

INDIA

Cyclone Phailin in Odisha

October 2013

Rapid Damage and Needs Assessment Report



Asian Development Bank



Government of Odisha



The World Bank

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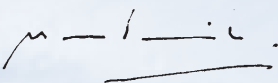
Foreword

The Very Severe Cyclone Storm "Phailin" that hit the coast of Odisha on October 12, 2013, brought with it very high speed winds and heavy rainfall that caused extensive damages particularly to houses, standing crops, power and communication infrastructure in the coastal districts of the State.

We are thankful that the casualties were minimal and my heartfelt gratitude goes to all the Government employees and the rescue teams for their efforts in creating the preparedness for this calamity and helping the Government to successfully evacuate nearly 1 million people. This has been one of the largest rescue operations in the history of our country.

This report – "Rapid Damage and Needs Assessment: Cyclone Phailin in Odisha 2013" – lays the ground for the effective recovery from cyclone impacts. The Odisha Government recognizes the necessity to continuously improve on disaster risk reduction and management capabilities, and aims to rebuild a more resilient future for its citizens.

Presently we need to immediately start rehabilitation and rebuilding of damaged assets, infrastructure and livelihoods. This report provides a detailed breakdown of the affected sectors, the extent of damages sustained, the reconstruction/recovery needs, and the recovery strategy. We in Odisha are committed to 'build back smarter' to minimize future risks.



NAVEEN PATNAIK

Chief Minister

Government of Odisha

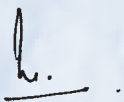
Foreword

On October 12, 2013, Cyclone Phailin hit the coast of Odisha near Gopalpur in Ganjam district, affecting about 13.2 million people in 171 blocks in 18 Districts of the state, and resulting in 44 human casualties. The damage caused by the cyclone was due to the unprecedented wind velocity of up to 220 kmph followed by torrential rains that caused massive destruction in the districts of Ganjam, Puri, Khurdha, and the Chilika lagoon.

The success of minimizing human casualties was due to the resolve of the state and our team's preparedness. The government of Odisha and OSDMA had commenced preparatory activities by immediately dispatching emergency assistance and evacuating people. Over 1 million people were evacuated within 36 hours preceding the landfall of Cyclone Phailin, which is one of the largest emergency evacuations carried out within a record timeframe. These efforts were made in close collaboration with the Odisha Disaster Rapid Action Force (ODRAF), National Disaster Response Force (NDRF), Central Reserve Police Force (CRPF), Odisha State Armed Police (OSAP), and the Indian Air Force (IAF).

The need to immediately start recovery and reconstruction work after Cyclone Phailin, especially in the affected districts, has prompted the State Government, in collaboration with the World Bank and the Asian Development Bank, to initiate an assessment of the recovery needs in order to draw up a comprehensive recovery framework. The "Cyclone Phailin in Odisha 2013: Rapid Damage and Needs Assessment" report is the result of this exercise which was undertaken during November 26 to December 3, 2013.

We recognize that each disaster is an opportunity to improve our resilience and risk measures within the State. This report lays the groundwork for an enduring recovery of high resilience measures within the State, and sustainable restoration of livelihoods among the affected population.



JK MOHAPATRA

Chief Secretary

Government of Odisha

Acknowledgement

The Rapid Damage and Needs Assessment Report (RDNA), post-Cyclone Phailin in Odisha, was prepared in response to a request from the Department of Economic Affairs (DEA), Government of India (GoI). It was undertaken jointly by the Government of Odisha (GoO), the Asian Development Bank and the World Bank. The RDNA team visited Bhubaneswar (Odisha) and the three most severely affected districts of Ganjam, Puri and Khordha, from November 26 to December 3 2013, and collaborated with the GoO to assess the damage and develop a recovery and restoration framework.

The team met with various line departments, and district officers of different sectors within the GoO that have been involved in the damage enumeration. The team extends its appreciation to Mr. Injeti Srinivas (ACS and Development Commissioner), Mr. U.N. Behera (ACS Finance) and Dr. Taradatt, (ACS, Revenue and Disaster Management Department MD-OSDMA), the district collectors of Ganjam, Khordha and Puri for meeting and sharing valuable information and insights.

The team wishes to acknowledge and sincerely thank all the other Government officials and various line departments who assisted and participated in this exercise, both at the state and at the district levels. Without their valuable insights, active support and logistical arrangements, the team's fieldwork would not have been productive.

The RDNA Team¹

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Abbreviations & Acronyms

ADB	Asian Development Bank
BCM	Billion Cubic Meters
CCA	Culturable Command Area
CDR	Cyclone Damage Report
CGP	Captive Generating Plants
CRPF	Central Reserve Police Force
CSMMC	Cyclone Shelter Management and Maintenance Committee
DEA	Department of Economic Affairs
DFO	District Forest Officer
DoWR	Department of Water Resources
DPR	Detailed Project Report
DSS	Decision Support System
FSI	Fishery Survey of India
FSMMC	Flood Shelter Management and Maintenance Committee
GIS	Geographic Information System
GoI	Government of India
GoO	Government of Odisha
GSDP	Gross State Domestic Product
HH	Households
IAF	Indian Air Force
IAY	Indira Aawas Yojna
ICZMP	Integrated Coastal Zone Management Project
IMD	Indian Meteorological Department
JnNURM	Jawaharlal Nehru National Urban Renewable Mission
KV	Kilo Volt
MDR	Major District Road
MSME	Micro, Small and Medium Enterprise
NCRMP	National Cyclone Risk Mitigation Project
NDMA	National Disaster Management Authority

NDRF	National Disaster Response Force
NTFP	Non-Timber Forest Product
ODR	Other District Road
ODRAF	Odisha Disaster Rapid Action Force
OLM	Odisha Livelihood Mission
OSAP	Odisha State Armed Police
OSDMA	Odisha State Disaster Management Authority
PMGSY	Pradhan Mantri Gramin Sadak Yojna
PPAS	Power Purchase Agreements
PWD	Public Works Department
RAY	Rajiv Aawas Yojna
RCC	Reinforced Concrete Cement
RDNA	Rapid Damage and Needs Assessment
R&DM	Revenue and Disaster Management Department
RWSS	Rural Water Supply Schemes
SLDC	State Load Dispatch Center
STU	State Transmission Utility
THR	Take Home Ration
ULBs	Urban Local Bodies
VSCS	Very Severe Cyclonic Storm
WB	World Bank
WBM	Water Bound Macadam

Executive Summary

1. The Very Severe Cyclonic Storm (VSCS) 'Phailin' made landfall at the coast of Odisha near Gopalpur in Ganjam district on October 12, 2013. Eighteen out of the thirty districts in the state were affected by the storm and subsequent floods. The majority damages were due to high speed winds of up to 220 kmph followed by flooding ensued by torrential rains. The observed storm surge was up to about 3.5 m above normal, inundating large areas in the districts of Ganjam, Puri, Khordha, and around Chilika lagoon. The cyclone left 44 people dead, damaged about 256,600 homes and affected about 13.2 million people in over 18,370 villages.
2. Preparedness of the Government of Odisha (GoO) and the coastal communities and their resolve to ensure zero casualties resulted in prompt action to the warning of the cyclone. The GoO dispatched emergency assistance and evacuated people to safer places. This effort was made in close collaboration with the Odisha State Disaster Management Authority (OSDMA), field level officers, Cyclone Shelter Management and Maintenance Committees (CSMMCs), the National Disaster Management Authority (NDMA), the Odisha Disaster Rapid Action Force (ODRAF), National Disaster Response Force (NDRF), Central Reserve Police Force (CRPF), Odisha State Armed Police (OSAP) and the Indian Air Force (IAF).
3. Around one million people were evacuated to nearby cyclone/flood shelters and to other identified safe buildings. This was one of the largest evacuation ever done in recorded history of Disaster Management in India. In addition, the state government opened 4,197 free kitchens centers from October 11 onwards. 185 medical teams were mobilized and 338 medical relief centers were opened. The cyclone caused extensive devastation uprooting vast number of trees, damaging roads, public buildings, houses and disrupting telecommunications and power lines. Due to the effective pre-positioning of men, machinery and materials and the able coordination among State, National and Local agencies, the restoration of connectivity was carried out in an impressive manner.
4. The World Bank and the Asian Development Bank received a request from the Department of Economic Affairs (DEA), Government of India (GoI) to support the efforts of the GoO for reconstruction and preparedness, and lay the groundwork for a recovery framework. The Rapid Damage and Needs Assessment team visited the State between November 26 and December 3, 2013, to jointly discuss with the GoO for a multi-sectoral needs assessment after Cyclone Phailin.

Methodology

5. The report provides an account of physical damages with a sector-wise reporting and assessment of post cyclone recovery needs. The assessment is based primarily on the data collected and reported by the GoO till December 02, 2013. The methodology is explained in Chapter 2.

6. The joint team undertook field visits in some areas of the affected districts to witness the damages and understand the data collection methodology of the state government. The sectors that were covered in the Rapid Damage and Needs Assessment (RDNA) included: Housing; Public Building; Roads; Urban and Rural Infrastructure; Agriculture and Livestock; Livelihood (Fisheries, MSME, Handicraft& Handloom); Energy/Power; and Forest and Plantations.

7. It is to be noted that the data on damages varies in scope and coverage as individual sectors reflect either data from the most affected districts and/or the whole state based on the availability of data.

Overview of Recovery Assessment

8. The human casualties were relatively low as compared with the Super Cyclone of October 1999, but the impact on the lives of coastal residents was still massive. In the Ganjam District of Odisha alone, about 90,000 houses were partially or fully damaged along the coastal areas. About 1,292,967 hectares of agriculture, horticulture and perennial crops have sustained more than a 50% loss due to the cyclonic storm and floods. The cyclone and floods affected 44,806 fishermen households, and 1,564 artisans.

9. The overview of the Damage and Needs Assessment is provided in Table 1

Table 1: Preliminary Estimation of Reconstruction Cost

Sectors	Cost (INR million)	Cost (US\$ million)
Housing	29,600	480
Public Buildings	6,620	110
Roads	7000	110
Urban and Rural Infrastructure	4700	80
Agriculture, Horticulture, Irrigation and Livestock	26,500	430
Livelihood (Fisheries, MSME and others)	3,960	65
Energy/ Power	10,480	170
Forest and Plantations	160	3
Total	89,020	1,450

Note: (i) The values have been rounded off so the totals may not match; (ii) Currency rate 1US\$ =INR 62.

10. The RDNA estimates the total damages and loss caused by Cyclone Phailin at about **INR 89,020 million (equivalent US\$ 1,450 million)**. The bulk of the reconstruction costs are in Housing (33%), Agriculture and Livestock (30%). Chapter 3 provides a detailed sector-wise description of the damage and needs assessment.

11. **Recovery Needs:** Chapter 4 of this report discusses several factors that need to be taken into consideration to inform the design of a comprehensive reconstruction and recovery strategy which would assist the State to ‘build back better’. Below are a few key

findings that further informs the GoO's recovery and reconstruction strategy:

- Housing (both *Pucca* and *Kutcha*) has incurred severe damages due to the disaster. An appropriate housing reconstruction policy will need to be prepared and adopted to clearly identify criteria for eligibility, required relocation, and an approach for reconstruction.
- In urban areas, upgrading informal settlements with access roads which connect to city roads and adequate storm water drainage system are essential for both evacuation and safety of the community.
- Energy infrastructure is vulnerable to high velocity winds during a cyclonic event and future resilience can be improved by using underground cabling as part of the reconstruction plan of both the Power and Telecommunication networks.
- The assessment highlights a significant social impact – particularly for those whose livelihood depends on agriculture and fisheries. Recovery efforts need to focus on those communities.
- Together with the WB, additional areas have been identified in Chapter 5 to enhance the disaster risk management operations in Odisha, which includes: investing in risk mitigating infrastructure (i.e., resilient housing, additional cyclone shelters, strengthening embankments and power infrastructure), planned urban infrastructure, risk knowledge management and improving forest resources.

1. Introduction

1.1 Vulnerability to Natural Disasters

1. The State of Odisha is vulnerable to multiple natural hazards. Due to its sub-tropical littoral location, the state is prone to various hydro-meteorological hazards such as tropical cyclones, storm surges and tsunamis. The state has a 480 km long coastline with a significantly high population density in the coastal areas as compared to the interior regions². Odisha's population stands at 41 million as per the 2011 census and a large portion of this population are located on the plains of its river systems. The rivers in these areas contain heavy alluvial deposits of silt that substantially reduces the carrying capacity resulting in frequent floods that at times is compounded by breach of embankments.

