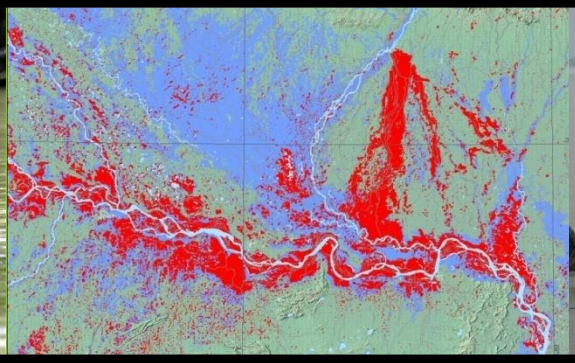
BIHAR
KOSI FLOOD (2008)
NEEDS ASSESSMENT REPORT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Prepared by

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Global Facility for Disaster Reduction & Recovery

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GFDRR
Global Facility for Disaster Reduction and Recovery

Executive Summary

On 18 August 2008, the Kosi River burst through its eastern embankment about 13 km upstream of the Kosi Barrage in Nepal, 8 km north of the Indian border. At its peak, the intensity of water force went up to 166,000 cubic feet per second (cusec) compared with the regular 25,744 cusec, running straight down south through a new course 15-20 km wide and 150 long north to south. This created major flooding in Nepal and India - Bihar in particular. According to official sources, a total of 3.3 million people were affected in Bihar alone.

The districts of Supaul, Saharsa, Madhepura, Araria and Purnia in Bihar were severely affected by the flood. A total area of close to 3700 sq. km, 30 percent of the affected areas districts, was inundated, affecting 412 Panchayats and 993 villages. Approximately 493 lives were lost and 3,500 were reported missing after the disaster.

The Government of Bihar (GoB) was extremely proactive in relief operations in the immediate aftermath of the flood. An emergency response effort was initiated by the State government with assistance from the Indian Army, Air Force, Navy, National Disaster Response Force (NDRF), as well as a number of international and national relief organizations. An extensive evacuation operation was undertaken to bring approximately 1 million evacuees to safety. The State Government set up 360 relief camps within school and college buildings and tents to house evacuees. At peak, more than 440,000 people were living in camps.

The floods impacted already vulnerable communities with low human and economic development indicators and relatively low coping capacities. Bihar's poverty rate is 42 percent compared with India's average of 28 percent. Rural poverty in Bihar was 45 percent in 2004, the second highest after Orissa. [1] The population in Bihar is perennially affected by floods - 30 of its 38 districts (73 percent of its geographical area) are flood-prone and afflicted by floods almost annually, especially from the rivers west of the Kosi. The state is the most flood-prone in the country. Bihar's hydrological vulnerability is aggravated by its flat topography, high rainfall (more than 2,500 mm annually and up to 80 percent of annual precipitation from June to September) and high sediment loads of rivers.

The Government of Bihar's institutional capacity to manage the disaster was particularly challenged with the preceding large-scale flood of 2007 followed by the Kosi floods of 2008. Furthermore, the affected districts were not exposed to inundation from the Kosi River since it's embankment in 1963. The population, as well as local and state government structures, was not fully prepared for such a level of disaster. Hence, recovery from these two consecutive 'unprecedented' disasters ha stretched public infrastructure, public services, and fiscal resources beyond limits. While GoB was extremely proactive in

[1] In India, Below Poverty Line (BPL) is an economic benchmark and poverty threshold used by the Government of India to indicate economic disadvantage and identify individuals and households in need of government assistance and aid. Criteria have been developed for rural and urban areas to measure the degree of deprivation through a host of parameters with scores given from 0-4. Families with 17 marks or less out of 52 marks are classified as BPL. The World Bank recognizes the poverty line to be per capita income under US$2 a day.

the emergency response, there has not been any significant reconstruction, and recovery needs are still enormous and beyond present capacity.

The Bank received a request for reconstruction assistance in December 2009. A mission to the affected areas in April 2010 concurred with the GoB that a comprehensive assistance program was urgent. Reconstruction and recovery activities have been significantly delayed due to insufficient funding. Already vulnerable populations are stretched to the limits to cope with the aftermath of the disaster. The Bank immediately initiated the preparation of an emergency recovery project, beginning with a Needs Assessment.

The objective of the Needs Assessment is: (i) to guide the design and investment prioritization of the proposed Kosi Flood Recovery project; (ii) provide a damage overview in key sectors including water resources and flood management, roads and bridges, housing, agriculture, social, environmental, and health; (iii) to identify current recovery initiatives and progress made; and, (iv) to identify short, medium, and long-term needs and priority interventions. The Needs Assessment was undertaken by a World Bank/GFDRR team in close cooperation with GoB.

Methodology and Limitations

A three-pronged methodology was employed to complete information gathering in the Needs Assessment: (i) obtaining government damage data from the relevant government departments; (ii) review of reports on damage and recovery needs from GoB and other sources; and, (iii) limited cross-verification of the centrally obtained data through focused sample surveys, field visits, and the aggregation of the needs in the relevant sectors as derived from the verified damages.

During the Needs Assessment mission in May 2010, World Bank staff held extensive discussions with Development Commissioner, GoB, and Principal Secretaries of Planning, Water Resources, Minor Water Resources, Agriculture, Road Construction, Rural Works, Disaster Management and other relevant departments and obtained damage data. These reports were reviewed and followed by a field visit for sample verification of damages and validation of data furnished by GoB.

Subsequently, an extensive discussion was held with the GoB on the priorities of the report. It was determined that greater emphasis would be given to a forward-looking recovery framework and the treatment of challenges and longer-term issues that GoB would utilize for planning its longer-term disaster risk management and reduction work plan.

As mentioned previously, a considerable period has lapsed since the disaster event – 22 months – which has impacted the overall Assessment as some amount of reconstruction work has been complete or is already underway. This poses a large structural limitation to verification of disaster damage.

The second limitation is data availability. As comprehensive data is not available on economic losses, it was not feasible to deploy the UN-ECLAC Damage and Loss Assessment Methodology.[2] The

[2] Methodology for disaster damage and loss assessment developed by the UN Economic Commission for Latin America and the Caribbean (UN-ECLAC)

Assessment Team used the empirical methodology of assessing damages and determining needs based on disaster risk reduction elements and under the overall reconstruction paradigm of building back better.

As GoB requested the team to focus on the worst-hit sectors and on the key components of the proposed Kosi Flood Reconstruction project, some sectors that are normally covered in typical Needs Assessments have not been covered due to negligible damage in those sectors, paucity of time, prioritization of sectors by the Government, and constraints of data availability.

Damage Overview

Housing: According to GoB figures, 236,632 houses were fully or partially destroyed across the districts of Supaul, Madhepura, Saharsa, Araria, and Purnea. The estimated damage is Rs. 5,935 million (US$ 134.9 million). Of these, the first three districts were the worst hit with over 95 percent of the reported damage.

