**44.0**	**2,721**	**53.6**	**590**	**61.7**	**6,441**	**539.2**	**77.0**

Note: PR&DW = Panchayati Raj and Drinking Water

Table 10.2: District-wise Consolidated Numbers for Buildings Damaged, Total Damage, Loss and Recovery Value (loss value taken as 10% of total damage value)

District	Damaged Buildings	Damage (INR crore)	Loss (INR crore)	Recovery (INR crore)	Recovery (USD million)
Angul	14	0.3	0.0	0.3	0.0
Balasore	1052	21.1	2.1	25.3	3.6
Bhadrak	73	2.6	0.3	3.2	0.5
Cuttack	1054	47.7	4.8	57.2	8.2
Dhenkanal	138	3.7	0.4	4.4	0.6
Ganjam	382	9.7	1.0	11.7	1.7
Jagatsinghpur	956	16.1	1.6	19.4	2.8
Jajpur	400	15.6	1.6	18.7	2.7
Kendrapara	230	7.6	0.8	9.1	1.3
Keonjhar	29	0.7	0.1	0.8	0.1
Khurda	1118	287.8	28.8	345.4	49.3
Mayurbhanj	37	0.8	0.1	0.9	0.1
Nayagarh	29	1.1	0.1	1.4	0.2
Puri	929	124.5	12.4	149.3	21.3
Total	**6441**	**539.2**	**53.9**	**647.1**	**92.4**

10.5 Impact on Development Goals

Public buildings support a range of societal dimensions and contribute widely to the targets of the Sustainable Development Goals (SDGs). A 2018 Oxford-United Nations Office for Project Services (UNOPS) report on the role of infrastructure in sustainable development, highlights the link between non-networked public buildings and infrastructure and the potential achievement of Target 1.3 in Goal 1, to implement nationally appropriate social protection systems and measures for all. (See Economist Intelligence Unit, 2019)

10.6 Sector Recovery Needs and Broad Recovery Strategy for the Sector

10.6.1 Short-term Measures

1. Keeping in mind the upcoming monsoon, the government's immediate priority should be that of securing damaged buildings. This would include cleaning up and stacking the debris such that it can be reused/ disposed safely, recover furniture, equipment and store properly in a secure room, cover the buildings with tarp, tying down the same adequately and board up/ seal all doors and windows.
2. From the nature of damage, it is evident that while buildings with sloping AC sheet roofing suffered maximum damage, the RCC roofed buildings were also widely hit (though roof damage was not much seen). Keeping in mind the large building stock with AC sheet roofing, the resilience strategy should be to enhance the resilience of sloping roofs, doors and windows, compound walls and other associated elements like water tanks. Trees, their species and location, also play an important role in a cyclone resilient public building compound/campus and this area needs to be addressed. (refer to Annex Table A10.1. and A10.2 on nature of tree damage, remedial actions, and recommended tree species).
3. The upcoming building stock is RCC roofed framed buildings. Care needs to be taken towards ensuring cyclone (and multi-disaster) resilient design and detailing, with a focus on doors, windows, water tanks, piping, solar panels, air-conditioning units, wiring etc., in terms of sizing, location, specifications, design detailing and construction supervision. Certain design elements like large glass windows, and glass and aluminium panels need to be revisited and if retained, need to be designed structurally to withstand these wind speeds.
4. A comprehensive inventory/database of all public buildings (including all in use, abandoned, unused, partially used and under construction) must be created. A rapid visual assessment of all buildings using government formats can be undertaken. The audit shall recommend steps to prevent/ reduce future damage. Buildings should be prioritised based on usage/need and structural condition to develop a multiple phase repair/ retrofit/ reconstruction programme with adequate financial and technical resources. Additionally, there may be a need to develop guidelines to protect public buildings and their contents in a timely manner, and to further develop protection standards for new facilities.

The large number of public buildings that played the vital role of serving as evacuation shelters need to be audited in addition to their critical evacuation function, and an action plan in terms of repair/ retrofitting, enhancing the overall facilities should be prioritised. Introduce survivability features in these buildings so that they can successfully hold out during the disaster/ post-disaster phases. Also add new features such as emergency communications/ emergency lighting/ emergency water provision (rain water harvesting) etc., to public buildings.

10.6.2 Medium- to Long-term Measures

1. Adopt higher standards for infrastructure design to make structures resilient to climate change and other hazards.
2. Hazard zoning should inform siting/placement of public building and allied infrastructure.
3. Undertake maintenance and protection measures in a timely manner for existing buildings and introduce formal procedures for safety inspection/ audit of buildings, and a replacement programme for buildings that have completed their service life and are structurally deficient/deterrent to public health.
4. Develop new protection guidelines/standards for public buildings/ critical facilities.
5. Determine select public buildings as emergency facilities and undertake structural and non-structural mitigation measures, such as elevating structural and non-structural elements in police station, emergency shelters, fire station, and health centre.
6. Protect and build redundancy measures in public buildings/critical facilities and ensure that buildings are accessible and operable during and following most hazardous events.

10.7 Sector Assessment Methodology

This report has primarily relied on data collected by officials of the respective line departments of the Government of

Odisha. The Public Buildings team customised the sector-specific data collection and aggregation template for the damage and needs assessment, in the context of the state of Odisha and as per data availability. With regard to sectors like Health, Education, Women and Child Development, Agriculture, Fisheries and Animal Resources, Tourism and Culture, Forest and Environment, the Damage, Loss, and Needs Assessment (DLNA) secretariat determined that these public buildings were essential to the functioning of the above sectors. A discussion on the damage to the public buildings of each sector is covered in the chapter on that sector.

The Public Buildings team also conducted detailed interviews with sectoral counterparts from the respective line departments of the most affected districts to understand their data collection methodologies and address any gaps. The team conducted field visits to understand the extent and type of damages. Currency conversion rate of USD 1= INR 70 was used while costing damages.

References

Arya, A.S., (2010), *Guidelines. Improving Wind/Cyclone Resistance of Housing*, Building Materials & Technology Promotion Council, Ministry of Housing & Urban Poverty Alleviation, Government of India, New Delhi.

The Economist Intelligence Unit Limited (2019), *The Critical Role of Infrastructure for the Sustainable Development Goals*, supported by the United Nations Office for Project Services; see p. 5.

11

Water Resources

11.1 Pre-Disaster Context

Odisha has 476.40 kilometres (km) of coastline with a flood-prone area of 33,400 square kilometres (km^2). The coastal districts are vulnerable to frequent cyclonic storms. The South-West monsoon (June-August) brings heavy rainfall to Odisha annually, and the state receives an average annual rainfall of 1,500 millimetres (mm). Odisha has five major river systems, namely, Mahanadi, Brahmani, Baitarani, Subarnarekha and Rushikulya that experience major floods in their delta region. Structural measures such as construction of reservoirs, flood protection embankments and other related works have been taken up by the Government of Odisha for flood management. In addition to these and other interventions carried out by the Government of Odisha, several non-structural measures like flood forecasting have also been initiated. Flooding caused by the rivers, particularly in the deltaic area, are controlled by the flood protection embankments which are constructed on both banks of the rivers. Odisha has 7,138 km of embankments under various categories (like river embankments for protection from floods, coastal embankments to protect from ingress of saline water) to protect land and population from floods in the deltaic areas and to check ingress of saline water in the tidal zones of rivers, or directly from the sea.

Cyclonic storms are common in the Bay of Bengal, and Odisha is prone to these storms. They bring intense and severe rainfall with high cyclonic gales, tidal waves and storm surges which would inundate coastal lands and severely impact peoples' livelihoods, lives as well as infrastructure.

The Department of Water Resources (DoWR) in Odisha is involved in the construction, operation and maintenance of major, medium, minor flow and lift irrigation schemes. It also constructs and maintains river and saline embankments, flood management works, river training works, drainage channels and also deep irrigation tube wells. To support State's irrigation needs, DoWR has developed a storage capacity of 17.34 billion cubic metres (BCM) through 2,387 major, medium and minor irrigation projects. Another 1.67 BCM storage capacity is being created through 11 ongoing major and medium projects. A net irrigation potential of about 3.815 million hectares was created by 2017 against an estimated total irrigation potential of 4.99 million hectares through major, medium and minor (flow and lift) irrigation projects. The state government completed 84 major and 6,902 minor lift irrigation projects under Biju Krushak Vikash Yojna during 2001–2012.

A total of 7,138 km of protective embankments, 1,952 spurs and 253 km of stone packing has been completed to provide protection from floods and saline water inundation particularly in the deltaic areas. Due to flat terrain in the deltaic areas, about 0.22 million hectares suffers from drainage congestion and water logging, and 6,317 km of drains have been completed to improve the drainage condition of the area. Nearly 70 km of saline embankments in the coastal areas were recently strengthened, raised and upgraded under various programmes of international and national funding agencies.

11.2 Disaster Effects: Damages and Losses

The assessment scope covers the damage caused by cyclone Fani and those of associated rains, floods and/or storm surge. While heavy storm and wind force affected most districts within the state, the severe cyclonic storm directly affected three districts, namely, Puri, Khurda and Kendrapara, which suffered the bulk of the damages in various sectors. However, damages to irrigation infrastructure and flood protection and saline embankments were not significant, except for a few areas in the districts of Puri and Kendrapara. The assessment methodology for this sector broadly estimates the physical damages and the corresponding needs for recovery. The reconstruction needs are computed and expressed as the financial requirement for restoring damages with a 'build back better' factor for quality improvements and risk mitigation, wherever possible.

The landfall of cyclone Fani which occurred on 3 May 2019, did not cause appreciable damage to canal and minor irrigation projects. Since the landfall occurred during low

tide, the storm surge did not cause major damage to the recently upgraded saline embankments, except for a few locations where strong wave actions caused minor damages. However, some other stretches of saline embankments in Puri and Kendrapara districts were significantly damaged due to storm surge and wave actions and will need immediate restoration and subsequent methodical strengthening. This is particularly true for areas where sea-side embankment slope and toe have not been protected by stone pitching or gabion mattresses so far. Apart from these specific locations, the damages were, in general, minor in nature. DoWR had already carried out emergency closure of the breached sections of the Satpada Saline Embankment in Puri. However, this will need to be further strengthened to ensure long term sustainability of investments and safety of assets and security of people living behind these embankments.

11.3 Recovery Costs and Strategies

For immediate restoration of damaged embankments, work can be undertaken with stone or gabion protection of embankments. The places where the original embankment height is lower than required and slope of toe protection is not provided, the 'build back better' principle can be applied. This will, however, enhance the cost of restoration significantly. Therefore, the need assessment is

Location: Rajnagar Block, Kendrapara District – washed away portion of Keredaga Atlang Saline Embankment

Location: Brahmagiri Block, Puri District – damaged section of Nadiakhai Saline Embankment

categorised in two steps—first, for immediate restoration of the embankments in original sections with very limited improvement, and second, to strengthen and upgrade the poorly designed portions of the saline embankments to the required standards. The overall damage is estimated to be INR 4.68 crore (USD 0.66 million). The estimated cost for restoring the damaged embankments in Puri and Kendrapara districts is INR 6.33 crore (USD 0.9 million). The estimated cost for strengthening the identified embankment infrastructure in Puri and Kendrapara districts is INR 79.96 crore (USD 11.42 million). The total recovery needs for embankments is estimated as INR 86.29 crore (USD 12.32 million).

Total recovery need for the identified embankments are summarised in the Table 11.1 and split up details for short and medium-long term needs are given below.

Table 11.1: Total Recovery Needs

Districts and blocks	Damaged length (km)	Damage (INR crore)	Damage (USD million)	Total recovery needs (INR crore)	Total recovery needs (USD million)
Puri district *(Krushnaprasad, Brahmagiriand Astaranga blocks)*	21.67	3.15	0.45	64.26	9.18
Kendrapara district *(Rajnagar and Mahakalapada blocks)*	1	1.53	0.21	22.03	3.14
Total		**4.68**	**0.66**	**86.29**	**12.32**

Some select stretches of embankments in Puri and Kendrapara districts were severely affected and would need significant restoration and upgradation activities. Other damages observed are minor in nature. Before the upcoming monsoon season, the flood protection structures and damaged saline embankments should be rehabilitated on a priority basis to avert future losses and damages.

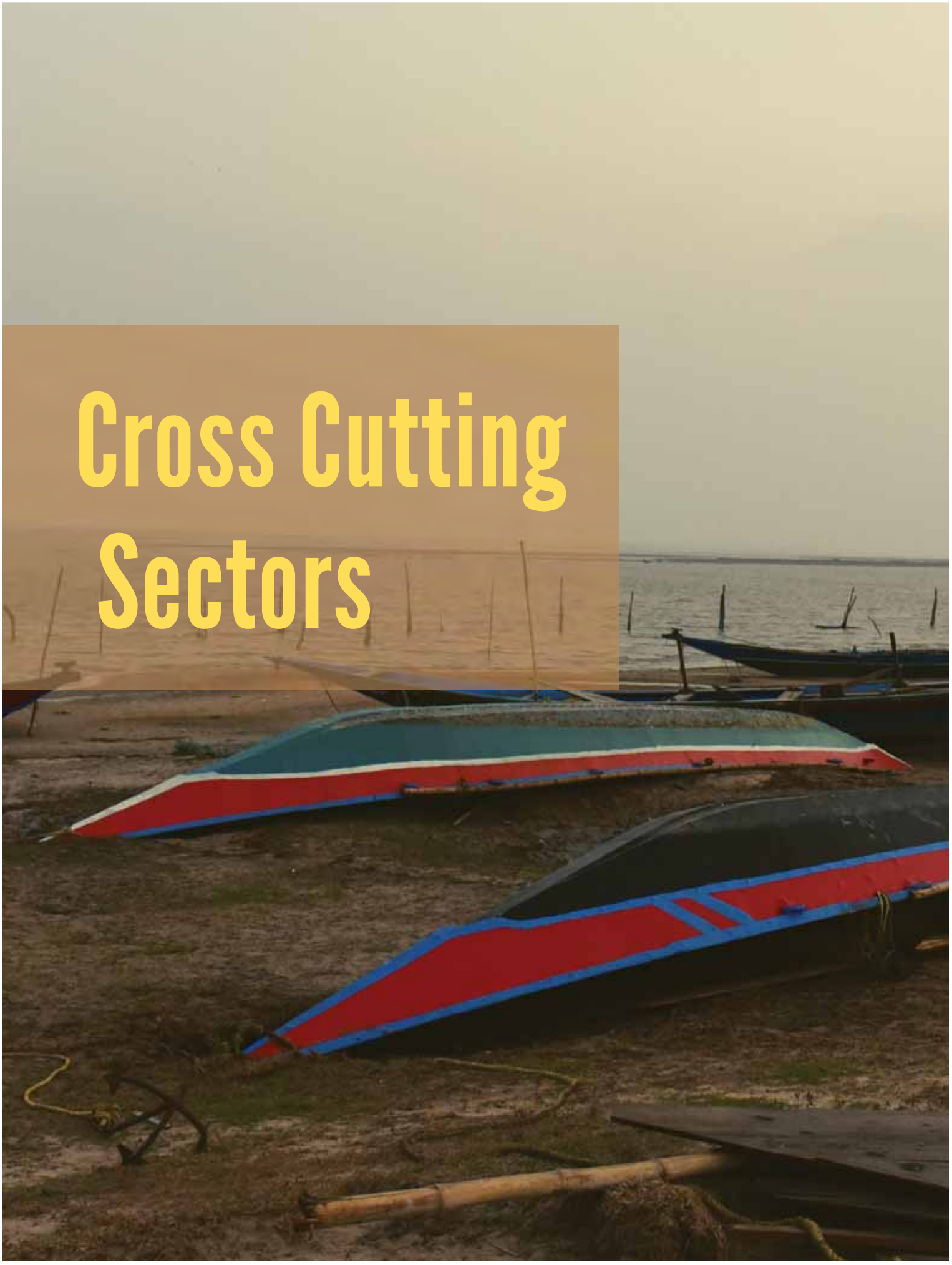
The short-term recovery strategy for the embankment will include immediate restoration and bringing it back to the pre-cyclone condition/shape with minor additional items such as erosion control measures, repacking of lost stones, etc.

The medium- to long-term strategy would include technical studies to establish the design criteria for raising and strengthening of embankments, establishing enhanced technical specifications and performance criteria/characteristics, provision of sluices where necessary, and protection of river/seaside slopes and toe of the embankments by stone rip-raps, gabion mattress, toe wall, etc., as applicable.

11.4 Sector Assessment Methodology

The team visited the two affected districts on 25–26 May 2019. The assessment team's estimation of the damages presents a consolidated view on the basis of relevant information received, physical verification of damages observed, discussions with concerned Government of Odisha officials and also the expertise of the assessment team.

Cross Cutting Sectors



Cross Cutting Sectors: Tables and Figures

Tables

Figures

12

Employment, Livelihoods, and Social Protection

12.1 Pre-Disaster Context

It is imperative to understand the employment and livelihoods profile of the people of Odisha, to provide a background to the assessment of the impact of cyclone Fani and the reconstruction programme. Key statistical indicators of Odisha's labour market are summarised in Table 12.1.

Odisha's LFPR (53.2%) and WPR (51.2%) are slightly higher than the corresponding national LFPR (52.4%) and WPR (50.5%). Though the state's male LFPR (78.9%) and WPR (76.6%) are higher than the corresponding national averages (LFPR 75.5%; WPR 73.3%), the female LFPR (25.4%) and WPR (23.7%) are lower than their corresponding national averages (LFPR 27.4%; WPR 25.8%).

The UR in Odisha at 3.8% is almost at par with the national UR at 3.7%. While UR among males in Odisha is slightly lower than the national average of 3%, the UR rate among females is higher than the corresponding national average of 5.8%. One of the reasons female UR is high is because education levels have improved among females and they are available in the labour force, but there is a paucity of suitable jobs. Accelerating economic growth, commensurate with growth in employment and livelihood opportunities, has been one of the key objectives of Odisha's economic policy. The above are regarded as policy imperatives for inclusive development and reversing the poverty trap.

Odisha achieved 24.6% poverty reduction between 2004–05 and 2011–12 (from 57.2% to 32.6%), the highest achieved among Indian states during the period.[1] Poverty declined among the Scheduled Castes (SCs) by 26.51% and among the Scheduled Tribes (STs) by 20.88%. However, the population living just above the poverty line continues to remain vulnerable to falling back into poverty due to natural calamities and disasters. Extreme Weather Events (EWE), such as Fani, particularly impact children, the elderly, women-led households, and persons with disabilities.

Table 12.1: Employment Profile Summary Table

Category	Male Urban	Male Rural	Male Total (U+R)	Female Urban	Female Rural	Female Total (U+R)	Total (Male + Female)
Total labour force (lakh)	22.19	105.86	128.05	4.14	36.21	**40.35**	**168.41**
Total workforce (lakh)	21.40	102.82	124.22	3.77	33.83	**37.59**	**161.81**
Total unemployed (lakh)	0.79	3.04	3.83	0.38	2.38	**2.76**	**6.59**
% Labour force participation rate (LFPR)	72.90	80.00	78.90	14.20	27.40	**25.40**	**53.20**
% Workforce participation rate (WPR)	70.30	77.70	76.60	12.90	25.60	**23.70**	**51.20**
% Unemployment rate (UR)	3.50	2.80	2.90	9.40	6.40	**6.60**	**3.80**

Source: Labour Bureau (2016), *Report on Fifth Annual Employment-Unemployment Survey 2015–16*, Government of India, Ministry of Labour and Employment, Labour Bureau, Chandigarh.

The provisional report of the *Sixth Economic Census 2012–13* states that 43.18 lakh people in Odisha are employed in 20.89 lakh establishments engaged in different activities.[2] The annual employment growth rate for the state between 2005 and 2013 was 1.93%.[3] This was higher than the annual growth rate of 1.81% between 1998 and 2005 (*Fourth Economic Census 1998* and *Fifth Economic Census 2005*). More than 50% of the Odisha's population depends on agriculture for its livelihood. The sector continues to absorb more than 62% of the total workforce in the unorganised sector, although the share of agriculture in the Gross State Domestic Product (GSDP) has declined to less than 20% leading to a rise in the share of marginal agriculture workers from 33% in 2001 to 39% in 2011.

Although the share of industry is declining in Odisha's GSDP (from 43% in 2011–12 to an estimated 34.8% in 2017–18), the sector remains important in the state's economy. The industry sector comprises four sub-sectors: (i) manufacturing; (ii) mining and quarrying; (iii) electricity, gas, water supply, and utility services; and (iv) construction. The manufacturing sector comprises both formal and informal enterprises, and contributes to employment generation. Industries that fall under the basic metals category are major employment generators.

According to the NSS 67th Round, 2010–11, about 12.66 lakh persons were employed by informal manufacturing enterprises in Odisha. Construction has capital goods characteristics and contributes to employment generation; it is thus considered an 'industry and services' sector. In 2017, about 18.11 lakh construction workers were registered with Odisha Building and Other Construction Workers Welfare Board. Banking and tourism are the other major services sub-sectors. Tourism is a labour intensive sector with a 3:1 ratio of indirect to direct jobs.[4]

The share of organised sector employment in Odisha is small, with public to private sector employment ratio skewed at 85:15. Employment in the organised sector declined from 7.95 lakh in 2013 to 5.03 lakh in 2015. Between 2004 and 2015, the compound annual growth rate (CAGR) of employment in public sector fell by 2.1%, and in the nearly same period (between 2008 and 2015) the share of private sector employment increased from 14.55% to 17.54%.[5]

The information technology and information technology enabled services (IT–ITeS) sector contributed to employment growth in the private sector. Besides this, there have been conscious efforts to promote employment and skill development in the agro-based and food processing industries, and revitalise the non-farm micro, small, and medium enterprises (MSMEs). In manufacturing, most MSMEs are in the areas of repairing and services followed by textiles. Handicrafts and cottage industry in Odisha shows a declining trend in terms of number of units as well as employment generation.

12.2 Build Back Better: Employment and Livelihood

Untimely cyclones such as Fani are likely to become more frequent in the future. The post-Fani reconstruction plan should therefore be based on the core principle of Build Back Better (BBB), for a more disaster-resilient and environment-friendly Odisha. A simultaneous imperative would be to create opportunities for 'decent work' (as articulated by the International Labour Organisation [ILO]),[6] enhance resource efficiency and build low-carbon sustainable societies.

Sectors with BBB potential are: energy, housing, agriculture, fisheries, plantation, and tourism—many of these have been serious affected by Fani. Applying BBB to these sectors can enhance livelihood opportunities and create 'green jobs'.[7] Examples of green initiatives supporting green jobs include organic and conservation agriculture, extensive plantation for rebuilding green cover, green-building construction, renewable energy applications, ecotourism, and managing waste from a circular economy perspective.

Another avenue for green jobs creation is through ecosystem services of the following types: 'provisioning services (e.g. food, water, wood for timber and fuel); regulating services (e.g. water purification, climate regulation); supporting services (e.g. soil formation and nutrient cycling); and cultural services (e.g. spiritual, cultural and aesthetic uses).'[8]

12.3 Estimates of Damage and Loss

The loss of income in the 14 districts affected by Fani has been estimated using the last available Gross District Domestic Product (GDDP) of 2018–19 at current prices.[9] In the case of Puri District, considering that its power distribution networks and other infrastructure have been completely destroyed and the green and brown debris would take some time to clear, it has been assumed that the district's population will be affected in terms of income loss for 60 days.

Following the path taken by cyclone Fani, quick assessments showed about 50% of the population of Khurda and Cuttack districts could be assumed to be affected for about a fortnight. Across other districts about 20% could be assumed to be affected for about three days. This assessment was also corroborated with findings from the rural housing sector, where data collected till 31 May 2019 showed that 92% of all rural house damage was in Puri, Khurda, and Cuttack districts only; none of the other districts assessed showed comparable extent of damage.

It may be noted that the severely-affected districts (and within them cities such as Bhubaneswar, Cuttack, Khurda, and Puri), are the major commercial hubs of Odisha. Any shutdown of the public sector and private enterprise activities in these commercial hubs will send economic shocks to other districts, even if they are not directly affected by the cyclone. Hence, the assessment of affected population for the purpose of income loss computation (100% for Puri, 50% for Khurda and Cuttack, and 20% for other districts) is different from the affected population data that has been maintained at the Special Relief Commissioner's Office, Government of Odisha. The total income loss, thus computed, stands at INR 4,105.13 crore (estimate by districts given in Table 12.2).

Table 12.2: Estimated Income Loss from Cyclone Fani 2019, Odisha

District	No. of males (projected) 2017–18*	No. of females (projected) 2017–18*	Total population (projected) 2017–18*	% total affected*	Total no. affected	Per capita GDDP 2018–19 (INR)**	GSDP Per capita per day (INR)	No. of days lost	Total income (GDDP per capita) loss (INR)	Total income (GDDP) loss (INR crore)
Angul	695,698	656,393	1,352,091	20%	270,418	2,45,191	672	3	**2,015**	**54.5**
Balasore	1,283,010	1,230,823	2,513,833	20%	502,767	85,169	233	3	**700**	**35.2**
Bhadrak	812,713	799,922	1,612,635	20%	322,527	72,637	199	3	**597**	**19.3**
Cuttack	1,438,773	1,354,255	2,793,028	50%	1,396,514	1,24,309	341	15	**5109**	**713.4**
Dhenkanal	653,969	612,728	1,266,697	20%	253,339	1,06,049	291	3	**872**	**22.1**
Ganjam	1,897,860	1,845,796	3,743,656	20%	748,731	98,513	270	3	**810**	**60.6**
Jagatsinghpur	593,380	576,706	1,170,086	20%	234,017	1,37,888	378	3	**1133**	**26.5**
Jajpur	987,710	962,158	1,949,868	20%	389,974	1,07,235	294	3	**881**	**34.4**
Kendrapara	757,849	758,831	1,516,680	20%	303,336	64,792	178	3	**533**	**16.2**
Keonjhar	983,320	978,394	1,961,714	20%	392,343	1,45,139	398	3	**1,193**	**46.8**
Khurda	1,299,312	1,229,989	2,529,301	50%	1,264,651	1,57,495	431	15	**6,472**	**818.5**
Mayurbhanj	1,335,732	1,369,175	2,704,907	20%	540,981	85,706	235	3	**704**	**38.1**
Nayagarh	536,128	483,104	1,019,232	20%	203,846	59,485	163	3	**489**	**10**
Puri	929,161	890,815	1,819,976	100%	1,819,976	73,857	202	60	**12,141**	**2,209.60**
Overall	**14,204,615**	**13,749,089**	**27,953,704**		**8,643,420**					**4,105.13**

Source: No. of males (projected) 2017–18*/ No. of females (projected) 2017–18*/ % total affected*: Affected population (male, female and total) and number of days lost are estimates based on discussions and field assessments.
Per capita GDDP 2018–19 (INR)**: Sourced from GDDP 2018–19 at current prices, provided by Nabakrushna Choudhury Centre for Development Studies, Bhubaneswar

12.3.1 Estimate of Person-days Lost and Wage Loss for Workers

Loss to the workers can be assessed in terms of person days lost as well as wage loss. The macro estimates are based on the assumption that the proportion of workers affected is the same as the affected population. For estimating the four broad categories of workers—casual, regular (wage/ salaried employee), contract workers and self-employed—the study has used data from the Labour Bureau's Fifth Annual Employment-Unemployment Survey 2015–16.[10] State-level data has been apportioned among the districts based on the share of GDDP of the respective districts in state GSDP. A summary of these estimates is given in Table 12.3 and the detailed computation in Annexe 12.A: Table 12.A1.

Table 12.3 presents wage loss data of trainees in privately owned and affiliated skill development institutes who were on the verge of completing their courses, but now face an extension of the training period since the institutes were damaged and shut down in the wake of Fani. Restarting classes on completion of reconstruction activities is likely to take an additional month. A 70% job placement rate was taken for the batch to estimate wage loss for trainees, assuming an average of INR 7,000 per month as the starting

Table 12.3: Estimated Person-Days Lost and Wage Loss for Workers

Category	No. of affected workers (lakh)	Person days lost (lakh)	Wages lost (INR crore)
Workers			
Male	37.06	496.87	2,128.97
Female	11.55	182.22	650.53
Total	**48.61**	**679.08**	**2,779.50**
Trainees			
Trainees (wage loss for training period extension)	0.08	2.53	5.89

Sources:
- **Workers:** Data sourced from Office of Labour Commissioner, which provided average wages of workers (prevailing market rates) by skill level. Computation details provided in Annexe 12.A, Table 12.A1.
- **Trainees:** Data sourced from Deen Dayal Upadhyay Grameen Kaushalya Yojana (DDU-GKY), implemented by Odisha Rural Development and Marketing Society (ORMAS)

salary. It is likely that apprentices and other trainees in public institutions, who may have been put-up for final assessments, were similarly affected, however their potential wage loss has not been computed here.

12.3.2 Migrant Workers

Odisha's coastal districts are labour surplus with minimal inbound interstate migrant workers and more outbound migrant workers. Income losses of outbound migrants were not considered. However, there is a sizeable number of intrastate migrants from the tribal districts and from comparatively less developed districts of the state, who come to Bhubaneswar, Cuttack, Khurda, and Puri in search of livelihood. Qualitative assessments and anecdotal evidence shared during consultation meetings showed that the adverse impact on such intrastate migrants may have been disproportionately high during relief distribution, particularly when it came to availing assistance and accessing social protection benefits. However, in the absence of any reliable data on migrant workers, estimating income loss for these cohorts has not been attempted in this exercise.

12.3.3 Estimate of Person-days Lost and Wage Loss in Key Economic Sectors

Comprehensive field assessments by state government departments to ascertain damage and loss were yet to be completed at the time of writing this report. However, it was evident that apart from its devastating impact on power distribution networks, agriculture and allied services, the impact of cyclone Fani was also severe on the housing sector and MSMEs. Thus, information from a combination of sources on damage and loss—to the extent available with the respective Government of Odisha agencies having jurisdiction over different enterprise segments, observations made by the Damage, Loss, and Needs Assessment (DLNA) team during field missions and extrapolated secondary data—has been used to estimate the person days and wages lost in key economic sectors. Sector-level records maintained by the Office of Labour Commissioner, Odisha are presented in Table 12.4, assessments done for the agriculture and allied sectors are presented in Table 12.5, and listing of affected sectors, where enterprises engage a large portion of the workforce, is presented in Table 12.6.

Table 12.4: Estimated Person-days Lost in Sectors Employing Registered Labour Force

District	Total no. of workers	Total no. of affected workers	Person-days lost (lakh)	Wages lost (INR crore)*
Building construction	27,15,058	4,72,030	47,62,525	133.35
Shops and commercial establishment	1,07,042	41,316	4,99,290	13.98
Beedi and cigar workers	1,19,003	31,639	2,51,685	7.05
Motor vehicle workers	19,635	4,943	32,955	0.92
Total	**29,60,738**	**5,49,928**	**55,46,455**	**155.30**

Source: Office of the Labour Commissioner, Odisha

Disaggregated information on number of affected workers and person days lost by various categories of workers belonging to agriculture and allied sectors in the affected districts has been obtained from the state government and analysed. The impact of Fani on agriculture and horticulture will have serious implications for livelihoods of farmers and their enterprises for the next two years. This will further impact income of families involved in both agricultural and supporting enterprises. Similar impact on fisheries and livestock could be observed. Summarised data of livelihood loss by sub-sectors is presented in Table 12.5 and supporting computation details are provided in Annexe 12.B, Tables 12.B1–12.B5.

It was observed that the maximum workers were affected in Puri district, followed by Khurda and Cuttack; other districts follow thereafter. Overall, agriculture and allied activities lost 95.78 lakh person days amounting to INR 306.69 crore in terms of lost livelihood across the 14 affected

Table 12.5: Agricultural and Allied Sector Loss Affected by Cyclone Fani, 2019 (by Sub-sector)

Sub-sector	No. of affected workers	No. of person days lost	Livelihood loss (INR crore)
Agriculture	23,056	13,83,347	34.58
Horticulture	1,13,180*	68,01,822	255.91
Fisheries	18,197	11,84,738	13.47
Poultry	1,331	1,19,746	0.04
Livestock	3,673	88,151	2.64
Total	–	**95,77,803**	**306.65**

*Excludes coconut farmers affected on a large scale in Puri, Cuttack, and Khurda districts.
Source: Base data from respective Directorates of Government of Odisha and computations by DLNA team

Table 12.6: Estimated Damage and Loss for Enterprises

Enterprises (selected list)	Affected workers / assets / estab. (as applicable)	Damage (INR crore)	Wage Loss (INR crore)	Total (damage + wage loss) (INR crore)	Ownership of assets	
					Public	Private
Handicrafts (workers)	70,900	221.65	29.58	251.23	6.20	215.45
Tourism* (workers)	63,291	156.51	123.35	279.86	24.03	132.48
Handloom (workers)	47,208	98.42	17.82	116.24	8.94	89.48
Sub-total (A)**	-	-	**170.75**	-	-	-
MSME (enterprises)	830	309.59	25.86	335.45	153.35	156.24
Mission Shakti and Odisha Livelihoods Mission (OLM) (workers)	1,09,815	21.78	36.94	58.72	0	21.78
MGNREGS (count of impacted assets)	5,637	43.21	46.73	89.94	31.79	11.42
KVIB (units)	139	0.42	0.11	0.53	0.04	0.38
Markets, vending zones under urban local bodies (units)	20,900	45.06	14.72	59.77	0	45.06
Sub-total (B)	-	**420.06**	**124.36**	**544.41**	**185.18**	**234.88**
Total (A+B)	-	**420.06**	**295.11**	**715.17**	**185.18**	**234.88**

* Computed for Puri and Khurda districts as impact on tourism was maximum in these districts
** The data on damage and loss of revenue from Tourism, Handicrafts & Handloom sector have already reflected in the sector chapter 'Cultural Heritage and Tourism'. This table focuses on the workers' related wage and employment loss. The total damage figure does not include the Tourism, Handicrafts & Handloom sector for avoiding duplication while considering the damage and loss of entire state
Source: Base data obtained from concerned Government of Odisha Departments and agencies followed by computations by the DLNA team

districts. Supporting computation details are provided in Annexe 12.C, Tables 12.C1–12.C6. Estimation of losses in coconut plantations needs to be done separately and the recovery strategy for the same, specially formulated.

12.3.4 Estimated Damage and Loss in Industrial Infrastructure supporting MSMEs

A field survey of MSMEs in industrial estates and parks was carried out for damage and loss assessment (Table 12.7). Findings show that such infrastructure needs to be made disaster resilient to minimise recovery time and income losses in the event of future climate related calamities.

An assessment, from a BBB perspective, of damage to government industrial training institutes (ITIs), polytechnics, engineering and professional schools, skill development centres (SDCs housed in government-owned buildings) and the College of Engineering and Technology (CET) near Bhubaneswar showed that about INR 100 crore would be required to make them more resilient to impact from cyclones, and to replace equipment damaged (adhering to current government norms regarding equipment for the courses that were being run). The initial estimates of restoration works and the BBB estimates are provided in Table 12.8.

Table 12.7: Estimated Damage and Loss Calculation for Affected MSME Units and Industrial Estate Infrastructure

District	No of units affected	Damages (INR crore)	Loss (INR crore)	Total effects damage+loss	Public ownership of asset	Private ownership of asset
Puri	278	69.53	5.55	75.08	0	75.09
Khurda	309	64.16	18.54	82.7	0	82.7
Cuttack	203	20.67	1.63	22.3	0	22.3
Other 11 districts	40	1.381	0.14	2.021	0	2.021
Sub-total	**830**	**156.24**	**25.86**	**182.10**	**0**	**182.10**
Common infrastructure at IDCO* Ind. Park, Ind. Estates		153.35	0	153.35	153.35	0
Total	**830**	**309.59**	**25.86**	**335.45**	**153.35**	**182.10**

IDCO*: Odisha Industrial Infrastructure Development Corporation
Source: Department of MSMEs, Government of Odisha

Table 12.8: Estimated Damage on SD&TE Institutional Infrastructure and Build Back Better Estimates

Type of training infrastructure	No.	Estimated restoration cost (INR crore)	BBB estimates (INR crore)	Remarks
Government ITI	22	25.72	45.50	ITI Puri needs major works Flagship ITI Cuttack needs to be built as a resilient model Special ITI (for persons with disabilities) at Khudupur Equipment purchase to be as per new Government of India norms and not replacement at book value Development deficit not included
Government polytechnics and engineering schools	18	22.00	35.50	BBB concepts applied to rework earlier estimates Film and TV Institute studio needs major repairs urgently Development deficit not included
Government engineering and management colleges	4	8.64	17.50	BBB estimates obtained for only CET amounted to INR 15.80 crore; other institute restoration estimates remained unchanged
Skill development centres	7	0.60	0.90	BBB concepts applied to rework earlier estimates Development deficit not included
Other offices	2	0.60	0.60	Estimates kept unchanged
Total		**57.56**	**100.00**	**Overall BBB estimates: INR 100 crore**

Source: Department of Skill Development and Technical Education, Government of Odisha

12.4 Decent Work and Social Protection for Reconstruction Workers

It is expected that the affected districts would see a higher level of reconstruction activities in the short to medium term. While the infrastructure build-back would be driven mainly through public spending, private expenditure on reconstruction is also expected to go up. Reconstruction activities would require a workforce with multiple skills, and most of such works would be contracted out. Construction enterprises from other states could also seek these contracts and send their workforce for reconstruction projects in Odisha.

As and when construction activity momentum picks up, key issues may be expected to emerge around occupational safety and health (OSH), working conditions, wages, insurance, equal pay to women, as well as issues with interstate migrant workers. The Labour Commissioner's office would need to exercise additional vigil to ensure that employers to meet their obligations to provide safe working conditions and institute appropriate OSH measures at construction sites.

12.5 Livelihoods

Livelihood opportunities in Odisha are as varied as its landscape, which includes high hills and the sea, deep lagoons, and dense forests. The people of Odisha earn their livelihood from diversified farm and non-farm activities. Though, there is a high dependency on agro-based livelihoods (61.81%) as compared to the national average, a substantial portion of the self-employed workforce depends on traditional sectors such as handicrafts and handlooms, trading and petty vending, manufacturing and the service sector. A massive number of micro/nano women entrepreneurs have recently entered into the livelihood domain, thriving under government schemes and projects like Mission Shakti and Odisha Livelihood Mission.

There is big push for developing livelihood assets and eco-infrastructure in agriculture and allied sectors, especially for marginalised sections of the community under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS). Most of these livelihoods are susceptible to hydro-meteorological hazards like flood and cyclone. Periodic natural disasters deepen poverty by affecting the life and livelihood of the marginalised in Odisha. Fani had a major impact on the livelihoods of resource-poor families. A suitable recovery strategy for livelihood options should be devised based on a need assessment study.

12.5.1 Handicrafts

Handicrafts, run mostly through generations as a family enterprise, provide livelihood support to about 1,30,000 artisans in the state,[11] around 70,900 of whom have been severely affected[12] by cyclone Fani. The damage and loss to work sheds, equipment, products stocked and raw materials has been put at about INR 251.23 crore (Table 12.6). In some cases, the damage to raw material will lead to loss of employment till the next season.

Artisans depending on tree-based handicrafts (especially coconut, palm, and bamboo) may have to wait for two to five years till the affected plants regain their pre-cyclone condition.

The handicraft business also mostly depends on tourist inflow to the area. As the tourism sector is also badly affected, income from handicrafts closely linked with tourism also will take a hit for a minimum of two to three months. As recommended in the Odisha Handicraft Policy 2019, artisans need institutional assistance for easy credit access to restore damaged infrastructure, equipment and to begin procuring raw materials. Detailed damage analysis has been undertaken in the chapter on 'Culture, Heritage, and Tourism'.

12.5.2 Handloom

Odisha has a rich tradition of handloom weaving. It is one of the largest unorganised livelihood sectors after agriculture. It employs 1,92,339 weavers[13] and their products are appreciated worldwide for their exquisite designs, natural motifs, and superb colour combinations. However, about 45% of weaver families live below the poverty line and the cyclone has had a severe impact on their livelihoods. Individual and cooperative productive assets and infrastructure like work sheds, looms, raw material, yarn on loom, and weaving equipment have been damaged or destroyed. An estimated INR 116.24 crore of damage and loss was suffered by 47,208 affected weavers (Table 12.6).[14] Detailed damage analysis has been undertaken in the chapter on 'Culture, Heritage and Tourism'.

12.5.3 MGNREGS Beneficiaries Suffer Losses

About 5,637 MGNREGS beneficiaries suffered losses to livelihood assets. This was in addition to damage to assets worth INR 43.21 crore that had been created by them for individual and public benefit (Table 12.6). This leads to a loss of INR 46.73 crore as wages under MGNREGS.

Data available with the Panchayati Raj and Drinking Water Department reveals that the average days of employment provided per household under this scheme was only 40.37%. Thus available MGNREGS resources can be utilised for reconstruction work in rural Odisha.

In the case of Category B works,[15] which are the key component for livelihood asset creation, Odisha has achieved an average of 72.02% of total works between 2015–16 and

2018–19; similarly, in the last four years, expenditure on agriculture and allied works averaged 61.78%. (Additional MGNREGA national MIS data is provided in Annexe 12.D, Table 12.D1.)

This shows there is BBB scope under MGNREGS through land development, agricultural support structure creation, and provision of wages, housing, sanitation, debris removal and plantation. The state can work with the central government to revise the MGNREGS annual plan in light of the devastation wreaked by Fani, and add 50 additional days of employment to affected job card holders.

12.5.4 Women's Enterprises and Income Generation

Mission Shakti focuses on providing institutional grants and enhancing the credit services, while the Odisha Livelihoods Mission (OLM) works to further address issues such as productivity enhancement, extension service delivery, and value chain development for improved market access. These issues are commonly faced by small and marginal producers and entrepreneurs.

Cyclone Fani's onslaught left 1,09,815 members of self-help groups (SHGs) facing the loss of the land-based assets they had created for agriculture and allied activities (Table 12.6). Work sheds, micro-agriculture production, and productive assets of enterprises were damaged. For rebuilding livelihoods, there is a need for financial and handholding support services such as:

- Interest subvention credit linkage
- Market development
- Establishment of value-chain
- Need-based capacity building
- Education and awareness on disaster-resilient livelihood options among women entrepreneurs
- Developing systems and institutions managed by the community, and supported by professionals, to bring sustainability in livelihood development programmes

12.5.5 Tourism

Almost 10% of Odisha's GSDP comes from tourism. With average annual growth of 9% it was estimated that INR 15,051.82 crore flowed into the state through tourism during 2017–18. Puri and Khurda districts attract most of the tourists in Odisha. Fani has had a devastating effect on tourism and its related infrastructure here.

As per the data collected by Department of Tourism, 63,291 direct and indirect employees were affected in Puri and Khurda districts. The recovery and rebuilding of tourism infrastructure to the extent possible, before the July festivities is very important for the sector to pick up.[16] An overall discussion on direct and indirect livelihoods affected may be found in the chapter on 'Culture, Heritage and Tourism'.

Case Study 12.1: Impact of Fani in Chudanga Tribal Hamlet and Assessment of its Restoration (conducted with the support of Gram Vikas)

Chudanga is a hamlet with a population of 771, in Daruthenga Gram Panchayat in Bhubaneswar Block of District Khurda. The habitation is in the periphery of the Chandaka Forest Reserve and has 190 households, of which 148 are Munda households, listed as ST.

	Damage	*Number*	*Value in INR*	*Remarks*
Damage analysis in brief	Houses	164	4,40,00,000	108 houses partly damaged and 56 houses completely damaged
	Agriculture: standing crops	30 families	10,00,000	Paddy, brinjal, bitter gourd, ladies finger and banana in 18 acres
	Vegetation other than standing crops	180 trees	5,40,000	Mango, tamarind and chakunda trees are major trees lost
	Toilets	70	8,40,000	
	Poultry	25 families	6,000	Poultry and its cage
	Wage loss (outside job) (days and cost of loss)	190 families	7,20,000	400 workers unable to work for 6 days; average INR 300 lost.
	Total		**INR 4.71 crore**	

Field Observation: Unavailability of drinking water, damage to houses, absence of sanitation facilities and loss of livelihood are the key effects of the cyclone in the habitation. In any case, five tube wells were defunct; Fani has worsened the situation.

Key recommendations for recovery needs based on rapid need assessment process	
Recommendations on recovery needs	*Approximate cost (INR)*
Construction oriented skill building in livelihood	12,50,000 (25,000 x 50 persons)
Cashew plantation in 20 acres	7,00,000 (35000 x 20 acres)
IGP (Goats, poultry): strengthening 15 all-women SHGs	9,75,000 (5000 x 13 goats x 15 groups)
Cyclone shelter/community hall	5,00,000
Piped water supply project with a source, water tank and individual pipeline connection to each household	1,14,00,000 (60000 per household x 190 households)
Construction of household sanitation units	38,00,000 (20000 x 190 units)
Support towards construction of damaged households	6,56,00,000 (4,00,000x 164 household)
Total	**INR 8.42 crore**

Key strategies and recommendations identified with the support of community

1. The land in and around the habitation is under the Forest Department; only 85 families have legal ownership of homestead land. Ownership rights of the remaining 100 families need to be acknowledged to take up house construction and agriculture activities.
2. Hamlet rebuilding—including houses, sanitation facilities and drinking water facilities—can be taken up in a community-owned and managed construction process. A piped water-supply system can be built with new water sources.
3. Disaster resilient livelihood development can include:
   a. organic agriculture initiatives to feed the urban market,
   b. construction-oriented skill building (masonry, plumbing, electrification, carpentry etc.),
   c. institutionalisation of SHGs and their federations to take up income-generation activities linked with available market, and
   d. plantation activities to restore fruit, fuel and fodder production under MGNREGS.

12.6 Social Protection

Social protection aims at reducing vulnerabilities and managing the economic risks of underprivileged people and includes interventions that support individuals, households, and communities in their efforts to prevent, mitigate, and overcome risks and vulnerabilities and enhance the social status and rights of the marginalised. Odisha has steadily been increasing its social protection spend by introducing own schemes and improving implementation of national programmes as well.

The state is addressing a wide range of these vulnerabilities with corresponding social protection schemes, including social insurance initiatives (pensions, health insurance); social assistance programmes (cash and in-kind social transfers, which includes food subsidies, subsidies for rural household constructions, child welfare programmes, disaster relief programmes, elderly assistance, health assistance for infants and mothers, disability programmes) and labour market programmes (food for work and employment guarantee programmes).

The DLNA assessed the following vulnerable population segments:

- Children: An estimated 5 million children (below 18 years of age) across 14 districts were affected by Fani (derived from Census 2011).
- Persons with disabilities: Fani has impacted around 1.5 lakh differently-abled people in the five most affected districts. Those covered under Indira Gandhi National

Table 12.9: Social Profile of Affected Districts

Indicator	Year	Puri	Khurda	Cuttack	Jagatsinghpur	Kendrapara
Child population (0–6 years) (million)	2011	0.17	0.24	0.27	0.11	0.16
% Scheduled Tribe population	2011	0.4	5.1	3.6	0.7	0.7
% Scheduled Caste population	2011	19.1	13.2	19	21.8	21.5
% Rural BPL families	1997	69.1	59.2	52.4	52.8	59.9
Persons with Disability (Number)*	2011	53,667	63,949	1,02,018	34,284	40,110

Source: *Census of India 2011,* Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India

Disability Pension Schemes (IGNDPS) under the National Social Assistance Programme (NSAP), receive a monthly pension between INR 500 and INR 900. Inputs received during consultation and assessments in the affected districts showed exclusion error.

- The elderly: Findings show that the older adults are more vulnerable to immediate impact of natural disasters and suffer more from injuries and loss of life in disasters than do younger people. In Odisha 9.5% of the population are elderly, higher than the national average of 8.6%. A staggering 80% of the elderly in Odisha work due to economic and other compulsions. About 12 lakh of the elderly population covered under NSAP and Madhu Babu Pension Yojana (MBPY) have been affected in five most affected districts.
- SC and ST population: SCs comprise 17% and STs 22.85% of Odisha's population. Fani has impacted these most deprived and marginalised groups disproportionately.

12.6.1 Post-Disaster Effects

Social protection assistance provided post Fani was of different types. Cash assistance, including cash transfer (both conditional and unconditional) helped households meet basic needs for food and non-food items and services. It also helped them to buy assets essential to resume economic activity and further supported the local market to recover and provide the beneficiaries the opportunity to choose expenditures as per their specific needs. However, social protection systems and operations faced several constraints (both legacy constraints and those imposed by Fani) which impaired service delivery to some of the most vulnerable community members in the disaster affected areas.

It may be important to mention that the damaged buildings of childcare institutions managed by NGOs need urgent repairs. The preliminary budget estimate for restoration works obtained from the Department of Social Security and Empowerment of Persons with Disabilities (SSEPD), Government of Odisha amounts to INR 20 crore.

12.6.2 Recovery Imperatives

A well designed and implemented social protection scheme can directly help in achieving progress towards the Sustainable Development Goals (SDGs) including: poverty eradication (SDG 1); health and well-being (SDG 3); quality education (SDG 4); gender equality (SDG 5); and, reducing inequality (SDG 10), etc.

Increasing the reach of existing social protection programmes to all vulnerable groups in Odisha has ensured heightened returns on investment, strengthened sustainability, and addressed persisting inequalities. However, without a lifecycle approach that supports families and households at all life stages and across the rural–urban divide, the prevalence of the caste system and gender inequality can potentially affect vulnerable population groups.