2. India's east coast is one of the six most cyclone prone areas in the world. Although the coastline of Odisha is only about 17% of the Indian east coast, it has been affected by nearly 35% of all cyclonic and severe cyclonic storms that have crossed the east coast and associated storm surges that have often inundated large tracts of coastal districts³. On an average, about five to six tropical cyclones form in the Bay of Bengal every year, of which two to three are within the mild to severe range. Taking together the storms and severe storms, coastal Odisha is about twice as vulnerable as compared to the other eastern states. The Figure 1 shows the cyclone zones for the state of Odisha.

3. The State has two cyclone seasons, the first during the pre-monsoon period (April – May) and the second during the post-monsoon period (September - November). In October 1999 the cyclone that hit Odisha was classified as a 'Super Cyclone' due to its severity and left the state virtually paralyzed due to the destruction to its infrastructure and communication systems. The cyclone severely affected around 18 million people in 14 districts and left about 10,000 people dead.

4. After the 1999 super cyclone, the state government has taken measures like the installation of modern communication systems, construction of cyclone shelters, and other improved infrastructure including *pucca*⁴ houses for the poor in the cyclone prone areas to reduce the physical vulnerability of the coastal districts to cyclonic winds and tidal surges. However, with the increase in population in the coastal areas, and depletion of mangroves and shelter belts, the state continues to be vulnerable to cyclones.

5. In addition, while a large part of the state comes under Earthquake Risk Zone-II (Low Damage Risk Zone), the Brahmani Mahanadi graben and their deltaic areas come

² As per 2011 census the Population density is 269 persons per sq. km. While in 2001, the population density was 236 persons per sq. km and the population density in coastal Districts was 410 per sq km.

³ State Disaster Management Plan, Odisha, August 2013, GoO, OSDMA

⁴ Houses made with Reinforced Cement Concrete (RCC) structure with RCC roofs or with brick/laterite masonry with RCC roofs.

under Earthquake Risk Zone-III (Moderate Damage Risk Zone) and this covers 43 out of the 103 Urban Local Bodies in the state. Furthermore, the state is also vulnerable to flash floods and landslides.

Figure 1: Wind and Cyclone Zones of Odisha



Source: OSDMA 2013

1.2 The Disaster: Cyclone Phailin

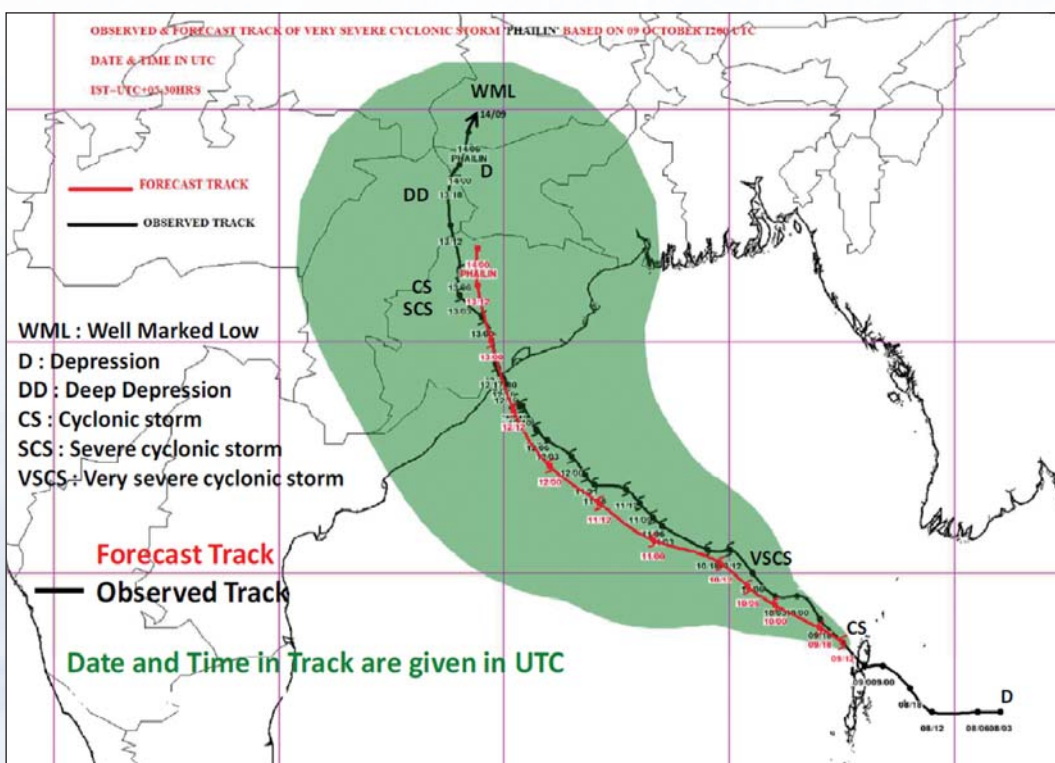
6. The Very Severe Cyclonic Storm (VSCS) Phailin⁵ originated from a remnant cyclonic circulation from the South China Sea. The cyclonic circulation lay as a low pressure area over the Tenasserim coast on October 6, 2013. It subsequently moved over to the north Andaman Sea as a well-marked low pressure area on October 7. It concentrated into a depression over the same region on October 8 moving west-northwest wards, and then intensified into a deep depression on the morning of October 9 and further into a cyclonic storm (CS), 'Phailin' in the evening of the same day. Moving northwest wards, it further intensified into a severe cyclonic storm (SCS) in the morning of October 10 and into a VSCS in the forenoon of the same day over east central Bay of Bengal.

7. The VSCS Phailin crossed Odisha and the adjoining north Andhra Pradesh coast near Gopalpur (Odisha) around 2230 hours IST on October 12, 2013 with a sustained maximum surface wind speed of 200-210 kmph gusting up to 220 kmph. It caused very heavy rainfall over Odisha leading to floods and strong gale winds causing large scale structural damage and storm surges triggering widespread coastal inundation over Odisha.

⁵ Very Severe Cyclonic Storm, PHAILIN over the Bay of Bengal (08-14 October 2013) : A Report by India Meteorological Department

The maximum rainfall occurred over the northeast sector of the system centre at the time of landfall. A maximum 24 hour cumulative rainfall of 38 cm has been reported over Banki in Cuttack district of Odisha. Based on the post-cyclone survey report, a maximum storm surge of 3.5 meters above the astronomical tide has been estimated in the low lying areas of Ganjam district of Odisha in association with the cyclone and the in-land inundation of saline water extended upto about one kilometer from the coast.

Figure 2: Tracking of Cyclone 'Phailin'⁶



Source: IMD

8. The damages caused by the cyclone were due to the very high wind velocity, torrential rains and subsequent flooding that affected eighteen out of the thirty districts in Odisha. The cyclone left 44 people dead, damaged 256,633 homes and affected 13 million lives. Though the human casualties were relatively low as compared with the Super Cyclone of October 1999, about 1,292,967 hectares of agriculture, horticulture and perennial crops have sustained more than a 50% loss due to the cyclonic storm and floods. The cyclone and floods affected 44,806 fishermen households, and 1,564 artisan households.

9. The Ganjam district was the most affected. The cumulative amount of rainfall during this spell was as high as 241.1 mm in the district and about 2,812 villages have been affected. Public and private properties, agricultural crops and horticultural plantations

⁶ IMD Forecast tracking (in red) as issued on October 9, 2013, with observed tracking (in black) of VSCS Phailin during October 8-14, 2013.

have all suffered severe damage. All surface communication systems, telecommunication, power supply and water supply lines were totally disrupted⁷.

10. Following the cyclone, due to heavy rainfall, Baitarani, Budhabalanga, Rusikulya, Subarnarekha and Jalaka rivers witnessed floods/ flash floods affecting the downstream areas of mainly Mayurbhanj, Balasore, Bhadrak, Keonjhar, Jajpur and Ganjam districts.

1.3 State Government Response

11. The GoO was proactive and well prepared to deal with the impending cyclone. In addition to the updates from IMD, the path, intensity and magnitude of the cyclone were continuously tracked at OSDMA and a range of preparatory activities were launched to face the cyclone with a zero casualty approach.

12. Prior to landfall, the OSDMA conducted mock drills at all the cyclone shelters and also checked and replaced equipment's available at many of these shelters. Cyclone and Flood Shelter Management and Maintenance Committees were activated in order to facilitate the evacuation of vulnerable populations. All 14 cyclone prone districts were provided with satellite phones for communication in case of failure in telecommunication lines. In addition, the state government ensured that 4,197 free kitchen centers were opened from October 11 onwards that covered more than 2 million affected people. In addition 185 medical teams and 338 medical relief centers were also opened. As the event was unfolding during the Indian festive season of '*Dussehra*' all government employee holidays were cancelled and all field offices were kept open. About 30 nodal NGOs were also engaged in various vulnerable blocks of the coastal and flood prone districts.

13. To ensure zero casualties, the GoO ordered all people living in low lying areas and *kutch*a houses or tin roof houses within 0-10 km of the coastline to be evacuated to nearby cyclone shelters or other identified safe buildings. Similar steps were undertaken to shift the livestock to safer places. Over 1 million people were evacuated within 36 hours preceding the landfall of Cyclone Phailin, which is one of the largest emergency evacuations carried out in a record timeframe. These efforts were made in close collaboration with the Odisha Disaster Rapid Action Force (ODRAF), National Disaster Response Force (NDRF), Central Reserve Police Force (CRPF), Odisha State Armed Police (OSAP) and the Indian Air Force (IAF).

14. Cyclone Phailin and the floods that followed after heavy rainfall caused extensive devastation in the affected districts, uprooting vast number of trees, damaging roads, public buildings and disrupting telecommunications and power. Due to the effective prepositioning of men, machinery and materials, and the able coordination among State, National and Local agencies, the restoration of connectivity was carried out in an impressive manner. Major roads were cleared within 24 hours. About 5.7 MT of dry food were airdropped by IAF helicopters to inaccessible areas. Over 0.5 million families were provided with temporary shelter and elaborate arrangements were made for safe drinking water and power supply. Medical teams and sanitation kits were also deployed to all affected areas.

⁷ Very Severe Cyclonic Storm, PHAILIN over the Bay of Bengal (08-14 October 2013) : A Report by India Meteorological Department

2. Process and Methodology of the Assessment

1. This RDNA report is a joint collaborative effort of the GoO, the WB and the ADB in response to a request from the Government of India (GoI). The objective of the exercise is to undertake a rapid assessment of the damage and needs after Cyclone Phailin and the subsequent floods, and lay the groundwork for a recovery and reconstruction framework with assistance from the WB and ADB.

2.1 Assessment Process

2. A Joint team led by the DEA to support the State Government of Odisha, with representation from NDMA, the WB and ADB, visited Odisha on November 13, 2013. Subsequently, a request from GoI was received on November 18, 2013 by the WB and ADB to field a post-cyclone damage and needs assessment mission in Odisha. The joint mission team in partnership with GoO visited the state between November 26 and December 03, 2013, in order to produce a rapid multi-sectoral assessment of the damages and needs. The field visits were confined to three majorly affected districts of Ganjam, Khordha and Puri.

3. The RDNA team was briefed by the GoO on November 26, 2013 where the scope of the assessment was agreed upon with the GoO. A wrap up session was held on December 03, where the mission team shared the assessment findings with the GoO. The mission team then debriefed the DEA in New Delhi. During the assessment mission, meetings were held with the Chief Secretary, Additional Chief Secretary, Finance; Additional Chief Secretary (Revenue) & the Managing Director, OSDMA; Development Commissioner; Secretaries and senior officials of line departments and the District Magistrates of the three most affected districts – Ganjam, Puri and Khordha. Table 2 shows the schedule of activities.