Roads and Bridges: About 1800 kilometers of paved and unpaved roads and about 1100 bridges and culverts were destroyed in the floods. Maximum damages were reported in Supaul, Madhepura and Saharsa.

Water Resources (Irrigation and Flood Protection): Extensive structural damage was caused to irrigation and flood protection infrastructure, including the Kosi barrage. More than 6 km of the main Eastern Kosi Canal was fully damaged, 3 km of the branch, and 1 km partially damaged. Over 150 km of the distributaries and sub-distributaries were fully damaged, as well as 730 km of the water courses, 151 canal bridges, and 138 regulators.

Agriculture and Livestock: Over 350,000 acres of paddy, 18,000 acres of maize and 240,000 of other crops were adversely affected, impacting close to 500,000 farmers. Approximately 10,000 milk animals, 3000 draught animals, and 2500 small ruminants perished in the disaster

In addition to these sectors, major damages were caused to the livelihoods, health, education, social, and environment sectors. Over 90 percent of the flood affected population was dependent on agricultural livelihoods which were severely affected. Educational infrastructure and scholastic calendars were affected in all five districts, and regular curative and preventative health services disrupted. In addition, 273,000 acres of arable land has been rendered fallow due to sand-casting with long-term implications for the environment, agriculture, and livelihoods.

Overview of Recovery and Reconstruction Needs

Housing: Immediate reconstruction needs in the housing sector have been calculated at Rs. 9.9 billion (US$ 225 million) for 157,428 houses declared eligible for assistance under current GoB interventions. Special attention needs to be paid to the landless, to affordable availability of quality construction materials and re-verification of eligible beneficiaries.

Roads and Bridges: The need for reconstruction for roads and bridges has been estimated at Rs 13.9 billion (US$317 million) taking into account the time elapsed since the disaster, the need for multi-hazard resistant construction, and better quality construction to “build back better” after the disaster.

Water Resources (Irrigation and Flood Protection): A comprehensive assessment of long-term needs for water resources has not been complete, however, GoB figures estimate the need for reconstruction in the sector to be Rs 26828 million (US$591.4 million). This approximate figure is for reconstruction needs of the bund, barrage, embankments, and Kosi Main canal and related irrigation networks.

Agriculture and livestock: With long-term damage to the agricultural sector, the needs assessment has identified a set of technological and agricultural measures to be taken in the medium and long-term to restore fertility, where possible, and to assist populations to transition to alternative livelihoods wherever reclamation is not feasible.

The Assessment also identified a number of priority areas for recovery in the livelihoods, health, education, social, and environmental sectors. There is a need to build a strategy that includes increasing agricultural productivity as well as developing alternative livelihood options in the non-farming sector. Other needs include reconstructing destroyed academic institutions, putting in place counseling programs for students and teachers, re-distributing pedagogic materials, strengthening basic health services in communities, and maintaining vector and water-borne disease control.

Challenges

Recovery of flood affected areas in Bihar should be an opportunity to initiate improvements in quality of life and changes in attitudes about risk while undertaking reconstruction tasks. Sustainable reconstruction efforts after a disaster can help revive the local economy, restore livelihoods, and improve access to housing, its quality and safety, as well as social and community infrastructures. Peoples' participation in reconstruction activities through processes such as owner-driven reconstruction reinforces equity and strengthens community networks.

While the Needs Assessment points to a number of specific interventions and activities for future recovery, the real challenge in a vulnerable State such as Bihar is to ultimately achieve policy and institutional paradigm shifts towards mainstreaming disaster risk management into the overall development process rather than one-time initiatives focusing on small groups of people, or led through short-term project approaches. There is an urgent need for long-term transformations on how risk is managed in the State to ensure that the normal stay of development interventions are not put in jeopardy.

This specifically entails measures for risk reduction from future flooding of the Kosi through a combination of structural and non-structural measures as well as the development of an overall state-wide holistic flood risk management master plan. In the long term, measures should include scaling up of Kosi-specific measures to the entire State of Bihar. The interventions need to be supported by institutional and structural measures for enhanced disaster risk reduction and better disaster response preparedness to ensure that the Bihar growth story remains sustainable in the long run.

Recovery Framework

A two-phased approach for reconstruction is recommended in order to address the short, medium, and long-term needs of recovery. The objective of Phase I would be to provide timely and focused support to Bihar's reconstruction efforts in the short-term with World Bank assistance for reconstruction and restoration of priority infrastructure, housing reconstruction and livelihoods restoration of the affected

population in the Kosi Command Area. The objective of Phase II would be to enlarge the interventions of Phase I to the entire disaster-prone areas of Bihar in and beyond the Kosi Command Area, including support for the State's longer-term needs for overall disaster management, in particular, flood risk management.

The presented assessment report should be understood as an important contribution for identifying key priority areas in support of long-term sustainable development in the State of Bihar.

Contents

List of Abbreviations

BPL	Below Poverty Line
CCA	Cultivable Command Area
CSO	Central Statistical Organization
DaLA	Damage and Loss Assessment
DRR	Disaster Risk Reduction
ERM	Emergency Repair and Maintenance
GDP	Gross Domestic product
GFDRR	Global Facility for Disaster Reduction and Recovery
GoB	Government of Bihar
GoI	Government of India
GoN	Government of Nepal
GSDP	Gross State Domestic Product
IAY	Indira Awas Yojana
ICDS	Integrated Child Development Scheme
IRC	Indian Road Congress
KBCAT	Kosi Breach Closure Advisory Team
MDR	Major District Road
MoSPI	Ministry of Statistics and Program Implementation, GoI
NH	National Highway
NRHM	National Rural Health Mission
NSSO	National Sample Survey Organization
PHC	Primary Health Center
SHC	Subsidiary Health Center
TSC	Total Sanitation Campaign
SH	State Highway

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Section 1 The Disaster

1.1 The 2008 Kosi Floods

Figure 1 State of Bihar

On 18 August 2008, the Kosi River burst through its eastern embankment about 13 km upstream of the Kosi Barrage in Nepal, 8 km north of the Indian border. At its peak, the intensity of water force went up to 166,000 cubic feet per second (cusec) compared with the regular 25,744 cusec, running straight down south through a new course 15-20 km wide and 150 long north to south. This created major flooding in Nepal and India - Bihar in particular. According to official figures, a total of 3.3 million people were affected in Bihar.

Bihar is divided into 38 districts, of which five districts, namely Supaul, Saharsa, Madhepura, Araria and Purnia, were severely affected by the flood. These districts make up 12 percent of Bihar's landmass. They had not experienced significant flooding since the completion of the barrage and afflux embankments in 1963, with consequent lack of preparedness. The total population in the 5 main affected districts is estimated to be 9.4 million, of which 32 percent (3 million) were affected by the floods.[3] A total area of close to 3700 sq. km was inundated, affecting 412 Panchayats and 993 villages.