12.7 Recovery Strategy and Recommended Interventions

The recovery strategy should take into account repeated severe cyclones (Super-Cyclone, Phailin, Titli, Fani) hitting Odisha. The state needs BBB infrastructure, ushering in more climate-resilient livelihoods. The immediate approach of the recovery programme should focus on meeting emergency needs while promoting an enabling environment for mid- and long-term BBB recovery measures.

Table 12.10: Top 15 Recommended Interventions (detailed calculations in Annex 12.E, Table 12.E1)

Interventions	Short term	Medium term	Long term	Total recovery needs
BBB: 22 government ITIs, 18 polytechnics, 9 SDCs, 1 CET	INR 100 crore	-	-	INR 100 crore (with nodal responsibility assigned to SD&TE Department and other agencies)
Ramp up skill delivery needs for rural housing construction (PMAY-G); 45 days training for five trainees under one supervisor	Begin training rural masons at all PMAY-G reconstruction sites	-	-	671 lakh person-days: training schedule to be worked out
MGNREGS: request for additional 50 days work for reconstruction and restoration	INR 1,122.60 crore; part of this budget can be used for debris removal	-	-	INR 1,122.60 crore

Response workforce planning for waste management, green and brown debris removal		Equipment hiring, workforce training	Equipment, workforce training	To be discussed with concerned state government department
MSME recovery (for enterprises and units)	INR 477.37 crore (BBB)	INR 80 crore (cluster and skill development)	INR 80 crore (cluster and skill development)	INR 637.37 crore (Recovery, cluster and skill development)
Women enterprises, small business recovery (through OLM and Mission Shakti)	INR 169.56 crore (BBB)	INR 124.10 (PG, entrepreneurship, financial inclusion)	INR 26.56 (PG, entrepreneurship, financial inclusion)	INR 320.22 (Recovery, system development entrepreneurship, financial inclusion)
Supporting formal sector MSMEs through disaster resilient industrial estate infrastructure	INR 50 crore (Khurda)	INR 200 crore (four industrial estates)	-	INR 250 crore for five industrial estates
Recovery support to urban informal economy	INR 75.78 crore (BBB)	INR 7.00 crore (infrastructure and skill development)	INR 7.00 crore (infrastructure and skill development)	INR 89.78 crore (Recovery, resilient infrastructure, skill development)
Better livelihood recovery scheme for fishery, coconut growers, poultry				The detailed recovery need assessment provided in chapter 'Agriculture, Livestock and Fisheries'
Tourism	The detailed recovery need assessment in chapter 'Culture, Heritage and Tourism'			
Setting up Community Crisis Management Fund as a viability gap fund as security to livelihood credit	INR 200 crore	INR 150 crore	INR 50 crore	INR 400 crore as viability gap fund for credit security
Green plantation: 210 lakh trees in six years, 24 lakh trees first year (planting manpower and training costs, excludes seedling, material and transportation)	INR 4.15 crore	INR 12.86 crore	INR 19.28 crore	INR 36.29 crore (manpower training costs for plantation, excludes weeding, pruning, other annual expenditure)
Improve service delivery of social protection schemes	INR 120 crore (Emergency top-ups in NSAP and MBPY, Banishree)	Bring forward disbursement of MBPY/ other entitlement to beneficiaries on India Meteorological Department's (IMD's) forecasted cyclone path 48 hours before landfall		(i) Beneficiary identification; CCT/ DBT; (ii) Additional two months top-up to beneficiaries in severely affected districts
Appoint Empowered Nodal Officer at Labour Commissioner's Office. Single window to monitor compliance by contractors and facilitate decent work through field formation during Fani reconstruction	Mechanism to be set up as soon as DLNA works commence			Large number of construction contracts to be awarded, issues can be around OSH, working conditions, wages, insurance, interstate migrant workers
Restoration of damaged buildings of childcare institutions managed by NGOs	INR 20 crore (as these are not public buildings, they are not accounted for in damage computation)			INR 20 crore (as these are not public buildings, they are not accounted for in damage computation)
Total	**INR 2,319.46 crore**	**INR 573.96 crore**	**INR 182.84 crore**	**INR 3,076.26 crore**

Notes: PG = Producer Groups; CCT = Conditional Cash Transfer; DBT = Direct Beneficiary Transfer

12.8 Key Recommendations

12.8.1 Short-term Plan (0–12 months)

1. Women-led and youth-led enterprises need to be promoted to set up **horticulture planting material nurseries** for the cyclone-affected population. Two to three such nurseries per block can cater to the demand. Government departments can also source planting materials from these nurseries as per requirement.
2. Promote entrepreneurship in **fodder seed, planting material, and azolla culture centres.** These centres can supply fodder seed as and when required by the government department and private entrepreneurs. The centres can also be developed as a model for a cyclone resilient low-cost hydroponic system for fodder production. Youth and all-women SHGs may be encouraged to start this activity. One fodder seed bank can be promoted at the block level in 50 most affected blocks with high cattle density.
3. Start **community managed agro-marts and custom hiring centres** in most-affected blocks to provide support services and tools for affected farmers' families.
4. **Special credit package (including interest free loans) for farmers and micro/ nano entrepreneurs** may be designed to support aspiring farm or non-farm entrepreneurs who are women and/or belong to marginalised communities.
5. Ensure a **digital database of psycho-social counsellors and counselling sessions** for the vulnerable such as affected children, the elderly, and persons with disabilities. Post the cyclone, several UN agencies and civil society organisations (CSOs) in partnership with government departments organised psycho-social counselling for affected children. However, the coverage was low and practically could not reach those who needed it most, including children with disabilities and the elderly. There is a need to have a digital database and constant engagement with the counsellors for similar future situation.
6. Certain aspects of **governance** need improvement. For instance, there is every possibility that people have lost important documents due to damage to their own houses, or due to loss of records following damage to government buildings. Immediate policy decisions are needed either for relaxing or making alternative provisions for transferring social assistance to such people. Similarly, it is important to improve accountability in the implementation of social protection programmes and introduce/ strengthen downward accountability mechanisms by mobilising Panchayati Raj Institutions (PRIs) in the state.
7. **Social dialogue and tripartite participation between government, employers, and workers** could form the basis of reconstruction activities being planned. Award of reconstruction contracts has started and an even larger number is in the pipeline. Issues are likely to come up around OSH, working conditions, wages, insurance, interstate migrant workers during reconstruction work. Towards this, it would be beneficial to appoint an empowered Nodal Officer at the Office of the Labour Commissioner. The Office of the Labour Commissioner could thus act as a single window to monitor compliances by contractors and facilitate 'decent work' through the field formations during post-Fani reconstruction activities.

12.8.2 Medium-term Plan (13–36 months)

1. **Building efficiency in social protection service delivery:** Quick damage assessment may be done within a public–private partnership (PPP) model. With support of technology, a single registry of beneficiaries of key social protection schemes may be conceptualised. This would help in ensuring reach of immediate relief to the affected households.
2. **Promotion of women-centric farm-based livelihood:** There should be an effort to promote SHG/joint-liability group (JLG)-based women entrepreneurs in farm and non-farm sectors. This will work as an insurance scheme at the family level to absorb the shock of the disaster.
3. **Market linkages:** Agricultural and non-agricultural products of small, micro and nano enterprises should be systematically linked to the market. Product-based remunerative value chain needs to be developed and strengthened.
4. **System and institution development for livelihood development:**
   a. Form producers' groups with cadre building, mobilisation, formation, capacity building, and value chains along with collection centres and market development in the affected blocks.
   b. Establish Entrepreneurship Incubation Centres and mentorship cadre development in most-affected blocks. This will build existing livelihoods opportunities and entrepreneurship eco-systems in a better way to enhance the economic empowerment of women and marginalised.
   c. Establish Youth Employability Service (YES) Centres in most-affected districts, in order to match the demand and supply for skilling and

employment opportunities. This will include creating collaborative platforms and be based out of district employment exchanges network/ government ITIs and Polytechnics. A component of bridge training may be included, adapted from other states where this has already been implemented.

5. **Enterprise Incubation Centre and mentorship cadre building for supporting business development at block level/ULB Level:** A cadre of barefoot link workers may be developed as mentors who trained in both psycho-social mentorship and business support services for supporting these entrepreneurs. These hubs, at block, district and state level, can also facilitate innovation and conserve indigenous knowledge in livelihoods.
6. **Convergence** needs to be achieved between skill development programmes under centrally sponsored and state sponsored schemes (being implemented by the line departments) as well as those being undertaken by the Skill Development and Technical Education (SD&TE) Department. While a beginning has already been made, more could be achieved by way of synergising mobilisation and enhancing efficiencies for better outcomes. A case where this could be considered is rural masonry skilling for the massive house reconstruction efforts planned.
7. **Entrepreneurship promotion to strengthen the livelihood support system:**
   a. Agro mart/ custom hiring stations at Gram Panchayat level
   b. Construction and sanitary mart at Gram Panchayat level
   c. Handicrafts and handlooms block level hubs for value chain and marketing
8. Creation of a **guarantee fund** for proposed loans so that the affected people are able to access loans repeatedly. A first loan default guarantee fund of 10%–20% can be set up by Odisha Government in each department or through convergence with OLM/ Mission Shakti. A guarantee fund of INR 50 to 100 crore needs to be created to provide loans of INR 250 to 500 crore.
9. Since the reach of **microfinance institutions (MFIs)** is good in the state, they can be coopted as a distribution system for last mile access to people. A 1%–2% incentive on the **Banking Correspondent** model may be proposed to enable access to credit for these affected regions.

12.8.3 Long-term Plan (3–5 years)

1. **Link social protection with employment of youth and adolescent boys and girls:** Shortage of skilled labour was witnessed during the immediate relief and recovery phase. Filling this gap for change and growth presents an opportunity for highly productive investments in adolescent skilling. A savings-linked child support grant particularly for adolescent boys and girls (10 to 21 years) could lead to improvements in nutrition, cognitive development, educational attainments, and child protection, whilst providing livelihood support through ripple effects on families and communities, promoting financial inclusion and asset security.
2. Set up a **Community Fund for Crisis Management** with the Cluster Level Federations (CLF)/Block Level Federations (BLF)/CBOs of SHGs with part government investment. This could have repayment structure similar to insurance premiums. If another crisis were to strike again after, say 10 years, the community would then have saved enough funds to rebuild livelihoods without major government support. The Community Fund for Crisis Management could be managed from within Mission Shakti or OLM, thus building a livelihood risk-management structure at the block and panchayat level.

12.9 Sector Assessment Methodology

Analysis of government data was supported by extrapolations/ imputations on government statistics and policy briefs to arrive at sector-level estimates. The sources and (any) assumptions used have been mentioned as footnotes of the respective tabulations. Concerned departments (and their agencies) were met for consultations and obtaining inputs. These included Skill Development and Technical Education (SD&TE) Department, MSME, Odisha Industrial Infrastructure Development Corporation, Women & Child Development & Mission Shakti, Social Security & Empowerment of Persons with Disabilities, National Health Mission, Labour and Employees State Insurance (ESI), Department of Economics and Statistics (Planning and Co-ordination) (DES [P&C]), Panchayati Raj, Handicrafts, State Urban Development Authority (SUDA), Khadi and Village Industries Board (KVIB), Handloom, Agriculture, Fisheries and Animal Resources Development Department (F&ARD), and some others. Government officials and district magistrates were consulted and inputs obtained from CSO meetings, focus group discussions the community, SHGs, anganwadi workers, ASHAs, affected persons including women, people with disabilities, and the

elderly. Observations from field visits have formed the basis of the data and information used in this chapter.

Notes

[1] Poverty estimates based on revised Tendulkar methodology (computed by Planning Commission, now NITI Aayog cited in *Odisha Economic Survey, 2017–18*. Planning and Convergence Department. Directorate of Economics and Statistics. Government of Odisha. March 2018. https://pc.odisha.gov.in/Download/Economic_Survey_2017-18.pdf

[2] Provisional report of the *Sixth Economic Census 2012–13, Minsitry of Statistics and Programme Implementation, Government of India.* Accessed on 1 July 2019 at http://www.mospi.nic.in/sites/default/files/economic-census/sixth_economic_census/sixth_ec_prov_result_30july14.pdf.

Excluded are: crop production, plantation, public administration, defence, and compulsory social security services.

[3] The following work/ employment types were excluded from the *Sixth Economic Census 2012–13*: Employment in private households as domestic help, maid, driver etc.; all wage paid employees of casual nature; and informal workers engaged different kinds of activities based on availability of jobs such as loaders-unloaders, helpers to masons or carpenters, earth workers etc.

[4] *Odisha Economic Survey, 2017–18*. Planning and Convergence Department. Directorate of Economics and Statistics. Government of Odisha. March 2018. https://pc.odisha.gov.in/Download/Economic_Survey_2017-18.pdf

[5] *Odisha Economic Survey, 2017–18*. Planning and Convergence Department. Directorate of Economics and Statistics. Government of Odisha. March 2018. https://pc.odisha.gov.in/Download/Economic_Survey_2017-18.pdf. Also, Odisha Economic Survey, 2016–17, https://pc.odisha.gov.in/Download/Economic_Survey_2016-17.pdf.

[6] Decent work 'involves opportunities for work that is productive and delivers a fair income, security in the workplace and social protection for families, better prospects for personal development and social integration, freedom for people to express their concerns, organise and participate in the decisions that affect their lives and equality of opportunity and treatment for all women and men.' ILO's Recommendation No. 205 on Employment and Decent Work for Peace and Resilience (2017) provides guidance on world-of-work related measures to prevent and respond to crisis situations arising from conflict are disaster.

[7] As per the ILO definition, green jobs are defined as jobs, 'when they help reduce negative environmental impact ultimately leading to environmentally, economically and socially sustainable enterprises and economies. More precisely green jobs are decent jobs that: (i) reduce consumption of energy and raw materials and limit greenhouse gas emissions; (ii) minimise waste and pollution; and (iii) protect and restore ecosystems.'

[8] Montt, Fraga and Harsdorff (2018)

[9] Provided by Nabakrushna Choudhury Centre for Development Studies, Bhubaneswar for the purpose of this assessment.

[10] http://labourbureaunew.gov.in/UserContent/EUS_5th_1.pdf

[11] https://handloom.odisha.gov.in/pdf/2017/1044.pdf

[12] Based on data received from concerned department

[13] Based on data received from concerned department

[14] Data received from the concerned department

[15] Improving productivity of land, improving livelihoods through horticulture, sericulture plantation and farm forestry, unskilled wage component in construction of houses, infrastructure for promotion of livestock and fisheries

[16] Rath Yatra of Lord Jagannath, the largest annual festival of Odisha

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Planning and Convergence Department (March 2018), *Odisha Economic Survey 2017–18,* Directorate of Economics and Statistics, Government of Odisha, Bhubaneswar.

Planning and Convergence Department (March 2017), *Odisha Economic Survey 2016–17,* Directorate of Economics and Statistics, Government of Odisha, Bhubaneswar.

13

Gender and Social Inclusion

13.1 Pre-Disaster Context

Demography: The overall population sex ratio of 967 females (all ages) per 1000 males (all ages) for the 14 districts, is lower than the state average of 979.[1] The adolescent population (age group 10–19 years) accounts for 12% of the population, with 49% of whom are adolescent girls. There are 16,61,412 elderly persons (49% of whom are women).[2] Odisha has a total of 12,44,402 Persons with Disability (PwD),[3] (46% of whom are women) (Table 13.1). The 14 affected districts account for 64% (2,67,76,407) of the total population of Odisha.[4]

Table 13.1: Demography of Odisha

	Total Population	Scheduled Castes (SC) Population	Scheduled Tribes (ST) Population
Total	**2,67,76,407**	**48,03,578**	**36,51,111**
Male	1,36,14,071	24,28,220	18,15,341
Female	1,31,62,336	23,75,358	18,35,770

Poverty: Odisha, one of the eight Empowered Action Group (EAG) states of India, lags socio-economically and is amongst the poorest states of India with high poverty levels.[5] High levels of poverty lead to high-level disparity, resulting in exclusion. Women and adolescent girls from poor families are therefore more vulnerable than others in disaster situations. Overall, 33% of its population is below the poverty line (as per World Bank [WB] poverty line) and 83.3% of its population lives in rural areas. Being disaster-prone, recurrent disasters like floods, heatwaves, droughts and cyclones, huge damages and loss to infrastructure, compound levels of poverty in the state. There are significant variations in poverty and uneven progress across social groups with highest levels of poverty amongst the STs. Of the 14 affected districts, Mayurbhanj, Keonjhar and Nayagarh have both; high concentration of ST households and high levels of poverty.

Female-headed Households (FHHs) and Deserted Women: Odisha has a high presence of FHHs and deserted women. Women account for 49% of the total population in the 14 districts affected by Fani and 13% of the total households are FHHs. Most heads of the FHHs are widows (ranging from 48% in Kendrapara to 72% in Keonjhar).[6]

SC/ST Population: SC houses tend to be concentrated around marginal hamlets with lower access to key public services and infrastructure, like Integrated Child Development Services (ICDS) centres, schools and even cyclone shelters. This locational disadvantage of SC/ST households in a village/gram panchayat has a direct implication, especially on access to relief and recovery services. The intersectionality of barriers encountered by these families due to low literacy levels, subsistence income levels, participation in informal economy, and irregular access to public welfare schemes, makes them vulnerable to immediate and prolonged health and livelihood shocks in the aftermath of disasters. They are often the first victims and the last to recover.

Open Defecation and Water Availability: Odisha has the highest open defecation levels in India[7] and the rate is the highest amongst STs and SCs.[8] Access to drinking water is also poor among them.

Female Labour Force Participation: The female labour force participation rate is 35%, with women engaged mainly as marginal workers. There has been a sharp decline after 2005, with fewer women in non-farm and salaried sectors. A sizable proportion of the labour force in the agricultural sector of Odisha comprises women. With about 60% of the total workforce directly dependent on agriculture; female cultivators and agricultural labourers accounted for 20.11% and 53.90% of the total female labour force respectively.[9]

The percentage of female cultivators substantially reduced to 13%, while the percentage of agricultural labourers became 57.8% of the total female labour force.[10] Most women are employed on small and medium-sized farms and industrialised farms and plantations.

Institutional Births, Antenatal and Postnatal Care: Institutional delivery in 14 districts was recorded at 90%.[11] The Government of Odisha has set up 'Maa Gruhas' or maternity waiting homes to ensure safe deliveries. These waiting homes are designed to accommodate pregnant women around the expected dates of delivery and provide free food, transportation, and regular health check-ups for all admitted clients.

Menstrual Hygiene and Anaemia: 47% women and girls (in the age group 15–24) in Odisha, shared that they use a hygienic method of protection for menstrual health. Of these, 69% reportedly use cloth and 34% use sanitary napkins.[12] The Government of Odisha's 'Khushi Scheme' focuses on distribution of free sanitary napkins. Recognising the need for menstrual hygiene management, Odisha has prioritised free distribution of sanitary pads for women and girls in the affected districts. Approximately 42% women (in the age group 15–49 years) in the affected districts, are anaemic (as compared to 22% men who are anaemic).[13] Emergency situations can affect anaemia directly and indirectly, through poor food intake, infections and psychological stress associated with disasters.

Girl Child Marriage and Early Pregnancy: One in five girls gets married before age 18 in the 14 affected districts.[14] Keonjhar, Mayurbhanj, Baleswar, Nayagarh, and Ganjam have higher levels of child marriage ranging from 26% to 35%. Adolescent pregnancy rate is nearly twice the state average of 7.6% (Figure 13.1).

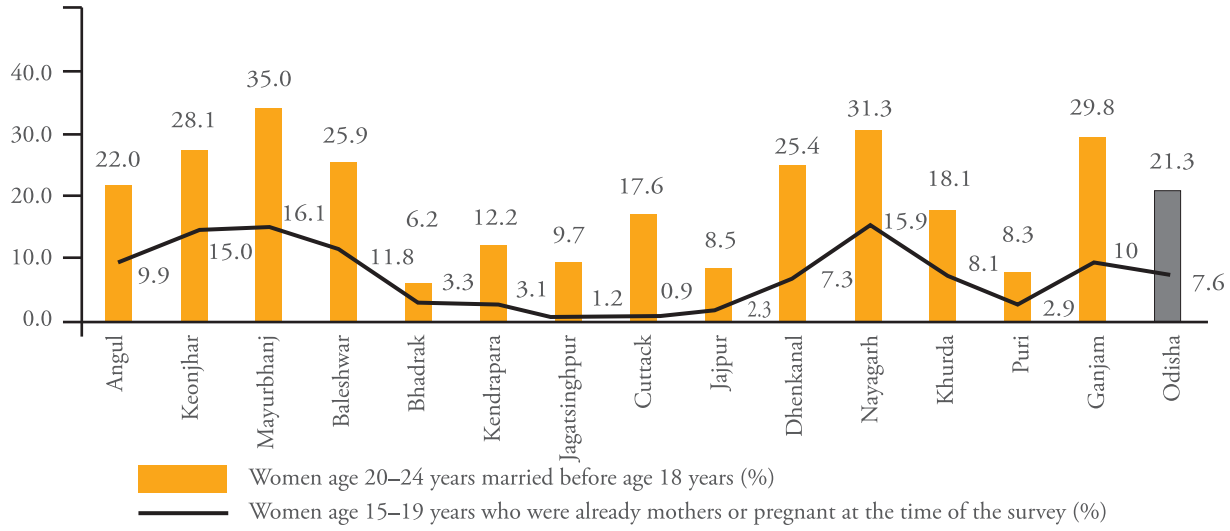
Gender-based Violence: Odisha ranks among the top three states in crime rates against women and girls;[15] with escalating figures each year. Of the total of 17,837 crimes against women reported in 2016, assault against women accounts for 16.08%, followed by 11.1% cases of rape and 7.84% cases of dowry.[16] Forty-seven cases of human trafficking were recorded in 2018.[17]

Intimate Partner Violence: 35% ever married women in Odisha have experienced violence from the husband, while.[18] 60% women and 41% men believe that a husband is justified in hitting or beating his wife under one or more circumstances.[19] An overwhelming majority of women (68%) who had experienced both physical and sexual violence, neither sought help nor confided in anyone about their experience.[20]

Households (HH) in Kutcha Houses: Housing is a complex asset. Sudden loss or damage to houses is directly linked to the decrease in quality of life. Overall, 41.9% HH live in one-room Kutcha houses in rural areas and 47.8% HH live in two-room Kutcha houses in Odisha.[21] Thatched and Kutcha houses are over-represented in SC/ST hamlets and FHHs. The houses are self-constructed, incrementally built and are of substandard quality, and therefore incur maximum damage during any kind of disaster (Table 13.2).

Education: Odisha performs above the national average in terms of access and equity. This is particularly significant, given the high population share of SC/ST communities in Odisha which account for 40% of the state's population.

Figure 13.1: Child Marriage and Adolescent Pregnancy—Baseline Data for the 14 Districts Affected by Cyclone Fani



Source: NFHS 4, 2015–16

Table 13.2: Housing Status in Odisha (by Social Categories)

District	% of HHs (SC)	% of HHs (ST)	% of FHHs with widow/separated woman	% of HHs with natural roofing (proxy for thatched houses)	% of HHs with rudimentary roofing (proxy for kutcha houses)
Angul	14.5	19.0	71.2	25.6	5.1
Baleshwar	23.7	12.7	63.7	32.2	3.3
Bhadrak	27.6	4.9	32.8	53.5	8.6
Cuttack	21.0	4.1	68.7	23.6	5.1
Dhenkanal	19.8	12.5	67.2	34.9	3.4
Ganjam	23.0	7.2	53.2	16.4	1.3
Jagatsinghpur	22.2	1.9	52.1	34.8	0.2
Jajpur	26.1	8.3	65.1	41.0	0.3
Kendrapara	25.5	1.1	46.3	52.2	1.9
Keonjhar	15.6	49.3	69.7	22.5	2.8
Khurda	12.3	6.9	56.1	13.5	0.9
Mayurbhanj	10.1	55.9	78.0	34.6	1.8
Nayagarh	18.2	6.7	53.9	27.3	0.5
Puri	23.1	1.2	64.1	24.4	0.3

Source: Census 2011

Transition rate for ST boys from elementary to secondary is 84% and the corresponding figure for ST girls is 87.20%. This is close to the state average of 91.73%.

Persons with Disability (PwD): The Social Security and Empowerment of Persons with Disabilities (SSEPD) Department was created as a separate department during 2015–16 and works for the overall development of disabled people. It runs a host of schemes that focus on provisioning pension to the destitute and PwD (Table 13.3).

Elderly: 2,19,797 senior citizens reside in Odisha.[22] 5.5% of the total elderly population were affected by cyclone Fani. Incidence of disability among senior citizens

Table 13.3: District-wise Data on Persons with Disabilities

District	No. of Persons with Disabilities as per Census 2011		
	Male	Female	Total
Angul	19,065	15,118	**34,183**
Balasore	39,577	31,159	**70,736**
Bhadrak	23,135	18,950	**42,085**
Cuttack	55,376	46,642	**1,02,018**
Dhenkanal	20,935	16,161	**37,096**
Ganjam	55,844	47,729	**1,03,573**
Jagatsinghpur	18,992	15,362	**34,354**
Jajpur	30,281	23,914	**54,195**
Kendrapara	22,503	17,607	**40,110**
Keonjhar	23,321	19,478	**42,799**
Khurda	36,635	27,314	**63,949**
Mayurbhanj	36,956	31,431	**68,387**
Nayagarh	19,289	14,335	**33,624**
Puri	29,659	24,008	**53,667**
Total	**4,31,568**	**3,49,208**	**7,80,776**

in Odisha is 26.3%. Poverty in households having a senior citizen is 45.54% with another 18.86% marginally above poverty line and at risk of slipping into poverty (Table 13.4).

Table 13.4: District-wise Data on Senior Citizens

District	Population	Elderly Persons	
		No. of People	% of Total Population
Angul	12,73,821	1,14,459	**9.0**
Balasore	23,20,529	2,13,188	**9.2**
Bhadrak	15,06,337	1,43,149	**9.5**
Cuttack	26,24,470	2,78,680	**10.6**
Dhenkanal	11,92,811	1,22,193	**10.2**
Ganjam	35,29,031	3,40,460	**9.6**
Jagatsinghpur	11,36,971	1,35,901	**12.0**
Jajpur	18,27,192	1,85,483	**10.2**
Kendrapara	14,40,361	1,69,309	**11.8**
Keonjhar	18,18,390	2,04,500	**8.0**
Khurda	18,07,589	2,07,559	**12.1**
Mayurbhanj	17,96,789	2,10,619	**4.4**
Nayagarh	17,85,989	2,13,678	**11.8**
Puri	17,75,188	2,16,738	**12.3**
Total	**17,64,388**	**2,19,797**	**10.0**

13.2 Post-Disaster—Social Impacts

13.2.1 Key Highlights:

- Vulnerable groups suffered severe damage to their houses, livelihoods and assets. This severity of loss is likely to deepen their vulnerability.
- Loss of life was largely averted, with the number of deaths recorded at 64 (46 male and 18 female).
- Approximately 81 lakh (50%) of the affected population is estimated to be women and girls:[23] 18% are estimated to belong to the SC community (49% women) and 14% from the ST community (50% women).[24]
- Kutcha houses have suffered the maximum damage (partial and complete); SC and FHHs are over-represented amongst households, with totally or partially damaged housing structures.
- Given that most of these households depended on either farm-based livelihoods or engaged in informal work, reduced agricultural work and time poverty is expected to push them into further poverty.
- Disruptions in economic activities and loss of income may have compounded impact on women, children and girls, like domestic violence, distress selling of assets, child and early marriage, child labour and human trafficking.
- Poor women engaged in microenterprises and small businesses have witnessed loss of common facility centres (CFCs), buildings, equipment, warehouses and raw materials. Damages and income losses will not only affect income and livelihood security of women producers and their households, but also impact their food consumption, health expenditures and quality of life. Adding to the high burden of credit, women may resort to taking further loans and fall into debt cycles.
- Breakdown of water supply systems has put responsibility of household water and food management on women and adolescents, including fetching and storing water for drinking, food preparation, personal use, washing, cleaning and taking care of dependents. Water scarcity has had a disproportionate impact on women and adolescents, including increased unpaid and care work.
- Safety and privacy of women and girls is at risk due to lack of sanitation facilities and disruption of electricity supply following the cyclone.
- Vulnerability of PwDs has increased with limited access to common facilities, relief and raw materials.

Fani affected 16.5 million people across 18,500 villages and 51 Urban Local Bodies (ULBs) of 14 districts—Angul, Balasore, Bhadrak, Cuttack, Dhenkanal, Ganjam, Jagatsinghpur, Jajpur, Kendrapara, Keonjhar, Khurda, Mayurbhanj, Nayagarh and Puri. Among these, Khurda, Puri, Cuttack, Jagatsinghpur and Kendrapara were most affected. As per the Inter Agency Group (IAG) assessment, 80% of rural households have been affected in Puri, Khurda, Cuttack and Jagatsinghpur. Slums in urban areas have also been affected in Bhubaneswar, Puri and Cuttack. Official data confirmed that in total, 64 persons lost their lives (46 men and 18 women). Further disaggregation in terms of social groups is not available (Table 13.5).

Table 13.5: Data on Casualties—Cyclone Fani

District	Male	Female	Fatalities
Cuttack	05	01	06
Jajpur	02	01	03
Kendrapara	01	02	03
Mayurbhanj	04	00	04
Puri	27	12	39
Khurda	07	02	09
Total	**46**	**18**	**64**

Differential Impact of Cyclone Fani: The disaster has had comparatively higher and differential impact on the socially vulnerable and marginalised population groups.

Poverty, location of residence, inequality, social and gender discrimination further compounded the pre-cyclone vulnerabilities of these groups. The severity of damage to houses, and loss of households and assets were most felt by vulnerable groups.

Women constitute 50% of the affected population. An estimated 1,65,55,507 persons have been affected;[25] 81 lakh are estimated to be women and girls;[26] 18% from SC community (49% of who are women) and 14% from ST community (50% of who are women)[27] (Table 13.6).

Table 13.6: Disaggregated Data on Persons Affected

	All Persons Affected		All SC Affected		All ST Affected	
	Number	*%*	*Number*	*%*	*Number*	*%*
Total	**1,65,55,507**	**100**	**29,69,990**	**18**	**22,57,434**	**14**
Male	84,17,404	51	15,01,337	51	11,22,401	50
Female	81,12,198	49	14,68,653	49	11,35,032	50

Source: State Emergency Operation Centre (SEOC), Bhubaneswar, Odisha

Damage to Houses: The 14 affected districts are densely populated, primarily rural but with a mix of urban areas, slums and informal settlements—as compared to other interior districts in Odisha. Kutcha houses have suffered maximum damage. Over 500,000 houses were damaged; thatched houses were destroyed while kutcha houses were extensively damaged. The SC and FHHs incurred maximum damage to their structures. Most kutcha houses in rural areas of the affected districts have also quoted loss of stored grains, which has a direct clear link to a diverse food basket and food-security. Furthermore, the landless or families with no land patta will receive no housing support from the Revenue & Disaster Management Department.

Food and Ration: It was noted that most anganwadi centres (AWCs) had stocked and distributed take-home ration (THR) before the disaster. Where THR was distributed beforehand, the possibility of THR being consumed by the whole family, instead of the child or the pregnant mother cannot be ruled out. While the government distributed 50 kg rice for each household with immediate effect through Public Distribution System (PDS) shops; households with no ration cards were not able to access it. Ration cards are given to families instead of individuals. Larger families with a higher number of members were clearly disadvantaged, getting the same amount of rice as smaller families. Access to relief materials and free cooked meals was especially challenging for senior citizens and PwDs. Central Statistics Office (CSO) reports suggest that persons with special distress ration cards, Antyodaya and Annapurna cards were not included in the list of the relief system.

Limited Access to Service Provision: Both government reports and community interactions corroborate that basic health service provision and AWCs were functional with immediate effect in all districts. However, with institutions like AWCs for service provision, primarily located in main revenue village or panchayat headquarters, access to services by certain castes living away from the revenue village was intermittent. Group discussions showed that children living far away from AWCs did not access services, because families were busy rebuilding and did not have time to take their children to these centres. According to the preliminary report on Fani, submitted by the Special Relief Commissioner, a total of 1,031 health institutions (including health sub-centres, Primary Health Centres (PHCs) and Community Health Centres (CHCs)) were damaged by the cyclone.[28] The total damage was calculated to be INR 1,276.25 lakh.[29]

Access to Health Services: Pregnancy and childbirth are additional vulnerabilities for women during emergencies. In terms of response initiated by the state government, a total of 1,945 pregnant women were shifted to Maa Gruhas/or delivery points.[30] Deliveries continued in all government-run hospitals. At district hospitals in the most affected districts, a separate ward was arranged for pregnant women and injured individuals. Within three days of the cyclone, medical teams were deployed to the field in all affected districts. However, the Health Management Information System (HMIS) will be required to provide information on the actual number of women, girls and members of vulnerable groups who accessed health services and or were treated for injuries caused by violence.

Increase in Open Defecation: With already low levels of toilet usage and extensive damage to toilets, a steep increase in open defecation was noted especially amongst women, children and adolescent girls. Focused Group Discussions (FGDs) with community members revealed that while men continue to access the toilets in cyclone shelters, most women face the challenge of lack of access to sanitation facilities. Absence of safe places and homes, non-availability of electricity, and damage to household

toilets means that women have become more vulnerable to harassment and violence even in the slums of the three affected districts. This may lead to increased health risks for women due to infection, sanitation related psychosocial stress, and increased risk of violence. These risks are further compounded for women, children, adolescents and elderly with disabilities.

Income Shocks for Women Self-help Group (SHG) Members and Producer Groups: The cyclone has significantly affected Odisha Livelihoods Mission (OLM) supported producer groups and SHG members. As per the rapid damage needs assessment conducted by OLM in 31 blocks of five most affected districts, more than 6,500 producer group members have lost raw materials, infrastructure, and finished goods. The CFCs, buildings, equipment, and warehouses associated with many of these activities have also been damaged. It is expected that this damage, loss of work days and income losses will affect income and livelihood security of the women producers and their households and thus further intensify their vulnerabilities.[31] Women comprise a bulk of the unskilled labour force across the 14 affected districts. With women having the largest credit burden, outstanding loans to banks, Micro Finance Institutions (MFIs) and Federations have become more vulnerable. Interactions with women's federation shows that the some MFIs have been aggressively seeking repayments of outstanding loans from the cyclone affected, especially women. Community interactions across all five affected districts reveal that instalment payment was met from INR 2,000 that they received as relief. With possessions lost, maximum investment in agriculture and no alternate livelihoods, coupled with poor access to services, there is significant possibility that marginalisation and feminisation of poverty would intensify in the affected districts.

Urban Slum Dwellers, **Brick Kiln Workers and Wage Labourers**: Food scarcity was a major challenge in urban slums in Bhubaneswar, Khurda, and Puri districts. It was noted that many people outside of camps, are still in need of food, drinking water, clothes, medicines, personal hygiene material, bedding material, kitchen utensils, and interim shelter. In Bhubaneswar, slum dwellers living in makeshift shanties have been rendered homeless without shelter, food or clean water. About 2,000 people, mostly brick kiln workers, including children, were evacuated near Bhubaneswar. These workers are from western Odisha districts and live in temporary earthen hutments, in about 15 brick kiln work sites in Bhubaneswar, and were most vulnerable to the effects of the cyclone.

Scheduled and Particularly Vulnerable Tribes: The impact of Fani has been relatively less on tribal communities, but schools and hostels run by the SC/ST department have been damaged in 11 districts.[32] In Mayurbhanj (Moroda block), Particularly Vulnerable Tribal Groups (PVTG) houses have been affected fully or partially, nurseries have been destroyed, and community infrastructure like school buildings has been damaged/destroyed. Most of the PVTG HHs roof has been partially or fully damaged. Nurseries raised in the PVTG area have been destroyed.

Agriculture, Horticulture, Livestock and Fishing: Sharecroppers and tenant farmers, who had already invested in agricultural and horticultural activities, are expected to suffer the most—with huge loss incurred to kharif crops, betel vines, coconut orchards and other cash crops. Poultry farmers have incurred huge losses as compared to other livestock.[33] Fishing communities have suffered large-scale damage to their habitat, boats and nets in Chilika, Puri, and Jagatsinghpur districts. Socially disadvantaged and economically vulnerable, the shock of losing all means of livelihoods is expected to push them into further poverty and debt.

Jagatsinghpur and Puri have reported instance of human trafficking; two instances of girl-child trafficking from Balianta block were identified. Women and children in the affected districts are likely to face an added risk of human trafficking, child labour, and violence (including sexual and gender-based violence [SGBV]) as a result of the disaster.

Group discussions with the community women in Pani Tanki slum of Bapuji Nagar, highlighted anecdotal instances of women reporting domestic violence. The incidence of domestic violence typically increases due to stress and feelings of powerlessness due to bereavement, loss of property and livelihood, mental health problems such as post-traumatic stress disorder and the scarcity of basic provisions. This may not reflect in officially reported numbers owing to the challenge of women's access to existing essential services. Studies indicate that women normally take 80% of unpaid work, 27.2 hours per week.[34] Women's care burden has increased dramatically in the post-disaster context. This includes an increase in working hours for restoring homes and farms, fetching water, arranging for food, and taking care of children due to lack of childcare provisions. Given the family practices, these additional tasks place a high work burden on women and girls. This has reduced the time they can devote to rest, recreation, and for accessing services for their health and well-being.

Persons with Disabilities: They are among the groups considered at highest risk and the first victims of natural disasters. Disabled people are often not reached on time and are not able to access common facilities and shelters exacerbating their vulnerability. While Fani affected 51.5% HHs of the PwD, affected SHGs of PwD (constituted under 'Mission Khyamata') account for 60.6% (736 SHGs, 3,680

Table 13.7: Data on PwD Affected

District	No. of PwDs as per Census 2011			Disability SHGs			
	Male	Female	Total	SHG No.	No. of PwDs	SHGs Affected	No. of PwDs Affected
Angul	19,065	15,118	34,183	22	110	0	0
Balasore	39,577	31,159	70,736	35	175	35	175
Bhadrak	23,135	18,950	42,085	34	170	4	20
Cuttack	55,376	46,642	1,02,018	102	510	102	510
Dhenkanal	20,935	16,161	37,096	21	105	0	0
Ganjam	55,844	47,729	1,03,573	71	355	0	0
Jagatsinghpur	18,992	15,362	34,354	141	705	141	705
Jajpur	30,281	23,914	54,195	53	265	53	265
Kendrapara	22,503	17,607	40,110	81	405	81	405
Keonjhar	23,321	19,478	42,799	143	715	0	0
Khurda	36,635	27,314	63,949	130	650	130	650
Mayurbhanj	36,956	31,431	68,387	154	770	0	0
Nayagarh	19,289	14,335	33,624	36	180	0	0
Puri	29,659	24,008	53,667	190	950	190	950
Total	**4,31,568**	**3,49,208**	**7,80,776**	**1,213**	**6,065**	**736**	**3,680**

members against total of 1,213) SHGs in the 14 districts, whereas no SHG is reported to be affected in 6 districts (Table 13.7).

Reduced Access to Infrastructure for Women: Field visits and discussions with CSO partners revealed that cyclone shelters, community halls and panchayat institutions are heavily dominated by men, while women continue to form huddles in the sweltering heat following the cyclone. The AWCs, which could have served as alternate public spaces for women, are usually located in upper-caste hamlets and are wanting in terms of structural design and adequate seating space. The damage to toilets and the contamination of village ponds used for bathing and cleaning functions, by debris during the cyclone, has impacted access to clean water and sanitation facilities for women and girls. Further, women take up multiple responsibilities—a primary caregiver, she simultaneously rebuilds homes, contributes to household incomes and therefore requires special social protection schemes in her favour.

Reduced Access to Shelters and Relief for SC (Dalits): Cyclone shelters successfully saved lives during and after cyclone Fani. However, their relevance, accessibility and utility for most vulnerable social groups, especially Dalits, has been undermined by caste discrimination. There were instances where SCs/Dalits faced discrimination and humiliation while seeking protection in cyclone shelters[35] at Balabhadrapur, Biripada, and Hatasahi in Puri. Fishing communities also faced the same discrimination. Cyclone shelters located in upper-caste hamlets were locationally disadvantageous for Dalits, who then took refuge in dilapidated and underequipped shelters in temples, colleges and schools. The CSO volunteers have documented such instances of discrimination from almost all affected districts. Instances of differential and delayed access to community kitchens, relief material and cooked food were also recorded. Anecdotes from community interactions highlighted that though almost all affected communities could access the relief provided by the state government (INR 2,000 and 50 kg rice), there have been gaps in equitable access to service delivery. Social cohesion and social capital are likely to have been strained due to disparities in access to relief and compensation. Levels of trust are likely to have decreased between communities and social groups.

Key Gaps in Sector Preparedness: Non-availability of disaggregated data by social groups was a major constraint. For instance, injuries and casualties were reported in terms of total numbers with no disaggregation. This made it difficult to objectively assess and understand specific risks, and the extent of impact on socially vulnerable groups.

13.3 Recovery Needs and Strategy

Inclusive access to public structures and buildings, equitable access to institutions such as elementary and secondary schools, fair price shops (FPS), AWCs, cyclone shelters, PHCs, community halls and panchayat buildings, especially Rajiv Gandhi Seva Kendras during and post-disaster, is

crucial towards fulfilling recovery needs and ensuring smooth restoration—considering that these structures serve as 'information booths' and relief distribution points for the administration, to reach out to the community. If located in socially-dominant hamlets, free access to women and SC/ST households is limited. The physical and social distance gets magnified during and in the post-disaster situation.[36]

Secondly, building social cohesion would require long-term equitable recovery strategies that could mobilise communities to reduce vulnerability, reverse social equations and increase overall resilience of marginalised sections. The strategies should be participatory and recovery resources need to be made favourable to vulnerable groups—like access to reconstruction and rehabilitation jobs would strengthen their capacities and skills to appropriately utilise them. Investment funds and income-generating projects will help them become resilient in the long term.

13.3.1 Immediate Recovery

1. Targeted support to FHHs, Widows, PwDs, Elderly, People without Ration Cards, Brick Kiln Workers:
   (a) Leveraging vulnerable households identified under the Socio Economic and Caste Census (SECC)
   (b) Data collection on women (especially single women), elderly PwDs and SCs/STs who access relief camps
   (c) Disaggregated damage assessment
   (d) Advance payment of social security entitlements and payments
2. Supporting Children in SC and ST Hamlets: Mid-Day Meal (MDM) resumed in affected areas even when schools are closed for summer vacations
3. Cash for Work and Food for Work for Vulnerable Households: Reactivate Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) and cash for work schemes to include activities like for debris cleaning, house construction, rebuilding community infrastructure
4. Relief Support to Share Croppers and Tenant Farmers: Procurement and compensation, equated monthly instalment (EMI) holidays, relaxing norms

13.3.2 Mid-Term Recovery

1. Financial Support to Women SHGs under OLM; Mission Shakti (MS) and SHGs with PwDs
   (a) Seed money and Community Investment Fund (CIF) to SHGs in cyclone-affected blocks
   (b) Vulnerability Reduction Fund (VRF) to MS for most affected vulnerable households in the villages
   (c) Advisory issued for EMI holidays for Scheduled Banks and especially private MFIs and Community Federations
2. Women's Producer Groups and Enterprises supported by MS, OLM and Odisha Rural Development and Marketing Society (ORMAS)
   (a) Provision finances to restart economic activities to run small enterprises linked with MDM and ICDS, lost raw material/finished goods
   (b) Handholding and marketing support
   (c) Government orders for goods and supplies to women's groups, PwDs, SHGs
3. Housing Support for Vulnerable Households: Owner-driven construction of housing approach (ODCH) especially for completely damaged houses. As against a pre-engineered house an ODCH will build capacity amongst communities to address differential needs of men, women, elderly, disabled, landless and even minor beneficiaries. A microfinance market could be incentivised to expand its services to low-income families where beneficiaries are willing to leverage additional resources.

13.3.3 Long-Term Recovery

1. Rebuild Social Capital and Cohesiveness: Community-based approaches that seek participation and mobilisation of especially vulnerable communities. Psychosocial care is a very critical need.
2. Policy to Monitor Action of MFIs and Banks: The Government of Odisha needs to make special policy provisions on the actions of MFIs and lending institutions during and in the aftermath of disasters. Clear standard operating procedures (SOPs) should be issued to provide for EMI holidays and waiver of loans, low interest loans, etc. especially for borrowers from marginalised sections.
3. Social Interventions
   (a) Support implementation of policies and social and behaviour change strategies (focusing on families).
   (b) Build capacity of stakeholders to address harmful practices like child marriage, child labour, trafficking amongst socio-economically vulnerable families in high prevalence districts.
   (c) Create skill building opportunities, especially for girls for improved livelihoods and gainful employment.
   (d) Ensure an effective health sector response to sexual and gender-based violence; Malware Information Sharing Platform (MISP) training for

all relevant government line departments and civil society organisations must be conducted periodically.

(e) The state government needs to prioritise repair and restoration of all damaged health facilities to ensure resumption of services and avoid overburdening of functional facilities. Ensure provision of supplementary nutrition through THRs prepared by women's SHG, which may have been impacted due to the damage borne by AWCs.

The immediate final recovery plan focuses on quick relief to reactivate thrift and credit activities to the affected SHGs.

The mid-term recovery plan focuses on providing financial support for setting up petty businesses including THR units, seed processing units, nursery raising.

The long-term recovery needs look at capacity building of SHGs to make them more disaster resilient. It is proposed that each SHG would at least be given five kinds of training, on the basis of the occupational mapping and profiling[37] and context specific income generation opportunities (Table 13.8).

Table 13.8: Costing for Assistive Devices for PwDs

District	No. of Persons with Disabilities as per Census 2011			Costing for Assistive Devices			
	Male	Female	Total	% of PwDs	No. of PwDs	Unit Cost (INR)	Total Cost (INR crore)
Cuttack	55,376	46,642	1,02,018	30	30,605	30,000	**91.82**
Jagatsinghpur	18,992	15,362	34,354	20	6,870	30,000	**20.61**
Kendrapara	22,503	17,607	40,110	20	8,022	30,000	**24.07**
Khurda	36,635	27,314	63,949	40	25,579	30,000	**76.74**
Puri	29,659	24,008	53,667	80	42,933	30,000	**128.80**
Total							**342.03**

It is assumed that 80% of the total PwDs have lost their assistive devices in Puri; 40% in Khurda, 30% in Cuttack; and 20% in the remaining 11 districts. The per person cost for the assistive device has been assumed as INR 30,000.

13.4 Key Policy Recommendations

1. Capacity building of key stakeholders on inclusive assessment and recovery planning
2. Development of Practical Tools/Templates, disaggregated indicators and Standard Operating Procedures (SoPs) for inclusive planning and recovery for Inclusive Recovery and Tracking Indicators
3. Study on medium- and long-term recovery of households affected by successive disasters, as well as access to post-disaster relief, shelters, food and compensation
4. Disaggregated Health Information: A critical aspect of disaster management is systematic, disaggregated (by sex and social groups) data collection, analysis and management.
5. Extend the existing social protection programmes for most vulnerable, including widow pension, elderly pension, support for PwDs, and scholarships for SC/ST students to address vulnerabilities and risks due to disasters.

Notes

[1] *Census of India 2011*, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India, New Delhi.

[2] Ibid.

[3] Ibid.

[4] Ibid.

[5] World Bank (2016), *Odisha: Poverty, growth and inequality (English)*, India state briefs, World Bank Group, Washington, DC.

[6] http://wcdodisha.gov.in/Application//uploadDocuments/plugin/doc20170729_123119.pdf

[7] http://documents.worldbank.org/curated/en/911551467996665257/pdf/105872-BRI-P157572-ADD-SERIES-India-state-briefs-PUBLIC-Odisha-HealthEducation.pdf

[8] http://documents.worldbank.org/curated/en/448471468194959218/pdf/105875-BRI-P157572-ADD-SERIES-India-state-briefs-PUBLIC-Odisha-Social.pdf

[9] Census 2001

[10] Census 2011

[11] Ibid.

[12] NFHS IV (2015–16)

[13] Ibid.

[14] Ibid.

[15] National Crime Records Bureau (2016), 'Crime against Women', *Crime in India 2016: Statistics*, NCRB, MInistry of Home Affairs, Government of India, New Delhi, pp 133–184.

[16] Ibid.

[17] State Crime Records Bureau, 2018.

[18] Ibid.

[19] Ibid.

[20] Ibid.

[21] Census 2011. These figures are higher than the national average.

[22] Census 2011.

[23] Estimates of affected women calculated based on proportion of women in the overall population of the 14 districts as reported in Census 2011.

[24] Estimates of affected SC and ST populations calculated based on proportion of total SC and ST in the overall population of the 14 districts as per Census 2011.

[25] State Emergency Operation Centre (2019), 'Situation Report on Extremely Severe Cyclonic Storm-Fani: 27.05.2019.' SEOC, Bhubaneswar, Government of Odisha.

[26] Estimates of affected women calculated based on proportion of women in the overall population of the 14 districts as reported in Census 2011.

[27] Estimates of affected SC and ST populations calculated based on proportion of total SC and ST in the overall population of the 14 districts as per Census 2011

[28] Special Relief Commissioner (May 2019), 'Preliminary Report on Extremely Severe Cyclonic Storm Fani'. Revenue and Disaster Management Department, Government of Odisha, Bhubaneswar.

[29] Ibid.

[30] Ibid.