Table 2: Assessment Time Frame

Time Period	Activity
November 13	DEA led mission to support GoO
November 18	Request received from DEA for Post-Cyclone Rapid Damage and Needs Assessment
November 26	Kick-off meeting with the GoO
November 27-29	Sector-wise data collection and field visits with line agencies
November 30 - December 03	Preparation of draft assessment report and filling up gaps
December 03	Wrap-up presentation of report to GoO
December 05-09	Report finalization
December 10	Final report sharing

4. Data collection and aggregation templates for damage and needs assessment were distributed to the sector teams who customized these templates to the specific context and as per data availability. The team conducted detailed interviews with sectoral counterparts from the respective line departments of the three most affected districts to understand their data collection methodologies and to fill any gaps that may exist.



Sector teams also conducted field visits to understand the extent and type of damages. This report primarily relies on the data collected by the district officials of GoO and collated at the state level. A sector-by-sector analysis of the damage was undertaken, utilizing specific templates for information recording and gathering in order to ensure consistency of information. *A currency conversion rate of US\$ 1 = INR 62 has been used.*

5. A stakeholder consultation was organized by OSDMA on December 02 with NGOs, UN agencies, academic institutions and government officials to discuss probable assistance and inform early recovery plans.

2.2 Assessment Scope

6. This assessment covers the damage caused by the cyclone of October 12 and the associated floods that occurred during October 21 to 26. While heavy rainfall and flooding affected almost all districts within the state, the heavy winds from the cyclone most directly affected three districts which sustained the bulk of the damages, namely Ganjam, Khordha and Puri. The following sectors are covered in the assessment: i) Housing; ii) Public Buildings; iii) Roads; iv) Urban and Rural Infrastructure; v) Agriculture and Livestock; vi) Livelihood (Fisheries, MSME, Handicraft and Handloom); vii) Energy/Power; and viii) Forest and Plantations.

2.3 Assessment Methodology

7. The main focus of this assessment report is to estimate the physical damages and the corresponding needs for recovery including the loss of livelihoods. It provides a preliminary estimate of the extent of damages and total cost of corresponding recovery and reconstruction needs. The reconstruction needs are computed and expressed as the financing requirement for restoring damages with a “build back smarter” factor for quality improvements and risk mitigation, where possible.

8. Teams visited the three most severely affected districts during November 27 to 29, 2013. The RDNA team’s estimation of the damages neither supersedes nor disregards the

assessments of damage and needs made by other entities. It presents a consolidated view, on the basis of relevant information received and the expertise of a multi-institutional and interdisciplinary assessment team.

2.4 Limitations and Caveats

9. The assessment is intended to quantify the consequences of the disaster, and to provide a first attempt at identifying immediate and longer term recovery needs. The team's analysis is based on discussions with the state government, short field visits and relies primarily on the assessments carried out by the GoO and data available at the time of the mission. It must be noted that the data on damages may vary in scope as the various sectors reflect either data from the most affected districts and /or the whole state, as per data availability.

10. The final recovery needs would be contingent upon future policy decisions by GoO that may include aspects of overall vulnerability reduction and increasing resilience of the communities.

11. The draft report was discussed and presented to GoO on December 03, 2013.

3. Damage and Needs Assessment

1. This chapter provides a sector-wise damage and needs assessment.

3.1 Housing

2. Cyclone Phailin that crossed coastal Odisha on November 12, 2013 caused major damages to coastal infrastructure, particularly to *kutcha* and semi-*pucca* houses due to high speed winds and associated rainfall. The State of Odisha has about 83% of its population in rural areas and the predominant building typologies in the disaster affected areas include (i) *kutcha* structures (i.e. semi-permanent houses of wattle and daub⁸ construction with thatched roofs or asbestos sheets); and (ii) *pucca* structures (i.e. houses made with Reinforced Cement Concrete (RCC) structure with RCC roofs or with brick/laterite masonry with RCC roofs).

3. Fully and severely damaged structures are those where both the walls and roofs are damaged and are not habitable while partially damaged structures are those where either a small portion of the roof or the wall is damaged and can be repaired.

4. Based on the information provided by the GoO about 256,600 units were damaged in the rural areas. In addition there were losses of personal and productive assets. Those however have not been quantified due to a lack of relevant available data at the time of this report. A snapshot of the damages is given in the following Table 3.



⁸Wattle and daub is a composite building material used for making walls, in which a woven lattice of wooden strips called wattle is daubed with a sticky material usually made of some combination of wet soil, clay, sand, animal dung and straw. “The Building Conservation Directory, 2001”

Table 3: Damages to Housing

Districts	Building Typology	Number of Units		
		Total	Partially Damaged	Fully/Severely Damaged
Ganjam	<i>Pucca</i>		75,936	2,288
	<i>Kutcha</i>			11,380
	Total	89,604	75,936	13,668
Khordha	<i>Pucca</i>		53,906	13
	<i>Kutcha</i>			3,542
	Total	57,461	53,906	3,555
Puri	<i>Pucca</i>		9,832	0
	<i>Kutcha</i>			2,888
	Total	12,720	9,832	2,888
Other districts	<i>Pucca</i>		58,963	426
	<i>Kutcha</i>			37,459
	Total	96,848	58,963	37,885
Grand Total		256,633	198,637	57,996

Note:

- The data for the three districts – Ganjam, Khordha and Puri are as per the revised data received from OSDMA while the other districts are derived from the Memorandum prepared by the Revenue and Disaster Management Department, Government of Odisha.
- In order to derive the data for the other districts from the Memorandum prepared by the Revenue and Disaster Management Department, Government of Odisha, based on the ratio of the initial and the revised data of the three districts, the following assumptions were made: i) fully damaged *Pucca* houses in other districts were taken as zero; ii) the numbers were reduced by 40% in the same proportion as between the revised and preliminary data for the three districts.
- Enumeration for Partially damaged houses include both *Pucca* and *Kutcha* houses
- Huts are included in the *Kutcha* houses

Reconstruction Needs

5. The discussions with the GoO and site visits to a few severely affected districts (Ganjam, Puri and Khordha) helped ascertain the scale of damage, area requirements and unit cost of construction and repairs. Table 4 below indicates the estimated reconstruction/repair cost for the damaged houses.



Table 4: Reconstruction Cost for Damaged Houses

Districts	No. of Units	INR Million	US\$ Million
Ganjam	89,604	6,864.48	110.72
Khordha	57,461	3,151.64	50.83
Puri	12,720	1,201.92	19.39
Other districts	96,848	12,966.32	209.13
Total	256,633	24,184.36	390.07

Note:

- Unit cost of reconstruction is taken as INR. 0.28 million (about US\$ 4,500).
- Cost estimate for partially damaged houses have been calculated taking the weighted average of construction cost of *Pucca* and *Kutcha* houses with following assumptions; i) Construction cost of *Kutcha* houses are taken as INR 70,000 and the repair cost for partially damaged *Kutcha* houses as 50% of the cost; ii) Construction cost of *Pucca* houses are calculated as INR 280,000 and the repair cost for partially damaged *Pucca* houses as 20% of the cost; iii) The weighted average is taken by taking 75% of the houses as *Kutcha* and 25% as *Pucca* resulting in an average repair cost of INR 40,000.

6. The total cost for providing basic services and relocation has also been worked out and amounts to INR 5,417 million (US\$ 87 million) provided as per Table 5 below:

Table 5: Cost for Providing Basic Services and Land Acquisition

Districts	Cost of Housing in INR M	Cost of Basic Services in INR M	Land in Acres	Cost of land acquisition in INR M	Total in INR M	Total in US\$ M
Ganjam	6,864.48	1,372.90	114	136.68	1,509.58	24.35
Khordha	3,151.64	630.33	30	35.55	665.88	10.74
Puri	1,201.92	240.38	24	28.88	269.26	4.34
Other districts	12,966.32	2,593.26	316	378.85	2,972.11	47.94
Total	24,184.36	4,836.87	484	579.96	5,416.83	87.37

Note:

- The cost of basic services is taken @ 20% of the reconstruction cost.
- The number of houses in need of relocation is taken as 50% of the total numbers of houses fully/severely for both *Pucca* and *Kutcha* houses.
- It is assumed that a maximum of 60 units of houses can be built in 1 acre of land including the basic services.
- The cost of land is assumed @ INR 1,200,000 per acre.

7. The total cost for reconstruction of houses including providing basic services and relocation has been worked out and amounts to INR 29,601 million (US\$ 477 million) provided in Table 6 below:



Table 6: Cost of Reconstruction, Providing Basic Services and Land Acquisition

Districts	Cost of Housing in INR M	Cost of Basic Services in INR M	Cost of land acquisition in INR M	Total in INR M	Total in US\$ M
Ganjam	6,864.48	1,372.90	136.68	8,374.06	135.07
Khordha	3,151.64	630.33	35.55	3,817.52	61.57
Puri	1,201.92	240.38	28.88	1,471.18	23.73
Other Districts	12,966.32	2,593.26	378.85	15,938.43	257.07
Total	24,184.36	4,836.87	579.96	29,601.19	477.44

3.2 Public Buildings

8. This section outlines the damages to public buildings (including residential buildings) in education, health, and government service sectors. The extent of the damages to buildings varies, with relatively more severe impacts in the districts of Ganjam and Puri. The main type of damage is to asbestos sheet roofs, followed by windows, doors, and cracked walls and boundary walls. The damages have led to the disruption of the routine functioning of these facilities. It is important to note the key role played by public buildings during the disaster given that many were used as evacuation shelters during the cyclone which also led to damages to equipment (furniture, teaching and learning material in schools).

9. The information was provided by Rural Works (Rural Development Department), Sarva Shiksha Abhiyan (Department of School and Mass Education), District Rural Development Agency (Panchayati Raj Department), Urban Local Bodies (Department of Housing and Urban Development), and OSDMA. The public buildings covered were from the departments of Higher Education, Health, Animal & Health Veterinary, Rural Development, Revenue, School and Mass Education, Panchayati Raj, Housing and Urban Development, Industries, Agriculture, Finance, Home, Law, Commerce and Transport, Tourism, Co-operation, State Archaeology, and others. Whenever information was not available, the data was calculated on the bases of the overall damage percentage that affected each district as per GoO's Memorandum.

10. As per the information obtained a total of about 12,811 public buildings were damaged, of which 12,296 correspond to non-residential and 515 to residential buildings respectively, with primary schools being the most affected. The damages to public buildings are given in Tables 7 and 8 below.



Table 7: Damages to Non-Residential Buildings

Type of Buildings	Ganjam	Puri	Khordha	Other Districts	Total
Primary Schools	1,059	226	312	4,228	5,825
High Schools and Higher Education	330	82	46	262	720
Health Centers and Hospitals	155	13	26	345	539
Other ⁹ Government Buildings	207	47	34	4,924	5,212
Total	1,751	368	418	9,759	12,296

Table 8: Damages to Residential Buildings

Type of Buildings	Ganjam	Puri	Khordha	Other Districts	Total
High Schools and Higher Education	7	6	1	2	16
Health Centers and Hospitals	152	30	15	134	331
Other Buildings	77	10	8	73	168
Total	236	46	24	209	515

Reconstruction Needs

11. The cost estimates are based on data provided by the GoO for the restoration of damaged structures as well as some estimates for equipment losses, which are still being collected and reported. The assessment includes an additional 20%: 10% each to account for furniture and other equipment; and as the cost for additional complexities on top of the estimate provided by the GoO.

12. Total reconstruction needs for public buildings amount to about INR 6,444.15 million (US\$103.94 million). The detail of the number of units damaged and the cost of reconstruction are provided in Tables 9 and 10 below.