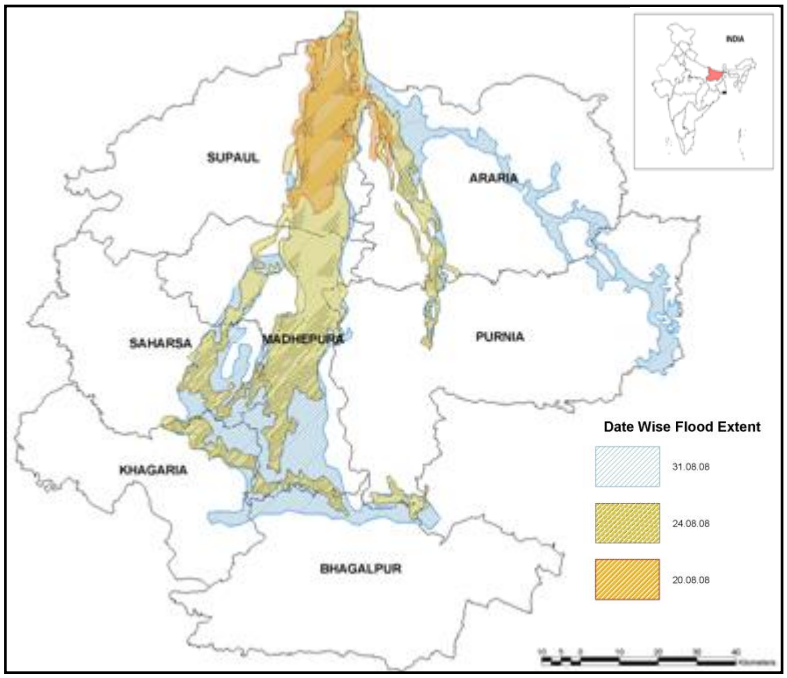


Figure 2. Map of Kosi river inundated areas in Bihar. Sphere India: Unified Response Strategy.

Approximately 493 lives were lost and 3,500 were reported missing after the disaster. The flood triggered one of the largest evacuation operations with over 1 million people evacuated, and about 460,000 people accommodated in 360 relief camps.

Houses, schools, roads, hospitals all were damaged. A total of 236,632 houses were either fully or partially destroyed in rural blocks across the five affected districts. Significant damage to infrastructure including rural roads, culverts and bridges was reported with approximately 1800 km of roads and 1100

[3] "Table: Ranking of Districts in Bihar by Population Size in 1991 and 2001."Office of the Registrar General and Census Commissioner, India. http://www.censusindia.gov.in. Retrieved 2010-06-26.

bridges and culverts damaged. All categories of roads ranging from national highways to village roads were affected. Many bridges collapsed and were not trafficable.

The floods resulted in a significant decline in the agricultural production base due to sediment deposition and loss of livestock, farm working capital and other farm assets (e.g. tube wells, implements, etc.). As per official estimates, coarse sediment was deposited on an area of 284,000 ha in 1063 villages in 35 blocks of the five districts. Generally, the deposits of sediment are deep, continuous and widespread in the northern parts (Supaul District) and relatively shallow and patchy in other districts.

The floods also caused severe damage to the East Kosi Main Canal and lower-order irrigation infrastructure in the large Kosi Irrigation Scheme. The damage included serious siltation of the main canal and distributaries, breaches and siltation of smaller canals and water courses, and destruction of hydraulic and other structures.

1.2 Emergency response

Figure 3. Evacuated people and livestock, Saharsa, August 2008

An emergency response effort was immediately initiated by the State government with assistance from the Indian Army, Air Force, Navy, and National Disaster Response Force (NDRF). Relief materials were airdropped by helicopter including 121,892 packets containing food and water purification tablets. Food packets totaling 239,858 were also distributed in the interior areas by boats.

In terms of evacuation, an extensive operation was undertaken involving 5,000 civilian personnel, 3,500 police personnel, 35 columns of the Army and 4 of the Navy working with 855 NDRF personnel and the Air Force. The evacuation operation involved 2,000 traditional country and mechanized boats to bring approximately 1 million evacuees to safety. The State Government set up 360 relief camps within school and college buildings and tents to house evacuees. At peak, more than 440,000 people were living in camps. The government camps were used for a period of approximately 4 months.

The Government of Bihar (GoB) was extremely proactive in relief operations in the immediate aftermath of the flood and also received GoI support of US$230 million from the Calamity Relief Fund. Although no formal international appeal for foreign assistance was made by the Government, the international community responded and contributed to the recovery effort. International and national organizations mobilized aid to assist with recovery needs both in India and Nepal. The WHO, for instance, provided emergency medical supplies and equipment for almost 200,000 people in Bihar. Other agencies such as WFP were active in distribution of food aid. Several national organizations launched relief efforts. See Annex 6 for the list of multilateral and bilateral support for recovery activities in Bihar.

The Bank offered support immediately after the disaster through the Global Facility for Disaster Reduction and Recovery (GFDRR), and the World Bank donated 10 motorboats to the Government of Bihar and 6 to the Government of Nepal.

1.3 The Kosi districts in the context of Bihar

Figure 4. Aerial view of Kosi Floods, 2008

The 2008 Kosi river floods impacted already vulnerable communities with low human and economic development indicators and relatively low coping capacities. Bihar is the third most populous state in India with nearly 8.5 percent of the country's population. Although there have been many positive developments in the areas of economic growth, female literacy, infant mortality, and others, the state remains one of the poorest in India with 42 percent living below the official poverty line and a rural poverty ratio of 45 percent in 2004, the second highest after Orissa.[4] The average annual per capita income of Bihar is a third of the national average. The state is also highly rural with 89 percent of the population living in rural areas.

The five districts affected by the flood were among the least developed even before the 2008 flood. Available district-level indicators show that they lagged behind the state as a whole: literacy rates in 2001 were lower than the state average of 47.5 percent, and lower than in neighboring districts (apart from Katihar and Kishanganj which lie further east). Female literacy rates were even lower, less than 20.5 percent on average. Since the 2001 Census, gains were made in elementary education, with near-total enrollment in Grades I-V but continuing low enrollment, ranging from 28 to 33 percent, in upper grades (VI-VII), according to the monitoring system of the SSA scheme (NUEPA 2009).

The state of infrastructure was poor in these districts. Rural connectivity levels were extremely low, with less than half of the villages in each district having access to a paved road (Census 2001).

A recent World Food Program report, using data from 1998-2005, classifies 3 out of the 5 districts (Araria, Madhepura, and Purnia) as priority districts for food security intervention on the basis of a food security index which aims to measure availability, access, and absorption.