[31] In Cuttack, SHGs—jewellery making, weaving and *dhokra* art; in Kendrapara—vegetable, and mushroom; in Jagatsinghpur—agriculture and off-farm activities,

[32] Balasore, Cuttack, Gajapati, Ganjam, Jagatsinghpur, Jajpur, Kendrapara, Keonjhar, Khurda, Nayagarh, and Puri.

[33] Exact losses accounted in the Chapters 5 and 12 of this report.

[34] http://asiapacific.unwomen.org/en/digital-library/publications/2019/04/addressing-womens-unpaid-work-in-india

[35] https://www.epw.in/journal/2019/21/commentary/multi-purpose-cyclone-shelters-and-caste.html

[36] As per the report of the Odisha State Disaster Management Authority (OSDMA 2019).

[37] Suggested in the Chapters 5 and 12 of this report.

14

Environment

14.1 Pre-Disaster Context

This section focuses on four key identified themes in the fallout of cyclone Fani: (i) the Balukhand–Konark Wildlife Sanctuary, (ii) Green cover and other natural assets, (iii) Chilika Lake and (iv) Debris and waste.

14.1.1 Balukhand–Konark Wildlife Sanctuary

Developed in 1984, this man-made sanctuary is spread over 5,406.76 hectare with a long coastline with well-developed coastal dune system. The dunes play a crucial role for Disaster Risk Reduction (DRR) and provide a host of ecosystem services. The sanctuary comprises of Balukhand Reserve Forest (RF) and six Protected Forests (PF) spread over Balukhand and Konark forest range of the Puri Wildlife Division. The flagship species of the sanctuary is the spotted deer, whose number is 4,315 as per a 2018 census.

Situated along the east coast, the sanctuary is vulnerable to cyclones. As a management intervention, extensive shelterbelt plantation in the sanctuary has been carried out by the Forest Department since 1916 and much before it was declared a sanctuary. The vegetation of the sanctuary is mostly exotic, dominated by *Casuarina equisetifolia* interspersed with cashew nut (*Anacardiumoccidentale*), *Acacia auriculiformis* and *Eucalyptus* sp., which can typically withstand wind velocities up to 100 to 150 kilometres. A number of indigenous trees and shrubs have also naturally regenerated and enriched the wildlife habitat. Together, the natural and shelterbelt green cover in the sanctuary play a significant role in DRR and provide a host of ecosystem services and protect the life and property of the adjoining villages. During the Super Cyclone 1999, extensive damage was caused to the sanctuary, particularly in the Konark Range. The uprooted and damaged trees were subsequently cleared and replanted with Casuarina Equisetifolia, between 2000 and 2003. In the recent past, the sanctuary was also impacted by tropical cyclones such as cyclone Phailin in 2013 and cyclone Hudhud in 2014, which caused damage to the trees and landscape. Cashew nut is the main non-forest product, with an assessed potential of 2,000 quintals per annum. There are 59 villages in and around the sanctuary, with a population of 45,000. A community-based ecotourism complex is operating in the sanctuary since the last two years. The sanctuary serves as a protective coastal barrier for the community and their agricultural fields, which are exposed to high speed winds accompanied by storm surges, saline water intrusion and sand casting.

14.1.2 Green Cover and Other Natural Assets

Trees and other coastal green cover, well-managed coastal dune systems, sea grass beds, and natural and artificial reefs are some of the nature-based solutions (NBS). In Odisha, coastal zone protection measures have included extensive shelterbelt plantations, comprising mangroves, casuarinas and cashew trees.

14.1.3 Chilika Lake

The Chilika Lake is the largest brackish water lake in India and a Ramsar site. The lake is a unique assemblage of marine, brackish and freshwater ecosystems with estuarine properties. It is a hotspot of biodiversity, a wintering ground for more than one million migratory birds and largest population of the Irrawaddy dolphin. The highly productive lake ecosystem sustains the livelihood of 0.2 million fishermen and a 0.8 million lake basin community. The 1,000 square kilometre lake plays a significant role in buffering flood and tidal surges – a vital DRR function – thereby protecting more than 150 adjoining villages. The inlet of the lake was choked due to littoral drift, resulting in poor inflow of seawater which resulted in salinity fall. The decrease in salinity caused proliferation of invasive species, increased turbidity, shrinkage of the water-spread area, loss of biodiversity, and depletion of fishery resources and degradation of ecosystem. To restore the salinity regime, a strait cut was made in the year 2000 to connect the lake to the sea, based on the outcome of numerical modelling.

After this hydrological intervention, there has been a significant improvement of tidal and salinity flux into the lake, recovery of fishery resources due to auto-

recruitment, decrease of freshwater invasive species, expansion of seagrass meadows, rise in dolphin population and overall improvement of the lake's ecosystem and biodiversity. The restoration strategy adopted by Chilika Development Authority (CDA) derived its uniqueness from the ecosystem-based management, firm participation by local communities, linkages with various national and international institutions, and intensive monitoring and assessment of the system. The sudden extreme events along the coast resulted in the increased wave energy and breached the sand spits/widened the inlet width. However, past experience in both cyclone Phailin (2013) and cyclone Hudhud (2014) showed that the opening of the mouths was naturally closed due to coastal processes over a period of time.

14.1.4 Debris and Waste

The 14 cyclone-affected districts generate 1,705.29 MT waste in a day under normal conditions. The Government of Odisha has initiated various integrated solid waste management projects in accordance with the Municipal Solid Waste (MSW) Rules in 2000, through urban local bodies (ULBs). Among the affected districts, Cuttack and Bhubaneswar municipalities have hired private agencies to collect and transport the solid waste to the dump yard. Cuttack and Bhubaneswar have one Temporary Transfer Station (TTS) and one permanent dumping yard each. There are no sanitary landfills in the cyclone-affected districts. Both the municipalities also do not have any organised Material Recovery Facility (MRF) or segregation centres.

Waste management solutions are present in only a few locations across the affected districts. For example, it was only in 2018, the Government of Odisha imposed a ban on polythene sheets less than 50-micron thickness in six cities — Bhubaneswar, Cuttack, Puri, Rourkela, Sambalpur, and Berhampur. Also, only Cuttack and Puri have sewage treatment plants.

14.2 Disaster Effects: Damages and Losses

14.2.1 Balukhand–Konark Wildlife Sanctuary

There has been large scale damage to the trees here, (estimated to be 700,000 in number) and other manmade infrastructure in the sanctuary. Debris from the uprooted and damaged trees is significantly impacting the forest floor and poses a significant fire hazard. While wildlife habitat here has also been severely damaged, there were minimal wildlife deaths as the animals moved to safer parts of the sanctuary. However, now the circulation of spotted deer and other wildlife species inside the sanctuary is also adversely affected. The road network inside the sanctuary was blocked due to obstruction by fallen trees. The meadows and the water holes created for the wildlife were also impacted.

The cyclone damaged the administrative and operational infrastructure of the sanctuary, field offices, staff quarters, rest houses and other vital installation. In addition, the communication network, electricity, water and other services were disrupted and are yet to be restored. The picture below indicates loss of forest cover in the cyclone-affected area.

Figure 14.1: Road Connecting Puri to Satapada

Source: OSDMA Cyclone Fani presentation

There has been a significant loss of ecosystem services. The shelterbelt used to protect the villages from the direct impact of the storm, saline water intrusion, sand casting and would also moderate the climate. The current annual crop of cashew nut has also been lost, and new trees will take time to re-establish.

14.2.2 Green Cover and Other Natural Assets

Out of the 14 cyclone-affected districts Puri, Khurda and Cuttack were the most affected and the maximum number of trees were destroyed in these districts. As per the estimate of the Principal Chief Conservator of Forests (PCCF), Odisha, about nine lakh trees were uprooted across the 14 districts inside the forest and sanctuaries. More than five lakh trees were damaged outside the forest area. Around 7.9 lakh trees were damaged in the urban plantation and other plantation areas. In the severely affected districts there are three important sanctuaries namely Balukhand–Konark Wildlife Sanctuary, Chandaka–Dampara Elephant Sanctuary and Nandankanan Zoological Park. Apart from Balukhand–Konark Wildlife Sanctuary, there was only minor damage to Nadankanan Zoo and Chandaka–Dampara Elephant Sanctuary. A large number of forest offices, staff quarters, Very High Frequency (VHF) towers, protection barracks, eco-tourism facilities, rest houses, boats, nurseries have been badly damaged in Puri and Khurda districts. Minor damages have also occurred to such facilities in other cyclone affected districts.

There have been damages in the NBS that were designed to protect the coastline. Although mangrove areas withstood the cyclone relatively well, tree shelterbelts were severely affected. This has implications for disaster mitigation in the short to medium term, until mature shelterbelts can be re-established. The sand dune zone along the coast will have to be protected which will be the first defence line. The shelterbelt plantation will have to be started leaving the sand dune zone intact.

14.2.3 Chilika Lake

The outer channel and the central sector of the ChilikaLake were within the cyclone landfall zone. This resulted in extensive damage to the property, particularly boats and nets of fishermen, infrastructure, embankment, livestock and trees. Fortunately, there was no loss of human life because of efficient relocation of vulnerable people to safe shelters by the administration. Due to storm surge triggered by the severe cyclonic storm, four new inlets were opened in addition to the existing two functional inlets of Chilika. Out of these four new inlets, two are on the north, and two are on the south side of the functional inlets. The width of the Sanapatna mouth, which was 485 metres before Fani increased to 658 metres.

Figure 14.2: Satellite image of four new inlets in Chilika lake

Source: Chilika Development Authority

The outer channel of Chilika Lake and the Brahmagiri and Krushna Prasad Block were severely impacted due to landfall of Fani. The buildings, landing centres, jetties, field offices, ecotourism complex, rest sheds and equipment of CDA were heavily damaged, and many of them need complete replacement. There was massive damage to the boats and nets of the fishermen of Chilika Lake and it has adversely affected their livelihood. The livelihood of 17 fishermen villages who have adopted dolphin watching as an alternative source of income is also adversely impacted. Out of 1,150 boats used for community based ecotourism, 200 are completely damaged, 250 are severely damaged and 200 are partially damaged due to cyclone Fani. Though May-August is lean tourist season; there is always a good

influx of tourists for dolphin watching throughout the year. However, due to the damaged boats, the fishermen are yet to resume this activity.

The most critical issue and matter of concern after the cyclone Fani was to assess the impact of the four newly opened inlets on the Chilika ecosystem. The salinity regime of the lagoon was expected to change due to the opening of four new inlets post-disaster. In response to this, CDA promptly embarked into a rapid assessment of salinity at 40 locations on 7 May following a grid to assess the impact of inlets. The assessment survey indicated that the overall salinity level of Chilika is currently maintained at the same level as compared to pre-Fani. Two of the newly opened mouths, north to the functional mouth, are almost closed and the other two are veering towards merging with the Arakuda functional mouth.[1] Therefore, as the salinity levels remain more or less the same, new openings have not had a sustained effect.

14.2.4 Debris and Waste

After the devastating cyclone Fani, the quantum of waste in the city suddenly scaled up to a new high. The waste mainly included tree debris, infrastructure debris, household level dry waste, plastic waste, poultry waste and animal carcasses. To manage this quantum of waste was a big problem for all the municipalities during that period. Bhubaneswar Municipal Corporation (BMC) used the open fields to store the green waste for temporary period. For the first few days, almost all the vehicles and human resources of municipalities in affected 14 districts were deployed to clear and transport the green waste on priority basis. As a result, municipal solid waste was not picked up across the cities. In Cuttack, some of the green waste was found in the Mahanadi and Kathajori rivers, and also in local water bodies. Due to the excess of dry tree debris and increasing temperature during summer, TTS-Bhubaneswar and Puri dumping yard caught several low-scale fires. The municipalities of these affected districts had to hire machinery and engage private agencies to clean in the localities.

The disposal of debris in the aftermath of cyclone Fani was a major challenge for municipalities. But there is no reliable data available with the municipalities on the quantum of debris generated or collected in a day. Cyclone Fani has also caused huge damage to urban slums in Bhubaneswar, Cuttack and Puri where almost all roof sheets were damaged. As a result, the more vulnerable waste pickers suffered the devastating impacts of the cyclone due to their pre-existing less privileged socio-economic condition.

No damage was reported to the physical infrastructure of the dumping yard in the 14 cyclone affected districts. The BMC incurred additional operational cost of transporting and disposing the additional large quantities of waste and debris.

For forests and environment, the damages and losses are INR 180.76 crore or USD 25.82 million. Due to the waste and debris generated, the damages and losses are INR 150.18 crore or USD 21.45 million.

14.3 Impact

Cyclonic events occur periodically and cause broader environmental impacts. Those pertaining to cyclone Fani are presented below:

Forest and tree cover serve as barriers to wind and storm / tidal surges. Due to the destruction of the coastal shelterbelts, the vulnerability of the villages within and adjacent to the sanctuary has increased. Moreover, due to high summer temperatures, the dried up uprooted trees and branches create a risk of forest fires. The wildlife habitat is severely damaged and community eco-tourism initiatives within selected forests have been badly affected. Many important ecosystem services such as storage of carbon, moderation of the climate, conservation of soil and water, nutrient cycling, water and air purification and wildlife habitat—have also been affected. These ecosystem services of coastal NBS and

Table 14.1: Overview of Damage and Loss

Description	Damage	Loss	Effects	Effects	Ownership Public	Ownership Private
Forests and Environment						
Balukhand Wildlife Sanctuary	10.05	28.19	38.24	5.46	38.24	0.00
Green Cover	53.04	75.00	128.04	18.29	76.96	51.09
Chilika Lake	4.77	0.00	4.77	0.68	4.77	0.00
Forest Infrastructure	9.59	0.12	9.71	1.39	9.71	0.00
Total	**77.45**	**103.31**	**180.76**	**25.82**	**129.67**	**51.09**
Debris from Urban, Rural, Energy and Public Buildings						
Debris and Waste	0.00	150.18	150.18	21.45	75.09	75.09
Total	**0.00**	**150.18**	**150.18**	**21.45**	**75.09**	**75.09**

their associated DRR benefits will take three to five years or more to recover.

The cyclone resulted in large quantities of waste and debris, including uprooted trees and damaged buildings. This has posed a major challenge to the already deficient waste management system in place. Asbestos waste (building debris that is hazardous), transformer oil leakages (hazardous waste) and wastes from rescue and relief operations (polythene roofing sheets, polythene packets, plastics and packaging) contribute to waste management challenges in the fragile coastal areas and ecosystems.

Therefore, environmental assets need to be protected so that they can protect us during extreme events. There is a need to shift towards Disaster Risk Management (DRM) that goes beyond protecting human lives and reducing property damage and losses, towards enhancing natural ecosystems so that it can in turn build the state's resilience towards extreme climatic events.

14.4 Recovery Costs and Strategies

14.4.1 Short-term Recovery Needs and Strategy

The immediate recovery action warrants clearance of the uprooted and damaged trees in the Balukhand–Konark Wildlife Sanctuary. The massive quantity of dried material lying on the forest floor poses a severe threat of fire hazard threatening the wildlife and the human life of adjoining villages. As per the Wildlife (Protection) Act, and Supreme Court directives, removal of any material from the sanctuary is not permitted. This statutory issue needs to be sorted out on priority basis. Paper and pulp industries could be engaged to use the green debris outside the protected area. Sharing of the revenue generated from the disposal of uprooted trees with the local community could be considered.

Trees that are partially damaged could be restored. Compensatory avenue and institutional tree plantations should be initiated at the earliest. The choice of species should be such that they are disaster resilient.

The renovation, reconstruction of the landing centres and jetty are also of high priority as they are the lifeline for the villagers for communication and fishing in Chilika Lake. The compensation for the damaged boats and fishing nets needs to be expedited. The damaged boats once used by the fishermen to take tourists on dolphin watching need to be included for a compensation package to restore their livelihoods.

The inlets influence the Chilika Lake ecosystem, productivity and biodiversity significantly. Thus, close monitoring of the cross sections of the inlets warrants high priority.

Repairing the sewage treatment plant in Puri to run on full capacity before the monsoon begins is also recommended so that the waste management problem is not exacerbated.

As a part of debris clearance, particular attention needs to be given to the disposal of roofing sheets that could have asbestos content in them. These should be disposed in a scientifically sound manner and in conjunction with the advice given by the State Pollution Control Board, which has already started taking action in addressing this issue.

The list of deep-rooted tree species that can withstand high velocity wind and are suitable for avenue and institutional plantations are given in the following box.

Box 14.1: List of Deep-rooted Trees with Capacity to Withstand High Velocity Wind

Avenue Plantation		Institutional Plantation	
Common Name	Botanical Name	Common Name	Botanical Name
Karanja	*Pongamiapinnata*	Panasa	*Artocarpusheterophyllus*
Nimba	*Azadirachtaindica*	Amba	*Mangiferaindica*
Bara	*Ficusbenghalensis*	Jamu	*Syzygiumcumini*
Aswasta	*Ficusreligiosa*	Oau	*Dillineaindica*
Dimiri	*Ficusrecemosa*	Kaitha	*Limoniaacidissima*
Jari	*Ficushispida*	Nara Koli	*Phyllanthusacidus*
Champa	*Micheliachampaca*	Tentuli	*Tamrindusindicus*
Sunari	*Cassia fistula*	Bela	*Aegle marmelos*
Kanchana	*Bauhinia variegate*	Amla	*Phyllanthusembilica*
Kanchana	*Bauhinia purpurea*	Kanchana	*Bauhinia vahlii*
Palasa	*Butea monosperma*	Asoka	*Saracaasoca*
Patuli	*Lagerstroemia speciosa*	Arjuna	*Terminalia arjuna*
Putranjiva	*Putranjivaroxburghi*	Chatian	*Alstoniascholaris*
Kasi	*Brideliaretusa*	Debadaru	*Polyalthialongifolia*
Naga Champa	*Couroupitaguianensis*	Champa	*Micheliachampaca*
Chatian	*Alstoniascholaris*	Patuli	*Lagerstroemia speciosa*

14.4.2 Medium-term Recovery Needs and Strategy

The coastal shelterbelt replanting should be carried out beyond the sand dune systems as per the Coastal Regulation Zone (CRZ) notification. Dunes are vital ecosystems and act as the first line defence against storm / tidal surges. Mixed species should be planted to improve biodiversity benefits, while including species that can withstand the high speed wind such as Neem, Karanja and Palasa.

The Balukhand–Konark Wildlife Sanctuary offers a unique opportunity to build back better. The replanting with a mix of native species of trees, shrubs and grass along with casuarina is desirable/recommended, with consideration of trees that can withstand wind speeds exceeding 100 km per hour. As a habitat restoration measure, the plantation of native species such as *Zyziphusmauritiana*, *Zyziphusxylopyrus*, *Mababuxifolia*, *Eugenia jambolana* and *Carissa spinarum* is also recommended. The meadows should also be restored as these are vital for the wildlife. All the restoration should be consistent with the approved sanctuary management plan.

Scientific and technical assessment of the entire Odisha coastline is required to identify appropriate NBS that could be used to better guide the planning for disaster-resilient recovery.

Waste management systems in the coastal districts needs to be substantially strengthened. This will include waste segregation at source, bio-degradable solid waste treatment and disposal, non-biodegradable solid waste recovery facilities, sanitary landfills for solid waste disposal and sewage treatment facilities. Further, the informal waste management led by waste pickers should be integrated. Capacity building training should be provided to these waste pickers. The waste management plans should be fully integrated with the District Disaster Management plans.

14.4.3 Long-term Recovery Needs and Strategy

In Chilika Lake, a real-time water level recorder should be installed and the monitoring of tidal influx should be strengthened. Using the data generated, an ecological model should be developed and used as a decision support system tool.

Investments to strengthen waste management should be progressively made in the coastal districts. As far as solid waste is concerned, this should include waste recovery / recycling centres with appropriate technology wherever viable and sanitary landfills for final disposal. In terms of sewage management, a combination of sewage treatment plants (STPs) and faecal sludge treatment plants (FSTPs) – as being planned – should be implemented.

In terms of developing coastal planning, a hybrid mix of engineering and nature-based solutions should become the norm. This will result in more effective coastal protection.

Table 14.2: Recovery Needs (in INR crore unless mentioned otherwise)

Interventions	Short-term	Medium-term	Long-term	Total recovery needs	Total recovery needs (USD million)
Forests and Environment					
Balukhand Sanctuary	11.83	19.35	26.93	58.11	8.3
Green Cover	101.84	34.25	81.56	217.65	31.09
Chilika Lake	20.68	3.78	0.5	24.96	3.57
Forest Infrastructure	14.38	0	0	14.38	2.05
Total	**148.74**	**57.38**	**108.99**	**315.10**	**45.01**
Debris from Urban, Rural, Energy and Public Buildings					
Debris and Waste	150.18	0	0	150.18	21.45
Total	**150.18**	**0**	**0**	**150.18**	**21.45**

For forests and environment, the recovery needs are INR 315.10 crore or USD 45.01 million. Due to the debris and waste generated, the recovery needs are INR 150.18 crore or USD 21.45 million.

Note

[1] The functional mouth refers to the stable opening through which water exchange took place between the sea and the lake (before the cyclone).

15

Disaster Risk Reduction

15.1 Pre-Disaster Context

Odisha, located on the eastern seaboard of India, is one of its most multi-disaster-prone states. On the east, the state is surrounded by the Bay of Bengal with a 480 kilometre (km) coastline. Due to its poor socio-economic profile, Odisha suffers from poor housing structures, large settlements (including densely populated islands near the sea coast) in areas extremely prone to tidal surges, depletion of mangroves and tree shelter belts, location of highly hazardous industries in cyclone-prone areas, and poor access to many villages near the coast, making the state highly vulnerable to hazards. Climate change further exacerbates these risks. The main hazards that threaten the state are:

- **Floods:** Amongst all the natural disasters afflicting the state, floods are the most frequent and devastating. With 80% of the state's annual rainfall concentrated over a short monsoon period of three months and given the flat coastal plains and precipitous slopes in the inlands, rains are often accompanied by floods. Damage due to floods is caused mainly by the rivers Mahanadi, Brahmani and Baitarani. Floods also affect the lower reaches along the Subarnarekha River, the Rushikulya, Vansadhara and Budhabalanga. The state is also prone to flash floods and landslides.
- **Cyclones:** The east coast of India is one of the six most cyclone-prone areas in the world. In the last century, out of 1,019 cyclonic disturbances in the Indian subcontinent, 890 were along the eastern coast. Of these, 260 cyclonic disturbances made their landfall along the Odisha coast. The coast of Odisha has the highest vulnerability among Indian coastal states in terms of landfall. The nature of cyclones across the world has been showing marked unpredictability and this was a feature of both cyclones Fani and Titli, which hit Odisha in October 2018. Since the 1999 Super Cyclone, four major cyclones have struck Odisha: Phailin (2013; 44 dead; 18 districts affected), Hudhud (2014; 0 dead; 15 districts affected), Titli (2018; 61 dead; 16 districts affected) and Fani (2019; 64 dead, 14 districts affected).
- **Droughts:** As the state receives 80% of its rainfall during the monsoon months from June to September, the risk posed by any change in the pattern and distribution of rainfall is substantial. Between 1982 and 2017, rainfall deficiency in the monsoon season varied from 26% to 36%, seven times causing severe droughts and crop loss. If one includes the frequency of moderate droughts, it can be concluded that droughts are very frequent, affecting some parts of the state almost every alternate year.
- **Heat waves:** Climatic changes, depletion of tree cover, overexploitation of ground water resources and high temperatures in the day during the months of May and June, have made the majority of districts in Odisha vulnerable to heat waves. Heat waves are becoming increasingly prominent and regular and bring with them the risk of heat stroke.
- **Lightning:** Lightning has been the single most deadly hazard in the state. Between 2010 and 2017, lightning claimed 2,408 lives—more than any other natural disaster during the period. Most deaths (about 71%) occur during the months of May to August.
- **Earthquakes:** As per the national earthquake hazard classification, the state of Odisha falls between Earthquake Risk Zones II and III, i.e. Low Damage Risk Zone and Moderate Damage Risk Zone, respectively. Although a large part of the state comes under Zone II, the Brahmani-Mahanadi and their deltaic areas come under Earthquake Risk Zone III, which come under 44 out of the 106 urban local bodies of the state.

The socio-economic profile of Odisha makes it extremely vulnerable to natural hazards. With more that 30% of its population below the poverty line, frequent hazards pose a serious threat to the development gains accrued over the years.

Figure 15.1: Multi-hazard Map of Odisha

Source: OSDMA

15.1.1 Institutional Arrangements for Disaster Risk Management in Odisha

Keeping in line with the provisions of the Disaster Management Act, 2005 the Government of Odisha constituted the State Disaster Management Authority (SDMA) in 2010. The Chief Minister is the chairperson of the SDMA and other members are nominated by the chairperson. The State Executive Committee (SEC) has been constituted to assist the SDMA in the performance of its function. The chairperson of the SEC is the Chief Secretary of the State who is also the Chief Executive Officer (ex-officio) of SDMA. The Office of the Special Relief Commissioner (SRC) has been designated as the secretariat of the SDMA. The SRC is also the Additional CEO of the SDMA.

The Revenue and Disaster Management Department is responsible for providing immediate relief to people affected by various calamities. It also leads the relief, rescue, rehabilitation and restoration work. The Special Relief Organisation was established for carrying out relief and rescue operations during and after various disasters. However, since its inception, the scope of the Special Relief Organisation has been diversified. It now also deals with coordination with districts/departments for relief and rescue, reconstruction and rehabilitation work. In addition, it promotes disaster preparedness at all levels in the state with the assistance of the SDMA.

The Odisha State Disaster Management Authority (OSDMA) was set up by the Government of Odisha as an autonomous organisation in the intermediate aftermath of the super cyclone in 1999. The Department of Revenue and Disaster Management is the administrative department of OSDMA. The OSDMA has established a dedicated Geographic Information System (GIS) cell, formulated 30 departmental disaster management plans, established a drought monitoring cell, integrated decision support system (SATARK—System for Accessing, Tracking and Alerting disaster Risk information based on dynamic Risk Knowledge web and mobile app), total lightning detection system, trained community taskforces linked to cyclone and flood shelters in 25 districts and also established a unit to manage the performance of all the District Disaster Management Authorities (DDMAs).

The State Emergency Operation Centre (SEOC) functions round the clock throughout the year. The organisation is headed by the SRC. To implement its mandate, the office of the SRC has an Early Warning Dissemination System (EWDS) with five layers of communication technology, relief code, norms of assistance under the State Disaster Response Force (SDRF) and National Disaster Response Force (NDRF) and District Emergency Operation Centres (DEOCs) in each of the 30 districts. The office is also responsible for requisitions and coordinating the deployment of emergency management services (national, state and local). Similarly, the DEOC functions within the DDMA and is chaired by the District Collector.

Odisha Disaster Rapid Action Force: In the post-1999 super cyclone reconstruction and preparedness phase, the Government of Odisha constituted the Odisha Disaster Rapid Action Force (ODRAF). The ODRAF was conceived as a force that is professionally trained and equipped with state-of-the-art emergency equipment to assist the civil administration in search and rescue operations and relief operations for effective management of disasters. There are 10 ODRAF units strategically located throughout Odisha.

National Cyclone Risk Mitigation Project: Odisha is one of the focus states of the National Cyclone Risk Mitigation Project (NCRMP) of the Government of India. The project aims to address cyclone risks in the country by undertaking suitable structural and non-structural measures to mitigate the effects of cyclones in the coastal states and Union Territories of India. Through the project, Odisha has been able to:

- Strengthen last mile connectivity through EWDS
- Construct and maintain Multi-Purpose Cyclone Shelters (MPCS)
- Build capacity and capability of local communities to respond to disasters

Odisha Disaster Recovery Project: In the aftermath of cyclone Phailin, Odisha is now implementing the Odisha Disaster Recovery Project (ODRP) in Ganjam, Khurda and Puri, with a focus on:

- Resilient housing
- Urban infrastructure
- Capacity building

15.2 Cyclone Fani: Preparedness, Impact, and Response by the Government of Odisha

Cyclone Fani was unusual in many ways. It began in a low-pressure area which was identified by the Indian Meteorological Department (IMD) on 25 April 2019. It was predicted to intensify into a cyclonic storm over the next 48 hours. It meandered over the Bay of Bengal for 11 days, making it the longest ever observed lifecycle of a cyclone over the Bay of Bengal. The forecast of its path was revised nine times. While Odisha was expected to be saved from the wrath of the cyclone in the initial days, on 29 April 2019 the cyclone was confirmed to make its landfall in Odisha. The IMD issued a cyclone-watch message for the Odisha coast at 1.00 PM on 30 April 2019. This was only the second time since 1891 that a cyclone made landfall in Odisha in the month of May.

Cyclone Fani made landfall at about 8.30 AM on 3 May 2019 between Satapada and Puri as an Extremely Severe Cyclonic Storm. A sustained surface wind speed of 170–180 kilometres per hour (kmph) gusting to 205 kmph was observed during landfall. Nine districts received more than 100 millimetres (mm) of rainfall within 24 hours of landfall.

15.2.1 Preparedness after Receiving the Cyclone Warning

As soon as the date of landfall was confirmed, the administration began the process of evacuating people from the most vulnerable areas and geared up for all possible eventualities. On 1 May 2019, Collectors of coastal and adjoining districts were instructed to:

- Identify all vulnerable people and shift them to safe shelters
- Provide special care to shift the old, physically challenged, women and children to shelters
- Ensure safety of residential schools, child care institutions, old age homes and similar institutions
- Ensure availability of sufficient food stuff, drinking water and essential medicines
- Organise cooked food through free kitchens, safe drinking water, lighting, health and sanitation
- Evacuate livestock and domestic animals in vulnerable areas
- Operationalise the DEOCs round the clock

Indian Administrative Service (IAS) officers were assigned to districts likely to be severely affected. Twenty ODRAF teams, 44 NDRF teams and 525 Fire and Disaster Response Teams were deployed strategically across the area of expected impact.

Cyclone related alerts and precautionary measures were delivered via SMS by a Location Based Alert System (LBAS). Cyclone warnings in Odia language were disseminated in the coastal areas through Alert Siren Towers under the EWDS. Early warning sirens were activated, and voice messages disseminated every hour in coastal areas.

Preparedness videos, safety tips were broadcast via major TV channels. FM and community radios were also leveraged for mass awareness. Non-governmental organisations (NGOs) and community volunteers were engaged for public preparedness, warning dissemination and expediting evacuation. Almost 1.8 crore SMSs, 274 siren alerts and 1,275 FM radio alerts had been disseminated before cyclone Fani made landfall. By collaborating with community volunteers, media houses and local agencies, the Government of Odisha ensured that the messages were sent to the most vulnerable areas.

All the key departments such as Public Works, Health and Family Welfare, Urban Development, Women and Child Development, and Energy were instructed to initiate preparatory measures to ensure that the response and restoration of essential services was swift. For instance, to provide shelter materials for the households whose houses were expected to be damaged in the cyclone or heavy rain, 5,97,006 polythene stocks were kept ready at the state and district level for emergency requirement. One lakh food packets were made ready for air dropping. Adequate dry food stock at the district and state level was kept ready for emergency relief. Review meetings were chaired by the Chief Minister to take stock of the preparations.

By taking all these steps, the state was successful in evacuating close to 15.5 lakh people towards 9,177 shelters, including 879 multipurpose cyclone/flood shelters and other safe shelters like schools and public buildings. About 25,000 tourists were also evacuated from the vulnerable areas by mobilising 23 special trains and 18 buses.

Figure 15.2: Districts Affected by Fani

Source: OSDMA

15.2.2 Response Measures in the Immediate Aftermath of the Cyclone

The government immediately responded to the crisis after the cyclone. The Chief Minister's package for gratuitous relief was announced and provided through various social protection schemes of the government. Some of the highlights are as follows:

- All families covered under Food Security in Puri and Khurda received 50 kilograms (kg) of rice plus INR 2,000 (unconditional cash transfer). About 15,35,320 beneficiaries were supported through this social protection scheme, helping in early recovery at household level.
- In all the affected districts, 1month additional pension and house building assistance was declared.
- A special package for street vendors, coconut growers and poultry farmers was announced.
- The distribution of *Chattua* (dry, ready-to-eat food) packets and eggs, two days prior to the cyclone, to the beneficiaries of the anganwadi system as a preparedness measure, added to the early recovery efforts.

In addition, the Inter Agency Group (IAG), a body of 29 international humanitarian agencies, was invited by OSDMA to the first Government of Odisha–NGO coordination for Fani meeting on 30 April 2019. The IAG members provided emergency relief to 1,28,910 households in the affected districts of Puri, Khurda, Jagatsinghpur and Cuttack. These coordination meetings continued to be held daily during and in the aftermath of the disaster.

15.2.3 Key Gaps and Challenges

- **Communication:** The OSDMA had 76 satellite phones under its possession, distributed across the 30 districts, ODRAF units, SEOC, State Fire Service, Police Commissioner, Chief Secretary and Chief Minister's office. However, despite the large number, they were unreliable during the cyclone. All satellite phones were handheld devices without docking stations, which meant they needed to be aligned with the satellite and operated outdoors. During cyclone Fani, this was impossible.
- The **EWDS for last mile connectivity** was implemented in 22 blocks of the six coastal districts. Under this initiative, a total of 327 villages in 22 blocks under six districts were covered with 122 siren towers. From the SEOC, warnings were disseminated to the targeted siren towers with a disseminating capacity of 3 km diameter each. The SEOC also had 160 digital mobile radios. This system functions through the recently established Odisha State Wide Area Network (OSWAN). However, OSWAN functions only on the terrestrial network of the Bharat Sanchar Nigam Limited (BSNL), which was dysfunctional during the cyclone. Hence, with all the telecommunication systems down, the digital mobile radios were also made redundant.
- In this backdrop, the state had to rely on ham radios for communication. The services of ham volunteer teams from West Bengal and Hyderabad were utilised in the districts along with NDRF teams.
- **Planning and Coordination:** The absence of standard operating procedures (SOPs) for preparedness response, use of communication and other Disaster Risk Management (DRM) assets, and social sectoral services led to many instances of confusion and delay. Lack of prepositioning of supplies, equipment, emergency response kits, etc., by line departments is one of the key reasons for the delayed response by some of the line departments. As cyclone Fani kept altering its path, the nodal officers of various departments had to be convinced that it would make its eventual landfall in their district. Once convinced, the officers were reluctant to initiate preparatory measures that had cost implications. This was due to the fear that if the cyclone did not make a landfall, the expenses would be hard to justify.
- The District Disaster Management Plan (DDMP), while being a handy document, must be made more specific to ensure timely humanitarian action and early recovery of services. No evidence emerged of the DDMP being used during non-disaster time as a systemic tool for preparedness within social-sector service delivery systems, nor as a robust guiding plan to coordinate preparedness for timely response. Field level inter-departmental coordination as well as collaboration with/between panchayats, community, Civil Society Organisations, private sector, faith-based and local influencers, media, academia, etc., to achieve early recovery at household level as well of routine social sector services was ad hoc. For DDMPs to become efficient, the Government needs to commit resources for regular simulation exercises and updating of the plans.
- While Odisha had prepared Departmental Disaster Management Plans for 30 departments, none of the departmental nodal officers at the districts had clarity on their roles and responsibilities during the disaster and most of the steps initiated were ad hoc. The department-wise checklist in the DDMPs was also inadequate to respond to the scale of the crisis. Lack of desktop operations and planning exercises and serious mock drills added to the deficiency of knowledge, attitude and skills necessary for emergency programming and service delivery.

- The role and responsibilities of the urban local bodies and the district administration vis-à-vis disaster management also needs strengthening and improved coordination.
- People living in districts that had not been affected by cyclones in recent times had to be convinced with great difficulty to move to the cyclone shelters. The days preceding the cyclone were sunny and clear with no hint of the impending cyclone. This too increased the burden on the administration.
- While the cyclone shelters played a critical role in reducing mortality, the scope for improvement of their quality is vast. Not all the cyclone shelters are electrified, and neither are all shelters equipped with diesel generator sets. Currently, each cyclone shelter has been assigned a corpus of INR 5 lakh. The interest generated from this is expected to cover the minimum maintenance and capacity building initiatives around the shelter. This is grossly inadequate when compared to the role that these shelters are expected to play in saving lives.

15.3 Disaster Effects: Damage and Losses

The damage considered in this section is related to the infrastructure and facilities relevant for DRM, including disaster response. Losses have been calculated based on the government's expenses related to response-related activities, including costs of evacuation, relief distribution, shelter management and expenditure on logistics by the OSDMA. Table 15.1 provides the total damage and loss incurred for disaster response.

Table 15.1: Damage and Loss (in INR crore unless mentioned otherwise)

S.No.	Category	Damage	Loss
1.	ODRAF	0.52	
2.	Odisha Fire Service	2.12	0.67
3.	Assets of Early Warning Dissemination System	2.86	
	Total (in INR crore)	**5.5**	**0.67**
	Total (in USD million)	**0.785**	**0.095**

Source: Government of Odisha

15.4 Impact

Cyclone Fani affected 18,388 villages, 51 towns and 159 blocks across 14 districts: Puri, Khurda, Cuttack, Mayurbhanj, Keonjhar, Baleswar, Bhadrak, Jajpur, Angul, Dhenkanal, Nayagarh, Ganjam, Kendrapara and Jagatsinghpur. Close to 1.65 crore people were thus directly affected by the cyclone in both urban and rural areas. The cities of Puri, Bhubaneswar, and Cuttack were adversely impacted.

Apart from large scale loss of housing, livelihoods and ecology, the cyclone disrupted critical services such as power and water supply, communications and social sector services such as health and education. The communication breakdown also impacted the disaster management function of the Government of Odisha. Despite a very successful evacuation and prompt action by the emergency management services in clearing of roads, the hardship continued for too long. The slow recovery of power and water supply and communication networks created numerous deprivations for the most vulnerable populations groups even though their wellbeing was a declared priority for Government of Odisha.

The total disaster effect due to Fani including damages and losses is equivalent to about 5% of Odisha's gross state domestic product (GSDP) of 2018–19. This becomes all the more significant considering the socio-economic profile of the state. When seen in the backdrop of the recent cyclones – Phailin and Titli – and the damages caused to the state exchequer, the case for Odisha to strengthen its resilience to disasters becomes all the stronger.

15.5 Recovery Costs and Strategies

The investments made by the Government of Odisha in disaster management after the previous disasters have contributed to the comparatively low mortality during cyclone Fani. The Government of Odisha's response to the crisis, its evacuation of at-risk people, and management of cyclone shelters has also gained it a lot of national and international attention. However, considering the state's hazard profile and socio-economic vulnerability of its population, it is imperative for it to keep investing in strengthening DRM systems. In this backdrop, the time has come for the OSDMA to roll out a second-generation Disaster Risk Reduction (DRR) programme with a focus on integrating DRR across the sectors. This will include strengthening governance mechanism to implement better standards for infrastructure design, setting up a monitoring mechanism to ensure compliance to various legislations and regulations, and building capacities at various levels.

Post-disaster recovery is a long-drawn-out and multi-dimensional process. The low asset base coupled with the massive destruction of housing, agriculture, small enterprises and livestock will translate to high levels of rural distress. To ensure that affected communities recover quickly, OSDMA must develop a recovery framework to monitor the progress and quality of early recovery interventions to achieve its resilience building goals and spread awareness as part of its engagement towards public accountability. The

experience of the ODRP should be documented and the success stories upscaled from the current focus districts of Ganjam and Khurda. To give it the seriousness it deserves, OSDMA must consider establishing a dedicated unit for recovery within the organisation.

The recovery strategy can adopt a three-pillar approach:

- Strengthen the robustness of the OSDMA in responding to disasters. This should primarily be through:
    - Expanding the Early Warning Dissemination System
    - Strengthening the Communications network for Disaster Management
    - Setting up of a backup State Emergency Operations Centre
- Promote risk-informed development planning principles and integrate DRR measures into sectoral development plans.
    - Revision of District and Departmental Disaster Management Plans
    - Prepare Multi Hazard Risk and Vulnerability Assessments at the District and State level
- Reduce economic loss and impact of disasters by building resilience among people, service delivery systems and critical infrastructure.
    - Setup a Centre for Mitigation and Recovery within SIDM
    - Promote the adoption of resilient infrastructure across all the sectors

These recovery interventions are further elaborated on the basis of Immediate, Medium and Long term needs as follows:

15.5.1 Immediate Needs

1. A fail-safe communication network needs to be established. This can be achieved by taking the following steps:
    a. Procure docking stations for the satellite phones to solve the problem of having to physically move the satellite phones for seamless connectivity
    b. Invest in portable Very Small Aperture Terminal (VSAT) antennas
    c. Establish a state-wide network of ham operators
    d. Revive the civil Very High Frequency (VHF) network that existed previously. Reviving this specifically for disaster management coordination could act as a backup to other technology-based communication systems.
2. To ensure a functioning communication network in all eventualities, OSDMA should consider establishing a dedicated Communications Unit within the organisation. The model followed by the NDRF, where each battalion has a dedicated Communications unit, could be emulated. Such a unit can also carry out weekly hardware tests with all the stakeholders.
3. The EWDS needs to be expanded to all districts. Currently, only six districts have EWDS capabilities.
4. The DDMPs for all districts need to be revised. This exercise should be aimed at ensuring that the DDMPs clearly define roles of line-departments with respect to preparedness for response. The DDMPs should provide clear guidance to service delivery systems on various elements of sectoral preparedness for response.
5. It needs to be ensured that DDMPs can be implemented by district level nodal officers by providing clear SOPs. Hazard specific SOPs must be prepared for nodal officers of various departments and enough training drills and table top exercises must be conducted.
6. City-specific disaster management plans need to be developed, along with a mechanism for coordination, and clear roles and responsibilities. The City Disaster Management Plans (CDMPs) should also have a direct link with the respective DDMPs.
7. An assessment of cyclone shelters must be carried out to explore possibilities to improve their functionality and make them resilient for the communities using them. The corpus allocated for each cyclone shelter needs to be augmented for operations and maintenance.
8. Develop shelter management SOPs, both for cyclone/flood shelters as well as mass shelters set up in other public buildings, with clear roles for panchayats, wards, ULBs, NGOs, community task forces, administration, etc., to deliver various services defined through defined service level benchmarks and commitments.
9. Regularisation and expansion of GO-NGO coordination for preparedness should be done.
10. The DRR roadmap planned by the state should be finalised and notified, followed by 6-monthly progress reviews with line-departments and other DRR stakeholders, with due focus on emergency preparedness for response. The roadmap should converge with the actions recommended in the State Action Plan on Climate Change.
11. The revised Odisha Relief Code should be finalised and notified to address the needs and event vulnerabilities of the most vulnerable.
12. The Indian Disaster Resource Network (IDRN): Odisha must encourage all districts to regularly update information on this platform. This will ensure

that the administration has the latest information while preparing for a crisis.

13. Disaster resilience should be integrated into sectoral recovery and development plans through large-scale public awareness programmes and capacity building of different stakeholders, especially on the need for integrating disaster resilient construction technology into all infrastructure.

15.5.2 Medium-term Needs

1. A backup SEOC needs to be established. Considering the hazard profile of Bhubaneswar, the OSDMA can do this by upgrading the DEOC of a neighbouring district such as Cuttack or Puri.
2. There is a need to develop hazard specific mitigation plans for the state of Odisha that address key risk and vulnerability drivers.
3. Volunteerism in the field of disaster management should be nurtured and institutionalised. To capitalise on the pool of young, energetic youth in Odisha, the government should formalise the process of registering volunteers and building their capacities. The capacities of civil defence volunteers should also be systematically built and expanded.
4. Sensitisation workshops for senior bureaucrats on climate change adaptation and DRR must be conducted on a periodic basis, including as part of routine staff development and training through Administrative Training Institutes.
5. Populations in cyclone prone districts must be sensitised to comply with the early warnings and advisories issued by the authorities. This could be achieved by preparing Village Disaster Management Plans, which will ensure that the communities are key stakeholders in disaster management. These plans should be an integral component of the Panchayat Development Plans.
6. Multi-hazard-resistant critical infrastructure must be ensured by preparing guidelines for resilient infrastructure across key sectors such as power, water, housing, health, education, etc. Capacity building programmes can also be conducted for various departments on resilient infrastructure planning, design and construction. Odisha could liaison with the soon-to-be-launched Coalition for Disaster Resilient Infrastructure (CDRI) of the Government of India. To complement the supply-side efforts mentioned above, the state should implement a campaign (mission mode) to improve demand for safety using building codes, both in urban and rural areas.
7. Technical experts from OSDMA should be seconded to line-departments to support the mainstreaming of DRR in sectoral systems, monitor recovery programmes and track progress in the developing and roll-out of sector disaster risk management plans.
8. A system of partnerships must be created to complement the formal governance of disaster risk capacity of the Government of Odisha. Two key priorities and entry points should be kept in mind:
   a. Social governance of risk at panchayat/ward level; for example, through appropriate management of common property resources, protection of mangroves, etc.
   b. Social behaviour change communication for DRR
9. A Disaster Management Information System should be established. Odisha has been one of the few states in India to systematically collect, compile and analyse data related to small, medium and large-scale disasters from 1970 to 2003. This effort should be institutionalised, updated and a robust sex/age/disability disaggregated Disaster Management Information System should be rolled out. Odisha should proactively engage with the National Disaster Management Authority's plan to roll out a pan-India National Disaster Management Information System (NDMIS).
10. The Rights of Persons with Disabilities Rules 2017 elaborates on the implementable strategy, specifically with respect to accessibility of infrastructure, transport, information and communication technology, which are important aspects in the context of DRM. OSDMA needs to inculcate the principles of inclusion, empowerment and multi-stakeholder collaboration to ensure their wellbeing.
11. The infrastructure facilities of ODRAF need to be updated.
12. Establish a State Platform for DRR: It is suggested that Government of Odisha sets up a multi-sectoral and multi-stakeholder State coordination mechanism for DRR. Such a mechanism, requested from all State Governments by MHA as one of the key components to implement the Sendai Framework for DRR in India, will galvanise stakeholders and capacities to devise and implement a comprehensive disaster risk management system including its support to the cyclone recovery and rehabilitation.
13. The State Institute of Disaster Management (SIDM), which is expected to be functional by 2020. The SIDM should invest in developing a dedicated Centre for Disaster Recovery and Mitigation. This centre

should carry out action-based research that is directly relevant to Odisha's hazard profile and recovery needs. The centre should also be able to emerge as a hub that attracts the best practices from around the globe.

15.5.3 Long-term Needs

1. A state-wide multi-hazard risk assessment should be conducted and risk profiles developed up to village level in each district, which can be annually updated.
2. Existing guidelines should be used for the construction of resilient infrastructure, including schools, hospitals, shelter and other critical public buildings. New guidelines should be developed where necessary. It is important to ensure their implementation alongside measures for non-structural resilience building.
3. A cell needs to be established to screen the design and costs of large infrastructure through a hazard safety lens before the approval and disbursement of funds. Spot checks must be conducted during the construction process through third-party certification.
4. Disaster risk insurance should be promoted in key sectors such as housing and suitable options identified for risk financing.

Table 15.2: Estimates of Recovery Needs (in INR crore unless mentioned otherwise)

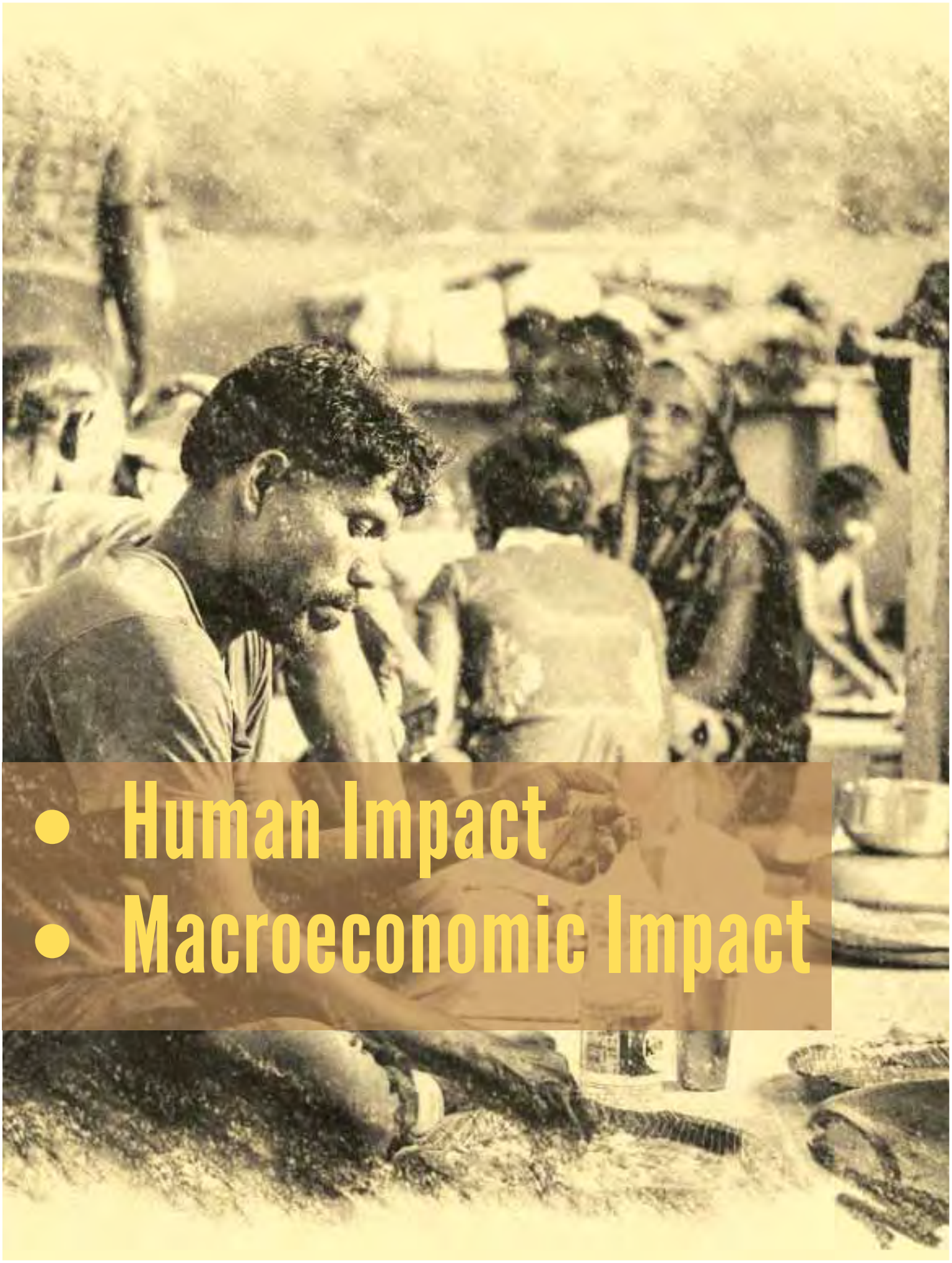
S. No.	Interventions	Short-term	Medium-term	Long-term	Total recovery needs	Total recovery needs (USD million)
1.	Strengthening Emergency Operation Centres at state and district level	18.7	170	0	188.7	26.96
	Expansion of the EWDS		120			
	Setup a Backup SEOC		50			
	Strengthen the Communications Unit	18.7				
2.	Mainstreaming DRR and Climate Change Adaptation through risk mapping	20.9	24.9	20	65.8	9.4
3.	Institutional strengthening	0	4.9	0	4.9	0.7
4.	Risk and vulnerability assessments	1.7	0	15.5	17.2	2.46
5.	Knowledge management	0.5	0	0	0.5	
	Total	**41.8**	**199.8**	**35.5**	**277.1**	**39.59**

Note: Refer to Annex 15.1 for the assumptions and calculations

15.6 Sector Assessment Methodology

The assessment of the DRR sector was carried out through interviews, focus group discussions, literature review and field visits. Detailed discussions were held with the OSDMA to understand the disaster management systems in place and the efforts taken by the SRC to prepare for and respond to the disaster.