⁹Anganwadis, Panchayat office buildings, Post office, Fire department buildings, Government offices; Revenue Inspectors Office, Work sheds, storage sheds, Gram Panchayat Office, Block office, Public parks, Town halls, Bus stand, Marriage halls, Markets, Public toilets others

Table 9: Estimated cost for Non-Residential Building

Districts		Primary Schools	High Schools and Higher Education	Health Centers and Hospitals	Others	Total
Ganjam	Numbers	1,059	330	155	207	1,751
	INR million	450.62	300.25	64.82	123.82	939.51
	US\$ million	7.27	4.84	1.05	2.00	15.16
Puri	Numbers	226	82	13	47	368
	INR million	96.17	74.61	5.44	28.11	204.33
	US\$ million	1.55	1.20	0.09	0.45	3.29
Khordha	Numbers	312	46	26	34	418
	INR million	110.63	34.88	10.87	16.95	173.33
	US\$ million	1.78	0.56	0.18	0.27	2.79
Other Districts	Numbers	4,228	262	345	4,924	9,759
	INR million	1,799.06	238.27	144.28	2,945.37	5,126.98
	US\$ million	29.02	3.84	2.33	47.51	82.70
Total	Numbers	5,825	720	539	5,212	12,296
	INR million	2,456.48	648.01	225.41	3,117.25	6,444.15
	US\$ million	39.62	10.45	3.65	50.23	103.94

Table 10: Estimated Cost for Residential Buildings

Districts		High Schools and Higher Education	Health Centers and Hospitals	Others	Total
Ganjam	Numbers	7	152	77	236
	INR million	1.94	51.24	27.18	80.36
	US\$ million	0.03	0.83	0.44	1.30
Puri	Numbers	6	30	10	46
	INR million	1.66	10.11	3.53	15.30
	US\$ million	0.03	0.16	0.06	0.25
Khordha	Numbers	1	15	8	24
	INR million	0.19	5.14	2.73	8.06
	US\$ million	0.00	0.08	0.04	0.12
Other Districts	Numbers	2	134	73	209
	INR million	0.43	45.28	25.86	71.57
	US\$ million	0.01	0.73	0.42	1.15
Total	Numbers	16	331	168	515
	INR million	4.22	111.77	59.30	175.29
	US\$ million	0.07	1.80	0.96	2.82

3.3 Damage to Heritage Monuments

13. Odisha has a rich cultural heritage with 218 monuments protected by the State Archaeological Department and 78 monuments and sites protected by Archaeological Survey of India¹⁰. Apart from these, large numbers of monuments (more than 3,000) are unprotected and were found in a dilapidated condition. The coastal areas of the State are also dotted with large numbers of standing monuments in a poor state of preservation.

Table 11: Damage to Heritage Monuments¹¹

S. No.	Monuments	District	Block	Nature of Damage
1	Jagannath Temple, Penthath	Khordha	Rajnagar	Crack developed on the connecting structure of the old kitchen room and temple which is not conserved so far
2	Bhabakundaleswar Temple, Manikpatna	Puri	Krushnaprasad	There is no structural damage, but branches of the banyan tree has been broken which has fallen on the scaffolding structure
3	British Cemetery	Ganjam	Ganjam	30 feet length of existing compound wall is fully damaged which has not been conserved so far
4	Bateswar Temple, Kantiagarh	Ganjam	Kantiagarh	Sand deposited on the excavated work site about 162.00 cum
5	Ganjam Fort	Ganjam	Ganjam	15 feet length of existing dilapidated brick masonry wall of the ruined palace is fully damaged which has not been conserved so far and 111 feet length of the wall of the ruined palace is partially disturbed from its original position due to velocity of cyclone Phailin and the rains.

Reconstruction Needs

14. In the case of heritage monuments the estimates as provided by the report of the Nodal Officer Culture, Integrated Coastal Zone Management Project (ICZMP) has been used. The estimates consider basic repair and restoration and are very preliminary. The exact details of restoration/preservation works is still being worked out and would require more technical assessment.

Table 12: Estimated Cost for Heritage Monuments

S. No	Monuments	INR	US\$
1	Jagannath Temple, Penthath	10,000	161
2	Bhabakundaleswar Temple, Manikpatna	20,000	323
3	British Cemetry	50,000	806
4	Bateswar Temple, Kantiagarh	20,000	323
5	Ganjam Fort	400,000	6,452
Total		500,000	8,065

¹⁰ Archaeological Survey of India.

¹¹ Cyclone damage report of the Monuments of 12-10-2013 and 13-10-2013 under ICZMP, Odisha, Bhubaneswar was prepared by Nodal Officer Culture, Integrated Coastal Zone Management Project (ICZMP).

3.4 Roads

15. The major effect of the cyclone and floods on the roads was damage to the embankments, road shoulders and the pavement caused by rain cuts and inundation. Another immediate effect was road blockage due to the falling of trees caused by high wind speeds. The Departments of Works, Rural Development, Panchayati Raj and Housing and Urban Development took immediate steps for cutting the fallen trees and clearing the roads to restore connectivity. JCB's and other heavy earth moving equipment were used to clear the roads. The Police, ODRAF, NDRF, and Fire Service units along with other inter-departments coordinated the clearing and most of the roads up to the Block level were cleared within 2 days.



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16. The extent of damage and reconstruction needs is based on the Cyclone Damage Report (CDR) and Flood Damage Report (FDR) prepared by the Roads & Buildings department and a consolidated summary of district-wise damage provided by the Rural Works department. The disaggregated damage assessment and reconstruction needs by type of roads such as State Highways (SH), Major District Roads (MDR), Other District Roads (ODR), and village/rural roads (including PMGSY) has not been presented due to lack of complete data at the time of this report. The State government estimates are preliminary in nature and would require additional field surveys and investigations for a realistic and engineering assessment. Moreover, while the reconstruction needs mentioned below is essentially to restore the road network to a pre-disaster condition, additional financing for 'building back smarter' would be necessary to build a disaster-resistant road network in the State.

Table 13: Damages to Roads

Districts	Roads & Buildings Department			Rural Works Department		
	Roads (Km)	No. of Breaches	No. of CD	Roads (Km)	No. of Breaches	No. of CD
Ganjam	321.40	77	94	2,450	112	106
Khordha	116.74	2	81	211	14	3
Puri	46.88	9	24	600	5	6
Other Districts	1,451.34	88	573	4,838	169	135
Total	1,936.36	176	772	8,099	300	250

Table 14: Estimated Cost for Reconstruction

Districts	Roads and Buildings Department	Rural Works Department	Total (INR M)
Ganjam	326.99	837.70	1,164.69
Khordha	45.40	451.60	497.00
Puri	123.00	352.00	475.00
Other Districts	2,009.78	2,861.40	4,871.18
State Total (INR M)	2,505.17	4,502.70	7,007.87
State Total (USD M)	40.41	72.62	113.03

17. As Odisha is susceptible to frequent cyclones, the restoration works need to incorporate disaster resilient design features such as raising embankments, wherever necessary, and incorporation of adequate protection and river training work. This is particularly important as roads and bridges also serve as a lifeline to the villages and communities during cyclones and disasters.

3.5 Urban and Rural Infrastructure (Water Supply, Roads, Drains and Sewerage)

18. Odisha is one of the least urbanized states in India. As per the 2011 census 6.99 million people, or 17% of the total state population, live in urban areas. The last decade has however seen a growth of almost 25% in terms of the urban population, higher than the national average. There are 103 Urban Local Bodies (ULBs) including 3 Municipal Corporations of Bhubaneswar, Cuttack



and Berhampur, 37 Municipalities, 63 Notified Area Councils and 2 census towns. Almost 55% of the urban population lives in the capital Bhubaneswar and the two cities of Cuttack and Berhampur. Many of the cities and towns in Odisha are popular tourist destinations because of the large number of temples. They are also hubs of educational institutions.

Recovery Needs

19. The Urban water supply has been affected in Berhampur town located in Ganjam district. After emergency interventions, the drinking water supply has been restored but

the replacement of the pumping/gravity mains of 23 km length is required as medium and long-term interventions. The urban water supply in the other six affected towns in the three districts has been brought to normal supply levels after interventions by respective government organizations.

20. Besides damaging the water supply network, the floods have also washed away or destroyed about 245 km of urban roads (in 7 ULBs in the three districts) and 66.6 km of roadside drains. Damage has occurred to other categories of roads on account of the bituminous top and metal layer getting washed off and disturbance to the top crust of Water Bound Macadam (WBM) Roads. Concrete roads have seen less damage than others. Roads have also been damaged due to the uprooting of nearby trees causing disturbance to the road base and drain walls, etc. However, the impact of the damages to urban roads and road side drains are not significant and have not disrupted the regular traffic. The district-wise break up of damages is given in the Table 15 below:

Table 15: Summary of Damage to Urban infrastructure

Districts/ affected towns	Roads (in km)	Drains (in km)	Street Lights (Nos)	Water Supply Sources	Water Supply Pipes (km)	Sanitation/ Solid Waste
Ganjam	82.90	57.20	250	3	32.50	0
Berhampur	69.65	53.30	0	1	23.00	0
Chetrapur	6.12	2.50	250	1	7.00	0
Ganjam	7.13	1.40	0	1	2.50	0
Puri	95.20	3.60	0	2	0	0
Puri Municipality	78.60	3.60	0	1	0	0
Konark NAC	16.60	0	0	1	0	0
Khordha	67.00	5.80	0	2	0	0
Balugaon	50.00	2.80	0	1	0	0
Banpur	17.00	3.00	0	1	0	0
Others Districts	0	0	0	37	0	0
Total	245.10	66.60	250	44	32.50	0

Note: Based on data received from Ganjam, Puri and Khordha as on December 2, 2013

Reconstruction Needs

21. While estimating the need for the rehabilitation of the water supply component of individual towns, the following basic service standards have been considered, keeping the network coverage the same. While estimating the need for road reconstruction, most of the ULBs have proposed concrete roads to avoid future damage from rains and flooding. Culverts have been damaged in some areas, the replacement cost of which is estimated to be INR 3.4 million or about US\$ 55,000.

Table 16: Summary of Preliminary Estimation of Damage to Urban Infrastructure

Districts	Water Supply		Urban Roads and Drains			Sewerage/ Sanitation/ Street Lighting		Total	
	No. of Affected Towns	Damage (INR M)	No. of Affected Towns	Reconstruction cost (INR M)		No of Schemes	Damage (INR M)	Reconstruction Costs	
				Road	Drains			INR M	US\$ M
Ganjam	3	404.27	3	520.68	484.25	1	6.6	1,415.80	22.84
Berhampur	1	237.8	1	487.55	463.75	0	0		
Chetrapur	1	96.4	1	15.30	15.9	0	6.6		
Ganjam	1	70.07	1	17.83	4.60	0	0		
Puri	2	4.05	2	274.47	32.4	0	0	310.92	5.01
Puri Municipality	1	3.76	1	232.97	32.4	0	0		
Konark NAC	1	0.29	1	41.50	0	0	0		
Khordha	2	0.64	2	170.00	22.40	0	0	193.04	3.11
Balugaon	1	0.28	1	127.50	12.40	0	0		
Banpur	1	0.36	1	42.50	10.00	0	0		
Others Districts	37	18.19	0	0	0	0	0	18.19	0.29
Total	44	427.15	7	965.15	539.05	1	6.6	1,937.95	31.25

Assumptions: *Per capita water supply need assumed as 70 lpcd for ULB upto population of 10,000; 100 lpcd for population between 10,000 to 50,000 and 135 lpcd for population above 50,000.

**Cost for 6 meter wide concrete road is INR 7000/m and for 3 meter wide concrete road is INR 2500/m.

3.5.1 Rural Water Supply and Sanitation

22. Ensuring safe drinking water is a major challenge in Odisha as the coastal areas are subjected to frequent cyclones and floods due to heavy rains, and ground water quality is affected by the increase of salinity, fluoride and iron contamination. In the state 35 million people are living in rural habitations and are being provided drinking water, fully or partially by the Rural Water Supply Department under the Ministry of Rural Development. 20% of the habitations are covered by piped water supply systems and 50% by hand pumps/bore wells.

23. The recent Phailin cyclone followed by heavy rains causing floods have severely affected the existing rural infrastructure crippling access to basic services, particularly water and sanitation in 18,374 habitations located in 18 districts. A total of 3,040 piped water supply systems and 162,170 tube/bore wells were damaged. Providing safe drinking water still remains a major challenge in some of the affected areas which can be addressed if the long-term interventions are initiated.

Table 17: District-wise status and impact of damaged Rural Water Supply Schemes

Districts	Total no. of existing schemes	Estimated cost of damages INR M	No. of damaged schemes			Affected habitation/population/ Households		
			Fully	Partially	Total	Habitation	Population	Household
Ganjam	971	2,000	648	323	971	1,060	500,000	120,000
Puri	243	213	235	8	243	3,222	700,369	133,493
Khordha	350	204	122	228	350	4,507	1,103,000	228,000
Other Districts	1,476	343	506	970	1,476	6,040	1,409,500	262,200
Total	3,040	2,760	1,511	1,529	3,040	14,829	3,712,869	743,693

24. Rural drinking water systems around the Chilika lagoon, comprising of revenue villages from three districts, Ganjam, Puri and Khordha, were the worst effected. Around 2,500 RWSS and 140,000 tube-wells were damaged/submerged due to the consequent floods. The quality of groundwater is the major concern due to the rise in fluoride and salinity levels to 3.64 mg/l and 2500 mg/l respectively.