The population in Bihar is perennially affected by floods with Bihar being the most flood-prone in the country.[5] About 30 of its 38 districts (73 percent of its geographical area) is flood prone and afflicted by floods almost annually, especially from the rivers west of the Kosi. Bihar's hydrological vulnerability is

[4] In India, Below Poverty Line (BPL) is an economic benchmark and poverty threshold used by the Government of India to indicate economic disadvantage and identify individuals and households in need of government assistance and aid. Criteria have been developed for rural and urban areas to measure the degree of deprivation through a host of parameters with scores given from 0-4. Families with 17 marks or less out of 52 marks are classified as BPL. One easy way to identify individuals who fall under BPL in India is a BPL Card. The World Bank recognizes the poverty line to be per capita income under US$2 a day.

[5] See Annex 4 for a list of floods in Bihar, 1979-2006

aggravated by its flat topography, high rainfall (more than 2,500 mm annually and up to 80 percent of annual precipitation from June to September) and high sediment loads of rivers.

In particular, the Kosi River is well-known in India for rapid and frequent changes of its course and the extensive flood damages it causes almost every year. As its waters carry a heavy silt load and the river has a steep gradient, the river has a tendency to move sideways. In about 200 years, the river has moved laterally by about 150 km.

The Government of Bihar's institutional capacity to manage the 2008 Kosi disaster was limited as considerable resources had been spent in dealing with the extensive floods on 2007, which affected nearly 25 million people in a different part of Bihar.

While GoB was extremely proactive in the emergency response, there has not been any significant reconstruction and recovery needs are still enormous and beyond present capacity.

Box 1. History of Kosi Embankment Breaches

The Kosi River presents a challenge in terms of long and recurring flood hazard. A major flood in 1953-54 led to the 'Kosi project' which was aimed at flood control and irrigation. The project led to the creation of a barrage and embankments on each side were designed to protect approximately 2800 km2 of land in north Bihar and Nepal. Despite this intervention and a long history of flood control management in the basin for more than 5 decades, the river continues to cause extensive flooding due to breaches.

1963: The first breach on the western embankment in Nepal

1968: Five breaches in north Bihar

1971: Collapse of the 1969-built Bhatania Approach Bund

1980: Eastern embankment breach

1984: Eastern embankment breach

1991: Breach in the western embankment near Joginia in Nepal

2008: Breach in eastern embankment

Section 2 Objectives, Methodology, and Limitations

2.1 Overview

A Needs Assessment was undertaken by the World Bank and GFDRR in close cooperation with GoB from May 24 to June 4, 2010. A considerable period of time had elapsed since the disaster event and a post-disaster needs assessment could help take stock of damages, present progress in reconstruction, and identify priority gap areas for potential assistance under the project.

2.2 Objectives

The objective of the Needs Assessment is: (i) to guide the design and investment prioritization of the proposed Kosi Flood Recovery project; (ii) provide a damage overview in key sectors including water resources and flood management, roads and bridges, housing, agriculture, social, environmental, and health; (iii) to identify current recovery initiatives and progress made; and, (iv) to identify short, medium, and long-term needs and priority interventions.

This report presents the findings of the Needs Assessment exercise. It is structured with more emphasis on post-disaster recovery needs and priority interventions to support the elaboration of the proposed World Bank Kosi Flood Reconstruction project. With considerable time elapsed, accurate estimation of losses was neither possible nor required by the Government. In addition, a number of organizations, including the UN, undertook assessments early on, focusing on the impact of the disaster and immediate needs. Therefore, these tasks were not repeated in the present Needs Assessment.

This report is based on the GoB's and others' findings of the impact and immediate recovery initiatives while providing recommendations for current as well as long-term recovery needs. Greater emphasis has been placed on the sectors that were worst affected by the disaster while mention has been made of others important but less emphasized areas.

2.3 Methodology

A three-pronged methodology was employed to complete information gathering in the Needs Assessment: (i) obtaining government damage data from the relevant government departments; (ii) review of reports on damage and recovery needs from GoB and other sources; and, (iii) limited cross-verification of the centrally obtained data through focused sample surveys, field visits and the aggregation of the needs in the relevant sectors as derived from the verified damages.

During the Needs Assessment mission from May 24 to June 4, 2010, World Bank staff (see Annex 13 for list) held extensive discussions with Development Commissioner, GoB, and Principal Secretaries of Planning, Water Resources, Minor Water Resources, Agriculture, Road Construction, Rural Works, Disaster Management and other relevant departments and obtained damage data. Baseline and disaster impact data were provided through templates shared with GoB (see Section 3). Sectoral reports were reviewed and followed by a field visit for sample verification of damages and validation of data furnished by GoB. In particular, sectoral damage data verification exercises were undertaken in the district of

Supaul in North Bihar. Upon return from field verification surveys, the Assessment team interacted intensively with the District Magistrate, Supaul and district-level departmental officers. This was followed up with focused interactions with government officials in Patna in order to validate the findings of the field surveys.

Subsequently, an extensive discussion was held with the GoB on the priorities of the report. It was determined that greater emphasis would be given to a forward-looking recovery framework and the treatment of challenges and longer-term issues that GoB would utilize for planning its longer-term disaster risk management and reduction work plan.

2.4 Limitations

As mentioned previously, a considerable period has lapsed since the disaster event – 22 months – which has impacted the overall Assessment as some amount of reconstruction work has been complete or is already underway. This poses a large structural limitation to verification of disaster damage.

The second limitation is data availability. As comprehensive data is not available on economic losses, it was not feasible to deploy the UN-ECLAC Damage and Loss Assessment Methodology. [6] The Assessment Team used the empirical methodology of assessing damages and determining needs based on disaster risk reduction elements and under the overall reconstruction paradigm of building back better.

As GoB requested the team to focus on the worst-hit sectors and on the key components of the proposed Kosi Flood Reconstruction project, some sectors that are normally covered in typical Needs Assessments have not been covered due to negligible damage in those sectors, paucity of time, prioritization of sectors by the Government, and constraints of data availability.

[6] Methodology for disaster damage and loss assessment developed by the UN Economic Commission for Latin America and the Caribbean (UN-ECLAC)

Section 3 Needs Assessment

3.1 Overview

The following section details the findings of the Needs Assessment with sector-specific profiles. Each sector profile provides a brief damage overview, identifies current recovery initiatives and progress made thus far, and short, medium, and long-term needs and priority interventions. This is not an exhaustive sectoral review but a snapshot to guide the elaboration of the proposed World Bank Kosi Flood Reconstruction and Recovery project. Greater emphasis has been given to post-disaster recovery needs in the following sectors: housing, roads and bridges, water resources and flood management, agriculture, social, environmental, and health.

Summary

Table 1 provides a summary of the reported damages and needs by sector.