Meetings were also held with key stakeholders to understand first-hand the challenges faced during the response and to develop recommendations towards ensuring a stronger response and coordination in future. These included the Odisha Police Service, the Odisha Fire Service, Odisha Civil Defence and the Odisha Disaster Rapid Action Force. Visits were made to four of the most affected districts—Puri, Jagatsinghpur, Cuttack and Kendrapara—to learn from the district administration about district level preparedness, response and coordination of relief activities. Visits to the villages, cyclone shelters and interactions with the communities have also contributed to the finalisation of this chapter, in addition to the engagement of the UN with the civil society organisations and various networks present in Odisha. All the data regarding damage and losses is based on actual figures submitted by the concerned government agencies.



- Human Impact
- Macroeconomic Impact

Human Impact and Macroeconomic Impact: Tables and Figures

Tables

Figures

16

Human Impact Assessment[1]

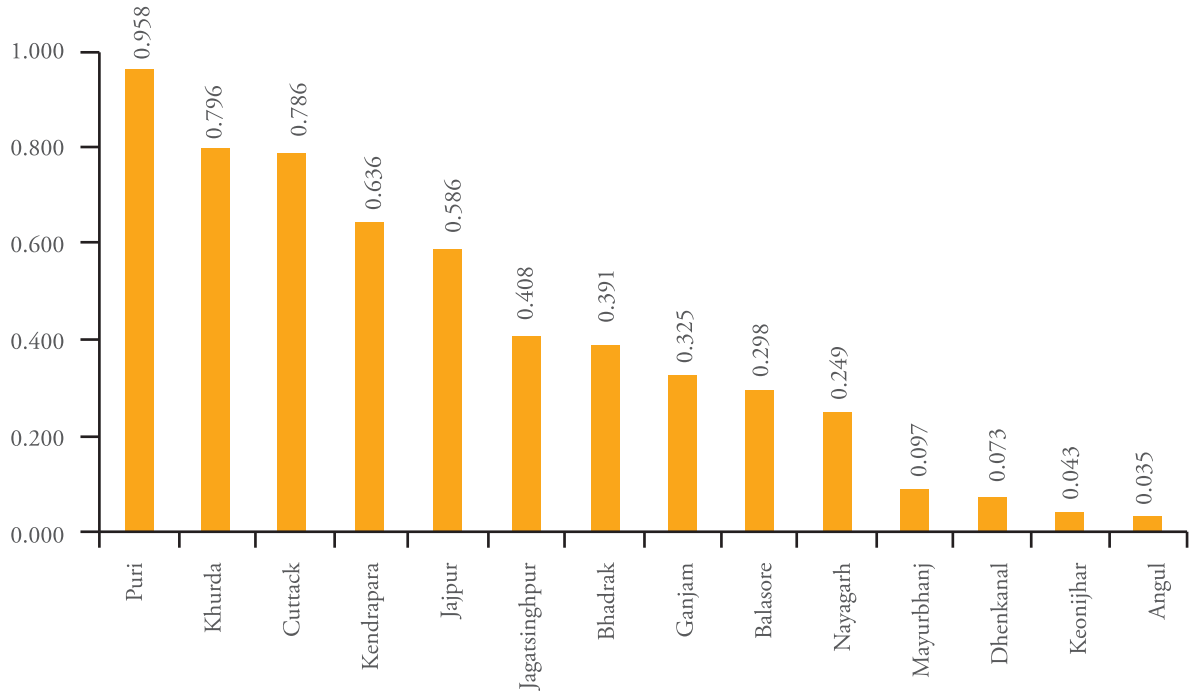
The extremely severe cyclonic storm Fani (pronounced Foni) crossed the coast of Odisha on 3 May 2019 and disrupted the lives and livelihoods of 1,65,30,900 people across 18,388 villages and 51 local bodies, located in 159 blocks of 14 districts.[2] The cyclone's impact was assessed as being extreme in district Puri and minimal in district Angul.

Our exercise on five dimensions—Health, Education, Agri-livelihood, Living standards, and Safe housing (HEALS)—provides a district-specific understanding of impact across these dimensions. An independent analysis also shows how Fani has further increased the incidence of income poverty in Odisha.

The impacts may be transient, but if not addressed could become chronic. To build back better (BBB), this chapter also calls for a community-specific, occupation-specific and location-specific approach that involves different stakeholders—the government, civil society, and the people themselves.

In terms of human impact, a Fani Impact Index was computed and the 14 districts classified into five groups—Extreme (Puri); Severe (Khurda, Cuttack and Kendrapara); Moderate (Jajpur and Jagatsinghpur); Subdued (Bhadrak, Ganjam, Balasore and Nayagarh); and Minimal (Mayurbhanj, Dhenkanal, Keonjhar and Angul)—as shown in Figure 16.1.[3]

Figure 16.1: Fani Impact Index across 14 Affected Districts



Source: Authors' calculation using the view of experts and proportion of affected population

Fani, true to its etymological meaning (the hood of a snake), kept changing course and direction; this made preparations prior to its landfall difficult. However, the Government of Odisha left no stone unturned and took the necessary steps to evacuate more than 15 lakh (1.5 million) people and provided them with basic facilities at shelter points. Drawing upon the lessons of the Super Cyclone 1999 (with near 10,000 fatalities) the state government successfully achieved greater disaster preparedness over the last two decades with better capability in technology, institutions, human skills, and coordination. In spite of these efforts, 64 lives were lost across the state of which 39 were lost in Puri, the district with the maximum impact.

The greater preparedness, however, cannot entirely limit damages and losses (computed at INR 24,176 crore, that is, around USD 3.5 billion) and the adverse impact on livelihood. A total of 88 lakh (8.8 million) livestock were affected:

- 24.4 lakh or 2.4 million large ruminants
- 10 lakh (1 million) small ruminants
- 53.7 lakh (5.4 million) birds

From among the affected livestock, 53.3 lakh (5.4 million) perished. The case fatality per 1000 affected stood at: 1.4 for large ruminants, 2.9 for small ruminants, and 999 for birds.[4] These losses have severely constrained the livelihoods of many engaged in rearing livestock.

More than 32 lakh (3.2 million) fruit and nut trees were either uprooted or severely damaged, including more than 10 lakh (1 million) coconut trees, 14 lakh (1.4 million) cashew nut trees, and close to 47,000 mango trees.

Overall, 3.2 lakh (0.32 million) farmers—approximately 16% of the total farmers in Odisha, and 44% of the farmers of the 14 affected districts—were adversely affected.

The cyclone damaged 1.82 crore (18.2 million) hectare (ha) of crop area that included 30% sown summer paddy, 12% sown mung and 11% perennial fruits.[5]

Last but not the least, 1.5 lakh (0.15 million) members of the traditional fishing community have been severely affected and do not have an alternate source of livelihood.

16.1 Pre-Disaster Context

On the human development front, Odisha is a modestly performing state. Odisha performs below India's average on the Human Development Index (HDI) and its three dimensions—health, education, and income—which are proxies for a long and healthy life, knowledge, and ability to achieve a decent standard of living, respectively (Table 16.1).

Odisha contributes 3.1% of India's Net Value Added (NVA), though population-wise its share is 3.4%. This is reflected in the state's per capita net income, which is 71.8% of an average Indian. In terms of characteristics of economy, Odisha being a mineral-rich state, the contribution of the industry sector to the entire economy is approximately one-third, whereas the corresponding figure for the national economy is nine percentage points less. Odisha has a greater incidence of poverty (i.e., in terms of head-count ratio) than India's average by at least ten percentage points. Odisha has a larger proportion of multi-dimensional poor (MDP) compared to national level, however the average deprivations among MDP in Odisha is at a similar level as that of national average.

In terms of certain social indicators such as sex-ratio, institutional birth rate, and proportion of anaemic children amongst those under five years, Odisha is better-off. However, in certain other indicators such as improved sanitation, use of clean fuel for cooking, stunted children, women with more than 10 years of schooling, women married before 18 years of age, and women with below normal BMI, Odisha is worse off than the national average.

Table 16.2 highlights some socio-economic indicators for the 14 affected districts. There is substantial variation across districts (last column, Table 16.2). In three of the four household-level factors (electricity, improved sanitation, and clean cooking fuel), Khurda scores the highest and Mayurbhanj the lowest. For improved drinking water in households, Bhadrak scores the best and Dhenkanal the least; the difference between the two is 40.6 percentage points, which is among the highest across all indicators reported. For institutional deliveries, Puri is the highest scorer and Keonjhar the least—with healthcare infrastructure taking a hit in Puri on account of Fani, this could have an adverse impact in the short to medium term.

Percentage of women with more than 10 years of schooling is highest in Khurda and lowest in Nayagarh. The district of Nayagarh also has the lowest number of girls per thousand boys (child sex ratio). In terms of sex ratio of the general population (females per thousand males), 10 out of 14 districts have more females than males (Angul has the lowest sex ratio). As against this, the child sex ratio is adverse (less than 1) in 12 of the 14 districts. Except for Dhenkanal, all the other 13 districts have a child sex ratio that is lower than the overall sex ratio for the state. Even if one imposes a stricter criterion taking a sex ratio of 952 females per 1000 males as a benchmark, seven of the 14 districts would still fall below this. The poor sex ratio among children should be a matter of concern in terms of access to healthcare for the girl child in a post-Fani scenario, when the healthcare infrastructure itself needs revival.

Across all the three child nourishment indicators (stunting, wasting, and underweight) Cuttack is the best performer with the lowest incidence. Keonjhar reports the

Table 16.1: Selected Socio-Economic Indicators of Odisha and India

Indicator	Odisha	India
HDI, 2017[a]	0.599	0.639
Life expectancy at birth (years), 2017[a]	68.2	68.8
Expected years of schooling (years), 2017[a]	11.9	12.3
Mean years of schooling (years), 2017[a]	5.6	6.4
Net State Value Added (NSVA) (Odisha)/Net Value Added (NVA) (India), 2011–12 constant price (INR lakh crore), 2017-18[b]	3.29	105.17
Share of Agriculture in NSVA (Odisha)/Gross Value Added (GVA) (India) (%), 2017–18[b]	15.10	14.82
Share of Industry in NSVA (Odisha)/GVA (India) (%), 2017–18[b]	32.24	23.47
Share of Services in NSVA (Odisha)/GVA (India) (%), 2017–18[b]	52.66	61.71
Per capita Net State Domestic Product (NSDP) (Odisha)/Net National Income (NNI) (India) at current prices (INR), 2017–18[b]	80,991	1,12,835
Proportion of people below poverty line (BPL) (%), 2011–12[b]	32.59	21.92
Proportion of people BPL rural (%), 2011–12[b]	35.69	25.70
Multi-dimensional poor (MDP) (%), 2015–16[c]	35.5	27.5
Average deprivation of MDP (%), 2015–16[c]	43.3	43.9
Multi-dimensional Poverty Index (MPI), 2015–16[c]	0.154	0.121
Population (crore), 2011[d]	4.2	121.1
Sex ratio (female per 1000 male), 2011[d]	979	940
Child sex ratio (female per 1000 males in 0–6 years), 2011[d]	941	919
Literacy rate (%), 2011[d]	73.45	74.04
Female literacy rate (%), 2011[d]	64.36	65.46
Rural literacy rate (%), 2011[d]	70.78	68.91
Households with improved drinking water resource (%), 2015–16[e]	88.8	89.9
Households with improved sanitation facility (%), 2015–16[e]	29.4	48.4
Households with clean fuel for cooking (%), 2015–16[e]	19.2	43.8
Households with access to electricity (%), 2015–16[e]	85.5	88.2
Women with 10 or more years of schooling (%), 2015–16[e]	26.7	35.7
Women aged 20–24 years married before 18 years (%), 2015-16[e]	21.3	26.8
Women aged 15–19 years, mothers or pregnant (%), 2015–16[e]	7.6	7.9
Institutional birth rate (%), 2015–16[e]	85.4	78.9
Children under 5: stunted (%), 2015–16[e]	34.1	38.4
Children under 5: wasted (%), 2015–16[e]	20.4	21
Children under 5: underweight (%), 2015–16[e]	34.4	35.7
Children aged 6–59 months: anaemic (%), 2015–16[e]	44.6	58.4
All women aged 15–49 years: anaemic (%), 2015–16[e]	51	53
Women with BMI below normal (%), 2015–16[e]	26.4	22.9

Source: (a) Subnational Human Development Index, 2017, Global Data Lab; (b) Handbook on Statistics of Indian Economy, 2018, Reserve Bank of India (including real time data); (c) Alkire, Oldiges and Kanagaratnam (2018); (d) Census 2011; (e) National Family Health Survey, 2015–16 (NFHS-4), International Institute for Population Sciences.
BMI: Body Mass Index

Table 16.2: Selected Socio-Economic indicators in 14 Fani-affected Districts of Odisha

Indicators	Puri	Khu-rda	Cut-tack	Ken-dra-para	Jaj-pur	Jagat-singh-pur	Bha-drak	Gan-jam	Bala-sore	Naya-garh	Ma-yur-bhanj	Dhen-kanal	Keon-jhar	Angul	Gap |Max-Min|
Households, electricity (%)[a]	95.0	**96.4**	91.6	92.4	93.2	92.9	87.2	89.4	88.7	93.4	73.9	88.7	75.0	87.4	22.5
Households, improved sanitation facility (%)[a]	40.1	**47.0**	38.8	25.6	30.7	30.8	23.0	40.7	37.3	31.6	18.1	33.3	20.5	35.6	28.9
Households, clean cooking fuel (%)[a]	19.9	**46.2**	31.0	13.8	15.9	12.8	10.7	34.5	14.2	21.0	9.5	21.0	16.4	21.4	36.7
Households, improved drinking water (%)[a]	95.0	84.6	91.1	98.8	87.8	96.9	**99.4**	90.3	97.7	80.2	81.5	58.8	85.4	77.2	40.6
Institutional births (%)[a]	**97.8**	85.1	94.7	94.2	94.0	97.6	87.7	91.5	91.9	92.5	85.6	90.1	72.7	90.3	25.1
Women, 10+ years of schooling (%)[a]	30.4	**38.3**	32.3	30.3	35.0	38.2	30.4	22.2	31.1	21.9	23.6	33.5	28.1	27.6	16.4
Sex ratio (females/1000 males)[a]	996	980	992	**1129**	1020	1070	1074	1111	1089	1009	1032	1026	1065	935	194
Under 5 years, sex ratio (females/1000 males)[a]	922	965	987	1007	725	929	875	801	969	725	983	**1044**	851	879	319
Children under 5 years, stunted (%)[a]	16.1	24.7	**15.3**	26.9	30.3	19.5	34.9	28.9	33.2	28.0	43.5	26.1	44.6	31.8	29.3
Children under 5 years, wasted (%)[a]	12.1	13.8	**9.1**	12.3	16.5	12.6	15.3	16.4	18.0	17.5	17.2	19.0	19.0	21.6	12.5
Children under 5 years, underweight (%)[a]	17.2	20.3	17.1	24.1	30.0	**16.5**	28.2	21.3	33.7	25.4	43.8	29.2	44.3	35.3	27.8
Children 6–59 months, anaemic (%)[a]	29.2	**19.0**	18.9	28.7	30.0	23.4	22.7	37.4	28.6	26.5	34.5	39.4	32.7	37.4	20.5
Women 15–49 years, anaemic (%)[a]	44.3	45.3	37.8	42.3	43.3	**35.8**	43.5	41.3	41.1	39.8	42.4	39.4	40.5	44.0	9.5
Women 15–19 years, mother or pregnant (%)[a]	2.9	8.1	**0.9**	3.1	2.3	1.2	3.3	10.0	11.8	15.9	16.1	7.3	15.0	9.9	15.2
Women 20–24 years, married <18 years (%)[a]	8.3	18.1	17.6	12.2	8.5	9.7	**6.2**	29.8	25.9	31.3	35.0	25.4	28.1	22.0	28.8
Women, BMI below normal (%)[a]	15.5	**15.4**	19.2	24.3	28.4	17.3	30.3	21.5	25.4	16.4	31.6	25.6	28.9	21.8	16.2
MDP (%), 2015–16[b]	**15.3**	17.4	16.4	27.2	25.0	16.7	35.2	23.6	30.5	24.5	51.0	37.4	45.7	31.3	35.7
Average deprivation of MDP (%), 2015–16[b]	**37.6**	41.5	40.2	39.4	41.3	38.2	39.2	43.6	40.8	41.6	44.6	42.1	47.0	41.4	9.4
MPI, 2015–16[b]	**0.058**	0.072	0.066	0.107	0.103	0.064	0.138	0.103	0.124	0.102	0.227	0.157	0.215	0.129	0.169

Source and Notes: (a) National Family Health Survey, 2015–16 (NFHS-4), International Institute for Population Sciences. (b) Alkire, Oldiges and Kanagaratnam (2018). The districts have been arranged as per our Fani Impact index (most to least impact), as indicated in Figure 16.1. The first eight indicators are for attainment (higher values are better) and the subsequent indicators are for shortfall indicators (lower values are better). Across the 14 districts, the district with the best performance (maximum in attainment indicators and minimum in shortfall indicators) presented in bold and the district that has the least performance (minimum in attainment indicators and maximum in shortfall indicators) is indicated in coloured font.

highest incidence of stunting and underweight children while Angul reports the highest incidence of wasting across affected districts.

Incidence of anaemia among children is the lowest in Khurda, and the highest in Dhenkanal (which is also the district with the poorest access to improved drinking water facility among households). It is intriguing that Khurda with lowest incidence of childhood anaemia reports the highest incidence of anaemia among adult women.

Cuttack has the lowest proportion of women in the 15–19 year age-group, who are either mothers or are pregnant. Bhadrak reports the lowest proportion of women in the 20–24 year age-group, who were married before 18 years of age. Khurda reports lowest proportion of women with a BMI that is below normal.

In all these three women-specific shortfall indicators, Mayurbhanj reports the most adverse figures wherein it may be reiterated that this is also the district where proportion of households with access to electricity, sanitation, and clean cooking fuel is the lowest.

From among the 14 affected districts, Puri has the least deprivation in terms of proportion of MDP, average deprivation of MDP and MPI. Given the impact of Fani, Puri is not likely to be the same. At the other extreme, with highest deprivation, are Mayurbhanj in MDP and MPI and Keonjhar in average deprivation of MDP.

16.2 Impact on Health, Education, and Agri-Livelihoods

In recent times, the multidimensional poverty index has been used as a basis to evaluate the outcome of certain sustainable development goals (Alkire and Jahan 2018). However, the application of that tool is based on availability of individual household-level data. Notwithstanding that, and as also espoused in the HDI, the importance of health, education and living standards are acknowledged.

Under normal circumstances, while not dismissing the importance of livelihoods and housing, they seem to be subsumed within living standards. In disaster situations like Fani, the study assumes that livelihoods are also an important and independent aspect.

In this section, the DLNA develops a Health Access Index (called the H Index, and particularly important immediately after disaster strikes), an Education Access Index (called the E Index, focusing largely on elementary/primary schools with the assumption that during crisis schools provide shelter and that, where feasible from an infrastructural perspective, school vacations were cancelled in the immediate post-Fani period), and finally an Agri-livelihoods Index (called the A Index, with agriculture being an important provider of employment) across the 14 Fani-affected districts. The degree of change in all three indices across all 14 districts can be seen in Table 16.3.

Table 16.3: Health, Education, and Agri-Livelihood Indices Pre- and Post-Fani across Affected Districts

Districts	H Index			E Index			A Index		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Puri	0.794	0.137	-0.657	0.870	0.116	-0.754	0.366	0.294	-0.072
Khurda	0.547	0.231	-0.316	0.901	0.709	-0.193	0.352	0.344	-0.008
Cuttack	0.687	0.363	-0.324	0.891	0.725	-0.165	0.357	0.340	-0.017
Kendrapara	0.728	0.289	-0.439	0.896	0.858	-0.038	0.324	0.317	-0.007
Jajpur	0.736	0.471	-0.265	0.888	0.733	-0.155	0.302	0.291	-0.011
Jagatsinghpur	0.886	0.363	-0.523	0.884	0.694	-0.191	0.355	0.298	-0.057
Bhadrak	0.637	0.364	-0.273	0.905	0.826	-0.079	0.311	0.307	-0.004
Ganjam	0.732	0.732	0.000	0.893	0.805	-0.087	0.426	0.425	0.000
Balasore	0.696	0.460	-0.236	0.938	0.839	-0.099	0.402	0.402	0.000
Nayagarh	0.897	0.355	-0.543	0.872	0.672	-0.200	0.357	0.357	0.000
Mayurbhanj	0.857	0.686	-0.171	0.971	0.953	-0.018	0.486	0.486	0.000
Dhenkanal	0.769	0.470	-0.300	0.911	0.822	-0.089	0.365	0.364	-0.001
Keonjhar	0.834	0.671	-0.163	0.969	0.966	-0.002	0.425	0.425	0.000
Angul	0.681	0.681	0.000	0.957	0.948	-0.009	0.413	0.413	0.000
All Fani districts	0.757	0.446	-0.312	0.914	0.780	-0.134	0.382	0.371	-0.011

Source and Notes: Authors' calculation based on information available in *Rural Health Statistics 2018*, Ministry of Health and Family Welfare Government of India, *Status of Elementary and Secondary Education in Odisha 2017–18*, Odisha Primary Education Programme Authority, and Census 2011 for pre-Fani scenario and data obtained through DLNA for post-Fani scenario. The H Index looks into availability across public health facilities; the E Index is focused on elementary/primary schools; the A Index is in essence the worker population ratio.

The H Index is a measure of access to public health facilities prior to and post-Fani, which is aggregated through the displaced ideal method (Mishra and Nathan 2018) across facilities.[6] It considers the existing population norms for sub-centres, primary health centres (PHCs), community health centres (CHCs) and the existence of district headquarters hospitals (DHHs) as ideal. Post-Fani, the index captures reduced access on account of damage to facilities. For DHHs, the damage is also adjusted with cost per bed benchmarked to the DHH with maximum damage per bed.

The maximum impact on health access has been in Puri, the change in the H Index being –81.1%.[7] The change was –60.5% in Nayagarh, –60.3% in Kendrapara, –59.0% in Jagatsinghpur, –57.7% in Khurda, –47.2 in Cuttack, and –42.9 in Bhadrak, which were with higher absolute values than the average for the affected districts at –41.1%. Impact on access to health was negligible in Ganjam and Angul.

The E Index measures access to elementary/primary schools through net enrolment ratio. Post-Fani, the index captures the possibility of reduced access on account of damage, which is also benchmarked to the district with the maximum damage per school.[8] The change in the E Index was –86.7% in Puri, –23.0% in Nayagarh, –21.6% in Jagatsinghpur, –21.4% in Khurda, –18.6% in Cuttack, and –17.5% in Jajpur, which were with higher absolute values than the average for the affected districts at –14.7%.

Agri-livelihood measured in terms of the worker–population ratio (as per the Census 2011) was taken separately for rural and urban areas and then adjusted to population shares as per extrapolated population values. Post-Fani, the A Index captures those affected among fishermen and crop farmers. It is indicative and could be an underestimation, as many other workers who lost their livelihood would not have been captured. The change in the A Index was –19.7% in Puri, –16.0% in Jagatsinghpur, –4.7% in Cuttack, and –3.6% in Jajpur, which were with higher absolute values than the average for the affected districts at –2.9%. There was no adverse impact on agri-livelihood in Keonjhar.

16.3 Impact on Living Standards and Housing

This section focuses on the Living Standards Index (the L Index), which aggregates access to the household amenities of electricity, sanitation, water and cooking fuel, using the displaced ideal method (Mishra and Nathan, 2018). For the pre-Fani scenario, district-level aggregate attainments on these household amenities are taken from NFHS-4. Post Fani, the adverse impact on household amenities are

Table 16.4: Living Standards Index (L Index) Pre and Post-Fani, Across Affected Districts

Districts	L Index, Rural			L Index, Urban			L Index, Combined		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Puri	0.465	0.267	-0.198	0.682	0.410	-0.272	0.500	0.290	-0.210
Khurda	0.432	0.392	-0.040	0.766	0.728	-0.037	0.618	0.579	-0.039
Cuttack	0.451	0.432	-0.019	0.769	0.754	-0.015	0.538	0.520	-0.018
Kendrapara	0.423	0.423	-0.001	0.548	0.547	-0.001	0.430	0.429	-0.001
Jajpur	0.437	0.429	-0.007	0.558	0.555	-0.003	0.451	0.444	-0.007
Jagatsinghpur	0.430	0.427	-0.003	0.516	0.509	-0.007	0.442	0.439	-0.004
Bhadrak	0.384	0.384	0.000	0.553	0.553	0.000	0.408	0.408	0.000
Ganjam	0.472	0.472	0.000	0.780	0.780	0.000	0.555	0.555	0.000
Balasore	0.429	0.429	0.000	0.753	0.753	0.000	0.467	0.467	0.000
Nayagarh	0.448	0.447	0.000	0.597	0.597	0.000	0.468	0.468	0.000
Mayurbhanj	0.342	0.342	0.000	0.667	0.667	0.000	0.370	0.370	0.000
Dhenkanal	0.385	0.382	-0.002	0.939	0.936	-0.003	0.443	0.441	-0.002
Keonjhar	0.351	0.351	0.000	0.719	0.719	0.000	0.408	0.408	0.000
Angul	0.434	0.434	0.000	0.673	0.673	0.000	0.477	0.477	0.000
All Fani districts	0.423	0.410	-0.013	0.728	0.703	-0.025	0.483	0.467	-0.015

Source and Notes: The L Index aggregates by using the displaced ideal method the household-level amenities on access to electricity, sanitation, clean cooking fuel, and water from NFHS-4 for the pre-Fani scenario. Post-Fani loss of access to household amenities is considered at 100% for completely and severely damaged houses and at 50% for partially damaged houses.

considered as 100% for completely and severely damaged and 50% for partially damaged houses.[9]

The fall in living standards has been the greatest in Puri. The change at the combined level for Puri stands at –42.0% (–42.6% for rural and –39.9% for urban). The change in Khurda is –6.3% and that in Cuttack is –3.3%. The decline in living standards in Kendrapara (–0.1%), which had a higher Fani Impact Index, is lower than that of many other districts. There are six districts (Bhadrak, Ganjam, Balasore, Nayagarh, Mayurbhanj, and Keonjhar), where the adverse impact was negligible, and finally, there was no adverse impact in Angul.

The housing damage on account of Fani is detailed in Chapter 1 on housing. For estimating the exact impact we have devised a safe housing index (the 'S Index') on a scale of 0–1 where 0 indicates no houses are safe, and 1 indicates that all houses are safe.[10] In devising the index, we first imputed the following safety scores: 0 (zero) for the homeless; 0.25 for a kutcha house; 0.5 for a semi-pucca house; and 1 for a pucca house. A weighted average of these safety scores, along with the share of population residing in each house, gave us the S Index.[11] The S Index, pre- and post-Fani, for affected districts is given in Table 16.5.

In Table 16.5, the maximum damage to houses is seen in Puri. Further, if one computes the change then in Puri it is –59.5% for rural, –60.2% for urban and –59.7% for both combined. The change in the S Index at the combined level, is –6.4 for Khurda (–9.4% for rural and –4.6% for urban), and –3.4% for Cuttack.

The decline in Jajpur at –2.1%, Jagatsinghpur at –1.3%, and Dhenkanal at –0.6% is greater than that in Kendrapara –0.3%, which in our earlier calculation had a greater Fani Impact Index. This could be because of resilient house structures in Kendrapara. It is said that Jagatsinghpur, which had borne the brunt of the super cyclone of 1999, and Kendrapara have developed resilient house structures. In fact, as Puri had not suffered much in 1999 or in subsequent cyclones, the house-structures there were older and perhaps not as resilient. Of course, Puri bore the brunt of Fani and the maximum damage in the district was inevitable, but better house structures might have reduced the impact of the damage on the houses.

16.4 The Multidimensional HEALS Index

The five indices (health, education, agri-livelihoods, living standards, and safe housing as mentioned above)

Table 16.5: Safe Housing Index (S Index), Pre and Post-Fani, across Affected Districts

Districts	S Index, Rural			S Index, Urban			S Index, Combined		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Chang
Puri	0.688	0.279	-0.410	0.755	0.300	-0.455	0.699	0.282	-0.417
Khurda	0.724	0.656	-0.068	0.978	0.933	-0.045	0.865	0.809	-0.055
Cuttack	0.708	0.674	-0.034	0.852	0.840	-0.012	0.747	0.719	-0.028
Kendrapara	0.513	0.511	-0.002	0.820	0.819	-0.001	0.529	0.527	-0.002
Jajpur	0.648	0.632	-0.016	0.937	0.930	-0.007	0.682	0.667	-0.015
Jagatsinghpur	0.642	0.633	-0.009	0.828	0.817	-0.010	0.664	0.655	-0.009
Bhadrak	0.540	0.540	0.000	0.650	0.650	0.000	0.555	0.555	0.000
Ganjam	0.800	0.799	0.000	0.989	0.989	0.000	0.851	0.851	0.000
Balasore	0.465	0.465	0.000	0.844	0.844	0.000	0.509	0.509	0.000
Nayagarh	0.586	0.586	0.000	0.884	0.884	0.000	0.627	0.626	0.000
Mayurbhanj	0.477	0.476	-0.001	0.680	0.679	0.000	0.494	0.494	-0.001
Dhenkanal	0.623	0.619	-0.004	0.957	0.955	-0.003	0.658	0.654	-0.004
Keonjhar	0.499	0.499	0.000	0.481	0.481	0.000	0.496	0.496	0.000
Angul	0.612	0.612	0.000	0.895	0.895	0.000	0.662	0.662	0.000
All Fani Districts	0.609	0.573	-0.036	0.875	0.837	-0.038	0.662	0.625	-0.037

Source and Notes: The number of houses in 2019 was extrapolated using compound annual growth rate (CAGR) from number of houses in censuses 2001 and 2011. Assuming the house size for rural and urban areas as in 2011, a district- and region-specific (rural/urban) population was estimated and adjusted pro rata to the 2018–19 population in Mishra, Gaurav and Nathan (2019). Further, the share of homeless population was as in 2011 and the distribution of house structure (kutcha, semi-pucca, and pucca) was as per Directorate of Economics and Statistics (2017). For impact of Fani the DLNA assumed that a severely damaged house rendered its residents homeless and a partially damaged house put it one notch below—i.e. pucca to semi-pucca, semi-pucca to kutcha, and kutcha to homeless.

are aggregated using the displaced ideal method to give us a multidimensional HEALS Index (see Table 16.6). Compared to our Fani Impact Index (an average of proportion of affected persons and the view of experts), if we look at the change, or change (%), in HEALS, the worst affected (Puri) and the least affected (Angul) seem to maintain their positions.

The adverse impact of Fani based on change (%) in HEALS, was the highest in Puri (–63.4%), followed by Jagatsinghpur (–20.2%), Khurda (–19.0%), Nayagarh (–18.2%), Kendrapara (–16.6%), and Cuttack (–15.8%), which were with higher absolute values than the average for the affected districts at –13.1%. Under HEALS, compared to Fani Impact Index, the districts of Nayagarh and Jagatsinghpur gained ranks by seven and four positions, respectively, because these two districts had relatively higher adverse impacts in health and education, and also for agri-livelihood in the case of Jagatsinghpur, but relatively less in the case of living standards and safe housing. Since the impact was relatively less on living standards and safe housing it affected less proportion of people and thereby leading to relatively lower scores in Fani Impact Index.[12]

For the districts ranked second to fourth under the Fani Impact Index, change (%) under HEALS indicates that the district of Cuttack seems to have suffered relatively less impact. This could be because the adverse impacts for the district, relatively speaking, were greater in terms of living standards and housing, but not in terms of health, education, and agri-livelihood.

The districts ranked seventh to tenth under change (%) in HEALS are Jajpur (–11.4%), Bhadrak (–11.3%), Dhenkanal (–9.9%), and Balasore (–8.5%). The case of Dhenkanal is intriguing. It could possibly have smaller areas where the impact was greater.

In the remaining three districts, change (%) under HEALS is the least in Ganjam. It was relatively less adversely affected in almost all domains, barring education.

The differences in the two sets of indicators (HEALS versus Fani Impact Index) point out that our exercise under HEALS has been independent of the Fani Impact Index. Further, as it dwells into specific dimensions of damage and loss, district-specific sector-specific healing interventions become possible.

16.5 Impact on Poverty

The discussion on five independent indices and the aggregated HEALS provides us a comparative picture across districts. This section uses Mishra and Hari (2019) to look into the impact of Fani on the income poor by adjusting consumption expenditure information of 2011–12 with growth, distributional concerns, and change in population.

A comparison of pre-Fani (2018–19) and base year (2011–12), indicates a decrease in incidence of the income

Table 16.6: Pre- and Post-Fani HEALS Index across Affected Districts

Districts	Pre-Fani	Post-Fani	Change	Change (%)
Puri	0.599	0.220	-0.380	-63.4
Khurda	0.600	0.486	-0.114	-19.0
Cuttack	0.600	0.505	-0.095	-15.8
Kendrapara	0.533	0.445	-0.088	-16.6
Jajpur	0.559	0.495	-0.064	-11.4
Jagatsinghpur	0.584	0.466	-0.118	-20.2
Bhadrak	0.518	0.459	-0.059	-11.3
Ganjam	0.644	0.637	-0.007	-1.1
Balasore	0.558	0.510	-0.048	-8.5
Nayagarh	0.585	0.478	-0.106	-18.2
Mayurbhanj	0.567	0.549	-0.018	-3.217
Dhenkanal	0.578	0.520	-0.057	-9.9
Keonjhar	0.561	0.543	-0.018	-3.213
Angul	0.591	0.591	0.000	0.0
All Fani Districts	0.593	0.515	-0.077	-13.1

Source and Note: Authors' calculation using displaced ideal method to the five individual dimension-specific indices discussed in Tables 16.3 to 16.5.

Table 16.7: Incidence of Income Poor for Pre- and Post-Fani Scenario in Odisha

Sub-Groups	Income Poor (%)									Change (percentage points)					
	Base, 2011–12			Pre-Fani, 2018–19			Post-Fani, May 2019			Pre-Fani minus Base			Post-Fani minus Pre-Fani		
	Rur	Urb	Com	Rur	Urb	Com	Rur	Urb	Com	Rur	Urb	Com	Rur	Urb	Com
ST	63.5	39.7	62.6	56.3	32.9	55.4	60.0	35.0	59.0	-7.2	-6.8	-7.2	3.7	2.1	3.6
SC	41.4	26.3	39.0	36.4	18.7	33.6	43.1	27.7	40.7	-5.0	-7.6	-5.5	6.7	9.0	7.1
OBC	24.2	22.1	23.9	18.2	20.0	18.4	24.0	21.4	23.7	-5.9	-2.1	-5.5	5.7	1.4	5.2
OSG	14.2	6.7	11.8	11.8	5.4	9.8	19.0	6.9	15.2	-2.4	-1.3	-2.0	7.2	1.5	5.4
CL-A	59.6	-	59.6	51.0	-	51.0	59.5	-	59.5	-8.6	-	-8.6	8.4	-	8.4
CL-NA	45.4	55.3	46.6	42.6	50.0	43.5	47.1	51.0	47.6	-2.9	-5.3	-3.2	4.5	1.0	4.1
SE-A	32.1	-	32.1	26.0	-	26.0	32.1	-	32.1	-6.2	-	-6.2	6.2	-	6.2
SE-NA	25.2	17.3	22.9	20.9	13.8	18.8	25.1	20.7	23.9	-4.3	-3.5	-4.1	4.3	6.9	5.0
RWS	12.0	8.7	10.4	9.2	5.6	7.5	11.6	5.8	8.8	-2.8	-3.1	-2.9	2.4	0.2	1.3
OOG	20.4	11.9	18.1	18.2	11.6	16.4	23.7	12.5	20.6	-2.1	-0.4	-1.7	5.4	0.9	4.2
Fani	26.4	11.2	24.1	22.7	9.6	20.8	31.7	14.8	29.2	-3.6	-1.5	-3.3	9.0	5.2	8.5
Non-Fani	51.8	27.2	47.9	43.2	21.1	39.8	43.2	21.1	39.8	-8.6	-6.1	-8.2	0.0	0.0	0.0
Odisha	35.7	17.3	32.9	30.3	14.0	27.8	36.0	17.2	33.1	-5.4	-3.3	-5.1	5.7	3.2	5.3

Sources and Notes: The estimates of the income poor are from Mishra and Hari (2019), which is based on a method in Mishra (2015). The study unit-level data of consumption expenditure from National Sample Survey (NSS) with poverty lines provided by Planning Commission (2013) that are adjusted for population estimates provided by Directorate of Economics and Statistics (2019). Distributional concerns impose a growth rate of 1.85% per annum on the bottom 50% of the population, and 1.91% on the middle 40% of the population, as per estimates by Chancel and Picketty (2017). The fall in income on account of damage and loss due to Fani across affected districts uses the Gross District Domestic Product (GDDP) provided by Mishra, Gaurav and Nathan (2019) to suggest that this would be equivalent to an income loss of 10%. For regions, Rur is Rural, Urb is Urban, and Com is Combined. Across social group, ST is Scheduled Tribe, SC is Scheduled Caste, OBC is Other Backward Classes, and OSG is Other Social Groups. Across occupational group, CL-A is Casual Labour in Agriculture, CL-NA is Casual Labour in Non-Agriculture, SE-A is Self Employed in Agriculture, SE-NA is Self Employed in Non-Agriculture, RWS is Regular Wage or Salary, and OOG is Other Occupational Groups.

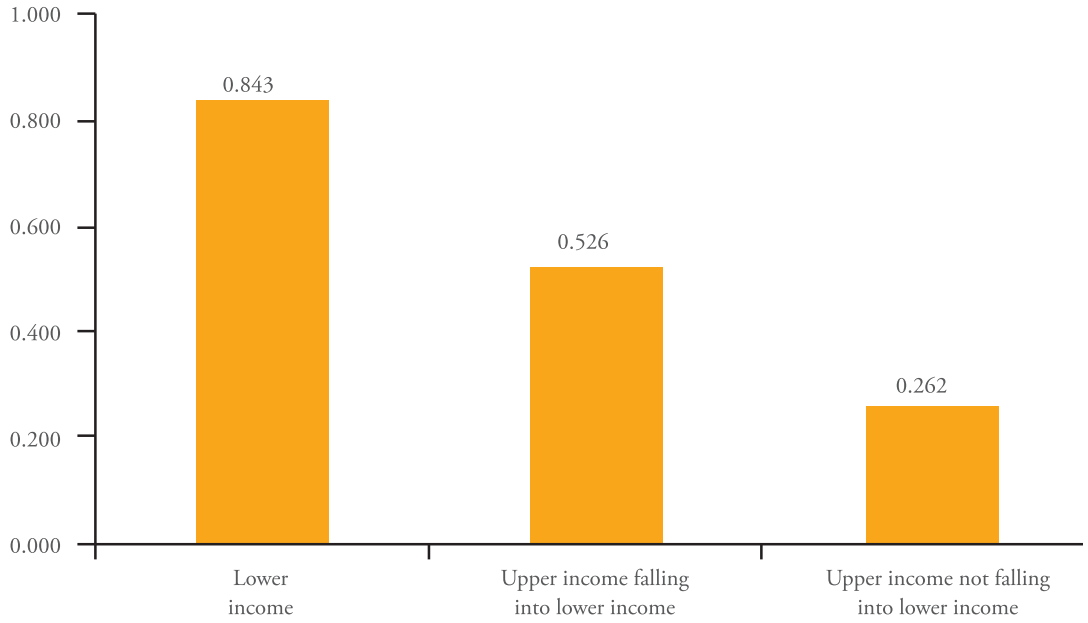
poor by –5.1 percentage points, that is –0.7 percentage points per annum (Table 16.7). What is more, this decline was greater in rural areas (–0.8 percentage points/year) compared to urban areas (–0.5 percentage points/year) and greater among the vulnerable population across social groups (–1.0 percentage points/year for Scheduled Tribes [STs], and –0.8 percentage points/year for Scheduled Castes [SCs], as also for Other Backward Classes [OBCs], as compared to –0.3 percentage points/year for Others).

As a corollary, the decline in incidence of the income poor was relatively greater in non-Fani districts, where the incidence of poverty in the base year (2011–12) was also higher. These achievements are quite impressive given the recurring disasters that the state has been exposed to—the cyclones Phailin (2013), Hudhud (2014), and Titli (2018), as also floods and droughts at regular intervals in the last seven years.

Comparison of the incidence of the income poor in the pre- with the post-Fani scenario, suggests that the entire gains in the last seven years were lost in the aftermath of Fani. The increase in the incidence of the income poor has been relatively low in the case of the STs (3.6 percentage points) as their population is relatively low in the Fani-affected districts. The increase has been the highest for SCs, particularly in urban areas (9.0 percentage points). In rural areas, the increase in the incidence of the income poor has been the highest for Others (7.2 percentage points).

Experts involved in the DLNA also provided their anonymised response on the impact of Fani on different income groups in a scale of 0–100. The average of their responses are normalised to a 0–1 scale such that, as in the Fani Impact Index (Figure 16.1), they are categorised into five impact groups: Minimal; Subdued; Moderate; Severe; and Extreme.

Figure 16.2: Fani – Impact by Income Group



Source: Authors' calculation using the view of experts.

The impact by income group (Figure 16.2) indicates that the lower income group suffered an extreme impact (0.843), the upper income group that fell into the lower income group on account of Fani, suffered a moderate impact (0.526) and the upper income group that remained in the upper income group suffered a subdued impact (0.262).

It is possible that the increase in the income poor in the post-Fani scenario (Table 16.7 and Figure 16.2), as also the shortfall under HEALS (independently and collectively, Tables 16.3 to 16.6) are largely transient. With appropriate relief, rehabilitation, and reconstruction most of the income poor may come out of it. Otherwise, they may fall into structural poverty.[13]

16.6 Impacts Highlighting Risks and Resilience Needs

The different risk and resilience needs identified during the discussion under the five dimensions of HEALS, also cut across gender, caste, occupational groups including small traders and business entities.

16.6.1 Health

Cyclone Fani has adversely affected 1,031 health centres including CHCs, PHCs, and sub-centres, and 12 medical colleges/DHHs (Special Relief Commissioner Office, 2019). The damage and devastation to the health centres on the one hand, and the need of emergency healthcare to treat cyclone-related injuries, and arrest risks of one or more epidemics on the other, creates a catch-22 situation for all those affected.

Interactions with victims in the worst affected district, Puri, revealed that there has been some incidence of waterborne diseases, like diarrhoea, post-disaster. People do acknowledge that medical care was provided promptly by the government. However, people carry the risk of infections of various kinds in post-disaster months, due to pollution of various kinds, including open defecation. Also, they are apprehensive about wild animals and snakes as certain affected localities are not far from forests.

Field interactions reveal that toilet facilities are damaged and as a coping strategy women have decreased their food intake to avoid defecating in the open, or to at least minimise their need to do so.

Limiting food intake at a time when physical requirement for nutrition has increased, has adversely affected their nutritional and health status. Their menstrual hygiene is also affected. In fact, shelter homes need to have dedicated spaces that provide privacy to women.

16.6.2 Education

The disaster has left at least 7,105 primary schools damaged. Incidentally, the disaster struck during school vacations. However, post-vacation there is a high risk of dropouts because of various externalities such as migration, distress,

and reprioritisation of household needs. This will affect girl children and children with special needs in particular.

Apart from damage to their school buildings, students have also lost books and notebooks, which need to be replaced. Some students have expressed signs of mental and physical exhaustion. Children from the vulnerable communities and marginalised households (particularly, adolescent girls) may not only be withdrawn from schools, but also face an increased risk of child labour, trafficking, abuse, and child marriage.

It is during these times of crisis that vacations should be cancelled and schools reopened, so that children find an avenue to interact with their peers and teachers. This will reduce their physical and mental stress, and also perhaps the time can be used to come up with positive strategies to engage with their community in rebuilding lives.

Going back to school will also provide the children with at least a mid-day meal, which during such periods of crisis may be their only meal of the day. Hence, even if the Fani hit during the vacation period, the DLNA considers the post-Fani period to be one without access to education.

16.6.3 Agriculture and Livelihoods

Those dependent on agriculture and allied activities have been adversely affected. Many fruit and nut trees have been destroyed. Further, horticulture crops, as also standing rabi crops, have been damaged. The loss of fruit and nut trees will not only result in income losses in the current year, but also in subsequent years. This does call for taking up resilient agro-ecological approaches.

Those Dependent on Fishing

The fishing community has also suffered greatly. Their boats, nets and other fishing equipment have been destroyed and it will take them some time before they can restore these and venture again into the sea. The women of the community, who used to sell fish or work as casual labourers, are also without jobs. Thus, both men and women of the fishing community are unable to earn a living.

Artisans and Craftspersons

During our visit to Raghurajpur, a heritage village, it came to light that not only were paintings damaged, but their raw material had also been damaged and both art and raw material will be in short supply in the months to come. This will adversely affect their business prospects.

Tourism and Small Businesses

In Puri, which traditionally attracts a large number of tourists, the loss of livelihoods can stretch to more than even six months, which also provides time enough for new entrants to come in and replace those who may never be able to get back their source of livelihood.

Small businesses, largely comprising own account self-employed informal workers, suffered damage to their business entities and loss of income ranging from a fortnight to a couple of months.

A recent synthesis report (UNDP, 2016) that also covered Puri after the floods in 2011, pointed out that the micro and small entities were themselves resource and expertise pools and should be involved by the administration in any recovery process.

16.6.4 Living Standards

The living standards of the affected people saw a sudden dip in the absence of access to electricity, water, sanitation, cooking fuel, and other basic amenities. For Puri, the worst affected district, the electricity restoration took more than a month (Fig. 16.3). Restoration of electricity was less than 5% even after two-weeks from the disaster and picked up after that. Almost a month after the disaster, that is, by June 4, electricity restoration in the district is approximately two-thirds.