25. The Rural Water Supply Department restored water supply in the groundwater affected rural areas after the cyclone, but the quality of water being supplied is a major concern. As a risk mitigation measure, four multi-village Rural Water Supply Schemes are proposed to serve around 279 villages in Ganjam and Puri.

Table 18: Reconstruction Cost for Rural Water Supply and Sanitation

Districts	Multi-village Rural Water Supply System		Sanitation		Hand Pumps		Total (Water Supply and Sanitation)	
	INR M	US\$ M	INR M	US\$ M	INR M	US\$ M	INR M	US\$ M
Ganjam	1,000.00	16.13	0	0	0	0	1,000.00	16.13
Puri	1,762.50	28.43	0	0	0	0	1,762.50	28.43
Khordha	0	0	0	0	0	0	0	0
Other districts	0	0	0	0	0	0	0	0
Total	2,762.50	44.56	0	0	0	0	2,762.50	44.56

3.6 Agriculture and Livestock

26. In Odisha the agriculture and animal husbandry sectors contribute about 15% of the State Gross Domestic Product. More than 70% of the state population is dependent on these sectors. Of the total geographical area of 15.57 million hectares (mha), the total cultivated area is about 6.2 million ha (40%) and about 35% of the cultivated land is irrigated. The majority of farmers are small and marginal having limited purchasing power and low literacy. Paddy and pulses are major crops covering 50% and 25% of the cultivated area respectively and the rest of the cultivated area is covered by other crops i.e. cereals (6%), oil seeds (10%), fibers (1.5%), sugarcane (0.5%) and others (7%). Odisha generally has a surplus of rice and cereals and is deficient in pulses and oil seeds.

27. The very severe cyclonic storm “Phailin” on October 12, followed by torrential rains caused severe crop damage due to the submergence of crop fields. Reservoirs for different irrigation projects also released excess water at the same time to accommodate incoming floods that led to the prolonged submergence of the



affected areas. The districts of Ganjam, Puri, Khordha, Gajapati, Balasore and Mayurbhanj were badly affected. Crops were also affected in Nayagarh, Cuttack, Jajpur, Kendrapada, Jagatsinghpur and Bhadrak districts to a significant extent.

Damage Assessment

28. As per the assessment completed by the Department of Agriculture, the total crop area affected by the cyclone and floods in the State was estimated at 1.3 mha out of a total area of 6.11 mha under the kharif crop, of which 0.78 mha has sustained more than 50% loss. The damage to the agriculture sector is mainly due to loss of standing crops from prolonged submergence and damage to agriculture infrastructure. In the three most severely affected districts of Ganjam, Puri and Khordha, the total crop area affected was reported to be 0.59 mha.

Table 19: Agriculture Lands Affected

Districts	Total Crop Coverage Area (ha)	Total Affected Crop Area (ha)	Total Area where Crop Loss is more than 50% (ha)			
			Rain fed	Irrigated	Perennial	Total
Ganjam	408,541	376,026	92,546	142,935	8,029	243,510
Puri	160,712	141,271	47,290	46,030	890	94,210
Khordha	123,518	75,301	39,025	17,244	175	56,444
Other Districts	3,567,281	700,369	333,615	52,807	2,403	388,825
Total	4,260,052	1,292,967	512,476	259,016	11,497	782,989

Source: Department of Agriculture.

Recovery Needs

29. Based on the reports, total damages in direct losses in the three most affected districts were estimated at INR 10,215.48 million (US\$ 164.77 million). According to estimates, the main damage is due to prolonged submergence of land, which lasted upto 10 days in

Ganjam. While detailed assessments are in progress, the state government has initiated provisions for relief to the affected farmers.

Table 20: District wise Estimated Loss to Agriculture Sector

Districts	Estimated Loss to Crop		Loss to Infrastructure		Total	
	INR M	US\$ M	INR M	US\$ M	INR M	US\$ M
Ganjam	6,680.29	107.75	52.5	0.85	6,732.79	108.59
Puri	2,345.06	37.82	0	0.00	2,345.06	37.82
Khordha	1,137.63	18.35	0	0.00	1,137.63	18.35
Other Districts	7,622.55	122.94	0	0.00	7,622.55	122.94
Total	17,785.53	286.86	52.5	0.85	17,838.03	287.71

3.6.1 Horticulture

30. The agro-climatic diversity in the state is suitable for growing a variety of horticultural crops: (i) perennial fruit crops like mango, litchi, guava, oranges and limes; (ii) annual fruit crops like banana, pineapple and papaya; (iii) spices like ginger, turmeric and chilli; and (iv) a variety of roots and tubers and a wide range of vegetables. In Ganjam district the major horticultural crops grown are cashew, mango, coconut, banana, kewda¹², floriculture, spices, and vegetable crops like tomato, cole (or stem and cabbage) crops, brinjal, greens, okra, cucumber, and different type of gourds.

Table 21: Horticulture Crop Production Details 2010-11

S.No.	Type of Crop	Area (1000 Ha)	Production (1000 MT)	Remarks
1	Coconut	51.0	190.0	
2	Dry fruit	149.0	91.0	Cashew nut
3	Fresh Fruit	320.7	2,048.3	Mango, Guava, Citrus, Litchi, Sapota, Banana, Papaya, Pineapple, Pomegranate, others
4	Vegetables	553.8	7,790.1	
5	Spices	124.0	174.7	
6	Floricultural crops	7.4	3.7 and 5,911 lakh cut flower	Rose, Gladioli, Tube rose and Marigold
Total		1,205.9		

Source: Indian Horticulture Database 2011, National Horticulture Board.

Damage Assessment

31. The disaster has caused widespread devastation to this sector; fruit and vegetable cultivations have been severely affected. An estimated area of about 43,400 ha under horticulture has been affected.

¹² Kewda is also known as screw pine, or pandanus.

Table 22: Horticulture Crop Area Damaged

Districts	Type of Crop	Area Affected (ha)	Remarks
Ganjam	Perennial Fruits	8,157	Coconut
	Vegetable	24,489	
	Kewda	734	
	Floriculture	245	
	Betel vine	528	
	Sub-total	34,153	
Puri	Perennial	1,340	Coconut, Palm
	Non-perennial	840	Banana, Papaya
	Vegetables	2,990	
	Sub-total	5,170	
Khordha	Perennial	175	Coconut
	Non-perennial	46	Banana, Papaya
	Vegetables	3,814	
	Sub-total	4,035	
	Total	43,358	

Source: Department of Agriculture.

Recovery Needs

32. The overall crop loss is estimated to be as high as INR 1,555 million (US\$ 25.1 million). In addition to the crop losses, the disaster caused damages to the horticulture department's infrastructure including nurseries and buildings - the estimated damages are about INR 4 million (US\$ 0.06 million).

Table 23: Estimated Loss of Horticultural Crop in Three Districts

Districts	Damage to Crop		Damage to Infrastructure		Total Damage	
	INR million	US\$ million	INR million	US\$ million	INR million	US\$ million
Ganjam	1,260.7	20.33	0.97	0.016	1,261.67	20.350
Puri	136.0	2.19	1.18	0.019	137.18	2.213
Khordha	158.6	2.56	1.41	0.023	160.01	2.581
Total	1,555.3	25.09	3.56	0.06	1,558.86	25.14

3.6.2 Irrigation Infrastructure

33. The Department of Water Resources (DoWR) in Odisha is involved in the construction, operation and maintenance of major, medium, minor and lift irrigation schemes and the construction and maintenance of river and saline embankments, flood management works, river training works, drainage channels, and deep tube wells. To support irrigation, DoWR

has constructed a storage capacity of 1.77 billion cubic meters (BCM) through 2,385 irrigation projects¹³. A net irrigation potential of about 3.1 mha has been created out of a total potential of 4.99 mha through major, medium and minor (flow and lift) irrigation projects. The State has completed 84 major and 6,902 minor lift irrigation projects under Biju Krushak Vikash Yojna during 2001-2012.

34. The total flood prone area of the state has been assessed as 33,400 sq.kms. About 302 km of the 480 km of Odisha's coastline is rated as medium risk with tidal ranges of 3 m to 3.5m. 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 mha suffers from drainage congestion and water logging and 6,317 km of drains have been completed to improve the drainage condition of the area.¹⁴

Damage Assessment

35. The cyclone and floods caused extensive damage to about 1,088 km of canals, 8,152 minor irrigation projects, 4,848 minor lift irrigation projects (affecting a command of about 0.27 mha out of a total command of 1.37 mha) 1,071 km of river/saline embankments, 744 km of drainage channels, 641 deep bore wells and 399 departmental buildings.

36. DoWR is in the process of restoring the irrigation network and breached sections of embankments with temporary measures such as stacking of sand bags. In order to provide irrigation during this rabi season a priority action is the restoration of power supply and replacement of damaged pumps and pipelines of affected minor lift irrigation projects.



¹³ 7 major, 38 medium and 2340 minor irrigation projects. Major projects have culturable command area (CCA) more than 10000 ha while CCA for medium project is between 2000-10000 ha and minor less than 2000 ha.

¹⁴ Annual Report 2011-12, Department of Water Resources.

Table 24: Details of the Damage to Irrigation Infrastructure

Name of Work	Total No. of Works	Breaches/ Damaged No.	Total Length (Km)	Damaged Length (Km)	Total Command Area (ha)	Affected Command Area (ha)
Canals	1,437	744	5,915.00	1,088.00	4,30,083	1,39,554
Minor Irrigation Schemes	1,716	8,152	-	-	5,94,723	25,819
Minor Lift Irrigation Schemes	15,238	4,848	-	-	3,44,076	1,03,884
River / Saline embankments	2,130	709	7,138.00	1,071.24	-	-
Drains	7,84	214	6,317.00	744.00	-	-
No. of Tube Wells	26,819	641	-	-	-	-
No. of Buildings	6,715	399	-	-	-	-

Source: Department of Water Resources, Odisha.

Recovery Needs

37. The total estimated cost of rehabilitation/strengthening of damaged irrigation infrastructure in the six districts of Ganjam, Puri, Khordha, Kendrapada, Jagatsinghpur and Baleshwar is INR 4,774 million (US\$77 million). The rehabilitation cost for Ganjam district alone, which is the most severely affected, is estimated at INR 2,408 million (US\$ 38.8 million). In the irrigation subsector, all damaged schemes and infrastructure were identified as public investments. During the upcoming season, the flood protection structures and diversion bunds should be rehabilitated on a priority basis to avert further losses and damage.

Table 25: Estimated Damage to Irrigation Infrastructure

Districts	Estimated Needs	
	INR Million	US\$ Million
Ganjam	2,408.48	38.85
Puri	357.10	5.76
Khordha	249.09	4.02
Kendrapara	278.25	4.49
Jagatsinghpur	225.72	3.64
Balasore	1,255.69	20.25
Other Districts	2,053.69	33.12
Total	6,828.02	110.13

Source: Department of Water Resources, Odisha.

3.6.3 Livestock

38. Odisha is endowed with a large population of livestock and accommodates nearly 5% of the total bovine stock of India. The animal husbandry sector contributes more than 30% to the net state domestic product to agriculture. The rearing of livestock is one of

the important economic activities in the rural areas and is an integral part of the farming system in the state. Farmers are dependent on livestock for milk, meat, eggs, manure etc. Home based animal husbandry units are a major support system for a majority of the rural poor who are either landless or are small and marginal farmers with un-irrigated land. Generally stock holdings are small and often made up of a mix of several species.

Damage Assessment

39. The Cyclone has caused a significant impact on the livestock in Odisha impacting the food security of the affected households. The total number of livestock that are affected in the thirteen districts due to the cyclone and floods are reported as 7.02 million which is about 16.7% of the total livestock population of the state¹⁵. The reported number of livestock deaths in the three most severely affected districts include 1,425 large animals (cow/buffalo), 2,906 small animals (goats/sheeps) and about 156,000 poultry. The production losses associated with the livestock damage are significant and have not been estimated here as they depend on the time taken to restore the infrastructure and provide new animals and required inputs to the farmers.