Sector	Sub-Sector	Disaster Damages		Reconstruction Needs	
		INR Million	US$ Million[7]	INR Million	US$ Million
Infrastructure					
	Housing	5935	134.9	99000	225
	Roads and bridges	5695	129	13936	317
	Water resources	-	-	26828	591.4
Productive sectors					
	Agriculture	-	-	-	-
	Livelihoods	-	-	1622.5	36.9
Social sectors					
	Education	-	-	1251	28.4
	Health	-	-	730.2	16.6
	Social	-	-	-	-
Cross-cutting					
	Environment	-	-	-	-

[7] A standard exchange rate of US$1=Rs 44 has been used throughout the report.

Infrastructure

3.2 Housing

Four types of houses existed in the disaster-affected areas: (i) huts (thatch and bamboo structures that can be re-erected); (ii) *kuccha* structures (non-engineered house made of mud, grass, bamboo, thatch or sticks); (iii) *semi-pukka* structures (a more robust type of house which is a mix between a kuccha structure and pukka); and, (iv) *pukka* structures (engineered house made of materials resistant to wear such as stone, brick, clay tiles, metal). According to the 2007-08 District-Level Household Survey, only a small fraction of the population in the affected districts resided in a "pukka" houses.

The GoB estimates that a total of 236,632 houses were either fully or partially damaged across the five affected districts. Of this number, 157,428 houses (67 percent) were completely destroyed, and another 85,355 were partially damaged. Most of the damage to houses was concentrated in the districts of Supaul, Madhepura, and Saharsa which sustained over 95 percent of the damage in the housing sector (see Table 2 below). The estimated damage is Rs. 5,935 million (US$ 134.9 million). As many as 460,000 people were without shelter initially and had to be accommodated in relief camps.

Sl	District	Pukka		Kuccha		Huts[8]	
		Fully	Partially	Fully	Partially		
1.	Supaul	185	1,478	29,761	41,150	69	
2.	Saharsa	34	118	23,754	-	1,461	
3.	Madhepura	704	6,409	38,963	27,038	56,346	
4.	Araria	-	-	320	303	977	
5.	Purnea	23	-	4,831	2,708	-	
	TOTAL	946	8,005	97,629	71,199	58,853	**236,632**

Table 2. Number of houses damaged in Kosi Floods 2008, by district and type of housing.

Needs

The GoB's estimate is that a total of 157,428 houses that were fully destroyed may still need external assistance for rebuilding. At an estimated cost per unit of Rs. 63,000 (US$1400) through owner-driven reconstruction, the total cost is estimated at Rs. 9.9 billion or US$225 million.

Initially, an estimate of Rs. 150,000 (US$3409) was calculated for a 215 sq. ft concrete and brick structure on a raised plinth and a small mezzanine, which was too high. An alternative unit costing Rs. 55,000 for the same built area was proposed by the Owner-Driven

	Number	Unit Cost	Total
Fully damaged units	157,428	63,000	Rs. 9.9 billion (US$225 million)

Table 3: Cumulative Housing Reconstruction Needs

[8] All affected huts were classified as fully damaged.

Reconstruction Collaborative (ODRC), a not-for-profit organization working closely with GoB. With additions including solar lighting and toilets, the total cost per unit is estimated at Rs. 63,000 (US$1430).

The model that has been proposed is owner-driven with GoB and ODRC providing technical, supervision, and monitoring support. The units include an elevated plinth of brick and concrete and a superstructure which uses reinforced bamboo poles as load-bearing columns and CGI sheeting with bamboo insulation as a roof. It would have a mezzanine for storage and shelter. This basic cost of Rs. 55,000 does not include a kitchen or toilet, with GoI's *Total Sanitation Scheme* expected to provide toilets. Solar lighting is estimated at an additional cost of Rs. 5000.

A number of key factors relating to quality and disaster mitigation have been integrated into the units' design given that the affected areas are prone to floods, earthquakes, and windstorms. The districts of Araria and Supaul also lie in seismic hazard Zone V, and Madhepura, Saharsa and Purnea in Zone IV. Kala Azar, a vector-borne disease, is prevalent in the area.[9] Therefore, the design is earthquake, flood and windstorm resistant and includes plastered walls to prevent Kala Azar.

Housing reconstruction is expected to take a phased approach due to resource constraints. The districts of Supaul, Saharsa, and Madhepura would be prioritized with fully damaged kuccha houses and huts (approximately 150,000 units) taken up in the first phase. Eligible Below the Poverty Line (BPL) households that have not yet benefited from the Indira Awas Yogana (IAY) rural housing scheme (see Box 2) would receive IAY benefits with GoB meeting the deficit. Other eligible households would be covered by GoB through its own resources.

Box 2: Indira Awas Yojana (IAY)
IAY provides a financial grant of Rs.45,000 per BPL family. The IAY beneficiary is also eligible for a loan of Rs.20,000 at 4% but banks have not started such financing.

Land issues are also important in shelter reconstruction. Approximately one in three beneficiaries is landless and would require land prior to reconstruction. Thus, adequate support to procure land is inseparable from housing reconstruction. GoB is contemplating commensurate additional assistance to support the eligible landless households to obtain right/title to land for housing reconstruction.

Demand for building materials needs to be addressed as well, with enormous demand potentially impacting the cost of supplies. There is a need to facilitate private sector suppliers to produce and stock these materials in sufficient quantities and to monitor fair price trades to discourage profiteering. The entire program could also trigger a potential shortage of bamboo required for the housing reconstruction at this scale. The proposed design requires mature (at least three years) and chemically reinforced bamboo. In addition, effective chemical treatment of bamboo is possible only within 6-7 hours of harvest.

Re-verification of eligible beneficiaries with community participation is necessary as many victims were absent during the Government of Bihar household survey, having relocated to different areas for safety and better livelihood options. Re-verification is even more necessary as some anomalous incongruities among affected districts were noted in the respective numbers of huts damaged.

[9] World Bank is funding a Program, National Vector Borne Disease Project that includes the eradication of *Kala Azar.*

It is also recommended that those who reconstructed houses with personal resources remain eligible. Excluding them would act as a perverse incentive and discourage communities from engaged in self-driven recovery through personal and community efforts.

Finally, the issue of the initial gratuitous relief given by GoB for reconstruction requires review. Between Rs. 2,000 and Rs. 25,000 was given by GoB early into recovery. The amount given was based on households based as follows:

Damaged house Category	**Relief compensation / household (INR Rs.)**
Pukka: fully damaged	25,000
Pukka: partially damaged	5,000
Kuccha: fully damaged	10,000
Kuccha: partially damaged	2,500
Huts	2,000

Table 4. GoB relief packages based on household categories

GoB is contemplating adjusting the proposed housing reconstruction grant by this initial relief, which may however, have already been spent by households for recovery needs other than housing reconstruction. Such a practice may have serious consequences on the viability and quality of reconstruction. Moreover, the current estimates are already austere and if such adjustments are made, households will either resort to spending their own money (if they have it) to complete houses or abandon reconstruction midway due to lack of funds. Finally, it may result in poor quality housing which may suffer from the same vulnerabilities existent prior to the disaster. GoB may want to reconsider the issue and its implications.