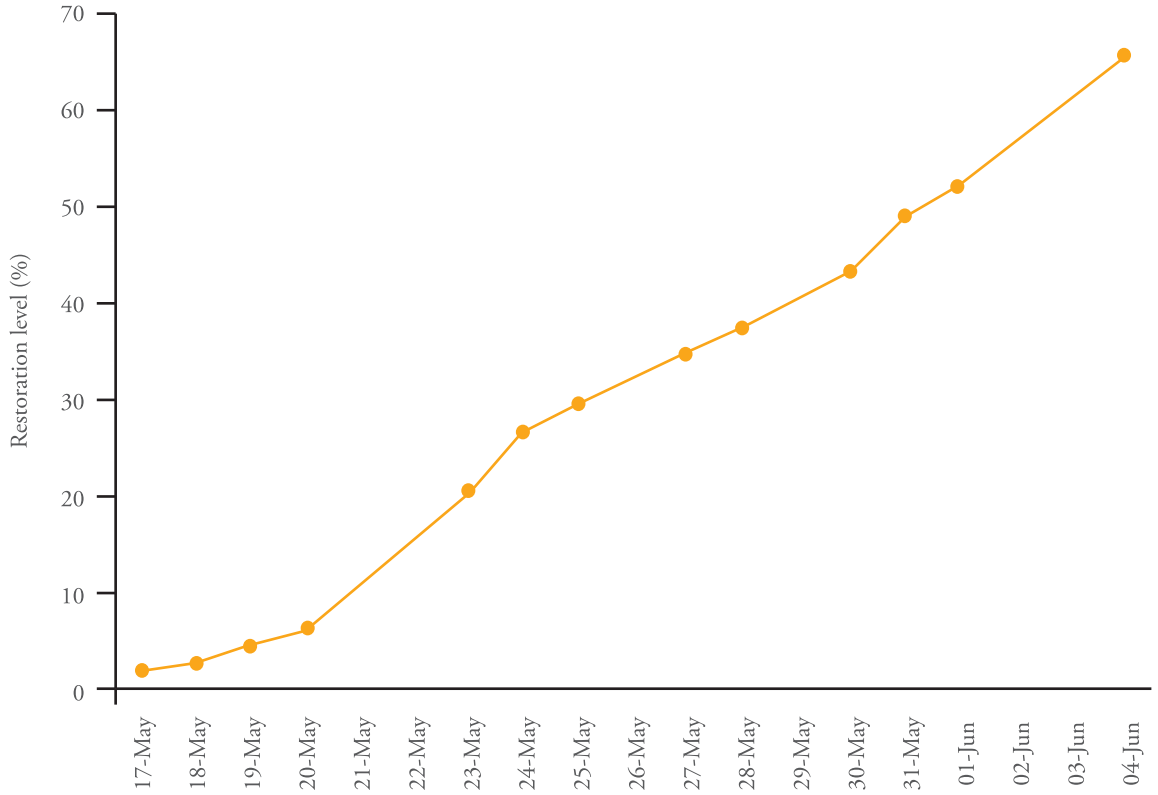
Access to electricity acts as not only a multiplier on the income generating activities in agriculture, industry, and services; but is also an enabler to provisioning of social amenities such as health care, water and sanitation (Birol, 2014; Nathan and Raj, 2016). Since electricity was not restored for more than a week even in the cities, water supply to the households (contingent upon power supply) was also affected. In those places where water supply source was restored in a few days, drinking water was not available at doorsteps.

Women had to walk a few kilometres thrice or even four times a day to fetch water for drinking and cooking. This was exhausting, time consuming and added to the burden of the women and girl children. As discussed earlier, under health, this also had adverse implications on their bodily integrity.

In the absence of electricity, people used kerosene lamps and candles during the night. During the day, to cope with the severe heat wave, people spent the day at shelter homes or schools (closed for vacations) and they returned home after sunset.

One of the welcome steps by the government, post disaster, was to allow the affected free access to forests to collect wood (fallen branches and uprooted trees). This has helped in two ways. The collected wood is being used as firewood and houses have temporarily shifted to this mode of cooking to address a crisis situation. Some of the better quality woods are being stored so that they can be used while rebuilding houses.

Figure 16.3: Electricity Restoration in Puri District Post-Fani (2019)



Source: Authors' calculation from Situation Reports released by Odisha State Disaster Management Authority (OSDMA)

16.6.5 Safe Housing

The loss of housing has jeopardised the safety and security of the assets. Field interactions with communities reveal instances of assets being stolen in some areas by anti-social elements.

Residents pointed out that after they returned home post-disaster, they found that all their belongings buried under mounds of debris as walls had collapsed. In addition to this, to their dismay, they also found that their lockers and trunks had been broken open and valuables stolen.

The field notes also show that the households are not immediately rebuilding or repairing their houses primarily for two reasons.

First, they are aware the damage assessment team is still visiting them, so an immediate repair or rebuild would underestimate the damage.

Second, the cost of rebuilding has increased. For instance, the cost of straw has multiplied five times from INR 200 (USD 3) for a 100-bunch lot, to INR 1,000 (USD 15).

16.6.6 Relief and Exclusion

Immediately after the disaster, the government gave relief to households in terms of ration (50 kg rice) and cash (INR 2,000 or USD 29). However, two concerns noted during field visits were: (i) in some cases, the rice packets invariably weighed 10 kg less; (ii) some were excluded as they did not have some identification documents, this is a major concern.

The non-requirement of any identification documents for immediate relief has been addressed by the administration, but it has led to some exclusion.[14] The question of exclusion also has a caste dimension. There have been reports that some social groups (particularly, the SCs) were denied access to shelter homes during Fani (Pattnaik, 2019). Such exclusions are unfortunate. Besides, the livelihood loss among these communities also needs special attention.

A study post the 1999 super cyclone (Roy, Mrutyunjaya and Selvarajan 2002) pointed out that some of the coping strategies were: migrating to other places, selling assets (land and cattle), shifting away from agriculture (because of its uncertain returns) to non-farm wage income for a regular source of earning. However, income-earning opportunities would themselves be limited.

Post disaster, with loss in avenues of income, people are taking up odd jobs such as rag picking, and waste recycling. However, opportunities here are also limited. This can lead to differences within families and within communities.

There have been reports of trafficking of children and minors, particularly girls. These need to be addressed.

16.7 The Way Forward

As the affected communities recover and strive to build a stronger society, the DLNA recommends the following.

First, the manner in which the agriculture sector is to be revived needs careful consideration. The agro-ecological approach of 'zero budget natural farming' in Andhra Pradesh has shown evidence of resilience to cyclone Pethai, when compared with 'input-intensive cultivation practices'.[15]

It is reported that the Government of Odisha is planning a new Agricultural Policy. The government should seriously consider taking up the agro-ecological approach. In fact, it would be a logical extension of its initiatives under the Odisha Millets Mission (OMM) and would lead to convergence with the integrated farming programme and organic farming policy.

In fact, Fani suggests that the climate crisis is real and makes it imperative that the agro-ecological approach be considered as a way out. This will be good for the farmer (revive livelihood and also open up opportunities for others), good for the consumer (provide healthy and nutritious food), and is good for the planet.

Second, akin to relief being paid in cash and kind, rebuilding and reconstruction assistance can also be given in cash and kind. For instance, coconut planters need good nursery plants, which can be sourced from Kerala and other coconut producing regions of the country. In fact, rearing of fruit and nut trees in the farmers' own fields can be linked to payment of wages for a few years through the employment guarantee scheme under Mahatma Gandhi National Rural Employment Guarantees Act (MGNREGA), as the fruit and nut trees need to be nurtured before they can become regular sources of income.

Third, the specific needs of communities must be addressed. For instance, the heritage village would immensely benefit from a greater tourist inflow post-disaster, enabling the local community to recover from the huge shock.

Similarly different contingency plans need to be put in place for different occupations. The handicrafts sector, in addition to financial assistance, will also need a bank/storehouse that acts as a safe repository for their raw materials, which they can use to prevent future loss and also to borrow and use during times of such emergent requirement.

Fourth, community-specific, occupation-specific and location-specific requirements call for special considerations for female-headed households, widows, the differently-abled, fishing communities, SCs and STs, among others.

It also needs to be kept in mind that SCs and STs are different constitutionally mandated social groups, but each comprises multiple communities. Hence, their intra-community-specific requirement should also be kept in mind whilst designing any recovery and rehabilitation effort.

Fifth, public buildings such as schools and hospitals need to be built in a cyclone resistant way. For instance, Puri has approximately 2,000 primary schools. It is disappointing to note that till date these are not housed in cyclone-resistant structures. While people do seek shelter in school buildings during times of disaster, in many cases these schools and other public buildings were themselves damaged.

It is necessary that these buildings are built to be disaster-resilient and safe structures. There is also a case to build more public buildings in disaster prone areas and to design them as places of shelter when the need arises.

Sixth, Odisha's towns and villages are known for their greenery. And human survival is contingent to the survival of plants. Hence, plantation drives are required in the affected districts. The government can develop a bank for seeds of different varieties; and in partnership with local institutions (civil society and community-based organisations [CBOs]) undertake plantation drives so as to restore the green cover on a war footing. Trees not only act as a first line of defence, but they also provide firewood and can also be a source of nutrition and perhaps the only source, during such times of crisis.

Seventh, a crisis of this proportion requires efforts from multiple quarters. The Government of Odisha alone cannot bear the burden and responsibility. International bodies, non-governmental organisations [NGOs], civil society groups, CBOs, and the people themselves need to be partners in recovery and reconstruction endeavours.

Last, but not the least, it's time that Odisha has an International Centre for Disaster Studies (ICDS) given the number of disasters the state has faced historically and the manner in which it has recovered despite these challenges.

The ICDS can act as a repository of knowledge on disasters and act as a collective endeavour of state, national, and international organisations. It can act as a linkage between the government, civil society, individual experts, and the public at large; and thus strive toward a collective effort to build more resilient societies.

16.8 Methodology for Estimating Human Impact

The human impact of Fani has been substantive for its geographical spread (14 districts) and multiple sectors, as provided in the specific-chapters of this DLNA exercise.

This human impact chapter has followed the following steps.

First, to provide a context the impact was discussed and a Fani Impact Index created using an average of proportion of population affected and the view of experts, to provide us with a working knowledge of the impact across the 14 affected districts. It also provided some basic background information on human development, economic, and social aspects for the state as a whole, and also for the 14 affected districts.

Second, the human impact was assessed through the lens of five dimensions—health, education, agri-livelihood, living standards, and safe housing or HEALS. An Index was prepared for each of these dimensions, and also for the combined five dimensions, which the DLNA referred to as the HEALS Index. This novel exercise provided us with a dimension-specific, as also a collective, understanding across the 14 affected districts, pre- and post-Fani.

Third, the chapter used a new method of computing poverty from earlier household-level data by adjusting for growth, distribution, and population. This showed that Fani led to an increase in the incidence of the income poor, and in the process completely reversed the gains in reduction of poverty made in the last seven years.

Fourth, the DLNA looked into risk and resilience through the lens of HEALS by drawing from our field insights, but in doing so also kept in mind all the other cross-cutting human impact requirements—gender, social group, and economic vulnerability among others.

Finally, the study provided an eight-fold path, for a way forward with a healing touch.

Notes

[1] This chapter has been prepared by Srijit Mishra and Hippu Salk Kristle Nathan for UNDP through Nabakrushna Choudhury Centre for Development Studies (NCDS), as part of Damage, Loss, and Needs Assessment (DLNA) exercise following Fani. The chapter benefitted from inputs by Lakshmikanth Hari, who computed the pre- and post-Fani incidences of poverty, Sarthak Gaurav who helped in designing and putting up the anonymous survey to the experts, and to Sidheswari Sahoo for her help during fieldwork and other research assistance. Comments from Krishna Vatsa on an earlier version, and from discussions and interactions with members of different sectoral teams and officials from the Government of Odisha were helpful.

[2] State Emergency Operation Centre, Bhubaneswar, Odisha (2019c).

[3] The Fani Impact Index is a simple average taken from the view of experts and the proportion of people affected. The index lies between 0–1, where 0 is technically not feasible, and hence, the lower end of the interval is excluded in each of the five groups: Minimal (0–0.2); Subdued (0.2–0.4); Moderate (0.4–0.6); Severe (0.6–0.8); and Extreme (0.8–1.0). The view of experts is based on an anonymised response solicited from those involved in the DLNA exercise. Their responses indicated the impact of Fani across districts as being 'extremely high', 'very high', 'moderately high', 'slightly high', and 'not high at all', and were given values of 4, 3, 2, 1, and 0, respectively. The aggregate value from all respondents was normalised to lie between 0–1 and this is referred to as the view of experts. The proportion of people affected was normalised to lie between 0–1 and is based on computations done in Mishra, Gaurav, and Nathan (2019).

[4] State Emergency Operation Centre, Bhubaneswar, Odisha (2019a). These numbers may not match with those given in the Agriculture, Fisheries, and Livestock chapter.

[5] State Emergency Operation Centre, Bhubaneswar, Odisha (2019b).

[6] Displaced ideal method is a measure of aggregation based on the notion that the closer one is to the ideal the better.

[7] Change expressed in % is [(Change in index value)/Pre-Fani index value]*100.

[8] The damage per school in Puri is greater than 15 times the other districts. We take the log of damages per district for computing the ratio, which in essence recognises that damages will have a diminishing marginal impact.

[9] Alkire and Jahan (2018) also use these indicators in their living standards dimension while computing multdimensional poverty. They use household-level data, whereas data availability not only constrains us to use aggregate district-level data but also limits us to fewer indicators.

[10] The S Index draws upon an approach followed in the computation of Youth Development Index by Rajiv Gandhi National Institute of Youth Development (2017).

[11] S Index, $S=\sum s_i w_i$; s_i is safety score for the i^{th} category of house, and w_i is the proportion of population staying in the i^{th} category of house.

[12] In fact, in the view of the experts, the adverse impact (ranked from worst to least) put Jagatsinghpur at fourth and Nayagarh at joint sixth.

[13] In fact, as Shephard et al. (2013) point out, natural disasters will be one of the important reasons for the reversal of progress against poverty. India is among those countries that have the highest exposure to such disasters and also have a high vulnerability to poverty. The study also puts in a case to consider some Indian states, including Odisha, as sub-national entities that require greater attention because of their exposure to recurring natural disasters.

[14] The concerns for over-invoicing, in the absence of unidentified recipients, is an independent and important concern and needs to be addressed separately.

[15] Webinar: Growing the new Green Revolution: Zero Budget Natural Farming in Andhra Pradesh. Global Sustainability Institute. Anglia Ruskin University, UK, 25 March, 2019.

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17

Macroeconomic Impact Assessment[1]

The recent and extremely severe cyclonic storm Fani considerably impacted lives and livelihoods of over 15 million people across 14 districts of Odisha. Damages and losses across sectors are estimated at INR 24,176 crore (around USD 3.5 billion). The study estimates the macroeconomic impact of Fani by presenting the following scenarios:

- The isolated impact of the disaster on growth and gross state domestic product (GSDP)
- The impact of the disaster by considering effects of recovery and reconstruction
- The indirect impact of the disaster that is emerging from reallocation of expenditure to the items that need recovery and reconstruction, disproportionate to their share in expenditure, pre-disaster

Three-fifths of the entire damage is to property in public ownership (this refers not just to buildings or land but anything from a pencil or a tree to a water body that was damaged in the area), whereas six-sevenths of the entire loss is of property under private ownership. Damage, loss, the need for recovery, and disaster resilient reconstruction will all impose a substantial fiscal burden on the state. Innovative ways to finance disaster risk and investment in disaster risk reduction (DRR), and mitigation in a manner that does not jeopardise the financial condition of households as well the state, is the need of the hour.

17.1 The Larger Context

Beyond the loss of human lives and damage to assets and production flows across 14 districts, the macroeconomic consequences are considerable. Total damage to existing stock of assets has been estimated at over INR 16,465 crore (around USD 2.4 billion) whereas the economic losses flowing from the disaster are estimated at nearly INR 7,712 crore (around USD 1.1 billion).[2]

Combining the value of damage and losses, the total disaster effect including damages and losses is equivalent to about 5% of Odisha's gross state domestic product (GSDP) of 2018–19, while losses from change in production flows comprise 1.6% of that year's GSDP.[3] The per capita disaster effect for the population in affected districts is around INR 9,617 (USD 137).

The sectoral chapters of this DLNA exercise suggest that the housing and energy (power) sectors have been particularly affected,[4] and it is of immediate importance to restore productive means of livelihood. Apart from the direct effects computed as damages and losses, there may be considerable higher order or indirect effects that are likely to persist for the most vulnerable.

The structure of the state's economy is such that the share of tertiary economic activities is the highest, contributing around 42% of the gross state value added (GSVA) in 2018–19.[5] Agriculture and allied economic activities, which include crops, livestock, forestry and logging, and fishing activities, contribute 18.9% to the state's economy, but employ 48.8% of the workforce.[6] However this economic activity is vulnerable to monsoon variability as well as climate-induced natural disasters. Under primary economic activities, apart from agriculture and allied activities, mining and quarrying contributed to 10.8% of GSVA and employed 1.2% of the workforce.

In the secondary economic activities, manufacturing is the highest contributor, at 18.5% while construction, and electricity, gas, water supply and other utility services contributed 6.5% and 3.7%, respectively. The secondary economic activities contributed 28.7% to GSVA and employed 26.4% of the workforce.

Under tertiary economic activities, trade, repair, hotels and restaurants contributed 10.3%; transport, storage, communication and services related to broadcasting contributed 7.5%; financial services contributed 3.4%; real estate, ownership of dwelling and professional services contributed 7.4%; public administration and defence

contributed 5.5%; and other services contributed 7.6%. Together tertiary economic activities contributed 41.6% of GSVA and employed 24.8% of workforce.

It is a matter of concern that in 2015 less than 6 lakh (0.6 million) people were in organised employment and more than 82% of them were in the public sector. With a workforce of 1.25 crore (12.5 million), only 6% are in organised employment.

Odisha's economy grew at an average of 8% per annum over the period between 2012–13 and 2018–19. However, there was a slump in economic growth in 2014–15 when real growth rate fell to 1.8%, largely due to a weakening commodity market. Incidentally, the state was battered by cyclonic storms Phailin in 2013 and Hudhud in 2014.

Following the legislation of the Odisha Fiscal Responsibility and Budget Management (FRBM) Act, 2005 and its subsequent amendment in 2016, the state continues to be revenue surplus and has shown remarkably prudent fiscal management. The state's own revenues grew notably over the past two decades, and the ratio of own tax to GSDP was 6.4% in 2017–18 compared to 3.6% in 1999–2000 when the state was devastated by a super cyclone. However, own non-tax revenue has grown erratically and was less than a third of the own tax revenue in 2018–19. In 2016–17, the year the goods and services tax (GST) was introduced, the growth of both own tax revenue and own non-tax revenue was among the lowest in recent times—with the former registering 1.4% growth while the latter showed negative growth of -7.7%. The fiscal deficit for 2019–20 is projected at 3% of GSDP which is well within the 3.5% ceiling of the Odisha FRBM Act, 2005. However, the debt-stock projection for 2019–20 was higher than 2018–19, at 19.2% of GSDP.[7] Statements presented along with the Vote on Account 2019-20, Finance Department, Government of Odisha.

Fani is a setback to the state's aspirations to become a fast-growing state and sustain its poverty reduction record. However, a spurt in labour demand for reconstruction may be expected to result in additional wage earnings in the short run. There may also be additional positive as also adverse effects on household consumption and private investment.

Before discussing the growth effects of the disaster on the economy, the study examines the differential effects of the disaster across different economic activities—primary, secondary, and tertiary.

17.2 Impact across Economic Activities: By Sector

Understanding the impact of Fani on different economic activities is based on sectoral assessments of damages and losses in the DLNA. The study attempts to explain how the disaster may impact different economic activities by comparing pre-disaster real growth and level of GSVA (2011–12 constant prices) with post-disaster revisions under two scenarios: (i) without recovery and reconstruction, and (ii) with recovery and reconstruction (Table 17.1).

In the post-disaster scenario, most sectors of the economy are likely to experience lower growth in 2019–20 (Table 17.1: column 7) with respect to 2018–19 estimates (Table 17.1: column 2). Agriculture and allied activities, manufacturing, trade and related activities, transport and related activities, utilities, construction, and public administration and defence activities—all show a decline in real growth rate. 'Other services' comprising education, and health and nutrition of DLNA will register a negative growth rate post disaster. However, upon including the recovery and reconstruction needs as suggested by the sectoral assessment, the growth rates are revised upwards (Table 17.1: column 8). Utilities and construction sub-sector show the highest increase in the growth rate.

In light of the findings of the sectoral damage and loss assessment, the following economic activities need special attention with appropriate strategies of DRR and to build back better (BBB) for adequate risk mitigation and resilience in future.

17.3 Economic Activities that Need Special Attention

17.3.1 Power

Electricity distribution infrastructure has been hardest hit, with destruction of assets worth INR 8,139 crore (USD 1.2 billion). The losses—in terms of revenue loss to distribution companies and loss in earnings of meter readers—are around INR 254 crore (USD 36 million). However, the post-Fani projection for this sector is likely to be positive with around INR 9,748 crore (USD 1.4 billion) of recovery and reconstruction expenditure estimated under an alternative option that follows the existing system with improved specifications, or, as decided by the state. This may have implications for other economic activities.

17.3.2 Housing

Housing structures suffered damage worth INR 3,075 crore (USD 439 million) and the recovery needs of the sector are estimated to be over INR 8,996 (USD 1.3 billion). Fani has made the housing goals of the state tougher, particularly for vulnerable households, including those headed by senior citizens, the differentially-abled, and low-income households. The estimated damages for public buildings is INR 539 crore (USD 77 million). The need for

Table 17.1: Effect of Disaster on Economic Activity by Sector

Activity	Real Growth Rate 2018–19	GSVA (INR crore) 2018–19	GSVA (INR crore) Pre-disaster projection 2019–20	Post-disaster GSVA without R&R (INR crore)	Post-disaster GSVA with R&R (INR crore)	Real Growth Rate Post-disaster 2019–20	Real Growth Rate post-disaster 2019–20 with R&R
Primary							
Agriculture, forestry and fishing	0.08	48,809	52,845	49,889	52,475	0.02	0.08
Mining and quarrying	0.04	50,638	52,813	52,773	52,800	0.04	0.04
Secondary							
Manufacturing	0.16	82,743	95,791	95,538	95,705	0.15	0.16
Electricity, gas, water supply and other utility services	0.04	13,489	14,033	13,696	13,936	0.02	0.03
Construction	0.03	23,799	24,440	23,805	25,540	0.00	0.07
Tertiary							
Trade, repair, hotels and restaurants	0.07	37,446	40,008	38,566	39,179	0.03	0.05
Transport, storage, communication and services related to broadcasting	0.10	27,394	30,117	29,935	30,350	0.09	0.11
Financial services	0.04	12,030	12,470	12,452	12,464	0.04	0.04
Real estate, ownership of dwelling and professional services	0.06	25,861	27,413	27,390	27,405	0.06	0.06
Public administration and defence	0.09	20,549	22,414	22,344	22,390	0.09	0.09
Other services	0.00	21,377	21,385	20,927	21,374	-0.02	-0.00
Odisha	**0.08**	**3,64,135**	**3,93,729**	**3,87,314**	**3,93,617**	**0.06**	**0.08**

Source: Calculation using Gross Value Added (GVA) by Economic Activity at Constant (2011–12) basic prices, is sourced from the Directorate of Economics and Statistics, Government of Odisha.

Notes: R&R denotes recovery and reconstruction proposed by DLNA in the short-term, i.e., first year. Current values of losses are converted to constant (2011–12) prices using ratio of GVA in constant to current prices for 2018–19 as deflator. deflator. Loss and recovery are based on DLNA. They have been intuitively linked to specific economic activity. For instance, DLNA sectors agriculture and fisheries, and environment and forestry are linked to agriculture, forestry and fishing, DLNA sectors of power, WASH, and water resources are linked to electricity, gas, water supply and other utility services, including energy, WASH, and water resources, DLNA sectors of transportation/roads, and telecommunications are linked to transport, storage, communication and services related to broadcasting, DLNA sectors of education, and health and nutrition are linked to other services. The cross-cutting DLNA sectors of employment, livelihood and social protection, DRR, and gender and social inclusion are distributed across economic activities as per their employment share for Odisha in the Periodic Labour Force Survey, 2017–18.

reconstruction in this sector, if met, is expected to boost construction activity in 2019–20 and is likely to result in greater demand for construction workers in the short term.

17.3.3 Livelihood

Estimations based on the employment, livelihood, and social protection sector DLNAs suggests that around 6.8 crore (68 million) person-days of work were lost, resulting in wage loss of around INR 2,780 crore (USD 397 million). Most affected were workers in the unorganised sector (94% of the state's workforce). Enterprises including handicrafts, micro, small and medium enterprises (MSMEs), and cottage industries have also experienced losses. As a result, livelihoods of affected workers will take time to recover. Agriculture and allied activities have also experienced wage employment loss of around INR 300 crore (USD

43 million). In particular, livelihoods based on coconut and betel vine are likely to experience losses that may have long-term consequences. Fani has also adversely impacted livelihoods in the tourism sector and that of rural artisans and craftspersons in affected areas.

17.3.4 Agriculture, Livestock, and Fishery

With around INR 3,033 crore (USD 433 million) in damages and losses, and recovery needs of INR 2,615 crore (USD 374 million), the agriculture, livestock, and fishery sector is expected to have lower production in the short term. Negative supply shocks in these activities—particularly poultry, dairy, fishery, horticultural produce, and coconuts—are likely to result in short-term inflationary pressures. However, if supply chains ensure availability from other regions such inflationary pressures may not persist.

Recovery and reconstruction from a BBB perspective are expected to result in slight productivity gains, if the production technologies in the affected sector undergo a transformation. Since this sector is particularly susceptible to the vagaries of the monsoon and climatic disasters, DRR expenditure is likely to minimise losses in the long term.

Activities in this sector also employ the highest proportion of the workforce, and unless labour productivity gains are experienced owing to the replacement of old capital or knowledge spill over, the earnings from these activities will continue to be relatively lower than from other activities. If there is one lesson from this natural disaster, it is that alternative resilient agro-ecological systems need to be considered.

17.4 Damage and Loss: Public versus Private

The damage and loss by ownership is reported across sectors in Table 17.2. In the productive sector of agriculture, fisheries and livestock, 94.3% of the damages and all losses are under private ownership. This sector is largely dominated by smallholders and reviving their livelihood should be of paramount importance.

In the infrastructure sector, the entire damages and losses from the sub-sectors of water, sanitation and hygiene; roads; energy; and, water resources and coastal protection are under public ownership. The hardest hit is the energy sector. In fact, 75.7% of the entire damages under public ownership and 30.7% of the entire losses under public ownership are from energy.

The burden from the other four sub-sectors under infrastructure constitutes 6.5% of the entire damages under public ownership and 18.3% of the entire losses under public ownership. Under infrastructure, it is only in the telecom sub-sector that some damages have been reported under private ownership. This has to be read with caution as, in the absence of data from private entities, damage has been imputed from information provided by the public entity. The burden of repairing the entire damage under infrastructure sector, except for part of the damages under telecom, seems to have fallen on the state.

In the social sector, damages to health and nutrition and education and child protection sub-sectors are entirely under public ownership. Of the total damages under public ownership, these constitute 1.2% and 7.6%, respectively. In this sector, the entire losses for housing and public buildings,[8] and health and nutrition sub-sectors are under public ownership. From the total losses under public ownership, these constitute 6.5% and 31.8%, respectively. Further, damages have also been reported under private ownership in the DLNA exercise for housing and public buildings, and tourism and cultural heritage sub-sectors. The damages in these sub-sectors under private ownership are 85.1% and 87.2%, respectively, of the total damages in these sub-sectors. Housing would have largely impacted individuals, whereas tourism and cultural heritage would have adversely affected enterprises. Both need different approaches for revival to pre-disaster levels.

In cross-cutting sectors, the entire damages and losses for environment and DRR are under public ownership. From the total damages under public ownership, these constitute 0.7% and 0.1%, respectively, and from the total losses under public ownership these constitute 12.5% and 0.1%, respectively. It is in the employment, livelihood and social protection sector that 55.9% of damages and entire losses were under private ownership.

Overall, 65.6% of the damages are under public ownership while 89.3% of the losses are under private ownership. From the damages under private ownership, the distribution is largely across housing (54.5%), agriculture, fisheries and livestock (26.5%), tourism and cultural heritage (8.6%), telecommunication (6.2%), and employment, livelihood and social protection (4.2%). Private ownership losses span employment, livelihood and social protection (59.6%), agriculture, fisheries and livestock (21.0%), and tourism and cultural heritage (19.4%). These are largely among smallholders and the unorganised workforce. The need is substantive and to address this, the state, civil society, and the people concerned need to come together.

17.5 Growth Effects

The economy of Odisha grew at an estimated real annual growth rate of 8.4% in 2018–19.[9] The year 2017–18 was

Table 17.2: Effect of Disaster on Economic Activity by Sector

	Damage by ownership (INR crore)		Losses by ownership (INR crore)	
Sector	Public	Private	Public	Private
Social sectors				
Housing and public buildings	539.2	3,075.0	54.0	
Education and child protection	814.0			
Health and nutrition	128.0		262.0	
Tourism and cultural heritage	71.8	487.7	1,334.6	
Productive sectors				
Agriculture, fisheries, livestock	90.8	1,494.4		1,447.5
Infrastructure sectors				
Power	8138.7		253.5	
Telecom	95.9	348.8		
Roads	326.2		22.0	
Water, sanitation and hygiene	267.0		129.0	
Water resources and coastal protection	5.0			
Cross-cutting sectors				
Employment, livelihoods, and social protection	185.2	234.9		4,105.1
Environment	77.0		103.0	
DRR	5.5		1.0	
Total	10,744.3	5640.8	824.5	6887.2

Note: From the total damages, ownership between public and private could not be ascertained for INR 80 crore, of which, INR 78 crore is for employment, livelihood and social protection, and INR 2 crore is for telecom.

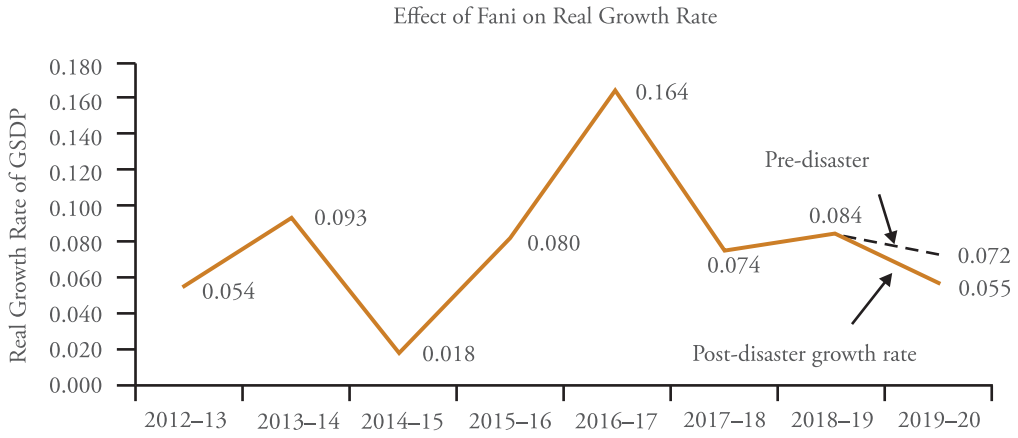
particularly adverse for economic annual growth, as real annual growth rate declined to 7.4% from 16.4% the year before, with agriculture and allied activities registering a decline. All things being equal, losses from Fani, in terms of 'isolated effect' of the disaster, are expected to result in the real growth rate falling to 5.5% from a projected 7.2% for 2019–20 (Figure 17.1).[10] For an improved understanding of how disasters such as Fani could influence the growth of the economy, and consequently the GSDP of Odisha, the study presents the scenarios of GSDP (2011–12 constant prices) in the post-disaster period under two conditions: (i) without recovery and reconstruction expenditure; and (ii) with recovery and reconstruction expenditure.

The GSDP of the state was INR 4.86 lakh crore (around USD 69 billion at current prices) in 2018–19. Since the disaster occurred in the second month of 2019–20, the study team posits that income losses will be accounted for in the same year along with the initial injection of capital in the form of recovery and reconstruction expenditure. It can be asserted that the damages to assets can also have long-term implications on income losses.

Table 17.3 shows the scenario of GSDP projections with and without the recovery and reconstruction expenditure incurred. The actual scenario may lie somewhere between the two scenarios. The inflow of funds due to Fani may partially compensate the losses to GSDP in the first year. Multiplier effects will be limited, as the fiscal multiplier of Odisha is near unity.[11] The growth rate and GSDP in the medium to long term will depend on a combination of several macroeconomic and natural factors.

Next, the study examines the implications of a shift in the form of opportunity cost of resource allocation to finance the aforementioned highly affected sectors due to the recovery and reconstruction needs that the DLNA has identified. This is followed by an assessment of the fiscal implications of the recovery and reconstruction.

Figure 17.1: Annual Growth of GSDP at Constant Prices: Pre-disaster and Post-disaster



Source: Authors' calculation using GSDP series at 2011–12 constant prices provided by the Directorate of Economics and Statistics, Government of Odisha.
Note: Growth rates reported are real growth rates of GSDP. Dashed line links the pre-disaster growth rate projections from 2018–19 to 2019–20.

Table 17.3: GSDP Projections (nominal and real values)

	Pre-disaster		Post-disaster	
	2018–19 GSDP	2019–20 GSDP: pre-disaster projection	2019–20 GSDP: No R&R	2019–20 GSDP: Full R&R
GSDP current prices (INR lakh crore)	4.86	5.36	5.27	5.30
GSDP (2011–12) constant prices (INR lakh crore)	3.96	4.36	4.27	4.32
GSDP current prices (USD billion)	69.42	76.51	75.28	75.80
GSDP (2011–12) constant prices (USD billion)	56.56	62.32	61.33	61.74

Note: Exchange rate of 1 USD = 70 INR is used for GSDP calculations in both current and constant prices. R&R denotes recovery and reconstruction.

Source: Calculation using GSDP series at current prices and 2011–12 constant prices provided by the Directorate of Economics and Statistics, Government of Odisha.

17.6 Reallocation of Resources for Recovery and Reconstruction

In order to understand how the financing of the recovery out of the state's own resources could result in diversion from other expenditure items, the study compares the expenditure patterns in 2018–19 (pre-disaster) with the post-disaster needs, assuming the share in expenditure needs to be dictated by the share in recovery needs (Table 17.4). Remarkably, the top three expenditure items (energy; water supply, sanitation and urban; and, agriculture and allied) would require over three-fourth of the expenditure in terms of recovery needs, while that jointly accounted for less than a fourth of the share in expenditure pre-disaster.

Such a considerable shift in expenditure would necessitate a shift away from other social and economic services. From a developmental outcomes perspective, if such a shift is attained at the cost of productive investment in capital formation (including human capital and spending on developmental schemes), the economic impacts of the disaster are gross underestimates.

Table 17.4: Expenditure Reallocation Toward Recovery and Reconstruction

Expenditure Item	Share in expenditure in 2018–19 (%)	Share in recovery needs (%)	Share in expenditure following resource reallocation (%)
Energy	0.04	33.77	33.77
Water supply, sanitation and urban	1.09	35.63	35.63
Agriculture and allied	1.83	8.05	8.05
Others	97.04	22.55	22.55

Note: Energy, and agriculture and allied are same as that in the DLNA. Water supply, sanitation and urban are similar to the DLNA sectors of water, sanitation and hygiene, and housing and public buildings. 'Others' includes all other DLNA sectors. 'Others' under expenditure items also includes also includes items not covered under DLNA.

17.6.1 Fiscal Implications of Disaster Financing

Fani has resulted in damages and losses as a result of which the revenue target for 2019–20 may not be met. Given the structure of revenue generation in the state, drop in collection is expected to be high across the sectors such as energy, housing, land administration, agriculture and allied activities. The extent to which the state is able to finance the recovery and reconstruction expenditure will have implications on the progress of fiscal consolidation. The means through which disasters such as Fani are to be financed may impose unforeseen fiscal burdens on the following grounds.

First, in 2018, the corpus of the contingency fund was increased from INR 400 crore (USD 50 million) to INR 1,400 crore (USD 200 million) and there has been an increase of the State Disaster Relief Fund (SDRF) corpus to INR 919 crore (USD 130 million) in 2019–20.[12] However, these amounts will not be enough to finance disaster-related recovery and reconstruction.

Second, INR 900 crore (USD 129 million) has already been spent under loans from the World Bank on the Odisha Disaster Recovery Project (ODRP), to partially fund reconstruction following Phailin and Hudhud. The state has also borrowed from the National Bank for Agriculture and Rural Development (NABARD) for flood control and spent over INR 1,000 crore (USD 143 million) on disaster prevention, including on cyclone and flood shelters. The state has also planned an investment of INR 700 crore (USD 100 million) for the purpose of building disaster-resilient power infrastructure and disaster response centres.[13] These may limit the possibility of seeking additional resources.

Third, in spite of gradual increase in own tax revenues (from 6% of GSDP in 2016–17 to 6.4% of GSDP in 2019–20), avenues to raise own tax revenues in the medium term are limited by a low tax base and low tax buoyancy of less than unity.[14] The largest component of own tax revenues is GST, but following its introduction in 2017 that subsumed several state and central taxes, the state has lost substantially. Sales tax/VAT has registered a decline and is estimated at around 1.6% of GSDP in 2018–19.[15] Excise duties continue to grow steadily but other own tax revenue sources such as registration fees, stamp duties, and motor vehicle tax are not buoyant. Electricity duty has registered growth but it continues to have a low share (0.52% of GSDP). It is also a matter of concern that professional tax revenue has fallen from 0.07% of GSDP in 2010–11 to 0.05% of GSDP in 2018–19 despite services sector-led growth of the economy. Own non-tax revenues comprise 2.32% of GSDP in 2018–19, with interest receipts having a higher share than dividends and payoffs.[16]

Fourth, transfers from the centre are limited in reach from a disaster financing perspective because the trend of growing grants and tax devolution (Table 17.5) is largely to implement centrally-sponsored schemes.

Table 17.5: Central Transfers as Percentage of GSDP

	2014–15	2015–16	2016–17	2017–18 (RE)	2018–19 (BE)
Tax devolution	5.15	7.12	7.51	7.52	8.25
Grants	4.11	4.27	4.00	5.51	5.58
Central transfers	9.26	11.39	11.51	13.03	13.83

Source: Finance accounts of various years and budget documents of 2018–19, Government of Odisha.
Note: Figures reported are percentages of GSDP. RE denotes revised estimates. BE denotes budget estimates.

Fifth, there is a need for rationalisation of expenditure, both revenue and capital account. On the revenue account, the state has an increasing expenditure requirement given higher salary expenditure, pending arrears of the 7th Pay Commission, and burgeoning pension allocation. With respect to the capital account, the state is committed to raising capital outlay by increasing budgetary support for infrastructure spending. Therefore, any diversion of resources towards disaster financing is likely to impact the developmental outcomes.

Sixth, interest rate payments and debt servicing liabilities of the state is expected to go up in 2019–20 (Table 17.6).[17] It is worth noting that there is not only a marked increase in the share of debt in the GSDP but also an increase in share of debt stock in GSDP. Further, debt projection for 2019–20 has exceeded INR 1 lakh crore.

Table 17.6: Debt and Interest Payment Obligations

	Debt stock as % of GSDP	Debt stock as % of revenue	Interest payment as % of revenue receipt
2016-17	16.2	86.6	5.4
2017-18	17.0	86.7	5.9
2018-19 (RE)	18.0	86.0	5.7
2019-20 (BE)	19.2	93.8	5.9

Source: Finance accounts of various years and budget documents of 2018–19, Government of Odisha.

Given the limitations for disaster financing, the recovery and reconstruction expenditure due to Fani has to be largely met from grants from the centre and multilateral organisations, and soft loans from national and international agencies. Any market-based risk financing alternatives that incorporate principles of risk layering and risk mitigation may be considered with caution, as they could have future welfare implications. Some policy suggestions based on the macroeconomic impact assessment are presented below.

17.7 Way Forward

The state of Odisha is vulnerable to frequent natural disasters and is coping with yet another hydrometeorological event that has put a spanner in the wheel of economic growth and poverty reduction. With damages and losses estimated at 5% of GSDP, the needs for recovery and reconstruction have to be structured judiciously. Additional expenses have to be undertaken in a manner that does not sacrifice future growth and jeopardise fiscal prudence. Going forward, the following ten suggestions (*DaSaNiTi*, ଦଶନୀତି) deserve policy attention.

First, Odisha should be given special treatment by the Centre on account of its chronic vulnerability and exposure to frequent natural disasters. At present, allocation of funds for disaster relief from the Centre is based on actual expenditure in the past—this places Odisha at a disadvantage. There are several exclusions in the State Disaster Response Fund (SDRF) legislation that limit the ability of the state to finance restoration of public infrastructure. The allocation of funds from the Centre under disaster relief should be based on the severity, impact, and need assessment, rather than on actual expenditure in the past.

Second, the per capita Net State Domestic Product (NSDP) of Odisha is 71.8% of the national average (at current prices) in 2017–18. This is likely to have declined post-Fani. Moreover, an estimate in the chapter assessing the 'human impact' in terms of the income-poor in the pre- and post-Fani scenarios, suggests an increase in incidence of poverty in the state by five percentage points; taking it back to the 2011–12 level of 33%, which itself was worse than the all-India incidence of 22%. In light of the substantive human impacts of natural disasters like Fani, multilateral agencies should consider Odisha as a special case in extending grants and concessional loans, as provided to low-income countries.

Third, given fiscal implications of financing recurring natural disasters, the Government of Odisha can consider accessing low-cost loans from NABARD's Rural Infrastructure Development Fund (RIDF), particularly to address DRR and BBB requirements. In addition, the Global Facility for Disaster Reduction and Recovery (GFDRR) may also be accessed for capacity building and technical assistance pertaining to DRR.

Fourth, given that the damages and losses on infrastructure were largely under public ownership (except for part of the damages under telecom), the fiscal burden on the state is excessive. One may start with an infrastructure risk pool in the telecom sector, such that the burden on the state is minimised.

Fifth, there is some discussion in favour of risk-layering and exploring possibilities of market-based risk transfer instruments—such as 'catastrophic bonds' or 'cat bonds'. It should be noted that in the past, the state has participated in arrangements for prepayment of high-cost market borrowings, debt swaps and buy-back of high cost loans. These and the excessive fiscal burden on the state may call for looking into other possibilities. However, structuring disaster financing mechanisms such as cat bonds calls for due cognisance of associated risk factors. In particular, it should be kept in mind that such bonds are generally floated in advanced economies, where there is an appetite for greater

risk and returns. In low risk and low return situations, cat bonds are not successful.

Sixth, to revive livelihoods across sectors, appropriate investments in capacity building and skilling need to be made. For instance, it has been reported that some of the young trainees under 'Skilled in Odisha' contributed in the post-Fani recovery activities. Institutionalising and incentivising the youth to participate in DRR and BBB should be considered.

Seventh, the agriculture and allied activities sector provides the highest employment but is also vulnerable to climatic shocks. Therefore, alternative resilient farming systems like the zero budget natural farming (ZBNF) initiative of Andhra Pradesh—which has demonstrated that impact from cyclones such as Pethai and drought had lower adverse impacts when compared with input intensive methods—should be promoted.[18] A similar initiative from the state is the Odisha Millets Mission, which should converge with integrated farming and other agro-ecological initiatives. These are win–win alternatives for the farmer, for the consumer, and for the planet.

Eighth, as the damages and losses under private ownership fall largely under agriculture and allied, housing, and employment, livelihoods and social protection, they are likely to affect the smallholder, the populace without safe housing and the workers earning a livelihood through unorganised employment—or, largely, the bottom 50% of the population. Addressing these requires the pooling of resources from non-governmental organisations (NGOs), civil society organisations (CSOs), and international development partners to facilitate recovery, as the Government of Odisha alone will not be in a position to take this up.

Ninth, the disaster affected populace are the most important players in their recovery. Their resilience itself will be a source of strength. They may also provide localised low-cost suggestions to address their requirement (for instance, producing and using raw materials required for housing from locally available resources). In involving people, it should also be kept in mind that the process does not exclude even a single individual.

Last, but not the least, as an afterthought, any DLNA exercise will benefit from timely access to updated data across the line departments. The time delays in DLNA become critical, given the window of risk for vulnerable households to slip from transitory shocks to structural poverty. This necessitates that the state also invest in upgrading its statistical system. On a related note, for an improved understanding of impacts of disasters and for studying general equilibrium effects, appropriate input–output tables and social accounting matrices (SAM) for the state economy can be developed.[19]

17.8 Methodology for Estimating Macroeconomic Disaster Impact

In order to assess the macroeconomic impact of Fani on the economy of Odisha, the study team followed the following procedures.

First, it estimated the isolated effects of the disaster by developing a baseline for growth and GSDP and compared the estimates with post-Fani losses assuming no recovery and reconstruction. Due to lack of updated district level disaggregated data, the study team generated gross district domestic products (GDDP) at current prices as well constant prices. Sub-group consistent population projections—based on censuses 2001 and 2011 data and available administrative data on population affected due to Fani—were also worked out.[20]

Second, the study demonstrated the sectoral impacts on GSVA using DLNA sectoral information on damages, loss, and recovery and reconstruction needs. The study emphasised the opportunity cost of reallocation of funds to meet the sectoral recovery and reconstruction needs. Further, the study showed the effect of the loss on the real growth and GSDP of the state. In addition, DLNA estimates for recovery and reconstruction were used to show effect on GSDP (current and constant prices) under scenarios with and without recovery and reconstruction.

Third, in order to understand the fiscal implications of financing recovery and reconstruction, the study identified structural limitations of the state finances.

Finally, the study provided some policy suggestions (or, *DaSa NiTi*, ଦଶନୀତି) for consideration.

Notes

[1] This report has been prepared by Srijit Mishra and Sarthak Gaurav for UNDP through Nabakrushna Choudhury Centre for Development Studies as part of damage, loss, and needs assessment (DLNA) exercise following Fani. The chapter benefited from comments from Krishna Vatsa on an earlier version and from discussions and interactions with Hippu Salk Kristle Nathan and Sidheswari Sahoo as also from members of different sectoral teams and officials of Government of Odisha.

[2] Damages to stock of assets and losses due to change in flow of production of goods and services have been calculated using the DLNA methodology. For details, please see chapters on individual sectors in this assessment report.

[3] GSDP is the value of final goods and services produced in the geographical boundaries of a state in a given financial year, that is, from 1 April of the first calendar year to 31 March of the second

calendar year. For instance, 2018–19 refers to the period 1 April 2018 to 31 March 2019.

[4] In this chapter, the term sector is largely used to describe the DLNA sectoral exercise. The discussion on the economy related to GSDP (or other macroeconomic indicators) will largely use the term economic activities that are primary, secondary and tertiary in nature. There may be overlap in some cases.

[5] Discussion on the structure of the economy is based on data pertaining to 2018–19 in current prices provided by the Directorate of Economics and Statistics, Government of Odisha.

[6] The workforce share is taken from National Statistical Office (May 2019) *Annual Report, Periodic Labour Force Survey (PLFS) July 2017–June 2018*, Ministry of Statistics and Programme Implementation, Government of India

[7] Statements presented along with the Vote on Account 2019-20, Finance Department, Government of Odisha.

[8] Please note that while the DLNA report categorises public buildings (separate from housing) under infrastructure sectors, in this chapter the impact on public buildings has been clubbed with housing under social sectors.

[9] This corresponds to a nominal growth rate of 11.8%.

[10] CAGR of 7.2% between 2011–12 and 2018–19.

[11] Centre of Excellence in Fiscal Policy and Taxation (Sept. 2015), 'Fiscal Multipliers in Odisha State Finance', O.P.No.004, CEFT, Xavier University Bhubaneswar, Bhubaneswar; https://www.xub.edu.in/pdf/fiscal-multipliers-in-odisha-state-finance.pdf

[12] Brief Note on Short Release of Central Share of SDRF for the Year 2019-20, Finance Department, Government of Odisha.

[13] Based on interactions with officials of state Finance Department.

[14] Nabakrushna Choudhury Centre for Development Studies (2019), *Outcome Evaluation of State Finances in the Context Of Recommendations of the 14th Finance Commission, Odisha*, Fifteenth Finance Commission, Government of India.

[15] Value added tax (VAT) is levied on six items including petroleum products and liquor.

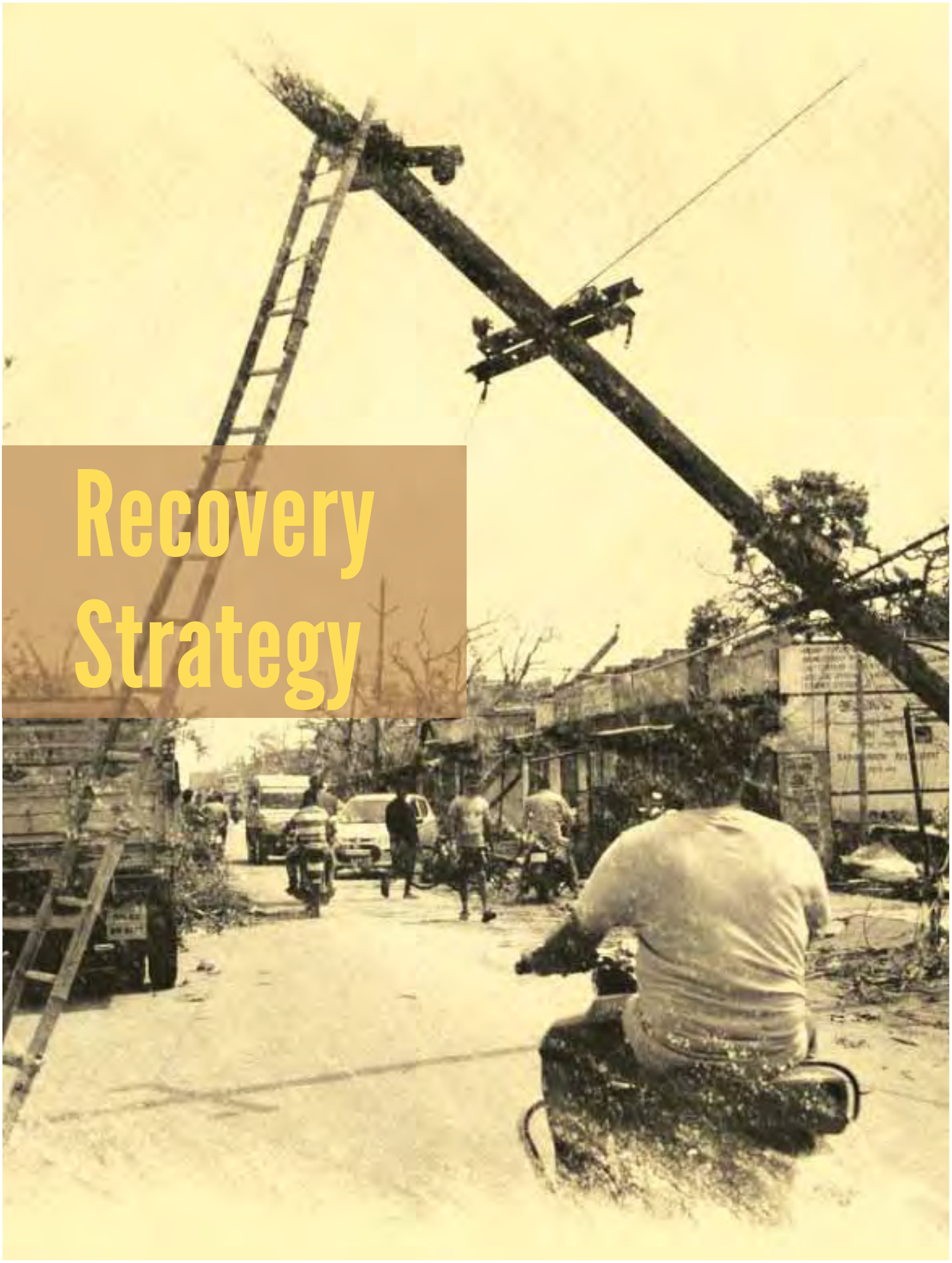
[16] Finance accounts of various years and budget documents of 2018–19, Government of Odisha.