Table 26: Number of Livestock Affected and Dead

Districts	Livestock Affected			Livestock Dead		
	Large (Cow/ Buffalo Bullocks)	Small (Goat, Sheep)	Poultry	Large (Cow/ Buffalo Bullocks)	Small (Goat, Sheep)	Poultry
Ganjam	632,000	253,500	1,110,000	1,059	2,645	155,779
Puri	341,185	159,367	4,775	339	240	0
Khurda	46,327	11,702	30	27	21	0
Other districts	2,283,416	1,063,992	1,118,554	410	1,903	17,095
Total for state	3,302,928	1,488,561	2,233,359	1,835	4,809	172,874

Source: Department of Fisheries and Animal Resources Development

Recovery Needs

40. The estimated livestock cost in the three most severely affected districts is about INR 138.2 million (US\$ 2.23 million).

¹⁵ Total estimated livestock population as per 2011 census in 41.94 million as per Annual Activity Report 2012-13, Department of Fisheries and Animal Resources Department, Government of Odisha.

Table 27: Estimated Loss of Livestock (Large, Small and Poultry)

Districts	Estimated Loss Livestock		Estimated Loss Infrastructure		Total	
	INR M	US\$ M	INR M	US\$ M	INR M	US\$ M
Ganjam	54.45	0.88	59.1	0.95	113.55	1.83
Puri	6.24	0.10	10	0.16	16.24	0.26
Khordha	0.88	0.01	1.5	0.02	2.38	0.04
Other districts	13.82	0.22	128.2	2.07	142.02	2.29
Total	75.39	1.22	198.8	3.21	274.19	4.42

Source: Based on information received from Director, Animal Resources Department and estimates.

Note: Average cost for large animal, small animal and poultry taken as INR 17,000, INR 2,000 and INR 200 respectively.

41. The government took immediate measures to dispose of carcasses, formed 260 teams to provide medicines and vaccines to animals wherever necessary, organized animal camps, and distributed cattle feed.

Table 28: Summary Table of Estimated Cost for Four Sectors

Districts	Agriculture		Horticulture		Livestock		Irrigation		Total	
	INR M	US\$ M	INR M	US\$ M	INR M	US\$ M	INR M	US\$ M	INR M	US\$ M
Ganjam	6,732.79	108.59	1,261.67	20.35	113.55	1.83	2,408.48	38.85	10,516.49	169.62
Puri	2,345.06	37.82	137.18	2.21	16.24	0.26	357.10	5.76	2,855.58	46.06
Khordha	1,137.63	18.35	160.01	2.58	2.38	0.04	249.09	4.02	1,549.11	24.99
Other Districts	7,622.54	122.94	0	0	142.02	2.29	3,813.35	61.51	11,577.91	186.74
Total	17,838.02	287.71	1,558.86	25.14	274.19	4.42	6,828.02	110.13	26,499.08	427.40

3.7 Livelihoods

42. Odisha's economy mainly relies on the Agriculture and Fisheries sectors. According to the Fishery Survey of India (FSI) the Fisheries potential of Odisha is 0.5 million MT. About 2.95% population (1 million people) depends upon fisheries for their livelihood. Of them, 0.7 million people depend on inland fisheries and 0.3 million on marine fisheries.

43. The cyclone and ensuing floods have had a catastrophic impact on the livelihood of the people in these areas, especially in the costal districts of Ganjam, Puri and Khordha, where more than half of all the damages in the state took place. Although the data is still being compiled, the livelihoods of an estimated 46,871 HH (households) in the subsectors of Fisheries, Handloom, and Handicraft have been severely affected, as well as people working in 1,309 damaged Micro, Small & Medium Enterprises (MSMEs). The estimated damage is summarized in the Table 29.

Table 29: Summarized Damages to Livelihood in Ganjam, Khordha and Puri

Sector	Damages	Financial losses	Livelihoods affected
Fisheries	8,423 Boats and 33,398 nets lost/damaged; 5,742 Ha of inland water bodies damaged	INR 3,783 million (US\$61 million)	44,806 HH
Handicrafts	763 Work-shed damaged (including raw materials and finished products)	INR 41.24 million (US\$0.67 million)	1,564 HH
Handloom	471 Work-sheds damaged; 365 equipment's damaged; 706 raw material and finished products lost	INR 5 million (US\$0.08 million)	501 HH
MSME	1,039 Units damaged (including buildings, raw material and finished products)	INR 135 million (US\$2.18 million)	Livelihoods of people working in 1,039 units

44. The most affected subsector is Fisheries which affects a total number of 44,806 fishermen HH. This was followed by losses incurred in the Handicraft or Artisan community (1,564 HH), livelihoods of people working in 1,039 MSME units, and 501 HH from weaving communities. The loss of livelihood has resulted in an increase in migration to other States, taking loans from money lenders (that charge around 10% p.m. interest) and pawning of family assets.

45. The following sections describe the damages, and immediate steps planned by the State government in each of the above subsectors.

3.7.1 Fisheries

46. Fisheries resources of Odisha comprise of marine, inland and the Chilika lagoon. Apart from these, there are several man-made reservoirs covering an area of more than 20,000 ha. The estimated annual fish production in Odisha for 2012-13(p) was around 410,144 MT, and the estimated exports for 2011-12 was INR 7,927.6 million (US\$127.74 million).



Damages

47. Due to the disaster, the fisheries activities (inland, lagoon and marine) in Ganjam, Puri and Khordha districts have been severely affected. As of November 29, 2013, an estimated total of 8,423 boats (including catamarans), 33,398 nets and 5,742 ha of inland fish tanks have been fully or partially damaged in the three districts. Due to the disaster, the tanks and the inland fish farms were contaminated and the fish escaped as the water table increased. As per field discussions with officers and community members, losses are estimated at INR 0.3

million per ha. Although data is still being compiled, the few fishermen that have resumed activities are currently fishing in the Chilika lagoon and estimate a 10% drop in catch.

Table 30: Damage to Fisheries¹⁶

		Ganjam	Puri	Khordha	Total	
Marine	Number of Fishermen Affected	1,839	9,098	-	10,937	
	Boats	Partially	43	488	-	531
		Fully	488	2,410	-	2,898
	Nets	Partially	42	984	-	1,026
		Fully	1,797	5,216	-	7,013
Chilika	Number of Fishermen affected	6,470	7,964	14,831	29,265	
	Boats	Partially	408	355	469	1,232
		Fully	417	1,065	24	1,506
	Nets	Partially	-	-	-	-
		Fully	5,645	5,920	9,872	21,437
Inland	Number of Fishermen Affected	3,777	274	553	4,604	
	Boats	Partially	502	69	-	571
		Fully	172	205	-	377
	Nets	Partially	1,019	397	-	1,416
		Fully	1,201	1,305	-	2,506
	Tanks affected (No)		993	7,331	1,428	9,752
	Ponds damaged (Ha)		1,324	3,865	553	5,742
	Seeds (No)		878	22	2,765,000	2,765,900
	Fingelings damaged (No)		805	22	2,765,000	2,765,827
Total Loses	INR million	1,171.00	2,139.00	463.00	6,047.00*	
	US\$ million	18.89	34.50	7.47	97.53*	

* The amount of total losses includes estimates for the rest of the State at INR 2,274 million (US\$36 million).

48. The damage for boats, nets and inland fish tanks in the three districts has been estimated at INR 3,783 million (US\$61 million). The total losses for this sector are estimated at INR 6,047 million (US\$97.53 million).

3.7.2 Non-farm Sector: Handloom, Handicraft and Small and Micro Enterprises

49. The non-farm sector (including handlooms and handicrafts) play a crucial role in Odisha's economy. Artisans from the three most affected districts are engaged in activities such as stone carving, pottery, brass and bell metal work, bamboo craft, etc. In addition, the MSME includes those engaged in agro based activities, metal products, ready-made garments and embroidery, paper products, agarbatti manufacturing, etc.

¹⁶ Marine Fisheries- the value taken for Boats Partial (INR 75,000) Fully (INR 150,000), Net Partial (INR 20,000) Fully (INR 40,000).; Inland Fisheries - for Boats Partial (INR 20,000) Fully (INR 40,000), Net Partial (INR 15,000) Fully (INR 40,000); BT (Bakegaon) Chilika - for Boats Partial (INR 20,000) Fully (INR 40,000), Net Partial (INR 40,000).

Table 31: Damage sustained by Handloom and Handicraft Sector

		Ganjam	Puri	Khordha	Total
No of Artisans affected		804	722*	38	1,564
Work shed damage		743	4*	16	763
Handicraft loses	INR million	35	5*	2	42
	US\$ million	0.56	0.08*	0.03	0.67
No of Weavers affected		358	12	131	501
Work shed damage	Partially	83	-	3	86
	Fully	275	10	100	385
No of looms affected		25	-	10	35
Accessories damaged		318	3	9	330
Raw and finished product damaged		642	9	55	706
Handloom loses	INR million	4.30	0.06	0.64	5.00
	US\$ million	0.07	0.00	0.01	0.08

* Cluster level data

Handicrafts

50. Many of the artisans lost their work-sheds, equipment, raw materials and finished products. Although the damage to these enterprises is still being assessed, it is estimated that around 1,564 HH have been adversely affected. Infrastructure losses are mostly confined to the three most affected districts where an estimated 763 units have been severely damaged. The livelihood impacts have been accentuated because the disaster came during the peak sale period for the artisans (Dussehra/Diwali festival) and they have lost heavily during the period (stocks of raw materials and finished products).

Damages

51. As far as damage is concerned, it is estimated that the 1,564 artisan HH have incurred a loss of INR 42 million (US\$0.67 million). This includes a total loss of INR 20 million of losses due to damage to artisan work-sheds. The district wise estimated loss is given in Table 31.

Handloom

52. The Handloom Industry in Odisha is the largest cottage Industry providing employment and sustenance to 4% of the population in the State. There are about 0.1 million looms in the state, of which 88,186



have been brought under the cooperative fold and developmental activities are mostly being undertaken in this organized sector under the directorate of Textiles.

Damages

53. As in the case of the Handloom sub-sector, the majority of the damages were recorded in Ganjam district, where about 358 weavers HH were affected out of a total of 501 HH in all the three most affected districts combined.

54. Many of the losses incurred were to work-sheds; 471 were either fully or partially damaged. The total estimated loss incurred by the weaver community in the three most affected districts is INR 5 million (US\$0.08 million), details of the losses is in Table 31.

Micro, Small and Medium Enterprises (MSME)

55. The MSMEs contribute significantly to value addition, employment generation, exports and the overall growth and development of the economy. In Odisha itself MSME units are the biggest employment generators after agriculture.

Table 32: Estimated Recovery Cost of MSME

Districts	No. of Unit Affected	No. of Building Damaged (INR M)	No. of Plant & Machine Damaged (INR M)	No. of Raw Material Damaged (INR M)	Finished products (INR M)	Total Loss (INR M)	Total Loss (US\$ M)
Ganjam	917	34.27	25.16	37.18	20.45	117	1.89
Puri	117	7.20	1.60	6.00	0	14.8	0.24
Khordha	5	0.50	2.00	0.40	0.30	3.2	0.05
Total	1,039	41.97	28.76	43.58	20.75	135	2.18

56. A total of 1,039 units were affected by the recent cyclone and ensuing floods in the three most affected districts. The total loss incurred in this subsector is estimated at INR 135 million (US\$2.18 million).

3.8 Power Infrastructure

57. Upon enactment of the Odisha Electricity Reform Act the GoO privatized the business of distribution and 51% of the equity share in three Distribution Companies of WESCO, NESCO and SOUTHCO was divested to Reliance Infrastructure (the erstwhile BSES). Odisha Power Transmission Corporation Limited (OPTCL) was incorporated to carry on the business of transmission as the State Transmission Utility (STU) and the State Load Dispatch Center (SLDC) functions of GRIDCO.

58. The Average Demand of the State is about 2,600 MW and generation installed capacity of the state is 6,500 MW, out of which 2,084 MW consists of hydro power. There is also Captive Generating Plants (CGP) capacity of 5,327 MW. The peak demand touches

to 3,511 MW which is met out of available generation capacity. 22% of the generation comes from hydro power generating stations which are used for peaking load requirements, while base load requirements are met out of the available thermal plants.