3.3 Roads and Bridges

A large number of roads and bridges were damaged by the floods. The embankment breach caused the following: (i) formation of new streams where no cross drainage works existed; and, (ii) flows in excess of design discharge of existing cross drainages structures resulting in the collapse of bridges and culverts and severe damage to roads.

A total of 1,830 km (78.9 percent) of roads in the five affected districts were either fully or partially damaged. Of this, a total of approximately 1,357 km (58.5 percent) were fully destroyed. In addition, a total of close to 1,100 bridges and culverts were damaged or destroyed.

With these districts having large rural concentrations, roads in rural areas were disproportionally affected. Rural roads sustained over 70 percent of total damage with 1635 km of rural roads either totally or partially destroyed. Of this number, 1212.8 km (72 percent) were fully destroyed, while the remainder 422.3 km partially destroyed. Table 5 and 6 provide the breakdown of damages to national and state highways and major district roads, as well as rural roads.

District	Road Type	Affected Roads (km)		Damaged Bridges (No.)		Damaged Culverts (No.)	
		Fully damaged	Partly damaged	Fully damaged	Partly damaged	Fully damaged	Partly damaged
Supaul	National highway						
	State highway						
	Major district road	25.70 (24.4%)		13			
Madhepura	National highway	16.00 (44.4%)			7		
	State highway						
	Major district road	28.10 (35%)	22.00 (27.5%)	1		6	
Saharsa	National highway	5.70 (10.8%)	30.00 (56.9%)		2		
	State highway			10			
	Major district road	55.25 (93.6%)		2		8	
Araria	National highway						
	State highway						
	Major	2.00		11		3	

District	Road Type	Affected Roads (km)		Damaged Bridges (No.)		Damaged Culverts (No.)	
		Fully damaged	Partly damaged	Fully damaged	Partly damaged	Fully damaged	Partly damaged
	district road	(2.6%)					
Purnea	National highway	10.00 (16.4%)		2	2		
	State highway						
	Major district road	1.00 (1.4%)		1		7	
Sub-Total	**National highway**	**31.70 (21.2%)**	**30 (20%)**	**2**	**11**	**-**	**-**
	State highway	-	-	**10**	**-**	**-**	**-**
	Major district road	**112.05 (24.3%)**	**22 (19.6%)**	**28**	**-**	**24**	**-**
Grand Total		**143.75 (22.6%)**	**52 (8.2%)**	**40**	**11**	**24**	

Table 5: Estimated damages to roads and bridges, national highways, state highways, and major district roads

District	Damaged paved roads (km)		Damaged unpaved roads (km)		No. of damaged - Bridges/Culverts	
	Fully damaged	Partly damaged	Fully damaged	Partly damaged	Fully damaged	Partly damaged
Supaul	136.15	44.35	232.01	37.80	298	19
Madhepura	104.05	33.80	692.70	71.15	490	4
Saharsa	12.73	79.35	0.00	0.00	15	65
Araria	13.61	66.46	0.00	0.00	5	34
Purnea	21.51	89.43	0.00	0.00	11	48
Total	**288.05 (17.1%)**	**313.38 (18.6%)**	**924.71 (55%)**	**108.95 (6.5%)**	**819**	**170**

Table 6. Estimated Damages to Roads and Bridges in Rural Areas

In terms of districts, of the total length of roads damaged, roads in Madhepura sustained close to 53 percent of total damage at 967.8 km, followed by Supaul at 26 percent (476 km), and Saharsa at 10 percent (183 km).

In terms of cost of damage to roads, including bridges and culverts along them, the total is estimated at Rs. 5.7 billion (US$129 million). See Table 7 below for the breakdown per district. The cost of damages to bridges and culverts is included in the cost of the roads.

District	NH	SH	MDR	Rural Roads	Total
Supaul	0.00	0.00	414.20	884.21	**1298.41**
Madhepura	440.00	0.00	272.60	1212.08	**1924.68**
Saharsa	287.00	500.00	395.50	209.62	**1392.12**
Araria	0.00	0.00	241.00	187.36	**428.36**
Purnea	340.00	0.00	47.00	264.88	**651.88**
Total	**1067.00**	**500.00**	**1370.30**	**2758.15**	**5695.45**

Table 7: Estimated cost of damages to roads and bridges in affected areas (in INR, million)

Needs

Since the disaster event, minimal reconstruction of damaged roads and bridges has been undertaken. It was noted by the Needs Assessment Team that almost all damaged bridges and culverts have been restored via temporary diversions. While majority of the paved roads have been restored, albeit the approaches to cross drainage works and near the new streams, the unpaved roads have not been substantially repaired. Therefore, reconstruction need for the roads and bridges is still substantial.

The total reconstruction need for road infrastructure including bridges and culverts is estimated at Rs 13.9 billion (US$317 million). This estimate was calculated taking into account the time elapsed since the disaster, the need for multi-hazard resistant construction, and the need for better quality construction to "build back better" after the disaster.

District	National Highways	State Highways	Major District Roads	Rural Roads	Total
Supaul	0.00	0.00	621.30	2568.82	**3190.12**
Madhepura	1080.00	0.00	408.90	5308.80	**6797.70**
Saharsa	550.50	750.00	593.25	314.43	**2208.18**
Araria	0.00	0.00	361.50	281.05	**642.55**
Purnea	630.00	0.00	70.50	397.32	**1097.82**
Total	**2260.50**	**750.00**	**2055.45**	**8870.41**	**13936.36 (US$317 million)**

Table 8. Cumulative needs in roads and bridges sector (in INR, million)

For reconstruction of roads and bridges, the following has been taken into account in the cost estimation:

- Reconstruction cost would be 50 percent above the value of damage. About 30 percent extra for build back better and about 20 percent to account for inflation. This is in line with the overall reconstruction needs calculated by GoB
- All fully as well as partially damaged bridges and culverts would need to be constructed anew, regardless of the extent of damage
- New bridges and culverts would be required at locations where new streams and channels have been created after the disaster
- Bridges and culverts would be designed as a minimum of two-lanes irrespective of current traffic needs as reconstructed brides and culverts would have an expected lifespan of 50 years and there is potential of increased traffic over this period
- All damaged roads, including those currently fair-weather roads, would be reconstructed as all-weather/bituminous roads

Recommendations for disaster risk reduction led reconstruction

Based on the observations of the Assessment Team, the following recommendations are proposed to ensure that appropriate disaster-resistant features are incorporated in the reconstruction of roads and bridges:

- Bridges should be constructed above the high flood line (HFL). The exact height should be determined through in-depth studies. No submersible bridges, causeways, spillways should be rebuilt.