[17] Statements Presented along with the Vote on Account 2019–20, Finance Department, Government of Odisha.

[18] Webinar, 'Growing the new Green Revolution: Zero Budget Natural Farming in Andhra Pradesh', Global Sustainability Institute, Anglia Ruskin University, East Anglia, UK, 25 March 2019.

[19] In the short term, general equilibrium effects should not be attempted, due to lack of information on relative prices as recommended in the GFDRR guidelines.

[20] Srijit Mishra, Sarthak Gaurav and Hippu Salk Kristle Nathan (2019), "Gross and Per Capita District Domestic Product for Odisha, 2018–19," Policy Brief 8, Nabakrushna Choudhury Centre for Development Studies, Bhubaneswar; http://ncds.nic.in/sites/default/files/PolicyBriefs/PB8NCDS.pdf



Recovery Strategy

18

Recovery Strategy

The Government of Odisha has received international acclaim for significantly reducing the loss of lives from nearly 10,000 in the 1999 super cyclone to less than 100 in the recent cyclones Phailin and Fani. While the goal of zero mortality is close to realisation, the economic loss in the form of livelihoods and infrastructure has been increasing. The combined economic loss[1] of INR 40,447 crore (USD 5.7 billion) from the recent cyclones—Phailin, Titli and Fani—demonstrates the need for the government to establish a strong framework of disaster risk governance and integration of the principle of resilience in every area of development planning and recovery process to achieve a substantial reduction in economic loss.

It is important to recognise that reducing economic loss due to these disasters is critical to reducing poverty and vulnerability in Odisha. This requires a continuous support for recovery as well as improving the quality of housing and infrastructure through better building standards and regulations. A recovery programme is the right context for bringing about these long-term changes and improving resilience at the household, community and state levels.

As per the latest available data this, damage, loss, and needs assessment (DLNA) study has estimated the cost of recovery to be INR 29,315 crore (USD 4,188 million). As part of the recovery process, the Government of Odisha has emphasised the need for building resilience across all sectors into the plans and programmes of the state. The narrative for building a resilient Odisha also resonates with the civil society groups and development partners including the United Nations, World Bank and Asian Development Bank. The strategy for building a resilient[2] Odisha is based on three pillars: Resilient Housing, Resilient Livelihoods and Resilient Infrastructure. These pillars are elaborated below.

18.1 Resilient Housing

Cyclone Fani hit the housing sector the hardest, damaging nearly 3.62 lakh units of houses across the 14 affected districts. The high damage to housing stock can be attributed to two factors, the quality of houses and the poor quality of construction. All the kutcha houses were fully destroyed and the semi-pucca ones along the coastline sustained significant damage. The total recovery needs are estimated to be INR 8,996 crore (USD 1,285 million), which include resilient and 'build back better' features.

Cyclone reconstruction is an opportunity to incrementally replace all the housing stock and provide safe and affordable housing to reduce the human and economic costs in a recurrent cycle of disasters. The key strategy for the reconstruction of the 3.62 lakh units of houses is owner-driven reconstruction, which would entail massive capacity building and skills training in disaster resilient construction technologies. The assessment team has proposed establishing 99 Housing Facilitation Centres at the block level with a technical team of three engineers/architects supported by three technical assistants. The team will have to work over a period of 18 months alongside house owners, masons and carpenters to oversee training and construction, and certify structural worthiness. The housing strategy also proposes the use of alternative materials such as fly ash bricks, compressed stabilised earth blocks (CSEBs) and treated bamboo as sustainable and cost-effective technologies to replace traditional construction materials. It is envisaged that a prioritised approach for all women-headed households, people with disabilities, the elderly and low-income households would result in the provision of safe shelter for all vulnerable people within five years. The reconstruction of all houses would significantly contribute to the resilience of households and communities.

18.2 Resilient Livelihoods

Ensuring that economic growth is commensurate with growth in employment and livelihood opportunities has been one of the key objectives of Odisha's economic policy. These are regarded as policy imperatives for inclusive development and reversing poverty. Despite

achieving impressive reduction in poverty in the last decade (2005–2012) from 58% to 33%, there is still a significant percentage of people (33%) living below poverty line. Extreme weather events such as cyclone Fani have a detrimental impact on the livelihoods and coping capacities of people, particularly extremely vulnerable groups reliant on a single source of income and social protection schemes. The major sectors of the economy are extremely vulnerable to the changes in weather patterns and the impact of climate change. Fisherfolk, small farmers, sharecroppers and people in tourism sector have been severely hit by the repeated cyclones. The recovery strategy proposes immediate, medium- and long-term policy recommendations to protect the livelihoods of people. Immediate assistance would require the replacement of all livelihood related assets of people, with cash assistance and interest subvention to support the recovery of small businesses. Using the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), the state can support the restoration and creation of livelihood assets. If required, a revision in the norms to provide 150 days of employment to people under this scheme could be considered to provide greater assistance.

In the long run, it is important to assist businesses to move from the informal to the formal sector to qualify for insurance coverage, credit assistance and better-quality services. Group insurance for all the Micro, Small and Medium Enterprises (MSME) is recommended to encourage better coverage and to reduce the premium. The services sector under tourism, which provides a significant opportunity for employment in the state, requires a large skill-upgrade programme.

Social protection schemes make a critical contribution to broader disaster recovery efforts by aiding disaster-affected households to protect their immediate well-being and helping them to recover more quickly. For example, the instant cash provided to the affected population post-Fani helped households purchase basic household items essential to resume economic activity.

The existing social protection schemes can be made more effective through top-ups to beneficiaries who are pre-enrolled in an existing safety net programme. An expansion of social protection schemes maybe considered to add additional eligible people. An integrated package of support to vulnerable households through safe housing, supplementary income sources and expanded social protection schemes will insulate them from the effects of disasters.

In Odisha, the government has taken several steps to empower women. Women have organised themselves into self-help groups (SHGs) and are leading handicrafts and cottage industries and service sector employment. It is important to encourage women as economic actors, improve their level of financial inclusion, and provide necessary skills and credit to help them diversify their livelihoods. Financially independent women will improve household resilience significantly.

18.3 Resilient Infrastructure

Infrastructure needs across all sectors are estimated to be more than INR 21,000 crore (USD 3.0 billion). The housing and power sectors have the highest needs among all sectors, followed by the stock of public buildings. The repair and reconstruction of all infrastructure works in the 14 affected districts has already begun, particularly in the power sector, given its critical importance in restoring services and economic activities.

A total of 6,441 public buildings, comprising 590 buildings under the urban local bodies, 914 under the Rural Works Department, 2,216 under the Public Works Department and 2,721 under the Panchayati Raj and Drinking Water Department suffered damage worth about INR 544 crore (USD 78 million). The number of public buildings that have suffered damage in the districts of Khurda, Puri and Cuttack are in the same range, due to the nature of building stock and exposure to the event. These exclude schools and hospitals.

Keeping in mind the upcoming monsoon, the government's immediate priority should be that of securing damaged buildings. This would include cleaning up and segregating debris so that it can be recycled or disposed safely.

From the nature of damage, buildings with sloping asbestos cement (AC) sheet roofing suffered maximum damage but reinforced cement concrete (RCC) roofed buildings were also widely hit. Keeping in mind the large building stock, the strategy should be to enhance the resilience of sloping roofs, doors and windows, compound walls and other associated elements like water tanks. Fallen trees have caused extensive damage to buildings; therefore, all tree plantation in compounds of public buildings need to be planned keeping in mind the species and distance from the building.

In future, all upcoming building stock in RCC roofed buildings need to be designed to withstand impacts of cyclones and other hazards. Special attention should be paid to securing all 'loose' elements such as doors and windows, water tanks, piping, solar panels, AC units, wiring, etc., to ensure that they can withstand wind speeds of 250 kilometres per hour (kmph). Certain design elements like large glass windows, glass and aluminium panels need to be revisited, and if retained, need to be designed structurally to withstand these wind speeds.

There is a need to create a comprehensive inventory and database of all public buildings currently in use and under construction, and to recommend steps to prevent or reduce future damage. Buildings should be prioritised based on usage and a phased plan should be developed to repair, retrofit and reconstruct them. Additionally, there may be a need to develop guidelines to protect public buildings and assets in the cyclone-affected districts.

The large number of public buildings that served as evacuation shelters need to be audited for their readiness to provide this function in future. An action plan for repair, retrofitting and enhancing the overall facilities should be prioritised. It is also important to introduce a survivability concept in these buildings to cope during and after the disaster, and add new features such as emergency communications, emergency lighting, emergency water provision (rain water harvesting), etc.

In addition to public buildings, other structures like embankments, roads, power supply and telecommunications need to be evaluated in light of the recent cyclone. Embankments need to be reviewed to establish a design and technical specifications for raising and strengthening embankments and protection of slopes. The power supply sector needs to work on accelerating the replacement of the overhead power supply with underground cable systems in the most vulnerable areas, even as remedial measures are taken to strengthen existing electric poles lines, incorporating features to withstand high windspeeds. In the long run, alternative energy sources such as solar power, bio mass and small hydro plants can be explored to reduce dependence on a single energy source. For the telecom sector, a gradual transition to future proof the communications systems should be adopted through better designed cell phone tower structures to withstand wind speeds above 250 kmph. Aerial cables should be replaced with underground cable ducts and multiple route redundancies with backup systems to ensure that telecom services are not disrupted in future cyclones. As the government continues to invest in infrastructure for economic growth, it is important to also invest in making assets multi-hazard resistant.

18.4 Guiding Principles

18.4.1 Principles of Recovery

The process of recovery in the state of Odisha will be guided by the following principles aimed at improving the quality of recovery, emphasising social inclusion and promoting resilience of all sectors. These guiding principles are articulated below.

- Recognising the differential impact of the cyclone on people, the recovery process will prioritise the needs of the most vulnerable, which include people with disabilities, women-headed households, fisherfolk, slum dwellers, artisans, Scheduled Caste communities and people in extreme poverty.
- Recovery interventions should be based on the principle of gender equity, with a specific orientation towards investing in women's capacities to contribute to the recovery process. The SHGs established through Mission Shakti may be further capacitated to take up non-traditional reconstruction jobs, including construction of public works and higher paid skilled jobs to build their resilience.
- Recovery should be risk informed and disaster resilient. This can be done through establishing project approval processes which would ensure that the location, design and construction of all public and private infrastructure are multi-hazard resilient.
- Nature based solutions should be promoted in recovery, which include using environmentally safe and locally produced materials, and establishing coastal belt plantations as opposed to concrete infrastructure-based solutions. The reconstruction of infrastructure must take into account environmental risks and be carried out in a manner that will prevent further degradation of the environment.
- Recovery efforts must build on international best practices, bringing in ideas and approaches that have been proven to be sustainable and resilient. At the same, they should promote vernacular design and the work of artisans to retain the flavour of Odisha's cultural heritage.
- Recovery should be a collective effort, using the resources and expertise of the government, civil society, development partners and the private sector. An inclusive and collective recovery effort will help the state reach out to all the affected areas and communities and reduce the burden on the state. People are integral to the recovery process and the government must create enabling conditions for their active participation and contribution.
- Recovery should be implemented in a transparent manner. All the information related to recovery must be made available in the public domain and be widely disseminated using means of communication that are accessible by the affected communities. Frequent monitoring and third-party audits should be conducted to provide quality assurance to recovery work undertaken by the government and private parties.

18.5 Policy Recommendations

The DLNA does not make new policy recommendations; rather, it proposes the reinforcement and modification of

existing policies of the state. It has been noted that in several areas, there is room for improvement in the application of existing policies. Each chapter makes recommendations to enforce or modify policies in specific sectors. The broad policy recommendations to guide the overall recovery and reconstruction process across all sectors are as follows.

- **Delivery and management of relief and recovery assistance**: The government assistance of INR 2,000 and 50 kilograms (kg) of rice per household distributed soon after the cyclone provided life-saving support to the affected people. This package of immediate assistance was distributed to ration card holders, with one package for each family. Though unintentional, this requirement became an exclusion criterion depriving the most vulnerable groups of people of assistance—among them were migrants, brick kiln workers and members of certain Dalit groups who did not have ration cards. Furthermore, the distribution of one package per family irrespective of family size meant that while the package may have been adequate for nuclear families, it was insufficient for large joint families. It is recommended that the distribution of immediate relief assistance be made to all people affected by a disaster on humanitarian grounds, with equitable food distribution based on the family size. This nuanced approach for the selection of beneficiaries and delivery of assistance is not specified in the Odisha Relief Code, the State Disaster Response Fund (SDRF) or the National Disaster Response Fund (NDRF). These should be reviewed to ensure that they include guidance on the delivery of assistance to affected families.
- **Equitable access to services**: Cyclone shelters across the state served their purpose by saving the lives of people. However, in many cases, it was noted that there was segregation in the arrangement of food and use of facilities between people from dominant social classes and those from socially vulnerable groups, forcing the latter to take shelter in other buildings such as anganwadi centres or available pucca structures in their villages. This narrative of discrimination must be addressed within the recovery process with a deliberate strategy to include low-income communities in decision-making bodies for reconstruction work. Prioritising the restoration of services for health and education, and reconstructing infrastructure in locations where poor communities reside is desirable. Additionally, any new cyclone shelters that are constructed should be located closer to Dalit hamlets to ensure access for people who need them the most. Programmes to create social cohesion among diverse social groups should also be taken up.
- **Regulation and enforcement of the Coastal Zone**: The Coastal Vulnerability Index prepared by the Indian National Centre for Ocean Information Services (INCOIS)[3] notes that vulnerability arising from loss and damage from sea level rise, coastal geomorphology, tidal range, and elevation in the 107 km of Odisha's coastline is high. These include parts of Puri, Jagatsinghpur, Kendrapara, northern and southern Bhadrak, and southern Balasore. Construction of any lifeline buildings in this zone should be reviewed carefully for their potential to withstand not only cyclonic wind speeds of 250 kmph but also shore erosion, coastal flooding, storm surge and inundation. The Integrated Coastal Zone Management Project (ICZMP), Odisha, has delineated areas under CZM and proposes approaches to the management of the shoreline and settlements around it, which also need to be taken into consideration in the recovery process.
- **Resilience building linked to livelihoods resilience and social protection:** The impact of disasters is felt more strongly by poor communities. Odisha's accelerated rate of poverty reduction could be slowed down due to the repeated occurrence of disasters. Therefore, any recovery programme should focus on building livelihoods of communities and extending social protection to the most vulnerable people. The coastal communities affected by the disasters are largely dependent on agriculture, fisheries and livestock, all of which are vulnerable to disasters and climate change. While the recovery of these key sectors can focus on 'protecting' and promoting by integrating disaster resilient practices in the sub-sectors,[4] there could be a special drive to provide a secondary source of income to these families through work opportunities in the service sector. This would also help low-income families move from the informal to the formal sector, thus providing them greater security. To achieve this, a very intense skills upgrading programme covering various categories of occupations and targeting specific age-groups and gender is required. This will help make gradual changes to the service sector, with the aim of having at least one member of the family working in the formal service sector over a period of five years. The state's role in ensuring this is critical, through the allocation of resources and surge capacities to Mission Shakti, Odisha Livelihoods Mission and by linking these with the Odisha Skills Development Authority.
- Low income families and other vulnerable groups are covered under various social protection schemes under the state government. The cash transfer albeit not large, provides a steady source of money to meet emergent

needs of the elderly, disabled, and widows. These schemes could be extended to ensure coverage of all eligible individuals and include provisions for topping up the monthly allowance following a disaster, which would go a long way in ameliorating their impoverishment after a disaster. A package of support to each family through skills training, livelihood support and cash transfer, combined with a pucca house with access to water and power, would improve their quality of life and build resilience against future disasters.

18.6 Institutional Arrangements

The Odisha State Disaster Management Authority (OSDMA) has been mandated with the role of coordinating recovery and reconstruction through the line departments. The OSDMA's project wing should be strengthened with additional capacities to coordinate and guide recovery efforts over the next five years. It is important for the OSDMA to be present in the most affected districts with technical experts such as engineers, architects and planners, and livelihood experts to coordinate recovery efforts. These additional technical capacities maybe outsourced from UN agencies, international and national partners on secondment to OSDMA to work with government officials. Similarly, line departments may consider augmenting their offices in districts and blocks, with technical experts from specific areas such as housing, roads, power, water resources and livelihoods. The line departments of the Panchayati Raj and Public Works are supposed to implement a major share of the recovery programmes; therefore, the departments need to be boosted with additional staff capacities for undertaking reconstruction. At the district level, the District Collectors are to coordinate the work of line departments and funds and programmes of all national and international agencies. It is recommended that a strong reporting mechanism be established at the district level, led by the District Collector, to review progress on a quarterly basis.

18.7 Implementation Arrangements for Recovery

The government will deliver recovery programmes in villages through block-level officials and Gram Panchayats. Gram Panchayats may be entrusted with the responsibility of restoring community infrastructure such as local roads, drainage, community centres, market sheds and water supplies. Adequate technical support maybe provided to the Panchayats to undertake these activities. Gram Panchayats can also play an important role in preparing communities for disasters through plans, drills and small mitigation projects.

Before the recovery process is initiated, it is important to draft detailed sector recovery plans for each district based on the recovery needs and strategy proposed in the DLNA. Such a plan would be based on available resources and will assist in prioritising the recovery needs based on urgency and directing resources for projects where they are most needed. Detailed implementation arrangements maybe developed on analysing the existing capacities of the line ministries and departments vis-à-vis the quantum of work to be done.

While the government must lead the recovery effort, it will not be carried out by the government alone. Civil Society Organisations (CSOs), local NGOs, the private sector and international development partners should also be invited and facilitated to participate. The government, in consultation with the civil society, should delineate areas of support and use allocated resources for projects within a community. The OSDMA has already prepared a list of projects that require support. International agencies and national NGOs or private sector partners may choose to fund a project or a series of projects within a village and completely rebuild it by providing necessary technical support to implement them against government-set building designs, standards and guidelines. The support of local NGOs can also be used to mobilise community-based organisations(CBO) and women's SHGs, and the CBOs and SHGs can be trained and provided with knowledge and skills to participate in recovery programmes.

18.8 Geographical Coverage

The recovery programme will be implemented in the 14 affected districts of the state, with a focus on the five most affected districts—Puri, Jagatsinghpur, Khurda, Cuttack and Kendrapara. These districts have been identified based on the severity of the damage to infrastructure and loss of economic activities.

18.9 Timeframe

The DLNA proposes the implementation of recovery in three phases—short, medium and long term. The duration of short-term recovery is set for 12 months, medium-term recovery for up to 2 years or 24 months and long-term recovery for 24 months and beyond. The total duration is anticipated to be 5 years. The time-frame of the recovery programme suggests a broad timeline for the completion of activities.

The short-term activities denote an urgency of things to be done. These include immediate repairs and reconstruction work that is required to restore lifeline services such as power, health, nutrition and education services and the repair of

embankments. Housing reconstruction will be initiated in the first year with preparatory work for the construction of all 3.62 lakh units of houses. In this year, 15% of houses will be reconstructed. Other activities in the short term include immediate support for the restoration of livelihood activities, particularly the resumption of agricultural activities for the next crop cycle.

The medium-term activities will focus on livelihood restoration and skills training. Housing reconstruction will be accelerated, and 35% of the houses will be completed within the next two years. The power sector and reconstruction and repair of public buildings will all be completed within the first two years. Tree plantation, which includes perennials and well as avenue plantation, will be a major activity from the first year and will continue through the next few years.

In the long term, all sectors will undertake upgrade and quality improvement of structures to make them disaster resilient. Feasibility studies will be conducted for selected sectors before undertaking large reconstruction projects. Research on design and structural stability of infrastructure such as roads, bridges, embankments and other infrastructure will be undertaken keeping in mind principles of being environmentally sustainable and disaster resilient. The remaining 55% of houses will be constructed in the last two years.

18.10 Conclusion

Cyclone Fani is an opportunity to rebuild assets and livelihoods, improve government services, and build resilience at all levels. Recovery should be organised as a distinct effort, targeting people who are severely affected by Fani. At the same time, the government should upgrade public buildings, services and infrastructure facilities so that they can withstand future disasters.

A sustained recovery effort will bring accelerated development to Odisha. It will bring in more investment, skills and regulations which create larger opportunities for civil society. Recovery should, therefore, be seen as a targeted effort for building resilience, meeting the Sustainable Development Goals, and improving the well-being of people.

Notes

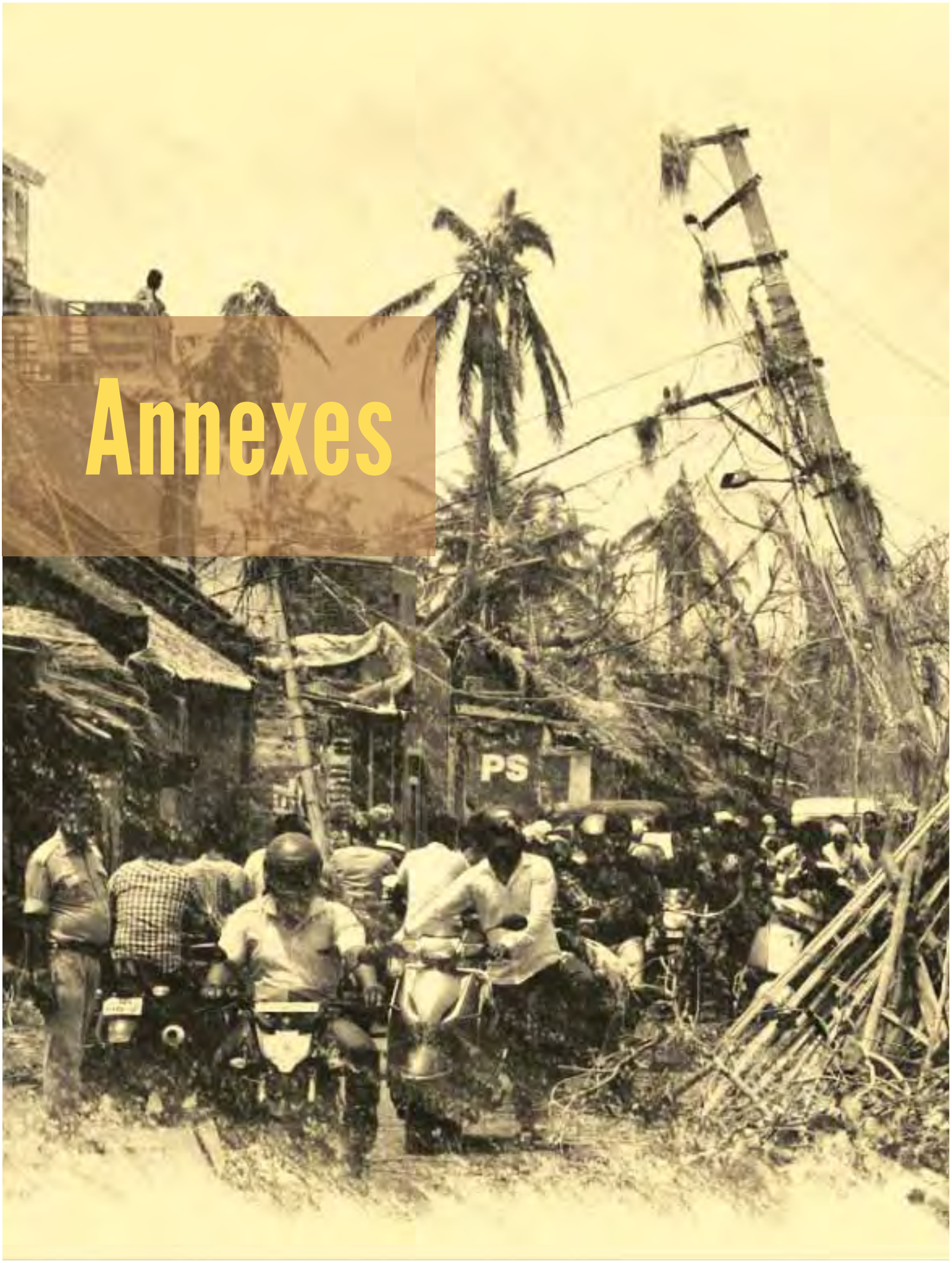
[1] Government of Odisha (2013), *INDIA Cyclone Phailin in Odisha October 2013: Rapid Damage and Needs Assessment Report*, World Bank, Asian Development Bank, Government of Odisha, Bhubaneswar. Final Memorandum on very severe cyclonic storm "Titli" and subsequent floods, by the Government of Odisha.

[2] The UN Office for Disaster Risk Reduction (UNDRR) defines resilience as: 'The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management'.

[3] 'Odisha State Climate Change Action Plan', Forest and Environment Department, Government of Odisha, 2018.

[4] The 'Odisha State Climate Change Action Plan', Government of Odisha, 2018 provides suggestions on climate resilient practices for Agriculture, Animal Husbandry and Fisheries.

Annexes



Annexes: Tables and Figures

Tables

Figures

Annexes to Chapters

Annexes to Chapter 1- Housing, Land and Settlements

Field Notes and Observations:

The following pages show the different housing types, pattern of building failure/survival due to Fani and how people are rebuilding their houses after Fani. The photos and the observations are based on field visits by the housing, land and settlement sector's team members to the rural and urban areas of Puri, Cuttack and Khurda districts.

Housing Types

URBAN AREAS

		
Bhubaneswar	Bodiya Ponda, Puri	Nulia Shahi, Puri

RURAL AREAS

		
Satyavadi, Puri	Bhabanpur, Bramhagiri, Puri	Harijan Shahi, Balianta, Khurda

Summary: Housing Type

People in Odisha consider buildings having brick, laterite, flyash block wall with RCC roof as pucca. The semi-pucca houses are those having pucca wall and roof with asbestos, CGI or straw on timber or bamboo under structure. The kutcha buildings have mud walls with straw roof on bamboo under structure. In the urban areas, it was observed that the non-slum areas had predominantly pucca buildings while the slum areas had mostly semi-pucca and kutcha. In the rural areas, the number of semi-pucca and kutcha buildings put together was more than the pucca buildings.

Pattern of Failure

URBAN

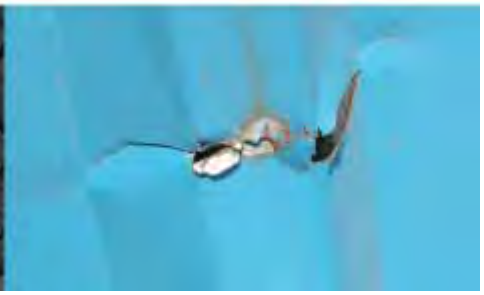
Roof blown off, Bodiya Ponda, Puri

Non-structural damage, Puri, seaside

Damaged building: Very poor construction, BBSR

Non-structural failure: windows not designed for wind load

Roof sheets damaged due to wind suction



Bearing failure: stress concentration: lack of wind arresters

RURAL

Bhabanpur Bramhagiri: roof damaged

PuriSadar: roof blown off- weak anchorage+ no wind arresters

Satyavadi Puri: straws blown off, the under structure is in place

Bishuniapada, Khurda: Building on the left is intact. Building on the right → roof blown off- cause → failure of purlins

Balianta, Khurda: 40 out of 60 poultry farms collapsed → no bracing & roof slope too gentle

Summary: Pattern of failure

Out of many reasons, the semi-pucca and kutcha buildings failed due to lack of adequate anchorage, bracing, corner/ joint detailing and lack of appropriate maintenance.

Many Kutcha Buildings Survived Fani

		
Satyavadi, Puri district- Straws blown away by high wind while the roof under-structure and Jhati Mati wall survived	Nolia, Bhubaneswar → kutcha roof structure survived the cyclone, though some straws flew away	Kantapada, Cuttack → kutcha roof structure on split bamboo under-structure survived the cyclone, with least damage

Summary

Many well-built traditional kutcha buildings did not collapse during Fani. Bamboo reinforced wall and roof under-structure with closely knit split bamboo withstood the cyclone with minimum damage. The traditional construction methods could be improved significantly by incorporating anchorage, bracing, connections/corners and detailing.

Rebuilding by the Community

		
Roof replaced: no anchorage, Bramhagiri, Puri	Repaired mud wall- no wind bracing, Niali, Cuttack	Rebuilding without bracing, Harijan Shahi, Balianta, Khurda

Summary

- Housing types in urban slum and rural areas were structurally similar (primarily semi-pucca and kutcha with pucca buildings as well)
- In general, the semi-pucca and kutcha buildings did not have resilient features
- Failure pattern of semi-pucca and kutch buildings were similar both in rural areas and urban slums
- People have started rebuilding kutcha houses and repairing semi-pucca houses without BBB features, thus increasing risks against future hazards.
- Pucca buildings were safe during Fani, however, they suffered non-structural damages such as windows pushed-in or sucked out following which the interior furniture fixture, false ceiling, mattress, etc. had extensive damage
- Many bamboo reinforced mud wall (Jhati Mati) and closely spaced spilt bamboo roof under structure withstood the cyclone Fani, though the straws were blown away by the wind. Performance of the traditional construction against high wind could be enhanced significantly by incorporating anchorage, bracing, connections/corners and detailing.

Annexes to Chapter 2-Education and Child Protection

Special design considerations to make buildings disaster resilient

- Buildings with RCC framed & RCC roof are absolutely necessary. In cyclonic regions close to the coast, construction should be done on stilts with no masonry or cross bracings up to maximum surge level, or on raised earthen mounds to avoid flooding but knee bracing may be used.
- Two layer of widows with exterior widows are to be either with solid Timber or steel. Inner layer windows with Glass & Aluminum frame or Glass with UPVC Frame. Toughened glass should be used and panes can be strengthened by transparent Polymer Films. This will help in holding the debris of glass panes from flying in case of breakage
- If the campus of the institutions are built on large land area, the external electric supply & distributions are to be done with underground cabling rather to control & prevent the damages due to disaster.
- Overhead water tanks over each building are to be provided with RCC tanks rather than that of PVC tanks which are more vulnerable to high speed wind.
- External walls or wall panels must be designed to resist the out of plane wind pressure adequately. The lateral load due to wind is finally resisted either by walls lying parallel to the lateral force direction (by shear wall action) or by RC frames to which the panel walls must be fixed using appropriate reinforcement such as seismic bands at window lintel level.
- Strengthening of walls against high wind / Cyclones it is very much necessary to reinforce the walls by means of reinforced concrete bands and vertical reinforcing bars as for earthquake resistance also.
- Typically, the Educational Institution buildings are to be designed to resist a strong wind and earthquake with a very long return period, such as 50 years or more. The design wind speed is determined from historical records using extreme value theory to predict future extreme wind speeds. Wind speeds are generally calculated based on some regional design standard or standards.

Annexes to Chapter 3- Health, Nutrition and Food Security (Additional to Section 3.1)

Annex 3.1: Demographic and Economic Profile of Odisha as Compared to India

Indicator	Odisha	India	Source
Total population	41,974,218	1,21,01,93,422	GoI Census 2011
Decadal growth rate of population (%)	13.97	17.64	GoI Census 2011
Sex ratio, 2011	979	940	GoI Census 2011
Population density, 2011 per square (sq) km	270	382	GoI Census 2011
Literacy rate, 2011 (%)	72.9	74.04	GoI Census 2011
Population below poverty line %	33	22	World Bank
Per capita health expenditure, INR	927	1657	National health profile 2018
% of Gross Domestic Product (GDP) expenditure on health	1.19	1.28	National health profile 2018

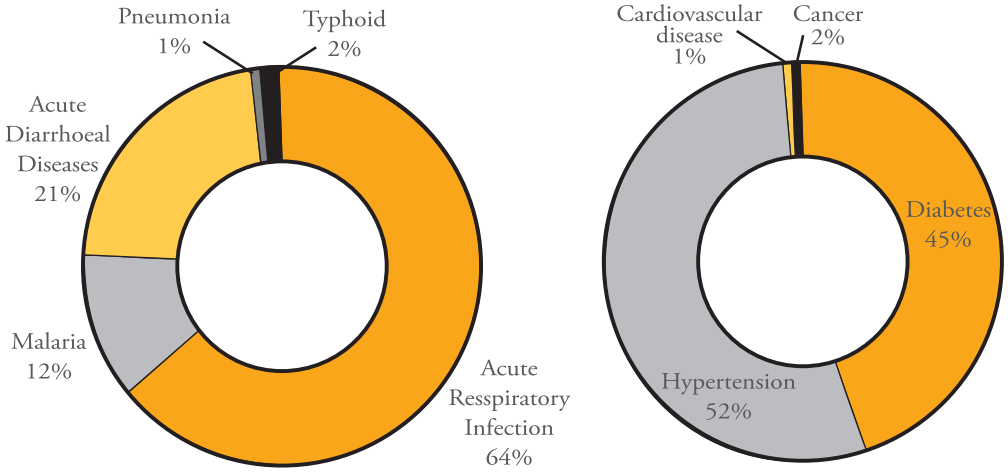
Annex 3.2: Public Health Institutions of Odisha State

Public Health Facilities/Institutions		Number
Allopathic	Medical college	3
	Training institutes	2
	District hospital	32
	Sub-district hospitals	32
	Community health centres	374
	Primary health centres	1303
	Other hospitals	54
	Sub-centres	6688
Ayush	Homeopathy medical colleges	4
	Ayurvedic medical colleges	3
	Ayurvedic dispensaries	619

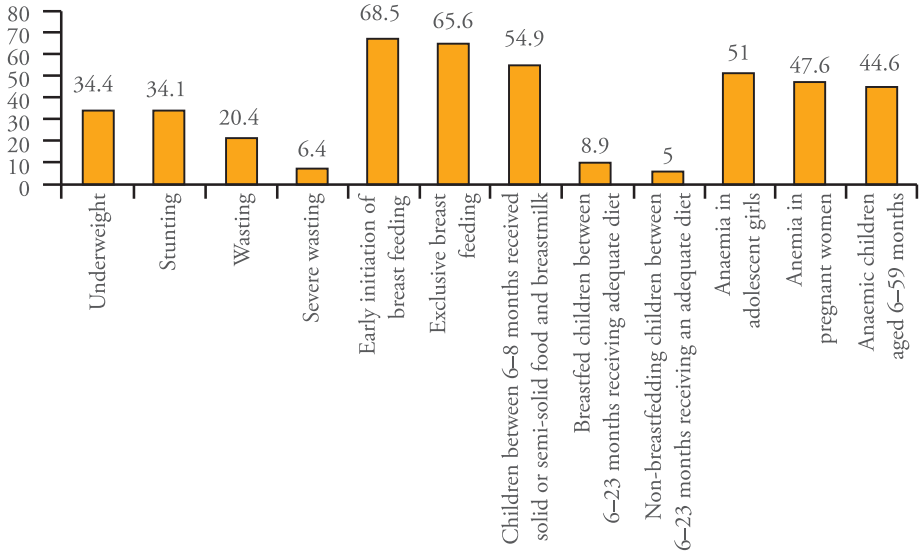
Annex 3.3: Human Resources in Health Sector, Odisha

Directorate	Categories	Sanctioned	Positioned	Vacancy	(%) Vacancy
Directorate health services	Doctors	6641	4349	2292	35
	Staff nurse	5628	1830	3798	67
	Pharmacist	2604	2119	485	19
	Laboratory technician	1145	657	488	43
	Multipurpose health workers (Male)	4952	3344	1608	32
	Multipurpose health workers (Female)	8793	7037	1756	20
NHM contractual	AYUSH doctor	1485	1235	250	17
	Additional midwife	1150	1127	23	2
	Additional staff nurse	2388	1876	512	21
	Lab technician	334	208	126	38
	ASHA	47147	46552	595	1

Annex 3.4: Percentage Morbidity Distribution of Reported Communicable and Non-communicable Diseases, Odisha–2017

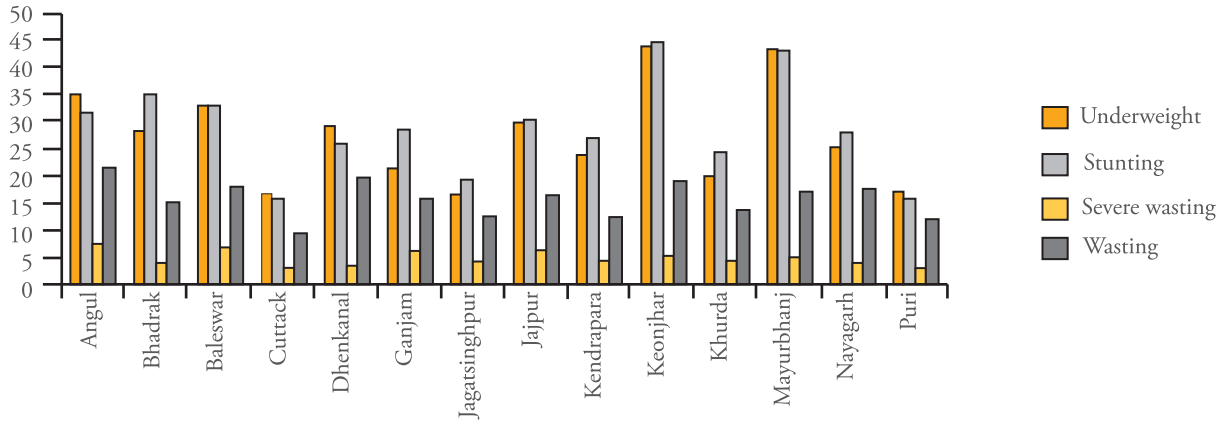


Annex 3.5: Nutritional Status of Vulnerable Population in Odisha



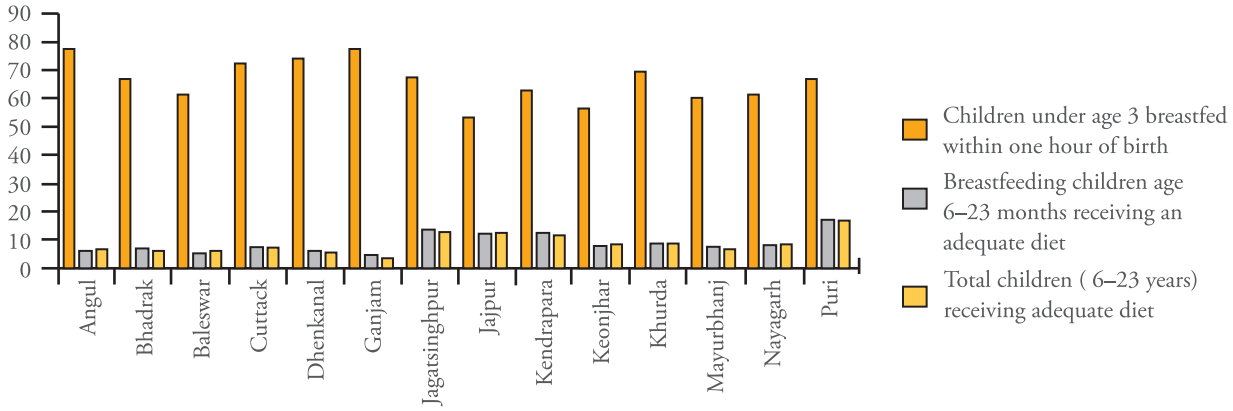
Data source: NFHS 4 (2015–16)

Annex 3.6: Scenario of Undernutrition in Below 5 Years of Age Children



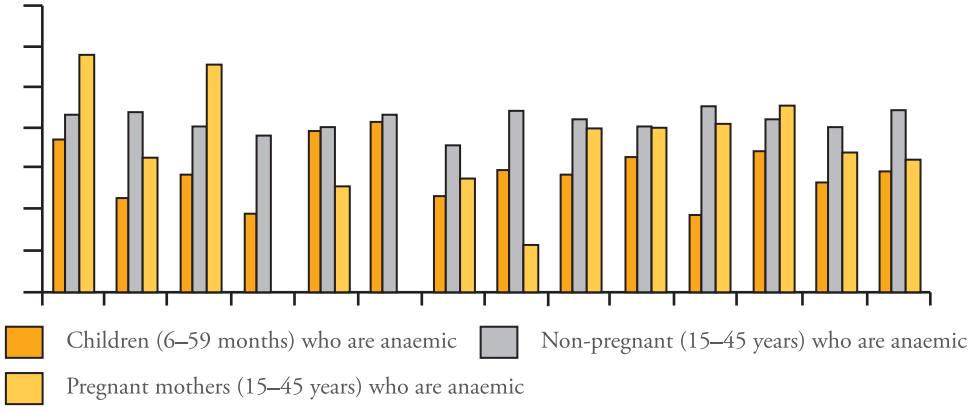
Data source: NFHS 4 (2015–16)

Annex 3.7: Infant and Young Child Feeding Practices in Cyclone Affected Districts



Data source: NFHS 4 (2015–16)

Annex 3.8: Status of Anaemia in Cyclone Affected Districts



Annexes to Chapter 4- Cultural Heritage and Tourism (Additional to Table 4.2)

Annex 4.1: Estimate of Damage and Loss for Tangible Cultural Heritage: Monuments and Sites

District	Description of damage	Damage Cost (INR crore)	Description of revenue loss	Revenue loss (INR crore)
Balasore	Damage to 4 properties. Partial structural damages, damage to lighting infrastructure in temples and other monuments. Shyamasundarjiu Temple also lost the boundary wall and the Dolamandap.	0.40	Subsumed under estimated losses to the tourism sector	Subsumed under estimated losses to the tourism sector
Bhadrak	Damage to 2 properties. No serious damages. Mainly the layer of plaster has been damaged. Shyamsundarjiu Temple in Chadumani has a lot of debris.	0.17		
Cuttack	Damage to 10 properties. Sculptures, plaster and compound walls have partial damages. In Kapileswar Temple, the cyclone destroyed the Mandap and the paving work as well.	1.32		
Dhenkanal	Damage to 5 properties. Minor damage to the main temples. Damage mostly to the compound walls.	0.49		
Ganjam	Damage to 4 properties. Main structure of the temples has been damaged. In Jhadeswar the core of the temple has been severely affected.	1.00		
Jagatsinghpur	Damage to 6 properties. The main temples of the district have been damaged both structurally and aesthetically. In Jhadeswar Temple the compound wall has been damaged as well.	0.45		
Jajpur	Damage to 4 properties. Most of the damages have occurred to the lighting systems. Sikharchandi Temple suffered some damages to the kitchen and the signages.	0.77		
Kendrapara	Damage to 6 properties. Mainly the compound walls have been damaged. Most severe damage at the Alam Chandi.	0.28		
Khurda	Damage to 31 properties. Most of the tin roofs have been seriously damaged. Parts of the compound walls and the kitchen structures have been demolished. Trees have fallen and signages have been dismantled. Jagat Mohan Dev Temple has suffered the most damages.	5.54		
Mayurbhanj	Damage to 2 properties. Some archaeological remains in Pedagadi have been damaged. Some sculptures and a portion of plaster affected.	0.20		
Nayagarh	Damage to 8 properties. Kitchen blocks and boundary walls damaged. Similar level of effects on other tangible heritage properties in the district.	0.80		
Puri	Damages to 31 properties. Harachandi and Bhabakundaleswar Temple suffered the extensive damage. Water leakages washed away colour and damaged compound walls were the most common damages on the sites in the region. Heavy crack in Gumuta in Gopinath Temple.	4.52		
Total (INR crore)		**15.9**		**0.0**
Total (USD million)		**2.3**		**0.0**

Notes: Damage estimates are based on preliminary assessment by the Odisha State Archaeology of 113 structures in 12 of the affected districts. The extent of damage was corroborated by field-visits to few of the sites such as Nikunja Bihari Temple in Khurda and the Gundicha Temple in Puri.

Annex 4.2: Estimate of Damage and Loss for Museums, Archives and Cultural Institutions

District	Description of damage	Damage Cost (INR crore)	Description of revenue loss	Revenue loss (INR crore)
Cuttack	Infrastructure damages to cultural institutions (Anand Bhawan, Netaji Museum, Madhusmriti, Swaraj Ashram, District Library)	1.6	Subsumed under estimated losses to the tourism sector	Subsumed under estimated losses to the tourism sector
Dhenkanal	Damages to Sanskruti Bhawan and District Library	0.2		
Khurda	Infrastructure damages to cultural Institutions (Sanskruti Bhawan, Utkal Sangeet Mahavidyala, Odisha State Museum, BK College of Art & Craft, HKM State Library, Odisha State Archives, GKCM Odissi Research Center, OIMSEAS, Utkal University of Culture, Odisha State Archaeology)	52.9		
Puri	Infrastructure damages to cultural Institutions (Netaji Memorial Museum, District Library)	1.2		
Total (INR crore)		**55.9**		**0.0**
Total (USD million)		**8.0**		**0.0**

Annex 4.3: Estimate of Damage and Loss for Intangible Cultural Heritage: Performing Arts

District	Description of damage	Damage Cost (INR crore)	Description of revenue loss	Revenue loss (INR crore)
Cuttack	Damage to musical instruments, costumes, rehearsal space in performing arts such as Pala, Sankirtan, DandaNach, GhodaNach, and others (involving 466 performing groups/3057 artists).	1.4	Income loss for artists due to lack of private performance opportunities and performance opportunities through government schemes	8.3
Khurda	Damage to musical instruments, costumes, rehearsal space in performing arts such as Pala, Sankirtan, Daskathia, Gotipua dance, Paika Akhada, Danda Nach, Ramleela, and others (involving 394 performing groups/3375 artists).	1.2	Income loss for artists due to lack of private performance opportunities and performance opportunities through government schemes	9.1
	Infrastructure damages to theatres / mandaps and other performing spaces (Natyagram, Rabindra Mandap, Bhanja Kala Mandap, Utkal Mandap, and Ramhari Das Odissi Gurukul Trust).	5.2		0.1
Puri	Damage to musical instruments, costumes, rehearsal space in performing arts such as Pala, Sankirtana, Daskathia, Gotipua dance, Paika Akhada, Danda Nach, and others (involving 1063 performing groups/14669 artists).	3.2	Income loss for artists due to lack of private performance opportunities and performance opportunities through government schemes	39.6
	Infrastructure damages to performing spaces / theatres (Annapurna theatre complex, Padmashree Guru Maguni Das Gurukul).	0.4		0.03
Total (INR crore)		**11.2**		**57.1**
Total (USD million)		**1.6**		**8.2**

Notes:

1. Damage estimates for performing artists has been collected by OSNA/UNICEF. As per the data compiled by OSNA/UNICEF, the folk performing artists in other districts have not been affected. Data has been collected by the department through field visits and interactions with about 20–30 artists from 5–6 groups.
2. Estimates of damages to performing spaces are based on data collected by the Directorate of Culture as well as field-level discussions with heads of non-public performing spaces.
3. Income losses are calculated using the average income earned by an individual folk performing artist per day based on rates provided in government outreach programmes conducted through UNICEF. An estimated loss of 45 days of work due to damaged equipment/ costumes, limited opportunities and other factors such as damaged living spaces have been considered.

Annex 4.4: Estimate of Damage and Loss for Intangible Cultural Heritage: Handloom and Handicrafts

District	Sector	Damage Costs (INR crore)	Revenue loss (INR crore)
Angul	Handloom	0.07	0.03
	Handicrafts	0.06	0.04
Balasore	Handloom	3.54	1.33
	Handicrafts	3.47	2.04
Bhadrak	Handloom	0.66	0.22
	Handicrafts	2.00	1.20
Cuttack	Handloom	38.51	14.80
	Handicrafts	19.19	10.20
Dhenkanal	Handloom	0.29	0.12
	Handicrafts	2.00	1.20
Ganjam	Handloom	0.97	0.38
	Handicrafts	3.00	1.80
Jagatsinghpur	Handloom	4.66	1.26
	Handicrafts	12.38	6.60
Jajpur	Handloom	4.40	1.75
	Handicrafts	7.05	4.20
Kendrapara	Handloom	3.42	1.25
	Handicrafts	12.38	6.60
Keonjhar	Handloom	3.99	1.57
	Handicrafts	0.16	0.06
Khurda	Handloom	20.76	4.17
	Handicrafts	54.26	18.00
Mayurbhanj	Handloom	2.59	1.00
	Handicrafts	1.04	0.60
Nayagarh	Handloom	4.44	1.77
	Handicrafts	3.05	1.80
Puri	Handloom	10.12	2.03
	Handicrafts	101.61	36.00
Total (INR crore)		**320.0**	**122.0**
Total (USD million)		**45.7**	**17.4**

Notes:

1. Damage estimates are based on data collected by the Department of Handlooms, Textiles and Handicrafts across affected districts, and field-level discussions with weavers, artisans, cooperative leaders and other stakeholders in five most affected districts, including Puri and Khurda.
2. The estimates do not include damages to workshed-cum-rooms, i.e. housing. These are addressed in another part of this report.
3. Income losses are calculated using average per-day wage for weavers and artisans and an estimated period of artisanal inactivity ranging from 1 month to 3 months after the cyclone, depending on the district.
4. Damage estimates include damaged looms and accessories / craft tools and equipment, community and public infrastructure, stock of raw material and finished goods.
5. For revenue loss, a period of 2 months of inactivity has been considered for Cuttack, Jagatsinghpur and Kendrapara, and 3 months for more severely affected districts of Khurda and Puri.