Damages Assessment

59. Assessment of cost for restoration of damaged T&D Infrastructure for Odisha State is presented in Table 33 below:



Table 33: Estimated Recovery Cost of Power

S. No.	Item	Unit	Damaged Assets - quantity	Cost (US\$ M)	Cost (INR M)
A	Transmission				
1	Transmission Lines 132kV and above	KM	124.45	17.5	1,082
2	Power Transformer	No.	1	0.8	50
3	Others(S/s Damaged)	Nos.	25	9.4	585
	Sub-total Transmission			27.7	1,717
B	Distribution				
1	Distribution lines 33kv	KM	991.93	12.7	786
2	Distribution lines 11kv	KM	5,146.1	32.7	2,032
3	Distribution lines (Low Voltage)	KM	10,179.84	60.4	3,745
4	Power Transformers	Nos.	143	9.0	557
5	Distribution Transformers	Nos.	5,638	21.6	1,343
6	Others		421	4.8	299
	Sub- total Distribution			141.3	8,761
C	Total Distribution & Transmission			169	10,478

Note: The cost estimates are based on present replacement cost of the existing systems subject to changes based on DPR for all the 12 affected districts of the State.

Recovery Needs

60. The cyclone and following severe flooding have caused extensive damage to the electrical transmission and distribution networks in Ganjam. The damage in Ganjam alone is US\$87 million out of a total estimated damage of US\$169 million and the key towns of Berhampur, Chetrapur and Gopalpur were affected significantly.

61. Based on the experience from Cyclone Phailin and taking into account past experience, phase 1 of the proposed recovery/reconstruction may cover the key towns of Berhampur, Chetrapur and Gopalpur by constructing about 200 kms of 33 kV lines, 1,400 km of 11 kV lines and substations and Ring Main Unit at appropriate places as per the system requirement with the objective to quickly restore power supply.



Table 34: Estimated Recovery Needs for Ganjam District

S. No.	Category	Amount (INR M)	Amount (US\$ M)
1	Transmission Disaster Resilient Infrastructure	2,250	36.3
2	Distribution Disaster Resilient Infrastructure	5,250	84.5
Total		7,500	120.8

62. The preliminary estimates for the three towns of Ganjam district; i.e. Berhampur, Chetrapur and Gopalpur amount to US\$ 120 million and will need to be detailed further.

3.9 Forest and Plantations

63. Cyclone Phailinca used extensive damage to natural resources: (i) damages to natural forests, commercial, community, and shelter belt plantations; (ii) a range of impacts on economic activities such as Non Timber Forest Products (NTFP) and tourism; and (iii) forest and silvi-cultural management infrastructure including forest nurseries. There was no reported loss of wildlife, while there has been considerable disturbance to wildlife habitats and the impact can only be ascertained in the medium to long term.

64. While the effective planning and remedial actions require accurate information, this mission focused on rapid damage assessment based on the data provided by the State Forest Department. The salient points of the rapid assessment for forests and biodiversity are presented below.

65. Ganjam, Khordha, and Puri districts' forest resources are severely affected. There has been estimated damage of 8-10% due to tree falls and loss of vegetation, mainly in the areas covered with forest plantations. More than the loss of vegetation, the main cause for concern is the crown damages which would take a long time for recovery and also affect the overall health of the forest. Table 35 below presents a summary of the district-wise affected forest areas:

Table 35: Damage to Reserve Forest and Plantations

District	Reserve Forest		Protected Areas		Plantations		Avenue Trees
	Total Area (Sq.Km.)	Affected Area (Sq.Km.)	Total Area (Sq.Km.)	Affected Area (Sq.Km.)	Total Area (Sq.Km.)	Affected Area (Sq.Km.)	
Ganjam	464.1	12.0	0	0	21.0	3.5	15,400 lost out of 48,450
Khordha	343.4	9.1 ¹⁷	0	0	15.8	4.3	NA
Puri	Information not available						

66. **Central Forest Nurseries:** 10 out of the 12 Central Forest Nurseries in all the three most affected districts are either fully or partially damaged. The estimated cost of restoration of these nurseries is about INR 40 million.

67. **Damaged trees:** The fallen trees are currently salvaged by the respective DFOs for recovering the timber. However, the biomass debris generated due to crown damages are yet to be cleared in most of the areas due to a lack of sufficient resources to deploy clean up gangs. In case of protected areas, such activities are currently being followed up in line with the forest conservation act which has limited provisions for clearing of dead trees or bio-mass debris. Delays in this regard could pose a potential risk of forest fires which in turn could lead to loss of habitats.

68. **Forest:** There has been considerable damage to forest related infrastructure including: (a) Complete & partial damage to the existing buildings; (b) Damage to forest road & culverts/causeway etc.; (c) Damages to Electric fence to prevent man/elephant conflicts; and (d) Damage to Communication systems like VHF network. While detailed assessment of damage in terms of restoration cost is being prepared, the rough estimate for restoration, prepared by the forest department for the three affected districts – Ganjam, Khordha, and Puri is INR 70 million.

3.10 Socially Vulnerable Sections: Cyclone Impacts and Recovery Needs

69. A large part of the affected population belongs to the scheduled caste and include fisher-folk and dalits also who are socially and economically vulnerable. Their houses and livelihoods have been severely damaged by the cyclone, though loss of life was averted due to timely evacuations. Experience suggests that disaster events accentuate pre-event vulnerabilities of the disadvantaged families and individuals exposing them to higher risks of impoverishment and social marginalization. Understanding the social dimensions of the cyclone impact therefore will be critical to developing a socially inclusive and environmentally sustainable recovery and risk reduction framework.

¹⁷ Total number of trees affected are 41,405

70. **Women:** The loss of shelter and livelihoods has disproportionately affected women in vulnerable categories: the old and the infirm, destitute and single women, women responsible for managing their families, daily labourers, and dalit women with restricted livelihood options. Factors such as poor living conditions, loss of shelter, low skill levels, limited access to credit and



markets, physical isolation and social exclusion account for higher levels of deprivation among dalit women affected by Phailin. House damages, absence of sanitation facilities, difficulties with fetching water, and uncertain incomes put enormous burdens on women as they struggle to reset their homes. The loss of shelter has compromised their privacy and security needs in the affected villages. Exposure to survival risks has raised concerns regarding threats to their personal safety and dignity including trafficking in some areas.

71. Several income activities including Take Home Ration (THR) units, Kewda plantations, etc. initiated by women groups under Mission Shakti have suffered damage. The government has declared a month's additional pension under the Madhubabu Pension Scheme for older women and has additionally provided a half a quintal of rice and 500 rupees immediate relief aid. The Department of Women and Child Development (DWCD) is aware of the post disaster risks facing women and is monitoring the situation to identify and address women's protection needs.

72. **Children:** The damage caused to shelter, schools and the loss of study materials have disrupted children's learning process. The cyclone and consequent floods damaged 7,324 schools and 1949 *Aanganvadi* Centers. Even as the government provided immediate relief aid, the nutritional needs of children are far from being met. The government has taken steps to provide the affected people with physical disabilities with aids and appliances. While many children may be able to cope with temporary disorientation, any form of trauma affecting their learning and development needs remains to be assessed. The damages suffered by the children's observation homes have been assessed and will need to be addressed.

73. **Urban Poor:** In the proliferating informal settlements with narrow pathways in Odisha's coastal cities, people live in small huts and semi-*pucca* structures without tenure security and with minimal access to basic services. Many of the 261 slums in Berhampur were damaged, with some slums submerged for days due to flooding. These poor slum inhabitants, mostly migrants, who settled in the city years back in search of employment, continue to live in vulnerable physical environments and are exposed to future calamity risks.

74. **Marginalized Livelihood Groups:** While a vast majority of those losing their shelters and livelihoods belonged to the scheduled caste, people rendered most vulnerable are dalits, wage laborers, and share croppers. The exact number of dalit/harijan habitations ravaged by the cyclone needs to be enumerated. The share croppers and land less labourers suffered loss of livelihood, but were not able to benefit from crop damage compensation provided only to the title holders.

75. **Social Capital:** The cyclone brought the communities together and has given rise to new aspirations in view of the government's effective emergency response activities. This aspirational solidarity amongst the affected people could manifest in the form of resistance and conflict in the absence of measures to utilize their cooperation for engineering a collaborative reconstruction, risk-reduction process.

4. Summary of Post-Cyclone Recovery Needs

1. This chapter summarizes RDNA team's preliminary findings for recovery needs after the cyclone and floods. These needs are based on the lessons learnt from historical experiences of 'building back smarter' that inform the design of a comprehensive recovery framework in Odisha. The framework would set the groundwork as a way forward to improve the resilience of state infrastructure and its communities for future natural disasters.
2. Table 36 below summarizes the key needs with details specified in the relevant sectors.

Table 36: Sector-wise Overview of Recovery Needs

HOUSING
<ul style="list-style-type: none">• The medium term needs include reconstruction of damaged houses in-situ and rehabilitation of a few villages which fall under the 500 m buffer zone of the CRZ to suitable locations. Reconstruction activities will need to incorporate multi hazard resistant features.• Suitable lands for relocation will need to be identified keeping the vulnerability, community preferences, and legal framework of coastal regulation zone.• Participatory planning for the cluster and housing design and options for reconstruction mechanism of houses such as: government led, by owners or group approach will need to be worked out and community preferences obtained for decision making.• Efforts will need to be made to expeditiously reconstruct the houses.• An appropriate housing reconstruction policy will need to be prepared and adopted to clearly identify the eligibilities, relocation requirement, approach for reconstruction and land acquisition etc.• While a part of the generated debris might be useful in reconstruction, a major part will need to be removed and safely deposited at identified sites.
PUBLIC BUILDINGS
<ul style="list-style-type: none">• The immediate recovery needs include the creation of temporary setups for schools and bringing the health facilities back into a functioning status.• Medium term needs include the reconstruction of damaged infrastructure. Since public buildings will continue to play a vital role of serving as evacuation shelters during times of emergencies, ongoing rebuilding and future building programs should integrate disaster resilient features and should be designed as multipurpose buildings. A protocol should be established that assures that all equipment is properly stacked and covered so as to create space and remain protected during the emergency phase.• Thought needs to be given to three key building details; Asbestos sheet roofing, doors and windows and boundary walls. Design and construction details need to be improved to assure better performance during extreme events.

HERITAGE BUILDINGS

- Detailed and thorough post disaster damage analysis or study needs to be undertaken systematically of heritage monuments especially in the coastal areas. Specialist Government, private and non-government agencies should be involved in this task.
- The nature of repairs for these heritage building can be time consuming, nevertheless emergency repairs and protective arrangements need to be developed.

ROADS

- To complete where necessary, the temporary restoration of the roads.
- Undertake permanent repair and restoration of the roads and bridges.
- In order to create sustainable road and bridge infrastructure, raise embankments, wherever required and incorporate adequate protection and river training works.

URBAN INFRASTRUCTURE

- Each ULBs should have a drainage master plan and storm water drains in the urban areas to be constructed accordingly with due diligence of disposal systems blockage/choking issues.
- The waste disposal sites should be located at a place which will not be washed away by storm water drainage over/excess flows.
- Power supply at water supply pumping stations and installations should be provided with back-up generator sets to run the systems in the absence of power due to cyclones.
- For vulnerable slums, provision of access roads which connect to city roads is essential for evacuation and relief when and if required. These roads and communities should be developed with adequate storm water drainage which connects to the city wide drainage system.

RURAL INFRASTRUCTURE

- The Ministry of Rural Development/Rural Water supply department need to form village groups to manage all the piped rural water supply schemes (village level operation and maintenance including billing and revenue collection).
- The Water Quality Monitoring need to be organised, the ground water sources with excessive Floride, Iron, Chlorides should be notified visibly and messages like “Not Fit for Drinking to be displayed” as soon as the adverse findings are reported.
- The Departments need to encourage the use of solar power to all the small pumps being operated in the rural habitation to overcome the drinking water supply problem in the absence of grid power.

AGRICULTURE

- Restoration of damaged irrigation facilities, restoration of power to minor lift irrigation schemes.
- Supply of adequate agricultural inputs to the affected farmers, vaccination of remaining affected animals to prevent spread of any disease.
- Provide extension services to affected farmers for providing technical input on agronomic practices, arrangement for distribution of adequate cattle feed.
- Provide resilient infrastructure to protect from flooding and tidal storm surges.