- Future bridge designs should allow for stopper blocks to prevent dislodgement, and adequate anchoring to prevent uplifting of the superstructure. This recommendation comes from observations that in many bridges inspected during Assessment, the superstructure was laterally displaced due to overtopping by flood waters and inadequate anchoring of concrete pavement to the supporting pillars.

- It is not recommended to base the design of bridges, culverts and roads on the impact level of the Kosi flood of 2008. This occurred as a result of an anomalous incident – a breach in the embankment. The IRC code precludes any such abnormal highs like dam burst, tsunamis etc. Design should be based on longer-term trends derived from available records of past years as well as field surveys including robust soil testing.

- Adequate protection work for the heads as well as sides of the approach roads should be provided (where the HFL width is larger than the bridge width, causing impact on approach embankments due to perpendicular flow of flood waters).

- Single circular piers in the bridges with cantilever pier heads supporting the superstructure are recommended. This will take care of skewed flows, if any.

- Bridges should be constructed on deep foundations except for culverts, using either well or pile foundations. Pile foundations are recommended over wells as they are faster and cheaper to construct. They are also more flexible than well foundations. This is further recommended given the seismic rating of the region.

- Elastomer bearings deflect considerably under horizontal force. Here, reference may be made to the amendment to IRC: 6.[10] This may halve the seismic coefficient from 0.18. It might be feasible to then design Elastomer bearings good for this reduced force. If such bearings are still unable to take the force, these could be designed for its maximum capacity and the balance force transferred to seismic arrester blocks as indicated in the above mentioned amendment of IRC:6

- It is recommended that proper hydrological and topographical surveys be undertaken on road stretches that had no bridges/culvert but were damaged due to road embankment breaches. Such surveys would improve scientific planning by identifying new flow channels that might have developed due to sedimentation of old channels or any other topographic changes. Waterway and bridge lengths may be fixed after assessing discharges through the new waterways and not on historical data which may be misleading

- Open foundations are recommended for small bridges and culverts. However, adequate disaster resistant features should be provided to safeguard the reconstructed structures from future disasters. Usual rigid concrete apron flooring flanked by adequately designed cut-off walls,

[10] Published in "Indian Highways", January 2003.

forming a protective box enclosure around the foundations, should be provided. Flexible launching aprons comprising boulder pitching on the bed both upstream and downstream and next to the cutoff walls form the last frontier and should be provided to safeguard against scouring.

- Bituminous roads should be designed based on soil characteristics and necessary soil investigations should be carried out.

- Wherever high embankments are required, necessary slope protection should be provided.

3.4 Water Resources

The floods severely damaged the Eastern Kosi Main Canal and secondary and tertiary irrigation infrastructure in the Kosi Irrigation Command Area.

- A total of 6.32 km of the main Eastern Kosi Canal was fully damaged, 3 km of the branch canal was also fully damaged and 1 km was partially damaged.
- 158 km of the distributaries and sub-distributaries/minor canals was fully damaged and 4 km partially damaged.
- 730 km of the water courses, 151 canal bridges and 138 regulators were fully damaged

The floods also caused substantial siltation of the main canal and distributaries, breaches in and siltation of smaller canals and water courses, as well as destruction of hydraulic and other structures. These damages have rendered the Eastern Kosi Canal system nearly dysfunctional to the present day resulting in a devastating impact on agriculture and livelihoods. The Kosi Cultivable Command Area (CCA) is 612,000 hectares in the five districts. Millions of people depend on this for agriculture and livelihoods.

Box 3. Background of Kosi Eastern Afflux Embankment

In order to contain the Kosi, GoI prepared a scheme in 1954 consisting of a barrage at Bhimnagar (Nepal) with canals with irrigation potential of millions of hectares, afflux bunds up to 13 km on western and 32 km on eastern side upstream of the barrage, and downstream flood embankments up to 100 km on the western and 124.5 km on eastern side.

On August 18, 2008, a 1.77 km wide breach opened in the Eastern Afflux Bund at about 13 km upstream. As this occurred at a river discharge of 164,000 cusecs (far less than the design discharge of 9,50,000 cusecs, the breach cannot be attributed to exceptional discharge. It was caused by a gradual shift of the flow due to uneven siltation impacting the left embankment and by lack of adequate and timely maintenance of the embankments. It was exacerbated by several shoals (sandbanks) that constricted the flow in narrow rapid channels. The breach was more devastating as it forced almost 80% of the discharge into an old channel, severely and abruptly flooding the five districts. The breach caused partial damage to the spur at km 11.90 and complete damage to spurs at km 12.1 and 12.9 on the Eastern Afflux Bund. The damage also included complete erosion of the nose at km 13.6. In addition, the countryside slope of the embankment was damaged from the Bhimnagar Barrage to km 11.7 upstream into Nepal.

Needs

Although the breach and resultant floods of 2008 were exceptional, going forward there is a need to relook and reformulate the way floods are perceived and managed throughout the state through activities in the short, medium and long-term. A more comprehensive flood risk management system is needed with a mix of structural (e.g. shelters, upstream storage, embankment rationalization, and asset management system) approaches as well as non-structural (e.g. institutional coordination, forecasting and communication systems, data monitoring, zoning, insurance) measures in an integrated basin context.

Kosi Eastern Afflux Bund & Related Infrastructure

GoB and GoI along with the Kosi High Level Committee (KHLC) conducted a series of investigative studies of the Eastern Afflux Bund which breached on August 2008. Areas of severe impact were closely examined at various discharges varying from 50,000 cusecs to 500,000 cusecs using post-2008 flood survey data and satellite imagery. In addition, model experiments were carried out and the flow patterns

were observed at spurs located at 11.9 km, 13.6 km, 15.8 km, 17.35 km, and 23.52 km on the Eastern Afflux Bund. These studies led to a series of recommendations summarized below:

- Closure of the eastern channel near the spur at 23.52 km on the Eastern Afflux bund
- Extension of the spur at 15.80 km by 125m on Eastern Afflux Bund
- Dredging a new pilot channel west of existing pilot channel to centralize the flow
- Extension of the left downstream guide bund; and,
- Dredging of the central pilot channel downstream of the barrage.