Annex 4.5: Estimated Damage and Losses for Tourism Sector

District	Description of damage	Damage Cost (INR crore)	Description of revenue loss	Revenue loss (INR crore)
Angul	-	0.0	Revenue loss in tourism characteristic and tourism connected industries due to reduced tourist footfalls for three months after cyclone	6.6
Balasore	Damaged government-owned tourist accommodation units, offices and amenities	0.3	Same as above	24.4
Bhadrak	Same as above	0.2	Same as above	5.4
Cuttack	Same as above	0.7	Same as above	48.8
Dhenkanal	-	0.0	Same as above	1.7
Ganjam	Same as above	0.8	Same as above	36.1
Jagatsinghpur	Same as above	0.3	Same as above	4.1
Jajpur	-	0.0	Same as above	10.4
Kendrapara	Damaged government-owned tourist accommodation units, offices and amenities	0.4	Same as above	2.0
Keonjhar	-	0.0	Same as above	15.9
Khurda	Damaged government-owned and private tourist accommodation units, offices and amenities	24.5	Same as above(Estimated reduction in tourist footfalls: 50% in May, 25% in June and 10% in July)	173.3
Mayurbhanj	-	0.0	Same as above	12.1
Nayagarh	-	0.0	Same as above	2.1
Puri	Damaged government-owned and private tourist accommodation units, offices and amenities	129.1	Same as above (Estimated reduction in tourist footfalls: 90% in May, 75% in June and 40% in July)	812.4
Total (INR crore)		**156.5**		**1155.4**
Total (USD million)		**22.4**		**165.1**

Notes:

1. Damage estimates are based on data collected by the Department of Tourism on government-owned tourist assets and a large sample of private hotels in Puri and Khurda.
2. Revenue losses are calculated using average visitor spend data as reported in Tourism statistics published by the Department of Tourism.
3. Estimates have been qualified based on field-level observations to Puri and Khurda districts and discussions with relevant stakeholders.

Annex 6.1 Detailed assessment and analysis of all recovery options (Additional to Table 6.4)

Base option: Costing based on data shared by the Energy Department

District	400/220 kV and 132 kV length	400/220 kV and 132 kV (INR Cr)	Length of 33 kV lines (km)	33 kV lines (INR Cr)	33/11kV substations	33/11 kV substations (INR Cr)	Length of 11 kV lines (km)	11 kV lines (INR Cr)	Number of 11 kV/ 415 V DTR transformers	11 kV/ 415 V DTR transformers (INR Cr)	Length of 415 V lines (km)	415 V lines (INR Cr)	Total cost per district (INR Cr)	Total cost per district (USD million)
Angul	5 towers for 400 kV lines. Towers; 111 Nos of towers for 220 kV and 132 kV towerslines	93.5	10	1.7	0	0	75	5.6	18	0.5	980	39.2	47.1	7
Dhenkanal			26	4.42	0	0	110	8.3	15	0.5	755	30.2	43.4	6
Cuttack			418	71.06	2	1.6	2200	165.7	1911	57.3	2620	104.8	400.5	57
Puri			360	61.2	6	4.8	4731	356.2	5641	169.2	1287.5	51.5	643.0	92
Khurda			493	83.81	1	0.8	2690	202.6	1152	34.6	952	38.1	359.8	51
Nayagarh			55	9.35	0	0	175	13.2	32	1.0	290	11.6	35.1	5
Jagatsinghpur			253	43.01	22	17.6	3806	286.6	3536	106.1	5982.5	239.3	692.6	99
Balasore			285	48.45	36	28.8	3345	251.9	148	4.4	2941	117.6	451.2	64
Bhadrak			357	60.69	26	20.8	2589	195.0	280	8.4	3598	143.9	428.8	61
Ganjam			1396	237.32	61	48.8	13987	1053.2	18814	564.4	12993	519.7	2423.5	346
Mayurbhanj			350	59.5	47	37.6	4262	320.9	50	1.5	8122	324.9	744.4	106
Jeypore			485	82.45	24	19.2	8666	652.5	415	12.5	9186	367.4	1134.1	162
Kendrapara			45	7.65	2	1.6	485	36.5	165	5.0	327	13.1	63.8	9
Keonjhar			453	77.01	36	28.8	5576	419.9	30	0.9	1288	51.5	578.1	83
Total		**93.5**	**4986**	**847.62**	**263**	**210.4**	**52697**	**3968.1**	**32207**	**966.21**	**51322**	**2052.9**	**8045.2**	**1149.3**
												Total	**8138.7**	**1162.7**

Unit Costs:

Item	Base Cost (INR)	Option 1 (INR)	Option 2 (INR)	Option 3 (INR)
33 kV lines	1,700,000	2,040,000	2,380,000	3,100,000
33/11 kV substations	8,000,000	9,600,000	11,200,000	50,000,000
Cost of 11 kV lines	753,000	903,600	1,054,200	2,500,000
11 kV/ 415 V DTR transformers	300,000	360,000	420,000	650,000
Cost of 415 V lines	400,000	480,000	560,000	1,500,000

Resilience Factors used for Option 1 & 2

Resilience Factor	
Option 1	**Option 2**
1.20	1.40

Option 1: Existing System with improved specification and quality control

Districts	400/220 kV and 132 kV length	400/220 kV and 132 kV (INR Cr)	Length of 33 kV lines (km)	33 kV lines (INR Cr)	33/11 kV substations	33/11 kV substations (INR Cr)	Length of 11 kV lines (km)	11 kV lines (INR Cr)	Number of 11 kV/ 415 V DTR transformers	11 kV/ 415 V DTR transformers (INR Cr)	Length of 415 V lines (km)	415 V lines (INR Cr)	Total cost per district (INR Cr)	Total cost per district (USD million)
Angul	5 towers for 400 kV lines Towers; 111 towers for 220 kV and 132 kV towers lines	93.5	10.0	2.0	0.0	0.0	75.0	6.8	18.0	0.6	980.0	47.0	56.5	8.1
Dhenkanal			26.0	5.3	0.0	0.0	110.0	9.9	15.0	0.5	755.0	36.2	52.0	7.4
Cuttack			418.0	85.3	2.0	1.9	2200.0	198.8	1911.0	68.8	2620.0	125.8	480.5	68.6
Puri			360.0	73.4	6.0	5.8	4731.0	427.5	5641.0	203.1	1287.5	61.8	771.6	110.2
Khurda			493.0	100.6	1.0	1.0	2690.0	243.1	1152.0	41.5	952.0	45.7	431.8	61.7
Nayagarh			55.0	11.2	0.0	0.0	175.0	15.8	32.0	1.2	290.0	13.9	42.1	6.0
Jagatsinghpur			253.0	51.6	22.0	21.1	3806.0	343.9	3536.0	127.3	5982.5	287.2	831.1	118.7
Balasore			285.0	58.1	36.0	34.6	3345.0	302.3	148.0	5.3	2941.0	141.2	541.5	77.4
Bhadrak			357.0	72.8	26.0	25.0	2589.0	233.9	280.0	10.1	3598.0	172.7	514.5	73.5
Ganjam			1396.0	284.8	61.0	58.6	13987.0	1263.9	18814.0	677.3	12993.0	623.7	2908.2	415.5
Mayurbhanj			350.0	71.4	47.0	45.1	4262.0	385.1	50.0	1.8	8122.0	389.9	893.3	127.6
Jeypore			485.0	98.9	24.0	23.0	8666.0	783.1	415.0	14.9	9186.0	440.9	1360.9	194.4
Kendrapara			45.0	9.2	2.0	1.9	485.0	43.8	165.0	5.9	327.0	15.7	76.6	10.9
Keonjhar			453.0	92.4	36.0	34.6	5576.0	503.8	30.0	1.1	1288.0	61.8	693.7	99.1
Total		**93.5**	**4986.0**	**1017.1**	**263.0**	**252.5**	**52697.0**	**4761.7**	**32207.0**	**1159.5**	**51322.0**	**2463.5**	**9654.2**	**1379.2**
												Total	**9747.7**	**1392.5**

Assumptions and Explanation

The costing, based on the data shared by the Energy Department, has been increased by 20%.

- The difference will be used to cater to additional transportation, machinery and overheads.

Option 2: Existing system, but using spun poles and H-poles along with improved specifications and quality control

Districts	400/220 kV and 132 kV length	400/220 kV and 132 kV (INR Cr)	Length of 33 kV lines (km)	33 kV lines (INR Cr)	33/11 kV substations	33/11 kV substations (INR Cr)	Length of 11 kV lines (km)	11 kV lines (INR Cr)	Number of 11 kV/ 415 V DTR transformers	11 kV/ 415 V DTR transformers (INR Cr)	Length of 415 V lines (km)	415 V lines (INR Cr)	Total cost per district (INR Cr)	Total cost per district (USD million)
Angul	5 Nos of 400 kV Towers lines; 111 220 kV and 132 kV towers lines	93.5	10.0	2.4	0.0	0.0	75.0	7.9	18.0	0.8	980.0	54.9	65.9	9.4
Dhenkanal			26.0	6.2	0.0	0.0	110.0	11.6	15.0	0.6	755.0	42.3	60.7	8.7
Cuttack			418.0	99.5	2.0	2.2	2200.0	231.9	1911.0	80.3	2620.0	146.7	560.6	80.1
Puri			360.0	85.7	6.0	6.7	4731.0	498.7	5641.0	236.9	1287.5	72.1	900.2	128.6
Khurda			493.0	117.3	1.0	1.1	2690.0	283.6	1152.0	48.4	952.0	53.3	503.7	72.0
Nayagarh			55.0	13.1	0.0	0.0	175.0	18.4	32.0	1.3	290.0	16.2	49.1	7.0
Jagatsinghpur			253.0	60.2	22.0	24.6	3806.0	401.2	3536.0	148.5	5982.5	335.0	969.6	138.5
Balasore			285.0	67.8	36.0	40.3	3345.0	352.6	148.0	6.2	2941.0	164.7	631.7	90.2
Bhadrak			357.0	85.0	26.0	29.1	2589.0	272.9	280.0	11.8	3598.0	201.5	600.3	85.8
Ganjam			1396.0	332.2	61.0	68.3	13987.0	1474.5	18814.0	790.2	12993.0	727.6	3392.9	484.7
Mayurbhanj			350.0	83.3	47.0	52.6	4262.0	449.3	50.0	2.1	8122.0	454.8	1042.2	148.9
Jeypore			485.0	115.4	24.0	26.9	8666.0	913.6	415.0	17.4	9186.0	514.4	1587.7	226.8
Kendrapara			45.0	10.7	2.0	2.2	485.0	51.1	165.0	6.9	327.0	18.3	89.3	12.8
Keonjhar			453.0	107.8	36.0	40.3	5576.0	587.8	30.0	1.3	1288.0	72.1	809.3	115.6
Total		**93.5**	**4986**	**1186.7**	**263**	**294.6**	**52697**	**5555.3**	**32207**	**1352.7**	**51322**	**2874.0**	**11263.3**	**1609.0**
												Total	**11356.8**	**1622.4**

Assumptions and Explanation

- The costing, based on the data shared by the Energy Department, has been increased by 40%.
- The difference will be used to cater to additional transportation, machinery and overheads.
- The additional costs are meant to make the system resilient and to withstand wind speeds of up to 250 kmph.

Option 3: Complete system, using underground cable network along with improved specifications and quality control

District	400/220 kV and 132 kV length	400/ 220 kV and 132 kV (INR Cr)	Length of 33 kV lines (km)	33 kV lines (INR Cr)	33/11 kV substations	33/11 kV substations (INR Cr)	Length of 11 kV lines (km)	11 kV lines (INR Cr)	Number of 11 kV/ 415 V DTR transformers	11 kV/ 415 V DTR transformers (INR Cr)	Length of 415 V Lines (km)	415 V lines (INR Cr)	Total cost per district (INR Cr)	Total cost per district (USD million)
Angul	5 Nos of 400 kV lines Towers; 111 Nos of 220 kV and 132 kV towers lines	93.5	10.0	3.1	0.0	0.0	75.0	18.8	18.0	1.2	980.0	147.0	170.0	24.3
Dhenkanal			26.0	8.1	0.0	0.0	110.0	27.5	15.0	1.0	755.0	113.3	149.8	21.4
Cuttack			418.0	129.6	2.0	10.0	2200.0	550.0	1911.0	124.2	2620.0	393.0	1206.8	172.4
Puri			360.0	111.6	6.0	30.0	4731.0	1182.8	5641.0	366.7	1287.5	193.1	1884.1	269.2
Khurda			493.0	152.8	1.0	5.0	2690.0	672.5	1152.0	74.9	952.0	142.8	1048.0	149.7
Nayagarh			55.0	17.1	0.0	0.0	175.0	43.8	32.0	2.1	290.0	43.5	106.4	15.2
Jagatsinghpur			253.0	78.4	22.0	110.0	3806.0	951.5	3536.0	229.8	5982.5	897.4	2267.1	323.9
Balasore			285.0	88.4	36.0	180.0	3345.0	836.3	148.0	9.6	2941.0	441.2	1555.4	222.2
Bhadrak			357.0	110.7	26.0	130.0	2589.0	647.3	280.0	18.2	3598.0	539.7	1445.8	206.5
Ganjam			1396.0	432.8	61.0	305.0	13987.0	3496.8	18814.0	1222.9	12993.0	1949.0	7406.4	1058.1
Mayurbhanj			350.0	108.5	47.0	235.0	4262.0	1065.5	50.0	3.3	8122.0	1218.3	2630.6	375.8
Jeypore			485.0	150.4	24.0	120.0	8666.0	2166.5	415.0	27.0	9186.0	1377.9	3841.7	548.8
Kendrapara			45.0	14.0	2.0	10.0	485.0	121.3	165.0	10.7	327.0	49.1	205.0	29.3
Keonjhar			453.0	140.4	36.0	180.0	5576.0	1394.0	30.0	2.0	1288.0	193.2	1909.6	272.8
Total		**93.5**	**4986.0**	**1545.7**	**263.0**	**1315.0**	**52697.0**	**13174.3**	**32207.0**	**2093.5**	**51322.0**	**7698.3**	**25826.7**	**3689.5**
												Total	**25920.2**	**3702.9**

Assumptions and Explanation

- The costing is based on contract rates for other underground cable projects in India.
- The increase from Option 1 will be used to cater to additional transportation, machinery and overheads.
- The increase from Options 1 and 2 will make the system completely robust and resilient to extreme climate conditions.
- This will also help in reducing transmission, distribution and commercial losses.

https://content.unops.org/publications/The-critical-role-of-infrastructure-for-the-SDGs_EN.pdf?mtime=20190314130614

Annexes to Chapter 10- Public Buildings

A10.1 AC sheet/ Mangalore tile roofing (Additional to Section 10.2)

The roof trusses have remained largely untouched. The support structure comprises purlins and rafters, some of which need to be replaced/ reset. To make the repairs resilient the following measures need to be taken:

- The pitched roof support structure needs to be anchored into the walls at:
    - The junction of the roof-framing rafters and eave level walls
    - Roof purlins and the gable wall
    - Roof projection at eave level and wall
    - Roof beams on gable wall
- Tie down the roof projection at eave level and wall. To do this, install a tie between the eave-level roof projection and wall below eave-level at approximately 45 degrees to wall. Connect tie securely at both ends using anchor ridge beam and intermediate beams to gable wall.
- Secure roofing to roof frame and wall using galvanised metal straps or multiple strands of GI wire to secure connections between roof frame elements—purlins, rafters and beams.
- Secure roofing to roof frame. To anchor roofing sheets, use 'J' hook or 'U' hook for wind speed zone 5. Anchor hurricane strips at the lowest rafter and then every alternative sheet.
- To anchor roofing tiles, anchor each tile using a GI hook to the purlin.
- Install RC strips of 100 × 100 mm with 10 mm diameter TOR [?] at a spacing not exceeding 1200 mm.
- On top of gable wall install RC load wall 230 x 100 mm with one 8 mm TOR bar.

A10.2 Doors and Windows (Additional to Section 10.2)

Doors and windows—including those in timber frames and timber shutters, aluminium frame and glass shutters and even those with metal frame and shutters—suffered different degrees of damage. This was due to weakness in anchoring of door and window to the masonry and weakness of window glass against air pressure/ suction. One of the most damaging effects of a cyclone is the extensive breakage/ shattering of glass panes caused by high wind pressure and/ or flying objects. Failure of doors/ windows leads to a cascade of impacts in the interiors, including collapse of false roofing etc. The following measures need to be taken:

- Make smaller window shutters/ panes. All glass panels must be securely framed.
- Timber door frames should be anchored with at least six holdfasts and window frames with at least four holdfasts. Holdfasts must be at least 230 mm long from the frame and must be well-nailed to the frame and also well anchored in a concrete block. Similarly, anchor the aluminium door and window frames to the masonry. All gaps between frame and wall need to be properly secured.
- Strong locking arrangement must be provided to resist wind suction.

A10.3 Compound Walls (Additional to Section 10.2)

The sustained high-speed winds of Cyclone Fani coupled with the quality of construction, caused extensive 'overturning' failures of compound walls of various types and about 25% damage value can be attributed to compound walls alone. The recent flooding event in Kerala caused extensive damage to compound walls, and the walls exacerbated floodingby blocking water flow, causing localised flooding events. This should additionally be factored in while rebuilding compound walls. Following measures are proposed:

- Do not repair/ rebuild compound, as that would only recreate more vulnerabilities. In most cases boundary walls are not critical and rebuilding them should be undertaken at a later stage.
- Laterite blocks and bricks from debris should be recovered, the mortar and plaster on them chiselled away and the blocks/ bricks properly stacked to be put back in use.
- Prioritise barbed wire and chain link fences, they cost a fraction of a masonry wall and will withstand cyclone and flooding events with minimal damage. The vertical angles, accompanied with diagonal angle supports, should be well anchored in the ground in concrete. Visual privacy can be established by growing native creepers and bushes.
- In case there is no choice but to rebuild masonry walls, consider: (i) reduced height; (ii) metal grill or reinforced precast concrete lattice-work (*jali*) grills at regular interval; or (iii) gaps at regular interval using PVC pipes like weep holes in retaining walls or in the brick/ stone work like lattice work. These will reduce the resistance, allow wind and flood water to pass through, without compromising its functions and stability. Details will have to be designed structurally.

- Check the wall for feasibility of retrofit measures. Additional cost in the range of 25% to 60% of new construction, is likely and doable. Measures include reinforced concrete vertical that would anchor the wall into the strata/ foundation and horizontal bands to obtain the required strength.
- In case there is no choice but to rebuild masonry walls make sure to start from the foundation. Have the pillars with vertical reinforcement (this could be a masonry pillar of 14" × 14" total size with a 5" × 5" vertical reinforcement for the entire height of the pillar) wall well anchored in the strata up to 45 cm below ground level. Masonry pillar with vertical reinforcement at about every 1.5 m interval and 7.5 cm horizontal reinforced band at every about 1.5 m interval from the first one at foundation level.

A10.4 Water Tanks (Additional to Section 10.2)

Rooftop water tanks, mainly PVC tanks, were badly hit by Cyclone Fani, with many tanks toppling over, getting blown away, and being punctured by high speed winds. These are lightweight tanks with nil or sub-optimal anchoring. Their performance during cyclones can be substantially enhanced at a marginal costby encasing them in a well-anchored metal strip cage and other similar details that will help hold them down and preventing sliding. Standard designs should be developed for the same, for various standard PVC tank sizes and issued widely by the government.

A10.5 Trees (Additional to Section 10.2)

Most public building compounds, small and large, have a fair number of trees, which have been damaged extensively. These trees render ecosystem services like providing shade, fruit, and a congenial working and living environment. Many of these trees are very old and while prioritising safety, action needs to be taken to revive and regenerate partly damaged trees and encourage plantation of tree species that fared well in the cyclone. The following steps should be taken immediately to ensure safety and regeneration. (Inputs received from Dr Nirmal Harsh, Dr Samrat Gowda and Dr Hemanth Kumar Sahoo)

Table A10.1: Nature of Tree Damage and Remedial Action

Nature of damage	Actions
Uprooted	To be removed in its entirety
Lost up to 50% of its branches but main trunk stands more or less undisturbed	Prune damaged and undamaged branchesto give an overall balanced shape. Maintain a clean cut and apply Chaubattia paste* to ensure no infestation in exposed tree parts. The tree will start coppicing this monsoon. Cut coppices, except one, for each of the branches/ trunks.
Partly tilted, may or may not have lost branches	Cut trunk about 3 feet above ground level, realign vertically if possible. Support the trunk with branches. Refill soil into gaps and shore soil around the trunk base. Maintain a clean cut and apply Chaubattia paste* to ensure that there is no infestation in exposed part of tree. The trunk will start coppicing this monsoon. Cut coppices,leaving a few to aid the tree to grow back in a balanced way
More or less intact	Has coped very well with cyclonic winds. Its saplings should be planted away from buildings, preferably close to the compound walls.

Chaubattia paste*: For definition see http://agropedia.iitk.ac.in/content/copper-fungicides-chemicals-disease-control

Table A10.2: Recommended Tree Species

Sl No.	Local name	Scientific name	
1	*Chhatian*	*Alstoniascholaris*	These species were found to have withstood Fani with minimal damage and should be prioritised.
2	*Karanja*	*Pongamiapinnata*	
3	*Deodar*	*Polyalthialongifolia, pendula*	
4	*Baula*	*Mimosopselengi*	These species withstood Fani, but lost 50% of their branches. These species should be planted with a preference closer to the boundary wall away from the building
5	*Putranjiba*	*Putranjibaroxburghii*	
6	*Jamun*	*Syzigiumcuminii*	
7	*Nimba*	*Azadirachtaindica*	
8	*Bahada*	*Terminalia bellerica*	
9	*Arjuna*	*Terminalia arjuna*	
10	*Asostha*	*Ficusreligiosa*	
11	*Bara*	*Ficusbenghalensis*	

Table A10.3: Data on Damaged Buildings from the Departments of Rural Works, PR&DW and Housing and Urban Development (Additional to Section 10.3)

District	Rural Works					PR&DW***			Urban Local Bodies	Grand Total
	Revenue	RD	Home	Others*	Total	GP/PS + CH****	RWSS*****	Total		
Angul	0	0	0	0	0	14	0	14	0	14
Balasore	33	18	8	9	68	891	0	891	26	985
Bhadrak	28	10	5	1	44	11	0	11	16	71
Cuttack	72	71	36	2	181	204	11	215	38	434
Dhenkanal	9	11	2	1	23	91	0	91	15	129
Ganjam	4	0	1	0	5	183	0	183	41	229
Jagatsinghpur	50	22	18	1	91	407	8	415	368	874
Jajpur	4	4	13	0	21	304	0	304	8	333
Kendrapara	38	21	11	0	70	72	0	72	0	142
Keonjhar	3	3	1	0	7	22	0	22	0	29
Khurda	32	78	18	6	134	166	20	186	0	320
Mayurbhanj	0	0	0	0	0	2	32	34	0	34
Nayagarh	7	10	2	0	19	0	0	0**	0	19
Puri	122	75	50	4	251	268	15	283	78	612
Total	**402**	**323**	**165**	**24**	**914**	**2635**	**86**	**2721**	**590**	**4225**

Others*: Co-operative Society, Horticulture, Excise, Soil Conservation, Labour and employment, Tourism and Culture, Industries,
0**We have not received a building breakdown for Nayagarh from the Panchyati Raj and Drinking Water Department
PR&DW***: Panchyati Raj and Drinking Water
GP/PS + CH****: Gram Panchayat / Panchayat Samiti and Community Halls;
RWSS*****: Rural Water Supply and Sanitation

Table A10.4: Damage to Works Department Buildings (Additional to Section 10.3)

District	Finance	General Administration	Revenue	Works	Home (Judicial)	Home	Others*	Total
Angul	0	0	0	0	0	0	0	0
Balasore	0	0	30	14	6	17	0	67
Bhadrak	0	0	0	2	0	0	0	2
Cuttack	17	207	90	76	65	140	25	620
Dhenkanal	0	0	6	3	0	0	0	9
Ganjam	0	0	45	16	4	86	2	153
Jagatsinghpur	2	0	11	28	29	9	3	82
Jajpur	5	0	20	16	8	9	9	67
Kendrapara	1	0	21	38	8	2	18	88
Keonjhar	0	0	0	0	0	0	0	0
Khurda**	18	452	73	83	20	89	63	798
Mayurbhanj	0	0	0	3	0	0	0	3
Nayagarh	0	0	0	6	2	0	2	10
Puri	14	6	52	90	21	97	37	317
Total	**57**	**665**	**348**	**375**	**163**	**449**	**159**	**2216**

Others*: Registration Department, Information & Public Relations, Economics and Statistics, SC & ST Department, Sports, Raj Bhavan, Industries, Labour, Commercial Tax, Social Welfare
Khurda**: This number includes 372 government housing complexes representing about 5,500 dwelling units
Public buildings belonging to Education, Women and Child Welfare, Health, Tourism and Culture, Fisheries and Animal Resources, Agriculture, Forest and Environment are covered in their respective sectors

Table A10.5: Consolidated Damage to Public Buildings (Additional to Table 10.1)

District	WD		Rural Works Dept		PR&DW*		ULB**		All Depts		
	RCC roof	AC sheet roof	RCC roof	AC sheet roof	RCC roof	AC sheet roof	RCC roof	AC sheet roof	RCC roof	AC sheet roof	Total
Angul	0	0	0	0	3	11	0	0	3	11	14
Balasore	20	47	24	44	178	713	16	10	238	814	1052
Bhadrak	1	1	15	29	2	9	10	6	28	45	73
Cuttack	186	434	63	118	43	172	23	15	315	739	1054
Dhenkanal	3	6	8	15	18	73	9	6	38	100	138
Ganjam	46	107	2	3	37	146	25	16	109	273	382
Jagatsinghpur	25	57	32	59	83	332	221	147	360	596	956
Jajpur	20	47	7	14	61	243	5	3	93	307	400
Kendrapara	26	62	25	46	14	58	0	0	65	165	230
Keonjhar	0	0	2	5	4	18	0	0	7	22	29
Khurda	239	559	47	87	37	149	0	0	324	795	1118
Mayurbhanj	1	2	0	0	7	27	0	0	8	29	37
Nayagarh	3	7	7	12	0	0	0	0	10	19	29
Puri	95	222	88	163	57	226	47	31	286	643	929
Total	**665**	**1551**	**320**	**594**	**544**	**2177**	**354**	**236**	**1883**	**4558**	**6441**

PR&DW*: Panchayati Raj and Drinking Water
ULB**: Urban Local Bodies

Annexes to Chapter 12- Employment, Livelihoods, and Social Protection

Annexe A: Additional to Table 12.3

Table 12.A1: Estimated Person-Days Lost and Wage Loss for Workers—Detailed Computations

Category	Total workers (lakh)	% Workers affected	Affected workers (lakh)	Days lost	Total person-days lost (lakh)	Daily wage rate (INR)	Total wage lost (INR crore)
Male workers only							
Puri							
Casual	1.58	100%	1.58	60	94.71	350	331.50
Regular (wage/ salaried employee)	0.01	100%	0.01	60	0.67	450	2.99
Contract workers	0.23	100%	0.23	60	14.04	350	49.15
Self-employed	2.48	100%	2.48	60	109.42	400	437.69
Total	4.30		4.30		218.85		821.34
Cuttack and Khurda							
Casual	8.76	50%	4.38	15	65.67	400	262.67
Regular (wage/ salaried employee)	6.15	50%	3.08	15	46.13	600	276.80
Contract workers	1.30	50%	0.65	15	9.74	400	38.95

Self-employed	13.75	50%	6.88	15	103.16	500	515.79
Total	**29.96**		**14.98**		**224.70**		**1,094.21**
Other 11 affected districts							
Casual	25.97	20%	5.19	3	15.58	320	49.87
Regular (wage/ salaried employee)	18.25	20%	3.65	3	10.95	420	45.99
Contract workers	3.85	20%	0.77	3	2.31	320	7.39
Self-employed	40.80	20%	8.16	3	24.48	450	110.17
Total	88.88		17.78		53.33		213.42
Female workers only							
Puri							
Casual	0.65	100%	0.65	60	39.12	300	117.35
Regular (wage/ salaried employee)	0.20	100%	0.20	60	11.73	400	46.94
Contract workers	0.04	100%	0.04	60	2.61	300	7.83
Self-employed	0.74	100%	0.74	60	44.62	380	169.55
Total	**1.63**		**1.63**		**98.08**		**341.66**
Cuttack and Khurda							
Casual	3.62	50%	1.81	15	27.12	350	94.92
Regular (wage/ salaried employee)	1.08	50%	0.54	15	8.14	400	32.54
Contract workers	0.24	50%	0.12	15	1.81	350	6.33
Self-employed	4.12	50%	2.06	15	30.93	400	123.74
Total	**9.07**		**4.53**		**68.00**		**257.53**
Other 11 affected districts							
Casual	10.73	20%	2.15	3	6.44	280	18.02
Regular (wage/ salaried employee)	3.22	20%	0.64	3	1.93	370	7.14
Contract workers	0.72	20%	0.14	3	0.43	280	1.20
Self-employed	12.24	20%	2.45	3	7.34	340	24.96
Total	**26.90**		**5.38**		**16.14**		**51.33**
Total loss of person-days and wage loss							
Male workers			37.06		496.87		2,128.97
Female workers			11.55		182.22		650.53
Total workers (Male and Female)			48.61		679.08		2,779.50

Note: Data on average wages of workers (prevailing market rates) by skill level were obtained district-wise from the office of Labour Commissioner. Unskilled workers wages are utilised to arrive at total wage loss in case of category of male casual and contract workers. In case of Regular male workers, the average of semi-skilled and skilled wage rate has been used to assess the wage loss. In case of self-employed male workers, the average of regular and casual wage rate has been applied to calculate the wage loss. Based on market assessment, lower wages have been considered for different categories of female workers.

1. Note: Numbers above are mentioned only up to two places after the decimal point, but hereon far more are mentioned. If there is a particular reason why so many more are being mentioned here in the annexures, the reason should be stated. Since the data converted into crore, the accuracy of the data is missing. Thus in the annexure it kept as it is to make it accurate but once it posted to the main table in the text, kept as rounded to two decimals. Otherwise we need to rounded it to two decimals.

Annexe B: Additional to Table 12.5

Table 12.B1: Livelihood Affected by Fani in Fisheries Sector

Capture fishery						
Districts	Boats partially damaged	Boats fully damaged	Number of fishermen	Total fishing man days loss	Total fishing man-days lost after ban period (till June 15) of 40 days	Livelihood income loss in INR cr
MARINE						
Balasore	21	2	92	4,500	544	0.04352
Bhadrak	6	0	24	1,080	48	0.00384
Jagatsinghpur	8	6	56	3,600	1,192	0.09536
Kendrapara	22	5	108	5,760	1,116	0.08928
Puri	1,445	1,460	11,620	7,85,700	2,86,040	0.30109
Total	**1,502**	**1,473**	**11,900**	**8,00,640**	**2,88,940**	**0.53**
CHILIKA (LAKE)						
Puri (Chilika)	1,376	988	4,728	3,01,680	98,376	7.870
Khurda (Chilika)	71	3	148	6,930	566	0.045
Ganjam (Chilika)	117	30	294	15,930	3,288	0.263
Total	**1,564**	**1,021**	**5,170**	**3,24,540**	**1,02,230**	**8.18**
INLAND (RIVERINE)						
Kendrapada	14	17	31	2,160	2,160	0.173
Puri	188	345	533	39,510	39,510	3.161
Mayurbhanj	16	4	20	1,080	1,080	0.086
Cuttack	120	89	209	13,410	13,410	1.073
Jagatsinghpur	19	4	23	1,215	1,215	0.097
Jajpur	36	4	40	1,980	1,980	0.158
Total	**393**	**463**	**856**	**59,355**	**59,355**	**4.7**
INLAND (CULTURE)						
	Fishponds damaged (Ha)	Men involved				
Kendrapada	2.995	9	24	18	18	0.00072
Puri	30.64	92	245	184	184	0.00735
Mayurbhanj	0.2	1	2	1	1	0.00005
Cuttack	0	0	0	0	0	0.00000
Jagatsinghpur	0	0	0	0	0	0.00000
Jajpur	0	0	0	0	0	0.00000
Total	**33.835**	**101.505**	**271**	**203.01**	**203.01**	**0.0081**
Grand Total	**3,493**	**3,059**	**18,197**	**11,84,738**	**4,50,728**	**13.5**

Note:

- Partially damaged boats: 45 fishing days to be rebuilt
- Purchase of new boats: at least 90 fishing days
- Average: four persons involved in sea fishing, two persons in lake fishing and one person involved in a boat per day. [highlighted text is one person involved in a boat per day – Means '*one person per boat per day involved in fishing with boats*'. unclear]
- A person involved in fishing gets INR 800 per day
- Total fishing days lost after ban period (June 15) 43 days, in case of riverine fishery there is no ban
- For inland culture: three persons per hectare affected for two days and getting INR 400 per day

Table 12.B2: Livelihood Affected by Fani in Livestock Sector (dairy sector)

Sl. No.	District	Buffalo/ Cow	Bullock	Calf	Total LA	Man-days lost	SA (Goat/ Sheep)	Man-days Loss	Total Man-days	Livelihood loss in crore
1	Anugul	0	0	0	0	0	0	0	0	0.00
2	Balasore	3	1	1	5	113	12	54	167	0.00
3	Bhadrak	9	0	7	16	360	12	54	414	0.01
4	Cuttack	253	10	64	327	7,358	773	3,478.5	10,836	0.33
5	Dhenkanal	0	0	0	0	0	0	0	0	0.00
6	Ganjam	13	3	20	36	810	21	94.5	905	0.03
7	Jagatsinghpur	18	0	8	26	585	8	36	621	0.02
8	Jajpur	9	0	8	17	383	9	40.5	423	0.01
9	Kendrapada	41	0	7	48	1,080	15	67.5	1,148	0.03
10	Keonjhar	0	0	0	0	0	0	0	0	0.00
11	Khurda	354	21	170	545	12,263	669	3,010.5	15,273	0.46
12	Mayurbhanj	0	0	0	0	0	0	0	0	0.00
13	Nayagarh	3	1	4	8	180	5	22.5	203	0.01
14	Puri	1,796	103	406	2,305	51,863	1,400	6,300	58,163	1.74
Total		2,499	139	695	3,333	74,993	2,924	13,158	88,151	2.64

Notes:

- Large animal (cow, buffalo, bullock)
- Small animal (sheep and goat)
- One person per day is required for care of four large animals
- One person per day is required for care of 20 goats
- Total days lost has been taken as 90 days, based on data given by Department

Table 12.B3: Livelihood Affected by Fani in Horticulture Sector

District	No. of cyclone affected workers	No. of days	No. of work-days lost	Livelihood loss (INR crore)
Anugul	28	15	420	0.49
Balasore	85	10	850	0.21
Bhadrak	18	10	180	0.05
Cuttack*	16,732	15	2,50,980	14.83
Dhenkanal	1,048	6	6,288	9.28
Ganajm	0	0	0	0
Jagatsinghpur	1,845	10	18,450	4.58
Jajpur	11,464	7	80,248	3.23

Kendrapara	994	2	1,988	5.39
Keonjhar	0	0	0	0.00
Khurda*	10,798	15	1,61,970	24.01
Mayurbhanj	0	0	0	0.00
Nayagarh	394	2	788	7.00
Puri*	69,774	90	6,279,660	186.85
Total	**1,13,180**	**182**	**68,01,822**	**255.91**

Note:
Source: Base data from respective Directorates of Government of Odisha, computations by PDNA team
*Excludes coconut farmers affected on a large scale in Puri, Cuttack and Khurda districts.

Table 12.B4: Livelihood Affected by Fani in Agriculture Sector

Type of affected crop	Cultivation area (ha)	Loss of Man-days	Livelihood loss in INR crore
Paddy	18,559.69	6,49,589	16.24
Greengram/ Blackgram	54,184.92	7,04,404	17.61
Maize	7.87	94	0
Groundnut	352.16	9,860	0.25
Sunflower	1,194.00	11,940	0.30
Til	454.80	7,459	0.19
Agri area crop loss >33% in ha, except vegetables & perennials (area in ha)	87,507.44	13,83,347	34.58

Note: Agriculture wage has been considered as INR 250/day based on the data provided by the Department

Table 12.B5: Livelihood Affected by Fani in Poultry Sector

District	No. of birds	No. of affected farmers	Person days lost	Livelihood loss in crore
Anugul	0	0	0	-
Balasore	15	0	0	0.0000
Bhadrak	1,502	0	34	0.0000
Cuttack	11,86,303	297	26,692	0.0089
Dhenkanal	0	0	0	-
Ganjam	4,897	1	110	0.0000
Jagatsinghpur	83,142	21	1,871	0.0006
Jajpur	18,435	5	415	0.0001
Kendrapada	14,248	4	321	0.0001
Keonjhar	0	0	0	-
Khurda	13,25,639	331	29,827	0.0099
Mayurbhanj	0	0	0	-
Nayagarh	20,000	5	450	0.0002
Puri	26,67,869	667	60,027	0.0200
Total	**53,22,050**	**1,331**	**1,19,746**	**0.04**

Note:
- 25 person required for 90 days for a lakh of birds
- Poultry wages have been considered as INR 300/day, based on the data from department

Annexe C: Additional to Table 12.6

Table 12.C1: Overview of Damage and Losses – MGNREGS Individual Benefit Scheme Assets and Loss of Works

	District	Total number of assets	Damage (INR crore)	Loss (INR crore)	Total effect (damage + loss)	Ownership	
						Public	Private
1	Angul	6	0.165	0.896	1.061	0.150	0.0147
2	Balasore	8	0.080	1.463	1.543	0.080	0
3	Bhadrak	0	0.000	0.000	0.000	0.000	0
4	Cuttack	56	1.522	0.004	1.526	1.511	0.011124
5	Dhenkanal	71	0.499	0.000	0.499	0.499	0
6	Ganjam	493	3.264	2.888	6.152	3.231	0.0325
7	Jagatsinghpur	454	6.205	3.224	9.430	6.189	0.016
8	Jajpur	124	0.749	0.639	1.389	0.717	0.032
9	Kendrapada	72	1.164	0.354	1.518	1.048	0.116
10	Kendujhar	1	0.010	0.001	0.012	0.000	0.0103
11	Khurda	1,306	7.140	1.518	8.657	3.241	3.89888
12	Mayurbhanj	0	0.000	0.000	0.000	0.000	0
13	Nayagarh	0	0.000	0.000	0.000	0.000	0
14	Puri	3046	22.415	35.746	58.161	15.126	7.2887
	Total	**5637**	**43.2119**	**46.7347**	**89.947**	**31.792**	**11.420**

Table 12.C2: Overview of Damage and Losses – Handicraft

	District	No. affected	Damage (INR crore)	Loss (wages) (INR crore)	Total effect (damage + loss)	Ownership	
						Public	Private
1	Puri	20,000	101.61	18	119.61	1.61	100.00
2	Khurda	6,000	54.26	2.4	56.66	4.26	50.00
3	Cuttack	7,000	19.19	2.8	21.99	0.07	19.13
4	Jagatsinghpur	5,400	12.38	1.08	13.46	0.01	12.38
5	Kendrapada	5,500	12.38	1.1	13.48	0.01	12.38
6	Jajpur	7,000	7.05	1.4	8.45	0.05	7.00
7	Bhadrak	2,000	2	0.28	2.28	0.00	2.00
8	Balasore	7,000	3.47	0.98	4.45	0.07	3.40
9	Nayagarh	3,000	3.05	0.42	3.47	0.05	3.00
10	Ganjam	3,000	3	0.42	3.42	0.00	3.00
11	Angul	500	0.06	0.07	0.13	0.00	0.06
12	Dhenkanal	2,000	2	0.28	2.28	0.00	2.00
13	Keonjhar	1,500	0.16	0.21	0.37	0.06	0.10
14	Mayurhanj	1,000	1.04	0.14	1.18	0.04	1.00
	Total	**70,900**	**221.65**	**29.58**	**251.23**	**6.22**	**215.44**

*Table 12.C3: Overview of Damage and Losses – Tourism**

	District	Affected people	Damage (INR crore)	Employment loss (wages) (INR crore)	Total effect (damage + loss	Ownership	
						Public	Private
1	Puri	42,443	129.1013	108.6528	237.7540	11.58	117.52125
2	Khurda	20,848	24.5443	14.6954	39.2397	9.59	14.95825704
3	Ganjam		0.8320		0.8320	0.83	
4	Cuttack		0.7320		0.7320	0.73	
5	Jagatsinghpur		0.3330		0.3330	0.33	
6	Kendrapada		0.3930		0.3930	0.39	
7	Bhadrak		0.2430		0.2430	0.24	
8	Balasore		0.3320		0.3320	0.33	
	Total	**63,291**	**156.5105**	**123.3482**	**279.859**	**24.0310**	**132.4795**

* This table is a subset of the main table discussed in the Chapter on 'Culture, Heritage and Tourism'. The table only considers the wage loss of Puri and Khurda districts where severe damage occurred.

Table 12.C4: Overview of Damage and Losses – Women Enterprises (Mission Shakti & OLM)

	District	No. of affected	Damage (INR lakh)	Loss (INR lakh)	Total effect (damage + loss)	Ownership	
						Public	Private
	Mission Shakti						
1	Puri	1,323	1.5067547	0.99225	2.4990047		1.5067547
2	Khurda	640	0.22458	0.48	0.70458		0.22458
3	Ganjam	1,361	0.83929	1.02075	1.86004		0.83929
4	Cuttack	1,811	0.72303	1.35825	2.08128		0.72303
5	Kendrapada	4,377	1.7865001	3.28275	5.0692501		1.7865001
6	Bhadrak	94	0.0412	0.0705	0.1117		0.0412
7	Mayurbhanj	55	0.4444	0.04125	0.48565		0.4444
8	Dhenkanal	459	0.1135	0.34425	0.45775		0.1135
9	OLM (all districts)	8,855	2.117928	6.64125	8.759178		2.117928
10	OLM SHGs	90,840	13.978762	22.71	36.688762		13.978762
	Total	**1,09,815**	**21.7759448**	**36.94125**	**58.7171948**	**0**	**21.7759448**

Table 12.C5: Overview of Damage and Losses – Handloom

	District	No. of affected	Damage (INR crore)	Loss (INR crore)	Total effect (damage + loss)	Ownership	
						Public	Private
I	**Handloom**						
1	Angul	71	0.07	0.02	0.09	0.00	0.07
2	Balasore	3,330	3.54	0.8	4.34	0.21	3.33
3	Bhadrak	547	0.66	0.13	0.79	0.11	0.55
4	Cuttack	18,503	38.51	8.89	47.4	1.50	37.01

5	Dhenkanal	292	0.29	0.07	0.36	0.00	0.29
6	Ganjam	950	0.97	0.23	1.2	0.02	0.95
7	Jagatsinghpur	1,569	4.66	0.37	5.03	1.52	3.14
8	Jajpur	4,386	4.4	1.05	5.45	0.01	4.39
9	Kendrapada	1,558	3.42	0.37	3.79	0.30	3.12
10	Kendujhar	3,926	3.99	0.94	4.93	0.06	3.93
11	Khurda	3,472	20.76	1.67	22.43	3.40	17.36
12	Mayurbhanj	2,499	2.59	0.59	3.18	0.09	2.50
13	Nayagarh	4,417	4.44	1.06	5.5	0.02	4.42
14	Puri	1,688	10.12	1.62	11.74	1.68	8.44
	Total	**47,208**	98.42	**17.82**	116.24	**8.94**	**89.48**
II Khadi and Cottage Industries							
	Khadi Total	139	0.4199	0.1104	0.5303	0.0405	0.3794

Table 12.C6: Overview of Damage and Losses – Markets and Vending Zones under Urban Local Bodies (units)

Sl. No.	District	No. of vendors affected	Damage (INR crore)	Loss (INR crore)	Total effect (damage + loss) in INR crore	Ownership	
						Public	Private
1	Jagatsinghpur	194	0.12497	0.04998	0.17495		0.12497
2	Jajpur	361	0.035059	0.026835	0.061894		0.035059
3	Puri	2,764	20.662	8.292	28.954		20.662
4	Cuttack	7,384	1.26971	1.74909	3.0188		1.26971
5	BBSR	10,197	22.96638	4.59714	27.56352		22.96638
	Total	**20,900**	**45.05812**	**14.71505**	**59.77316**	**0**	**45.05812**

Annexe D: Additional to Section 12.4.1: MGNREGS Beneficiaries Suffer Losses

Table 12.D1: MGNREGS MIS data on Odisha as on 30th May 2019

Total No. of Districts	30
Total No. of Blocks	314
Total No. of Gram Panchayats	6,801
I Job Card	
Total no. of Job Cards issued (lakh)	65.01
Total no. of workers (lakh)	163.89
Total no. of active Job Cards (lakh)	34.34
Total no. of active workers (lakh)	55.82
(i) % SC workers against active workers	16.81
(ii) % ST workers against active workers	30.98

II Progress	FY 2019–2020	FY 2018–2019	FY 2017–2018	FY 2016–2017	FY 2015–2016	Average of last 4 years
Approved labour budget (lakh)	1000	950	900	800	760.06	852.52
Person-days generated so far (lakh)	114.44	830.87	922.11	774.48	894.46	855.48
% of Total LB	11.44	87.46	102.46	96.81	117.68	101.10
% as per Proportionate LB	62.16					0.00
% SC person-days as of total person-days	16.22	16.12	16.58	16.09	15.91	16.18
% ST person-days as of total person-days	37.21	35.46	36.73	37.85	41.73	37.94
Women person-days out of Total (%)	44.43	41.99	41.86	39.82	38.02	40.42
Average days of employment provided per household	19.22	38.65	39.98	38.09	44.78	40.38
Average wage rate per day per person (INR)	182.57	179.74	173.91	171.51	188.02	178.30
Total no. of households that completed 100 days of wage employment	71	47,335	68,070	35,750	1,97,460	87153.75
Total no. of households that worked (lakh)	5.95	21.5	23.07	20.33	19.97	21.22
Total no. of individuals who worked (lakh)	8.63	33.71	37.55	32.87	31.48	33.90
Differently-abled persons worked	2,321	8,752	9,328	6,303	5,586	7,492.25
III Works						
IV Financial Progress						
Total centre release	29,721.57	2,21,821.01	2,19,834.66	1,89,526.84	1,47,941.05	1,94,780.89
Total rvailability	29,721.57	2,56,226.4	2,31,785.64	20,6674.96	2,05,910.58	2,25,149.40
% utilisation	109.67	90.38	108.01	103.33	99.63	100.34
Total Expense? (INR lakh)	32,595.31	2,31,566.16	2,50,356.97	2,13,557.14	2,05,151.55	2,25,157.96
Wages (INR lakh)	22,296.28	1,48,513.23	1,73,094.81	1,41,066.50	1,57,678.66	1,55,088.30
Material and skilled wages (INR lakh)	9,695.37	74,338.03	66,668.59	65,244.17	40,741.54	61,748.08
% material	30.31	33.36	27.81	31.62	20.53	28.33
Total Admn. Expenditure (INR lakh)	603.66	8,714.90	10,593.56	7,246.47	6,731.35	8321.57
% Admin. Expenditure?	1.85	3.76	4.23	3.39	3.28	3.67
Average cost per day per person (INR)	242.85	272.05	245.59	247.72	227.22	248.15
% of Total Expenditure through Electronic Fund Management System.	99.84	99.97	99.97	99.91	99.92	99.94
% payments generated within 15 days	99.96	99.82	85.48	33.53	37.08	63.98

Annexe E: Additional to Table 12.10

Note: Table 12.E1 below, presents the calculations for selected and not all areas discussed in Table 12.10. The serial numbers (first column on the left) are as selected section from Table 12.10

Table 12.E1: Livelihood Recovery Cost Calculation (INR crore)—Short Term (1–12 months); Medium Term (13–36 months), Long Term (37–60 months)