LIVELIHOODS

Robust and “out of the box” approaches are required to rebuild social capital; the focus should be on immediate support to self-help activities to develop their livelihood. These could involve:

- **Youth Employment:** Projects need to focus on providing skill development training (such as construction) for ensuring quick employability, and can be used for housing and building reconstruction. This will also go a long way in helping youth to participate in the government’s development and rehabilitation efforts.
- **Group and cluster based activities:** The cyclone and floods have affected the productive infrastructure that was supporting the livelihood activities of the communities such as handloom, handicraft and MSME. In this connection, the proposed livelihood plans outlined by the ongoing OLM, a society setup by the Government of Odisha for enhancing the socio-economic condition with presence in 30 districts, should be considered. OLM’s expertise could be used to support the commodity co-op/federations to set up their infrastructure, funding rehabilitation/setting up of critical market infrastructure and repurchase/repair damaged and lost assets. In addition, the OLM could also provide key technical assistance to these co-ops to ensure that they are vibrant and inclusive and are able to help in moving up the value chain.
- **Production:** Key priority needs to be given to help fisher folks and other persons reliant on the sector to restart their activity. Support is needed for repurchase/repair of boats and nets, land preparation, and construction/repair of inland fish farm water bodies.
- **Cash for work:** cash for work in community infrastructure needs to be initiated to help both in building the infrastructure and providing immediate support to affected communities. This will also stem the forced migration and curtail the dependence on money lenders.
- **Creation of the relief, revival and reconstruction fund:** Since Odisha is a cyclone prone state and has two cyclonic seasons, the concept of setting up a revival and reconstruction fund, separate from the CRF, needs to be explored for enabling the communities to get back on their feet.

ENERGY/ POWER

In order to ensure resilience to future disasters, the following measures can be undertaken:

- Establishment of upgraded robust T&D network which can withstand the Cyclone and flood to a reasonable extent as well as take minimum time for restoration,
- Vital / critical installations such as Water Supply, Hospitals, Railways, Airports, Bus stands, Telecommunications etc. be constructed with underground cabling with double circuit supply in a ring/ mesh mode having provision of RMU and sectionalisers, locating substations above the maximum recorded flood level,
- Trunk lines (11KV and 33KV) overhead lines must be erected with reinforced NBLS tower having capacity to withstand wind pressure of 300 kmph with a double circuit line where ever possible, and finally
- Set up for disaster response to Distribution network in each of the 3 electrical Circles. Each Disaster Management Cell (DMC) must be equipped with modern equipment.

FOREST AND PLANTATIONS

- Restoration of existing costal shelterbelts and raising of new plantations covering about 60 Km. coast line with block plantations in revenue forest land covering about 2200 Ha.
- Strengthening and establishing mangrove plantations in over 300 Ha. Covering relevant places in the coastal areas in Puri, Rajnagar, Bhadrak, and Balasore Wild Life Divisions.
- Restoration and promotion of agro forestry through central nurseries which would require investments to the tune of INR 40 million, including restoration of forest infrastructure at the cost of INR 70 million.

SOCIAL VULNERABILITY

- The state government will need to frame a housing rehabilitation policy that defines eligibility criteria, priority, and implementation modalities with community based planning and monitoring.
- While addressing house reconstruction needs of the slum households, upgrading slums with providing tenure security, better access, drainage, water, street lights and sanitation services, will have to be given priority. Upgrading slums will facilitate their sustainable integration into the urban mainstream, and reduce risks of future urban flooding.
- Providing supplementary education and sports materials for the cyclone affected children, enhancing schools and *anganwadis*, providing supplementary nutrition support, and monitoring children in difficult situations with the help of communities and child help lines will be important for securing children's learning and development needs.
- Making use of the on-going schemes such as Mission Shakti and OLM, the government will have to address the livelihood requirements of the most vulnerable groups as a priority, including the poor occupation groups that have lost their tools, work sheds, and income sources. The landless labourers, sharecroppers, crafts persons facing livelihood risks deserve special attention.
- In the light of livelihood losses suffered by the sharecroppers every time a natural calamity strikes which is difficult to compensate for within the existing frameworks for providing relief aid, technical engagement with experts and concerned stakeholders regarding land based livelihoods issues will be useful.

5. Enhancing Disaster Risk Management

The Way Forward

1. The GoO's efficient management of Cyclone Phailin and associated flooding has underscored the importance of disaster preparedness and investing in ex-ante measures for reducing vulnerability and building disaster resilient communities and institutions. The key driver of minimizing human casualty and expediting restoration of basic services and connectivity has underpinned the continuous efforts of the GoO in building capacity of its institutions and people. OSDMA, since its inception in the aftermath of Super cyclone in 1999, has invested in resilient infrastructure such as emergency shelters, trained CBOs at grassroots levels such as CSMMCs and shelter level task force members, strengthened State and District EOCs and established and supplied critical equipment to ODRAF, fire stations and emergency shelters. While these efforts have paid off in responding to the current disaster, the trail of devastation left behind also calls not only for sustainable recovery and reconstruction efforts but also to continue building the resilience of the state and its people to future disasters.

2. This chapter summarizes key areas for strengthening disaster resilience of Odisha based on the findings of the RDNA and detailed interactions with GoO and other stakeholders. The objective of this chapter is to lay the groundwork for assistance from ADB and WB and build upon existing Disaster Risk Mitigation measures.

A. Risk Mitigation Infrastructure

- i. **Resilient Housing:** Many settlements have developed on vulnerable lands that are too close to the High Tide Line (HTL) including the regulated coastal zone. These may require relocation to safer places, however not very far from the original settlements due to livelihood needs. In addition there is need for mass social housing programs to reconstruct the vulnerable houses along the coast, river and water bodies to minimize the number of *kutch*a and semi *pucca* constructions. This can be done by leveraging the ongoing schemes such as the Indira and Rajiv Awas Yojnas. Use of appropriate reconstruction approach and a supporting, facilitating and monitoring mechanism could bring about a much desired positive change and reduce vulnerabilities.
- ii. **Additional Flood and Cyclone Shelters:** Construction of additional multi-purpose emergency shelters (cyclone and flood shelters) and improved access to such shelters. This may include a broad set of measures such as investments in multipurpose emergency shelters, upgrading of existing roads and bridges suitable for evacuation, building alternate routes and constructing missing bridges, creation of corpus funds for operation and maintenance of emergency shelters, training and capacity building of communities and installation of early warning systems, etc.

- iii. **Strengthening Riverine Embankments:** To provide improved design and sufficient freeboard to make existing saline and riverine embankments more resilient to higher cyclonic storm surges and flood levels. This will protect the coastal areas of Odisha from saline water inundation to a larger extent. The embankments will also protect the area from riverine flooding, and appropriately designed and installed sluices will facilitate storm water evacuation from agriculture fields. Other benefits include the protection of agricultural and rural property from saline inundation, use of embankments as access routes, etc.
- iv. **Power:** In order to ensure resilience to future disasters, measures like (i) Establishment of upgraded robust T&D network which can withstand cyclones and floods to a reasonable extent as well as take minimum time for restoration, (ii) Vital / critical installations such as Water Supply, Hospitals, Railways, Airports, Bus stands, Telecommunications, etc. should be constructed with underground cabling with double circuit supply in a ring/mesh mode having provision of RMU and sectionalisers, (iii) locating substations above the maximum recorded flood level, (iv) Trunk lines (11KV and 33KV) overhead lines be erected with reinforced NBLS tower having capacity to withstand wind pressure of 300 kmph with a double circuit line wherever possible and finally (v) set up for disaster response to the Distribution network in each of the 3 electrical Circles. Each Disaster Management Cell (DMC) must be equipped with modern equipment.

B. Youth Engagement in Risk Mitigation

The youth in Odisha make up 42% of the State population¹⁸. Recognizing the role of the youth in the progress of the State will enable development to happen in a conscious manner. In the recovery phase after cyclone Phailin, the role of youth was commendable. Projects in risk mitigation need to keep the youth in focus by providing skill development training (such as communication techniques, masonry and others) for ensuring quick employability, and they could also be used for construction in resilient housing, public buildings, early warnings or coordinate evacuation process. This will also go a long way in helping youth to participate in the government's development and rehabilitation efforts.

C. Planned Urban Infrastructure

ULBs should have a drainage master plan, and storm water drains in the urban areas should be constructed accordingly with due diligence of blockage/choking issues in the disposal systems. The waste disposal sites should be located at a place which will not be washed away due to excess water flows from storm water drains. Also, ULBs should maintain data on flood prone areas with reference to frequency of rainfall and floods. Power supply at water supply pumping stations and installations should be provided with back-up generator sets to run the systems in the absence of power due to cyclones. In its absence, the resurgence of water will lead to pressure build-up in the pipelines causing damage. Back-up generators will also provide continuous water supply even during power outages. For vulnerable slums, provision of access roads which connect

¹⁸ Odisha State Youth Policy 2013. http://www.dsosodisha.gov.in/pdf/osyp_2013.pdf

to city roads is essential for evacuation and relief if and when required. These roads and communities should be developed with an adequate storm water drainage which connects to the city wide drainage system.

D. Knowledge Management

Given the massive scale of the recovery, reconstruction, planning and monitoring disaster-sensitive activities in Odisha, it is important to put in place a Decision Support System (DSS) for aiding the decision-makers and ensuring coordination among various stakeholders and implementing departments. Such DSS integrates and analyses vast amounts of data and displays it in user-friendly ways for consumption by various stakeholders for their decision making. Use of Geographic Information System (GIS) in the DSS helps assimilate multiple layers of spatial and statistical databases, historical and real-time, and represent them through map-based decision tools. A DSS can help in: i) tracking and reporting financial and physical progress towards achievement of the targets set, ii) enabling citizen feedback and a grievance redressal mechanism for active participation of communities in the recovery and reconstruction program (dedicated help line, social media channels and mobile apps can be considered for collecting feedback); iii) improving response planning in areas such as determining evacuation routes, locating vulnerable infrastructure and vital lifelines, and estimating the relief and response supplies, and iv) maintaining an inventory of the state's disaster preparedness and response resources. Ideally, such DSS should be web-based and make optimum use of the existing networks and facilities such as ORSAC, RRSSC-Kolkata, NICNET, POLNET, and ISRO DMS Network. It may also warrant coordinating with PWD's e-nirman portal, IBM's pro-bono project monitoring tool, and potentially serving as a one-stop system for monitoring all internally and externally financed DRM investments in Odisha.

E. Improving Forest Resources

Consultation with communities confirms the significant value of shelterbelt plantations for minimizing the impact of cyclonic winds. While casurina plantations are proven to be useful as wind breakers and firewood for the local population, the introduction of native species would further strengthen robustness and effectiveness of the plantation in the long term. Site selection for these plantations should consider the sensitivities of wildlife habitats such as nesting grounds of the olive ridley turtles. To overcome the paucity of available land the forest scrub land available with the revenue department could to be diverted for shelterbelt plantation. The benefits of a mangrove ecosystem services (such as surge protection, improving spawning grounds, biodiversity, improved fish-catch etc.) felt by the coastal communities need to be systematically documented and disseminated with supporting efforts for extending mangrove areas through plantations. Since the maintenance, management and recovery during disasters is observed to be more effective with involvement of Village Vanrakshak Samiti (VVS), it is imperative to involve VVS extensively in the process of implementing remedial actions to recover the forest and biodiversity losses. Clear role and responsibilities of the forest department, alongwith adequate equipment and training may benefit the communities located in forest blocks during the post-disaster phase.

"The response to cyclone Phailin underscores the importance of measures taken in the past for disaster preparedness, including sensitization of stakeholders and mock exercises. Every rupee spent on disaster preparedness is a saving of expenditure on post disaster relief, rehabilitation and reconstruction measures. Disaster Risk Reduction strategies therefore need to be mainstreamed into our developmental programmes and policies"

– Dr.Manmohan Singh, Hon. Prime Minister of India

"Odisha's handling of the very severe cyclone will be a landmark success story in disaster management. We are very impressed. We have plans to use it as a model for other cities and countries to follow as part of our global efforts on disaster risk reduction"

– Margareta Wahlström, United Nations Secretary General's Special Representative for Disaster Risk Reduction and Head of the UN Office for Disaster Risk Reduction (UNISDR).

"Very few human casualties and quickly setting about restoring power lines and mobile connectivity in areas that took the brunt of Phailin's gale force are manifest signs of a calibrated approach to disaster management, otherwise found wanting when large parts of Odisha were flattened by the 1999 super cyclone."

– Times of India, Oct.14, 2013.