Recommendation	Interventions	Rationale	Short Term (INR crore)	Medium Term (INR core)	Long Term (INR crore)	Total Recovery Needs (INR crore)	Possible convergence sources
BBB for polytechnics etc.	BBB for 22 Govt. ITI, 18 Polytechnic, 9 SDC, 1 CET		**100.00**			**100.00**	
MGNREGS – request for additional 50 days' work for reconstruction and restoration.	**MGNREGS**		**1,122.60**			**1,122.60**	Govt. of India and Govt. of Odisha
	Total affected households (R): 16,83,841 Estimated affected households (R) with active Job Cards: 7,16,553	This is calculated based on proportion of total rural population (R¬) and affected rural population after considering rural and urban division estimated based on the data available on affected total population and applying the active Job Card holder's ratio available at MGNREGS website					
	MGNREGS additional employment for 50 days for 13,72,478 households (R) (over and above the current annual plan). Estimated affected households (7,16,553)x 50 days x 188 ?=		673.56	An additional; package for employment linking it with Eco restoration and Green Jobs given separately			
	Material cost (wages to material in the ratio of 60:40)		449.04				
MSME recovery (for enterprises and units)	**Micro, Small and Medium Enterprises (MSME)**		**477.37**	**80.00**	**80.00**	**637.37**	DC-MSME, Govt. of India Govt. of Odisha Bank Credit
	Recovery of damage (INR 309.589 crore + 20% additional cost for BBB)	Source from department shared data on damage and 20% extra for building back better policy - Govt proclaimed financial assistance + bank loan	371.51			371.51	

	Recovery of loss (25% of the cost as compensation and remaining as loan)	Source from department shared data on loss	**25.86**			25.86	
	Convergence schemes for strengthening cluster common facilities, technology and marketing, technical support (existing central and state level mechanisms)	The recommendations gathered through field interaction and considering the possibilities of various schemes and programmes of both Govt. of India and Govt. of Odisha.	50	50	50	150.00	
	Skill development (through ITIs, polytechnics and others)		30	30	30	90.00	
Women enterprises, small business recovery (through OLM and Mission Shakti)	**Enterprises and small businesses**		**169.561**	**124.104**	**26.561**	**320.23**	
	Recovery of damage (INR 21.776 crore + 20% additional BBB cost)	Source from department (Mission Shakti and OLM) shared data on damage and 20% extra for BBB - Govt proclaimed financial assistance + bank loan	26.131			26.13	Govt. of Odisha, National Rural Livelihood Mission (NRLM)
	Recovery of loss (25% of the cost as compensation and remaining as loan)	The recommendations gathered through field interaction and considering the possibilities of various schemes and programmes of both Govt. of India and Govt. of Odisha	36.941			36.94	Govt. of Odisha

	Establishment of entrepreneurship incubation centre and mentorship cadre development for 20 most affected blocks	It is proposed to build existing livelihood opportunities and entrepreneurship ecosystems in a better way; i.e. enhance economic empowerment of women and the marginalised, developing sustainable system for the same. Taken from the model UNDP is implementing in other parts of the country	17.68	30.36		48.04	NRLM, Govt. of India and Govt. of Odisha
	Interest subvention to 50,000 women entrepreneurs at 5% for INR 50,000 per entrepreneur for 3 years	Major source of finance as a loan from banks and interest subvention element from Govt. Here calculated only interest as that is the Govt.'s responsibility		24.975	24.98		Govt. of Odisha
	Establishment of community managed 150 agro mart and custom hiring centres for most affected 50 blocks @ INR 15 lakh per unit (INR 10 lakh interest free loan, and INR 5 lakh grant; 100 agro marts to be established in first year, and 50 in the second year)	INR 10 crore from loan, and INR 5 crore as grant, plus interest subvention from Govt. (INR 2.023 crore)	5	4.523		9.52	Govt. of Odisha and Bank credit

	Establishment of 450 Grama Panchayat level community managed construction/ sanitary marts @ INR 5 lakh per unit. To be owned by SHSSELF HELP GROUP (SHG)? / Grama Panchayat federations at most affected Grama Panchayats.	Interest subvention cost = Govt. responsibility Capital = from bank loan	2.24777	1.1238		3.37	Govt. of Odisha and Bank credit
	First year = establish 300 marts Second year = establish 150 marts						
	10,000 JLGs/ SHGs (10 member) for women-centric livelihood initiatives in farming/fisheries/ poultry/animal husbandry in most affected blocks with INR 50,000 as a community grant for vulnerable reduction	For immediate release for building the livelihoods for the most affected families. This can be taken from the CIF/VRF of NRLM/Mission Shakti to SHGs	50			50.00	Govt. of Odisha
	Formation of 10 Producers Groups with cadre building, mobilisation, formation, capacity building, collection centre development, value chain and market development in	Use BBB on existing livelihoods opportunities and entrepreneurship ecosystems to enhance economic empowerment ofwomen and the marginalised in a sustainable way. Build market linkages and value	25	50	25	100.00	NRLM, Govt. of India and Govt. of Odisha

	10 most affected blocks (INR 10 crore per block for four years)	chain for products developed within state. [Taken from the model UNDP is implementing in other parts of the country]					
	Development of 150 plant nursery in 50 most affected blocks with investment INR 10 Lakhs for four years of interest free credit at 13.5%.	Interest subvention cost = Govt. responsibility Capital = from bank loan	1.266	2.531	1.266	5.06	Govt. of Odisha and Bank credit
	50 fodder seed banks for promotion of fodder; capital of INR 7 lakh for four years of interest-free credit at 13.5%	Interest subvention cost = Govt. responsibility Capital = from bank loan	0.295	0.591	0.295	1.18	Govt. of Odisha and Bank credit
	UNDP model Youth Employability Service (YES) Centres at five most affected districts for matching demands to supply of skills and employment, with adequate training support @ INR 1 crore per YES Centre per year	It is observed that the youth needs to be skilled and facilitated to enter the job market. This system, and institutions will enhance this process. [Taken from the model UNDP is implementing in other parts of the country]	5	10		15.00	Govt. of Odisha
Recovery support to urban Informal Economy	**Urban Vendors**		**75.7846**	**7**	**7**	**89.78**	**National Urban Livelihoods Mission (NULM), Govt. of**
	Recovery of Damage (INR 45.058 crore + 20% additional cost for BBB)	Source from department shared data on damage and 20% extra for BBB policy - Govt proclaimed financial assistance + bank loan	54.0696			54.07	

	Recovery of loss (25% of the cost as compensation and remaining as loan)	Source from department shared data on loss	14.715			14.72	India, Govt. of Odisha, Bank credit
	Disaster resilient Storage and gowdowns	The recommendations gathered through field interaction and considering the possibilities of various schemes and programmes of both GoI and State.	5	5	5	15.00	
	Skill Development		2	2	2	6.00	
Setting up Community Crisis Management Fund	Setting up Community Crisis Management Fund as a viability gap fund as security to livelihood credit	The key financial source for livelihood recovery is the credit from banks. Since the repeated occurrence of disaster will lead to non-performing assets (NPA), this fund will support banks as a security for the credit disbursed.	INR 200 crore	INR 150 crore	INR 50 crore	INR 400 crore as viability gap fund for credit security	Govt. of India, Govt. of Odisha and NABARD

Annexes to Chapter 15: Disaster Risk Reduction

Annex 15.1: Table indicating the calculation and assumptions made for estimating the recovery needs (Additional to Table 15.2)

Sl. No.	Activity	Cost (crore)	Cost (crore)	Cost (crore)	Total	
		Short Term	Medium Term	Long Term		Assumptions
1	**Recovery of Damaged Infrastructure**		**0**	**0**	**0**	
	Fire Service					
	ODRAF					
	Police					
	OSDMA					
a					0	
1	**Strengthening Emergency Operation Centres at state and district level**	**18.732**	**170**	**0**	**188.732**	
a	Procurement of Docking stattions for the Satellite Phones	1.16				2 lakhs per docking station for 58 units

b	Procurement of Portable VSAT Antennas	6				1.5 lakh per unit for a total of 400 units
c	Establishment of a State Wide Ham Network	2.7				100 Ham stations with two persons each. Rs. 2.5 lakh per station and Rs. 10,000 per person
d	Establish a civil VHF network	8.5				500 units costing 1.5 lakh. 2 person per unit with a training cost of Rs. 10,000 per head
e	Establishment of a dedicated Communications Coordination unit at OSDMA	0.372				One Senior Expert to lead the Communication Unit @ 1.5 lakh salary with 2 technical support @ Rs. 80,000 salary
a	Expand the EWDS to the other 24 districts of Odisha		120			Cost of a district level EWDS : 500 lakhs
b	Establish a backup SEOC:		50			
3	**Mainstreaming DRR and CCA through Risk Mapping**	**20.95**	**24.92**	**20**	**65.87**	13
a	Review the State Disaster Management Plan (SDMP) in light of recent extreme events	0.05				Lumpsome amount
b	Hazard Specific Mitigation Plan		0.6			3 hazard plans @ 20 lakh each
c	Review and Revision of the DDMP of the 30 districts	0.9			0.9	3 lakhs per DDMP
d	Revision of the Departmental Disaster Management plan with inclusion of SOPs for the district nodal officers		0.9			3 lakh per Departmental plan for 30 departments
e	Preparatation of City Departmental Plans for each of the Urban local bodies of Odisha		3.42		3.42	3 lakh per plan. (114 ULBs)
f	Strengthen the Community Based Disaster Risk Reduction Approach in the Villages of Odisha	20	20	20	60	Additional allocation of 10,000 per village @ 20,000 villages
	Insitutional Strengthening	**0**	**4.996**	**0**	**4.996**	
a	Strengthen the Recovery Unit within OSDMA		0.396			3 staff at avg 70,000 salary and 1 Technical lead @ Rs. 1.2 lakh
b	Establish a Center for Recovery and Mitigation within the SIDM		2		2	Lumpsome amount
c	Disability Inclusion Interventions		0.2			
c	Secondment of technical experts from OSDMA to line-departments		2.4		2.4	25 experts @ 80,000

5	**Risk and Vulnerability Assessments**	**1.758**	**0**	**15.5**	**17.258**	
e	Assessment of the Multi Purpose Cyclone and Flood Shelters and Develop SOPs for Shelter managament (Structural, Functional and Governance)	1.758				Rs. 20,000 for each of the 879 MPCS
a	Multi Hazard Risk and Vulnerabilty Assessment and micro level Risk mappring covering all Districts and State level			15.5		INR 50 lakhs is the cost for one Plan.
7	**Knowledge Managament**	**0.5**	**0**	**0**	**0.5**	
a	Establishment of State Platform on DRR to meet the Sendai and SDG commitments	0.1				
b	Compilation of a Lessons Learnt Report for the Government of Odisha	0.05			0.05	5 lakh allocation
d	Review of Risk Transfer Mechanism and promote disaster risk insurance in key sectors	0.3			0.3	One Time Allocation (Review and Consultations)
c	Training Needs Assessment of Departmental staff to manage disasters in the context of climate change	0.05				Lumpsome amount
	Total (INR in Crore)	**41.94**	**199.916**	**35.5**	**277.356**	
	Total (USD in mio)	**5.99**	**28.56**	**5.07**	**39.6223**	

Abbreviations and Acronyms

AC	Asbestos Concrete
ADB	Asian Development Bank
ADHSM	Additional Directorate of Health Services-Medical
AHP	Affordable Housing in Participation
ANR	Agriculture and Natural Resources
ARDs	Authorised Retail Dealers
ASCI	Administrative Staff College of India
ASHA	Accredited Social Health Activists
AWC	Anganwadi Centre
AWW	Anganwadi Worker
BBB	Build Back Better
BCC	Behaviour Change Communication
BIS	Bureau of Indian Standards
BLC	Beneficiary Led Construction
BOSs	Business Opportunity Seminars
BPL	Below Poverty Line
BRC	Block Resource Centre
BRR	BadanRehabilitasi Dan Rekonstruksi
BTS	Base Transceiver Receiver
CBDRM	Community-Based Disaster Risk Management
CC	Cement Concrete
CCA	Climate Change Adaptation
CCI	Child Care Institutions
CDRC	Capacity Development Resource Center
CEC	Continuing Education Centre
CEO	Chief Executive Officer
CERT	Community Emergency Response Team
CET	Colleges of Engineering
CGI	Corrugated Galvanised Iron
CLSS	Credit Linked Subsidy Schemes
CRZ	Coastal Regulatory Zone
CSEB	Compressed Stabilised Earth Blocks
CSO	Civil Society Organisation
CWC	Central Water Commission
CWC	Child Welfare Commission
CWC	Central Warehouse Corporation
CWSN	Children with Special Needs
CWRDM	Centre for Water Resources Development and Management
DCPU	District Child Protection Unit
DDMA	District Disaster Management Authority
DDU-GKY	Deen Dayal Upadhyaya Grameen Kaushalya Yojana
DEA	Department of Economic Affairs
DEO	District Education Officer
DHFW	Department of Health and Family Welfare
DLNA	Disaster Loss and Needs Assessment
DLU	District Level Unit
DMA	Directorate of Municipal Administration
DMF	Design and Monitoring Framework
DPO	District Project Officer
DPI	Directorate of Public Instruction
DPO	District Project Office
DPR	Detailed Project Report
DRM	Disaster Risk Management
DTE	Directorate of Technical Education
EE	Executive Engineer
EIA	Environmental Impact Assessment
EOC	Emergency Operating Centre
ESR	Elevated Storage Reservoir
EU	European Union
EWARS	Early Warning, Alert and Response System
EWS	Economically Weaker Sections
FALG	Fly-ash, Gypsum and Lime
FBO	Food Business Officers
FPS	Fair Price Shops
FRP	Fibre Reinforced Plastic
FSO	Food Safety Officers
FSCW	Food Supplies and Consumer Welfare
GDDP	Gross District Domestic Product
GER	Gross Enrolment Ratio

GI	Galvanised Iron
GIS	Geographic Information System
GKS	Gaon Kalyan Samhiti
GOI	Government of India
GOO	Government of Odisha
GPCPC	Gram Panchayat Child Protection Committee
GPDP	Gram Panchayat Development Plan
GRC	Gender Resource Centre
GSDP	Gross State Domestic Product
GST	Goods and Services Tax
GWP	Global Water Partnership
H&UD	Housing & Urban Development
ha	Hectares
HFC	Housing Facilitation Centre
ICMR	Indian Council of Medical Research
ICPS	Integrated Child Protection Services
IDRN	India Disaster Resource Network
IEC	Information, Education and Communication
IED	Independent Evaluation Department
IFA	Iron–Folic Acid
IHIP	Integrated Health Information Platform
IIT	Indian Institute of Technology
IMD	Indian Meteorological Department
IMR	Infant Mortality Rate
INCOIS	Indian National Centre for Ocean Information Services
IPPP	Innovative Poultry Productivity Project
IRDAI	Insurance Regulatory and Development Authority of India
ISM	Indian Systems of Medicine
ISSR	In-situ Slum Rehabilitation
IT	Information Technology
ITI	Industrial Training Institute
LAC	Livestock Aid Center
LIFE	Livelihood Inclusion and Financial Empowerment
LIG	Low Income Group
LPG	Liquefied Petroleum Gas
LSGB	Local Self Government Body
LSGD	Local Self Government Department
MBPY	Madhu Babu Pension Yojana
MDR	Major District Roads
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MHA	Ministry of Home Affairs
MHT	Mobile Health Teams
MMR	Maternal Mortality Rate
MT	Metric Tonnes
MS	Mission Shakti
MSME	Micro, Small, and Medium Enterprises
MSW	Municipal Solid Waste
NAC	Notified Area Council
NBC	National Building Code of India, 2016
NCCR	National Centre for Coastal Research
NCD	Non-Communicable Disease
NCMC	National Crisis Management Committee
NDRF	National Disaster Response Force
NESRIP	North Eastern State Roads Investment Program
NFHS-4	National Family Health Survey, Round 4
NFSA	National Food Security Act
NGO	Non-Governmental Organisation
NHM	National Health Mission
NICMAR	National Institute of Construction Management and Research
NIE	National Institute of Epidemiology
NIMHANS	National Institute of Mental Health and Neuro Sciences
NLM	National Livestock Mission
NNF	National Neonatology Forum
NNM	National Nutrition Mission
NPSP	National Polio Surveillance Project
NSAP	National Social Assistance Programme
ODR	Other District Roads
ODRAF	Orissa Disaster Rapid Action Force
O&M	Operation and Maintenance
OD	Open Defecation
OIIAWMIP	Orissa Integrated Irrigated Agriculture and Water Management Investment Project
OLM	Odisha Livelihood Mission
OMFED	Orissa State Cooperative Milk Producers Federation
ORC	Our Responsibility To Children
OSDMA	Odisha State Disaster Management Authority
OSCSC	Odisha State Civil Supplies Corporation
OSMCL	Odisha State Medical Corporation Limited
OSWAN	Odisha State Wide Area Network
OSWC	Odisha State Warehouse Corporation
OTDC	Odisha Tourism Development Corporation
PAB	Project Approval Board
PAI	Public Affairs Index
PCDC	Project Capacity Development Cell
PDNA	Post-Disaster Needs Assessment
PDS	Public Distribution System
PHFI	Public Health Foundation of India

PMAY-G	Pradhan Mantri Awas Yojana- Grameen
PMAY-U	Pradhan Mantri Awas Yojana- Urban
PMP	Probable Maximum Precipitation
PR&DW	Panchayati Raj & Drinking Water
PSU	Public Sector Undertaking
PwD	Person With Disability
PMAY	Pradhan Mantri Awas Yojana
PTA	Parent–Teacher Association
RBSK	Rashtriya Bal Swasthya Karyakram
RCC	Reinforced Cement Concrete
RRT	Rapid Response Team
S & R	Search and Rescue
SADHAC	Stage Agency for Development of Handloom Clusters
SAF	Society for Assistance To Fisherwomen
SAM	Severe Acute Malnutrition
SBM	Swachh Bharat Mission
SC	Scheduled Caste
SCERT	State Council of Education, Research and Training
SD&TE	Skill Development and Technical Education
SDGs	Sustainable Development Goals
SDMA	State Disaster Management Authority
SDRF	State Disaster Response Force
SEOC	State Emergency Operation Centre
SH	State Highway
SHG	Self Help Groups
SMC	School Management Committee
SNCU	Special New-born Care unit
SNP	Supplementary Nutrition Programme
SOPs	Standard Operating Procedures
SSA	Samagra Shiksha Abhiyan
SSI	Small-Scale Industry
ST	Scheduled Tribe
SWM	Solid Waste Management
TDR	Transfer of Development Rights
TFR	Total Fertility Rate
THR	Take-Home Ration
TPDS	Targeted Public Distribution System
UHC	Universal Health Coverage
ULB	Urban Local Bodies
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention On Climate Change
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
VAT	Value Added Tax
VD	Veterinary Hospitals and Dispensary
VHF	Very High Frequency
VRF	Vulnerability Reduction Fund
WASH	Water, Sanitation and Hygiene
WCD	Women and Child Development
WFP	World Food Programme
WHO	World Health Organization
WRD	Water Resources Department

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Sector	Sector Team Members	Government Focal Points	Government officials and other stakeholders consulted with
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Cultural Heritage and Tourism	1. Snigdha Bisht, UNESCO 2. Mirtili Kaffe, UNESCO 3. Karthik Laxman, WB 4. Subodh Patnaik, Consultant UNESCO 5. Birendra Das, Consultant, UNESCO	1. Subhra Mohanty, Joint Secretary, Tourism 2. Sanjya Kumar Jena, Asst. Director, Tourism	1. Manoranjan Panigrahy, IRS, Principal Secretary, Odia Language, Literature and Culture Department, Government of Orissa 2. Shubha Sarma, Secretary, Department of Handlooms, Textiles and Handicrafts, Government of Orissa 3. Sanghamitra Satpathy, Joint Director Culture & Ex- Officio, Joint Secretary to Government and Superintendent Archaeologist, Odisha State Archaeology, Government of Orissa 4. Anjana Panda, Joint Secretary, Department of Handlooms, Textiles and Handicrafts 5. Bijay Kumar Nayak, Director, Odia Language and Literature, Government of Orissa 6. Basant K Dash, Director, Directorate of Handicrafts and Cottage Industries, Department of Handlooms, Textiles and Handicrafts, and Additional Secretary, Industries Department, Government of Orissa 7. Debjit Nandy, Deputy Director of Textiles, Department of Handlooms, Textiles and Handicrafts, Government of Orissa 8. Saroj Kumar Jena, Assistant Director, Tourism Department, Government of Orissa 9. T. K. Panda, Executive Engineer, Orissa Tourism Development Corporation (OTDC) 10. Maulik Mavani, Ernst & Young Consultant, Project Management Unit, Department of Tourism

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			11. Prof. Kamal Kant Misra, Vice-Chancellor, Utkal University of Culture 12. Ashwini Kumar Satpathy, Curator, Odisha State Archaeology 13. Saroj Kumar Nanda, Archaeological Assistant Engineer, Odisha State Archaeology 14. Prasanna Kumar Sahoo, Conservation Assistant, Odisha State Archaeology 15. Bijay Kumar Jena, Secretary, Odisha Sangeet Natak Akademi 16. Basudev Malbishoyi, State Project Co-ordinator (ZKSS- Zilla Kala Sanskruti Sangha/ BKSS- Block Kala Sanskruti Sangha), Odia Language, Literature and Culture Department 17. Suchismita Mantri, Superintendent In-Charge, Odisha State Archives, Bhubaneswar 18. Jayanti Rath, Superintendent, Odisha State Museum, Bhubaneswar 19. Bhagyalipi Malla, Curator, Palm Leaf Manuscripts Section, Odisha State Museum, Bhubaneswar 20. T. Badri Narayana, General Manager, District Industries Centre (DIC), Puri District 21. BP Dash, Assistant Director, Directorate of Handicrafts and Cottage Industries, Department of Handlooms, Textiles and Handicrafts, Government of Orissa 22. Mallika Mitra, Director, Orissa Art Conservation Centre (OACC), INTACH, Bhubaneswar 23. Ramhari Das, Sangeet Natak Awardee for Odissi dance music, and Founder, Ramhari Das Odissi Gurukula Trust, Puri District 24. Meetu Das, Guru, Padmashree Guru Maguni Das Gurukul, Raghurajpur 25. Subodh Patnaik, Theatre Director & Founder, Natya Chetna (Natyagram), Khurda District 26. Priyaranjan Kar, Organising Secretary, Odisha Shilpi Mahasangha 27. Biswanath Swain, National Awardee, & Secretary, Parampara (a voluntary organisation for promoting art, crafts, and culture), Raghurajpur 28. Sarat Pradhan, National Awardee, Palm Leaf Engraving Craft, Puri District 29. Jabar Khan, Owner, Diamond Applique Work Shop, Pipli 30. Groups of performing artists, handicraft artisans and weavers, and people in the tourism business

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Agriculture, Fisheries and Livestock	1. Rajesh Dubey, FAO 2. Dr. A. B. Negi, Consultant, FAO 3. Ravishankar Thupalli, Consultant FAO 4. C. P. Mohan, Consultant, FAO 5. Vishnu Bhatt, Consultant, FAO 6. Shouvik Mitra, WB 7. Samik Sundar Das, WB	1. Subash Chandra Mohanta, Deputy Director of Horticulture 2. Dr. Gopal Tripathy, Public Vet & Training Administrator, Veterinary Officers Training Institute (VOTI) 3. Sibo Narayana Sahu, Joint Secretary, Fisheries & ARD Dept. 4. Sangram K. Mohapatra, Addl. Secretary, Agriculture & Farmers Empowerment Dept. 5. Gangadhar Nayak, Addl. Secretary, Fisheries & ARD Dept.	1. Vishal Gagan, Commissioner-cum Secretary, ARD and Fisheries 2. Bishnupada Sethi, Special Relief Commissioner 3. Sibonarayan Sahu, Joint Secretary, ARD 4. Ratnakar Rout, Director, Animal Husbandry 5. Dr. Malik, Director, Central Poultry Development Organisation, Bhubaneswar 6. Dr. D. K. Patnaik, Joint Director, Animal Husbandry 7. Dr. P. K. Singh, Joint Director, FSB Chiplima 8. Balwant Singh, Collector, Puri 9. Dr. P. K. Khamari, Chief District Veterinary Officer Puri 10. Dr. Naresh Rath, Chief District Veterinary Officer Khorda 11. Dr. Keshab Ch. Pradhan, Chief District Veterinary Officer Cuttack 12. Dr. Ramesh Chander Behra, Chief District Veterinary Officer Jagatsinghpur 13. Girish Chander Kar, CEO, OLDS 14. Rashmi Ranjan Dash, Asst. Director VOTI 15. Dr. S. K. Bahra, Block Veterinary Officer, Pipili 16. Subhenda Sahu, RO OBPI 17. Dr. Manas Kumar Chand, Block Veterinary Officer, Balipatna 18. Dr. Satyavrat Dash, Veterinary Officer, Balipatna 19. Pritosh Mahapatra, VO, Bramhagiri 20. Dr. Jyoti Ranjan Biswal, Addl. VAS, Balakoti Khorda 21. Falguni Jolly, President Satpura Fisherman Society 22. Dr. Lingaraj Panja, Addl. District Veterinary Officer (LP) 23. Dr. Prafulla Kr. Dash, District Veterinary Officer Cuttack 24. Dr. Prasanna Kr. Pruthy, Addl. District Veterinary Officer Jagatsinghpur 25. Dr. Naresh Kumar, Addl. District Veterinary Officer (LP) 26. Dr. Kunj Bihari Swain, Block Veterinary Officer, Biridi 27. Dr. Jagdish Kumar Mohanti, Addl. Veterinary Officer, Biridi 28. Dr. Umesh Ch. Rout, Block Veterinary Officer, Kantapada 29. Farmers from different villages in 8 blocks of four Districts of Puri, Khurda, Cuttack and Jagatsinghpur. 30. Vishal Gagan, Commisioner cum Secretary, Dept of Fisheries and ARD 31. Ratnakar Raut, Director of Fisheries, Dept of Fisheries and ARD 32. Umesh Kumar Mohanty, Joint Director of Fisheries 33. Pratap Kumar Rout, Joint Director of Fisheries

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			34. Subol Mohanty, Deputy Director of Fisheries 35. Babita Mahantha, District Fisheries Officer 36. Subrath Das, District Fisheries Officer 37. Jayantha Kumar Nayak, JFTA, Birdi 38. Abhaya Das, SFTA. Achutpur, District Fisheries Officer (B&T), Balugaon 39. Asst. Registrar of Co-Operative Societies (Fy), Chilika Circle, Balugaon 40. Rabindra Behera Birdi, Kulakaijaga 41. Ramesh Chandra Swain, Village Achuthpur, Raghunathpur Block 42. Babaji Sethy, Gokulpur Village, Raghunathpur Block 43. Fishers at Pentakota, Satapada 44. Farmers at Niyali, Kantapada 45. Sourabh Garg, Principal Secretary, Agriculture 46. Dr. Muthukumar, Director, Agriculture 47. Dr. Bijay Ketan Upadhyay, Director, Horticulture 48. Debashis Singh, Joint Secretary, Agriculture 49. S. C. Mohanta, Joint Secretary, Horticulture 50. Nandini Dalal, Asst. Director, Agriculture 51. S. Sahoo, Director, Department of Economics and Statistics 52. Susanta Panda, Asst. Director, Horticulture 53. Dr. B. K. Mohapatra, Joint Director, Extension, OUAT 54. S. Nayak, Managing Director, Odisha Cashew Development Corporation 55. Kalindi Pradhan and Deepti Pradhan, Farmers, Beladel Village, Sadar Block, Puri District 56. Dilip Baral and Bijay Kumar Bhoy, Farmers, Resinga Village, Nimapada Block, Puri 57. Ashok Behera, Laxmidhar Pradhan, Batakrishna and Rabindra Behera, Farmers, Puranpradhan Village, Balinda Block, Khorda 58. Babuli Biswal, Farmer, Puranasasan Village, Balianta Block 59. Dr. P K Panda, Asst. Director, Horticulture, Khorda 60. Bhaskar Barik, Deputy Director, Horticulture, Khorda 61. Padmini Bal, Asst. Horticulture Officer, Balianta Block 62. Paresh Chandra Sahu, Deputy Director, Agriculture, Cuttack 63. Baishna Charan Barik, Deputy Director, Horticulture, Cuttack 64. S. N. Bhoi, Asst. Director, Horticulture, Cuttack 65. Priyanka Das, Asst. Horticulture Officer, Niali Block

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Power	1. M. Dasarathi, WB 2. Mani Khurana, WB 3. Samrat Ray, WB 4. Jyotirmoy Banerjee, ADB	1. Sangram Keshari Swain, Special Secretary, Energy	1. Hemant Sharma, Secretary, Energy Department 2. Manoj Kumar Singh, Senior General Manager (AT&C) CESCO 3. N. R. Pradhan, DGM, OPTCL 4. Dandsena, DGM, OPTCL
Telecommunications	1. M. Dasarathi, WB 2. Mehul Jain, WB	1. R. N. Palai, Special Secretary, Dept of Electronics & IT	1. Dr. U. K. Panda, CGM, BSNL
Roads	1. Alok Bharadwaj, ADB 2. Prabhasa Sahu, ADB 3. Indranil Bose, WB	1. Chittaranjan Ray, Addl. Commissioner, Tech (I/c), STA, Cuttack, Odisha 2. Bhramabhar Mohaptra, OSD (Transport)	1. J. K. Das, Additional Secretary & Chief Engineer, Works Department 2. Sridhar Naik, Joint Secretary, Rural Development Department 3. Anil Kumar Patnaik, Joint Secretary, H&UD Department 4. Balwant Singh, Collector & District Magistrate, District Puri 5. Samarth Verma, Commissioner, Bhubaneshwar Municipal Corporation 6. P. Samant Ray, Executive Engineer, Puri Region-Works Department 7. Siba N Barik, Superintending Engineer, Cuttack Region- Works Department 8. D. R. Tripathi, Executive Engineer, Cuttack Municipal Corporation 9. Sahu, Executive Engineer, Rural Development Department
Water, Sanitation and Hygiene (WASH)	1. Shipra Saxena, UNICEF 2. Narendra Singh Chauhan, UNICEF 3. Vivek Pandey, UNICEF 4. Rudra P Ratha, UNICEF 5. Bikas Samantaray, UNICEF 6. Alka Gupta, UNICEF 7. Gautam Patnaik, UNICEF 8. Prasad Sevekari, UNICEF 9. Srinivas Panda, UNICEF 10. Hemant Khosla, UNICEF	1. Bhagban Sahu, EIC, RWSS 2. Janmajaya Sethi, CE, RWSS	1. D. K. Singh, Principal Secretary, Panchayati Raj & Drinking Water (PR&DW) Department 2. Roopa Mishra, Additional Secretary and Mission Director, PR&DW 3. Subash Chandra Das, Joint Secretary, SBM, PR&DW 4. Maheswar Panigrahi, Joint Secretary 5. Abhay Biswal, Superintending Engineer, RWSS circle Bhubaneshwar 6. Harichandan, Superintending Engineer, RWSS Circle Cuttack 7. Manoj Panigrahi, Team Lead, Water PMU (E&Y) 8. Sirisha, Senior Associate, Water PMU (E&Y) 9. Aroop Tripathi, Team Lead TSU, SBM, RWSS 10. Shoumit Mishra, Consultant, TSU, SBM 11. Sobhan Mehar, Consultant, TSU, SBM 12. Anil Kumar Patnaik, Joint Secretary, H&UD, Govt. of Odisha 13. S. Laxmipati, PHEO, H&UD, Govt. of Odisha 14. Prasant Kumar Mahapatra, Project Director, Odisha Water Supply & Sewerage Board, H&UD, Govt. of Odisha 15. Binod Sethy, Urban EIC 16. Chitta Ranjan Jena, Superintending Engineer, PHEO, H&UD, Govt. of Odisha 17. Santosh Kar, Executive Engineer, Bhubaneswar – I, PHEO, H&UD, Govt. of Odisha 18. Guru Charan Das, Executive Engineer, Bhubaneswar – II, PHEO, H&UD, Govt. of Odisha

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			19. Balwant Singh, District Collector, Puri 20. Basant Nayak, Executive Engineer, RWSS 21. P. K. Dey, H&UD, Govt. of Odisha, Project Engineer, Odisha Water Supply & Sewerage Board 22. Subrat Kumar Mishra, Assistant Executive Engineer, PHEO, H&UD, Govt. of Odisha 23. Ranjan Mishra, Junior Engineer 1, RWSS 24. Ranjan Samantrai, Junior Engineer 2, RWSS, PR&DW 25. Alokranjan Panda, Assistant Engineer (Sub Divisional Officer) RWSS 26. Prativa Sahu, BDO, Rural Development Raj 27. Ranjan Mishra, Junior Engineer 1, RWSS, PR&DW 28. Ulhas Sahoo, Assistant Engineer (SDO), RWSS, PR&DW 29. S. K. Behera, Executive Engineer, RWSS, PR&DW 30. Ramchandra Swami, Accounts officer, BDO office 31. Rosalin Pradhan, Community radio Person, Radio Namaskar 32. Debrat Sahoo, Sarpanch, Ganeshwarpur, Gram Panchayat 33. Mandal, Executive Magistrate 34. Sukanta Ray, Joint Secretary, Urban Corporation 35. Siva Nanda Swain, BDO 36. Kasturi Pradhan, Tehsildar 37. Rabi Narayan Barik, BDO 38. Smruti Ranjan Behera, JE-2 39. Prahallad Sahoo, Assistant Executive Engineer 40. Sarat Mishra, Executive Engineer, PHEO, H&UD 41. Arvind Agarwal, District Collector, Cuttack 42. Sanjay Kumar Samal, Executive Engineer, RWSS, PR&DW 43. Jyotiranjan Das, Assistant Executive Engineer, RWSS, PR&DWD 44. Sukantkumar Sethi, Assistant Executive Engineer, RWSS, PR&DWD 45. Devendra Das, Executive Engineer, District Rural Development Agency (DRDA) 46. Prabhakar Sahoo, Assistant Engineer, DRDA 47. Alaknanda Prajapati, Junior Engineer, DRDA 48. Dayanidhi Behra, Assistant Engineer 49. Debashis Mohanty, Deputy Executive Engineer 50. Sushanta Kumar Gharai, EE, Public Health Division-I, CTC, H&UD 51. Ajay Kumar Mishra, JE 2, RWSS, PR&DWD 52. B.R. Panda, Asst. EE, RWSS, PR&DWD 53. Debasish Dhal, JE 2, RWSS, PR&DWD

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			54. R.N. Panda, JE 1, RWSS, PR&DWD 55. Guha Poonam Tapas Kumar, District Collector, Jagatsinghpur 56. Rabindra, JE, Biridi 57. Bhupendra Poonia, Collector & District Magistrate, Khurda 58. Saroj Mishra, Project Director, DRDA, Khurda 59. Santosh Kumar Kar, Executive Engineer, RWSS Division, Bhubaneswar 60. B. B. Panigrahi, Deputy Ex. Engineer, Public Health Division, Bhubaneswar 61. Rabindra Kumar Mishra, Asst. Ex. Engineer, Public Health Sub division, Bhubaneswar 62. Mitanjali Das, BDO, Balipatna Block Khurda 63. Rashmirekha Pradhan, BDO, Balianta Block, Khurda 64. Sunil Kumar Pradhan, Jr. Engineer-1, Balipatna block, Khurda 65. Sunita Mohanty, Jr. Engineer-2, Balipatna block, Khurda 66. Sangya Sagarika Swain, Jr. Engineer-1, Balianta block, Khurda 67. Rajanikanta Panigrahi, Jr. Engineer-1, Balianta block, Khurda
Public Buildings	1. Peeyush Sekhsaria, WB 2. Anup Karanth, WB 3. Ella Kim, WB 4. Bhavesh kumar, ADB	1. Sridhara Nayak, Joint Secretary, Rural Development	1. Anil Kumar Pattanaik, Joint Secretary, H&UD Department 2. Sarat Chandra Nayak, Municipal Commissioner, Cuttack 3. Tapan Kumar Mohapatra, Executive Officer, H&UD 4. Dibya Ranjan Tripathi, Deputy Executive Engineer, Cuttack Municipal Corporation, H&UD Department 5. Satyaranjan Sethi, Chief Engineer, Buildings, Works Department 6. Jaya Krishna Das, Additional Secretary, Works Department 7. Jagabandhu Rao, Executive Engineer, Works Department 8. Mujbir Rahman Khan, Executive Engineer, R&B Division 1, Cuttack 9. Sudhir Kumar Panda, Executive Engineer, R&B Division -2, Cuttack 10. Pradeep Kumar Das, Executive Engineer, Works Department 11. Santosh Kumar Samal, Executive Engineer, Rural Works Division, Puri 12. Neelamadhab Sahu, Executive Engineer, Rural Works Division, Cuttack 13. Maheshwar Panigrahi, Joint Secretary, Roads, PR&DW Department 14. Purna Chandra Sahoo, Chief Engineer, Flood and Basin Control Manager, Lower Mahanadi Basin, Bhubaneshwar, Water Resources Department 15. Dr. Samrat Gowda, IFS, Additional Chief Executive, Chilika Development Authority

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Water Resources	1. Prabir Joardar, WB	1. Purna Chandra Sahoo (Water Resources Department)	1. Pradeep K Jena, Principal Secretary, DoWR 2. Er. Purna Chandra Sahu, Chief Engineer, Lower Mahanadi Basin 3. Er. Chinmoy Raut, Superintending Engineer, Central Irrigation Circle 4. Er. Pramod K Raut, Executive Engineer, Puri Irrigation Division (Puri District) 5. Er. Shashi Mishra, Executive Engineer, Nimapada Irrigation Division (Puri District) 6. Er. Purna Chandra Ratha, Executive Engineer, Aul Irrigation Division (Kendrapara District)
Employment, Livelihoods and Social Protection	1. Ruchira Chandra, ILO 2. Philip Mathew, UNDP 3. Soumen Ray, UNICEF 4. Partha S. Banerjee, ILO, Consultant 5. Manisha Mukherjee, ILO Consultant 6. R M Piyush, UNDP 7. Nihar Maharana, Intern UNDP 8. Balram Malhan, ILO 9. Rajashree Nanda, ILO 10. Shashi Prabha, UNICEF	1. Sudhakara Bangi, Addl. Secretary, Labour & ESI Dept. 2. Madhumita Nayak, Joint Secretary, SSEPD, Dept	1. L. N. Gupta, Addl. Chief Secretary, Micro, Small and Medium Enterprises (MSME) Department 2. Niten Chandra, Principal Secretary, Social Security and Empowerment of Persons with Disabilities (SSEPD) Department 3. Balwant Singh, District Collector, Puri 4. Sudarshan Panda, Addl. Secretary, Skill Development & Technical Education Department 5. Manmath Kumar Biswal, Addl. Secretary, Department of MSME 6. Subhra Mohanty, Joint Secretary, Tourism Department 7. Surath Mallick, Addl. Commissioner, Bhubaneswar Municipal Corporation 8. Prasanth Kumar Patra, Principal, College of Engineering & Technology, BBSR 9. Dilip Kumar Sahoo, Principal, Special ITI, Jatni, Khudupur, Khurda 10. S. K. Maharana, Training Officer, Special ITI, Jatni, Khudupur, Khurda 11. Parsuram, Principal, L&T Construction Skill Training Institute, Cuttack 12. Dr. H. K. Mohanty, Principal, Industrial Training Institute, Cuttack 13. S. K. Panda, Executive Engineer, Roads & Bridges Division, Cuttack 14. S. P. Mallick, Deputy Director (R&B), Directorate of Tech. Education & Training, Cuttack 15. P. K. Senapati, Asst. Engineer, Industrial Training Institute, Cuttack 16. Akshaya Ku. Mulia, Asst Ex. Engineer, Directorate of Tech. Education & Training, Cuttack 17. Nilaya Jyoti Behera, Asst. Director, Directorate of Tech. Education & Training, Cuttack 18. Deviprasad Patra, Consultant–civil, Directorate of Tech. Education & Training, Cuttack 19. Shisir Kumar Sahoo, Principal, Madhusudan ITI, Cuttack 20. Arun Kumar Mohapatra, Principal, Bhubanananda Odisha School of Engg. 21. Dilip Kumar Panda, Principal, Biju Patnaik Film & Television Institute of Odisha, Cuttack 22. S. V. N. Rao, Nodal Officer, Odisha, Skill Development Authority, Bhubaneswar

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			23. Narayan Sahu, Joint Secretary, Fisheries Directorate 24. Sidhartha Swarup Jena, District Fisheries Officer, Fisheries Directorate, Cuttack 25. P. R. Rout, Joint Director Fisheries (Coastal), District Fisheries Office, Cuttack 26. Sushanta Kumar Panda, Horticulture Directorate 27. S. C. Mohanta, Deputy Director, Horticulture Directorate 28. Rabi Narayan Mohapatra, Agriculture, Krishi Bhavan 29. Gopal Tripathy, Fisheries Directorate 30. Babita Mohapatra, Deputy Director, Odisha Livelihood Mission 31. Sarada Prasad Panda, Addl. Director, State Urban Dev. Authority (SUDA), H&UD Department 32. Manmohan Moharana, Sr. Consultant, State Urban Dev. Authority 33. Basant Kumar Dash, Director, Handicrafts and Cottage Industries 34. Soumit Mishra, Mission Shakti 35. Sudhanshu Sekhara Nayak, Director, Mission Shakti 36. Sikha Biswal, Addl. CEO Finance, Odisha Livelihood Mission 37. Debasis Mohapatra, Sr. Consultant, Odisha Livelihood Mission 38. Nilakantha Ratha, Addl. Director- Skill, Orissa Rural Development & Marketing Society (ORMAS) 39. S.K. Samal, Program Officer, MGNREGA 40. R.R. Nayak, Joint Secretary, Women and Child Development Department 41. Debjit Nandy, Deputy Director, Textiles Department 42. Dr. Bhakta Kabi Das, Chief General Manager (P&C), Odisha Industrial Infrastructure Development Corporation 43. K. Behera, General Manager, DIC, Bhubaneswar 44. Abhaya K Nayak, Spl. Officer, Dir. of Industries, MSME Department 45. Asit Baran Pradhan, Assistant Director, Directorate of Employment, Bhubaneswar 46. Ajay Kumar Panda, Deputy Director, Directorate of Tech. Education & Training, Cuttack 47. Himanshu Panigrahy, Nodal Officer, Odisha Skill Development Authority, Bhubaneswar 48. Sangram K Raysardar, Deputy Secretary, Skill Development & Technical Education Department 49. Shalini Meher, ASO, SSEPD Department, Bhubaneswar 50. Sanyasi Babu, District Social Security Officer, SSEPD Department, Bhubaneswar 51. Sachidananda Sahu, ADM, JagatsinghpurDistrict 52. Kalyan Saurabh Das, Emergency Officer, District Administration Jagatsinghpur

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			53. Ajay Kumar Khuntia, Swagat Ratnakar Behra, Secretary and Assistants of ASRA Home Jagatsinghpur Home for elderly and disabled and girls in Jagatsinghpur 54. Trinath Pathi, District Social Security Officer, SSEPD Department, Puri 55. Sanjib Mandal, National Health Mission, PFMS Cell, Govt of Odisha 56. Bishnu Mishra, Agriculture Department, eGovernance Cell, Govt of Odisha 57. Bhagwan, District Leprosy officer, Health Department, PuriSanjayji Colony for Leprosy cured person Puri district 58. Laxmi Narayan,Odisha State Disaster Management Authority 59. Interaction with Cyclone Fani affected people- Brahmagiri Block, Puri District
Gender and Social Inclusion	1. Shobhana Boyle, UNFPA 2. Sanya Seth, UNWOMEN 3. Lopamudra Tripathy, UNICEF 4. Soumen Ray, UNICEF 5. Kalika Mahapatra, Consultant, UNWOMEN 6. Shashi Prabha, UNICEF 7. Vivek Singh,WB	1. Madhumita Nayak, Joint Secretary, SSEPD, Dept	1. Bishakha Bhanja, Regional Manager, Water Aid 2. Manash Mishra, ED, Vasundhara, Bhubaneswar 3. Sandeep, N Cash, BBSR 4. Pradipta Mohapatra, UDYAM, Bhubaneswar 5. Sneha Mishra, Secretary Aaina, Bhubaneswar 6. Sanyasi Behera, DSSO- HQ, BBSR 7. Trinath Padhi, DSSO, Puri 8. Nitin Chandra, Principal Secretary, SSEPD Dept., Govt of Odisha 9. Sushanta Mohapatra, Director, SSEPD Dept. Govt of Odisha 10. Balwant Singh, District Collector, Puri 11. Lalatendu Mohanty, Sarpanch Kapileswarpur, Brahmagiri, Puri 12. Chinmayee, Community Organiser, BMC 13. Manoj Pradhan, Project Manager, SMRC, Bhubaneswar 14. Prakash Rath, CEO, Open Learning Centre, Bhubaneswar 15. Beena Mishra, Secretary, SWAD 16. Gauri Devi, CDPO, Biridi 17. Anuradha Mohanty, PECUC, Bhubaneswar 18. Kailash, Secretary, Jagruti, Kandhamal 19. Anu Garg, Principal Secretary, W&C Development, Govt. of Odisha 20. Jagadananda, Advisor, CYSD 21. Gauri Mishra, SPO, OSDMA, Bhubaneswar 22. Babita, OLM, Bhubaneswar 23. Falguni, OLM, Bhubaneswar 24. Amrita Patel, State Coordinator, OSRCW, WCD dept.

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Environment	1. Vaideeshwaran S, WB 2. Ajith Pattnaik, UNDP 3. Lisa Guppy, UNEP 4. Yeshika Malik, WB 5. Lokanath Das, UNDP 6. Amarendra, UNEP	1. Dr. S. Panda, Special Secretary, Forest & Environment Dept	1. Suresh Chandra Mahapatra, Additional Chief Secretary Forest, Forest & Environment Department 2. Dr. Sandip Tripathy, Principal Chief Conservator of Forest & HOFF, Odisha, Forest & Environment Department 3. Dr. Sudarshan Panda, Special Secretary, Forest and Environment, Forest & Environment Department 4. Dr. K. Murugesan, Special Secretary, Member Secretary, CZMA and Director, Climate Change Cell, Forest & Environment Department 5. Dr. Debidutta Biswal, Member Secretary, State Pollution Control Board, Forest & Environment Department 6. Sushanta Nanda, Chief Executive, Chilika Development Authority & Project Director, ICZM Project, Forest & Environment Department 7. Samrat Gouda, Additional Chief Executive, Chilika Development Authority, ICZM Project, Forest & Environment Department 8. Dr. R. N. Samal, Scientific Officer, Chilika Development Authority, ICZM Project, Forest & Environment Department 9. Rajiv Kumar, Managing Director, Odisha Forest Development Corporation, ICZM Project, Forest & Environment Department 10. A. K. Dash, DFO, City Forest Division, Forest & Environment Department 11. K. N. Swain, DFO, Chandaka Wildlife Division, Forest & Environment Department 12. B. N. Mishra, General Manager, Odisha State Disaster Management Agency 13. Bhupendra Singh Poonia (IAS), Collector Khurda, Revenue and Disaster Management Department 14. Manoranjan Mallik OAS (S), Additional District Magistrate, Khurda, Revenue and Disaster Management Department 15. Nihar Ranjan Sahu, Junior Engineer, Khurda Municipality, H&UD Department 16. Tapas Kumar Mohapatra, Executive Officer, Jatnai, Municipality, H&UD Department 17. Santosh Kumar Naik, Executive Officer, Banapur Municipality, H&UD Department 18. Surendra Nath Khuntia, Executive Officer, NAC, Balugaon 19. Rajendra Prasad Mishra, Junior Engineer, NAC, Balugaon 20. Balwant Singh, IAS, Collector Puri 21. Binaya Kumar Dash, Additional District Magistrate, Puri 22. Nrusingh Charan Swain, Project Director, DRDA, Puri 23. Harshababdhan Udgata, Divisional Forest Officer, Puri, Forest & Environment Department 24. Dr. Biranchi Naryan Samal, Assistant Conservator of Forest, Puri 25. Aravind Agrawal, IAS, Collector, Cuttack 26. Bijay Kumar Khandayatray, OAS(S), Additional District Magistrate, Cuttack

Sector	Sector Team Members	Government Focal Points	Government officials and other stakeholders consulted with
			27. Umesh Panigrahi, Chief Health Officer, Cuttack 28. Anil Kumar Patnaik, Joint Secretary, HUD, 29. Purna Chandra Rath, Executive Engineer – Kendrapara, Water Resources Department 30. Ashok Kumar Singha, Managing Director, CTRAN Consulting Pvt Ltd., 31. D. P. Dash, Coordinator, NETCOAST, NGO Network 32. Saswata Kumar Mohapatra, Director, SPANDAN, NGO 33. Parag Talankar, Director- Planning & Mobilisation, SEEDS, NGO 34. Bhaktabihari Mishra, Secretary, NIHIDA, NGO
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Sector	Sector Team Members	Government Focal Points	Government officials and other stakeholders consulted with
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Cyclone Fani

DAMAGE, LOSS, AND NEEDS ASSESSMENT

The extremely severe cyclonic storm 'Fani' or the 'Hood of the Snake' was the strongest tropical cyclone to strike Odisha since Phailin in 2013. Cyclone Fani made landfall at about 8.30 AM on 3 May 2019 between Satapada and Puri with a sustained surface wind speed of 175–180 kilometres per hour (kmph).

It unleashed copious rain and windstorm that gusted up to 205 kmph, leading to fatalities, destruction of homes, and swamping of towns and villages. Fani left a trail of devastation in large parts of coastal Odisha, with the seaside pilgrim town of Puri being the worst hit.

This Damage, Loss, and Needs Assessment (DLNA) of the Cylcone Fani in Odisha was conducted between 24 May and 4 June 2019 by Government of Odisha in collaboration with United Nations, World Bank, and ADB. Covering the 14 affected districts in the state, it presents estimates of the damage, loss, and recovery needs across 15 sectors.

Enriched by the multi-institutional and interdisciplinary expertise of the assessment team, the DLNA will contribute significantly to expediting the reconstruction and recovery process in the state.

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