Additional recommendations include:

- Blocking the upstream river channel by RCC porcupines opposite to the spur at 23.52 km on the Eastern Afflux Bund to weaken the attack on the spurs up to 15.8 km on the Bund
- Restoration of the nose of the spur at 15.80 km; restoration and strengthening of the noses of spurs at 5.31 km, 6.25 km, 6.94 km, 9.25 km, 10.0 km, 11.70 km and 14.10 km on the Eastern Afflux Bund, under attack
- Revision of the gate regulation of the barrage to improve the flow of the proposed pilot channel
- Stockpile materials, particularly sand filled geo bags/boulders, at vulnerable locations

Based on the recommendations of KBCAT, GoB initially requested assistance from GoI for closing the breach and protection works estimated at Rs.1.43 billion (US$32.5 million). However, after the works were completed the WRD revised its costs down to Rs. 1.14 billion (US$25.9 million) for the following works carried out: [11]

- Construction of pilot channel, dredging, porcupines;
- Breach closure including protection works;
- Construction of five new spurs in the damaged portion;
- Restoration of two damaged spurs near the breach; and,
- Miscellaneous works (including equipment, mechanical works, jungle clearance, etc.).

In addition, modernization of the Barrage at an additional cost of Rs. 0.87 billion (US$19.7 million) was also planned. This included automation and repairs of the gates and dividing walls, not directly linked to the Kosi Floods but are necessary as longer-term disaster risk reduction measures.

After the Eastern Afflux Bund repair, GoB undertook an assessment of the state of downstream embankments. Though the floods did not cause any direct damage to the Eastern and Western Kosi Embankment systems, they were in a state of disrepair and required urgent renovation. Many anti-flood sluices were non-functional due to progressive elevation of the river bed and had reduced the operational capacity of the embankments. This aggravated flooding and water logging in the affected districts along the Eastern and Western Embankments. Thus, suitable measures to strengthen the existing downstream embankments have become a complementary need.

[11] These works were completed at a cost of Rs. 1.14 billion (US$25.9 million).

GoB initiated a program titled the "Raising, Strengthening and Construction of Bituminous Road over Eastern and Western Kosi Embankments" at an estimated cost of Rs. 3.39 billion (US$77.1 million). Overall, in this project there is a provision for five new structures: two Double Lane Road (DLR) bridges, two anti-flood sluices in the Western Embankment and one anti-flood sluice in the Eastern Embankment.

GoB holds that the construction of bituminous roads on the embankment would stabilize the surface, make the embankments more flood resistant and ensure road connectivity during floods. However, although the roads will have a strengthening effect and allow for improved connectivity and embankment maintenance they may form an obstacle for future enhancement of the embankments. Therefore, this practice may have to be evaluated for long-term sustainability.

Eastern Kosi Canal & Related Irrigation Infrastructure

As noted above, the Eastern Afflux Bund breach severely impacted the main Eastern Kosi Canal, its branches and distributaries. Already under stress due to siltation, the floods rendered the entire irrigation network in the Kosi Command Area dysfunctional. Pre-2008 GoB reports had flagged that the head of the main canal and branch canals had gradually silted considerably reducing canal capacity and that the canal flow had encroached the free board of the canal endangering the safety of its embankments and related structures. In short, lack of maintenance and steady siltation aggravated the impact of the floods on the irrigation system. Currently, the irrigation system is servicing less than 50 percent of its command area.

GoB has initiated a program for repair and reconstruction works called the Extension, Renovation, Modernization (ERM) to address the -damages to the Eastern Kosi Canal System with an estimated cost of Rs. 7.50 billion (US$170 million) and an additional Rs. 0.37 billion (US$8.4 million) from the Calamity Relief Fund (CRF) for the repair and renovation of the main Eastern Kosi canal. The objectives of the project are to restore the irrigation capacity to 64 percent *Kharif (*monsoon*),* 62.5 percent *Rabi* (winter), 22 percent hot weather crops, and 1.5 percent annual crops.

Long-term Irrigation needs

A lingering concern for the East Kosi Main Canal system is the high sediment intake and the high seepage loss due to sandy loam sub-soil. There is a longstanding plan for concrete lining of the main canal and distributaries, estimated to cost Rs. 12 billion (US$ 256 million). It is not included in the ERM project. Drainage schemes are also not included under the project. Another concern is the ten-odd new small river streams (*dhars),* with a total length of 250 km which were created after the floods. No action has been taken for their training and management. These are now running through areas with no canal coverage and require urgent re-sectioning, re-grading, re-channelization/diversion. GoB has estimated that this would cost an additional Rs. 200 million (US$4.3 million) which is outside the scope of the ERM project. GoB has requested for World Bank support for addressing any additional works for the *dhars*.

The summary of costs for reconstruction needs of the bund, barrage, embankments, and Kosi Main canal and related irrigation networks is detailed in Table 9 below.

Type of Reconstruction Need	INR Million	US$ Million
Breach Closure Works on Eastern Afflux Bund	1140	25.9
Kosi Bhimnagar Barrage	870	19.7
Strengthening of Eastern & Western Kosi Embankments (including 8 km on Western Embankment)	3628	82.1
ERM Scheme for Eastern Kosi Main Canal System (incl. funds from Calamity Relief Fund)	7870	178.4
Lining of Eastern Kosi Main Canal	12000	256
Renovation of irrigations system to include 10 *Dhars*	200	4.3
Piloting of river training, localized erosion control, and strengthening of sections of embankments	328	7.0
Non- structural knowledge management and capacity building measures (incl. technical studies, models, flood forecasting, etc.)	792	18
Total	**26828**	**591.4**

Table 9: Reconstruction need of the Eastern Afflux Bund, the Bhimnagar Barrage, Kosi Embankments, the Eastern Kosi Main Canal system, and other structural and non-structural needs costing in INR, million

The following are specific structural and non-structural needs in the medium and long-term that are required to ensure improved flood management capacity in the state.

A. Structural Interventions Needed

- Constructing and maintaining flood embankments in a more sustainable manner by using modern design parameters and standards and more suitable construction materials.

- Developing and maintaining an asset management system for flood embankments and other flood management infrastructure using satellite imagery to detect river flow behavior changes and at-risk embankments. This should be corroborated by a system of regular physical monitoring and inspection.

- Strengthening of eight km of Kosi Western Embankment downstream in Bihar.

- Piloting of river training, erosion control and strengthening of sections of embankments using more suitable materials and construction techniques.

- Renovation of several dhars (small streams) that currently affect the Eastern Kosi Main Canal and related irrigation networks.

B. Non-Structural Interventions Needed

- Providing emergency/routine maintenance equipment to maintain the course of the Kosi River upstream of the barrage as much as possible in its central channel combined with a systematic silt management plan.

- Conducting a series of technical studies, geotechnical and other investigations, and setting up a center of excellence for water resources and flood management research and development, all aimed at improving the knowledge of river, flood, and sediment management in Bihar.

- Developing mathematical models to describe the morpho-dynamic behavior of the Kosi River to increase the understanding of the river dynamics, to predict river behavior under different events, and to determine the impact of interventions.

- Preparation of a comprehensive integrated flood and sediment management master plan that determines a set of priority structural and non-structural measures that will provide sustainable flood and sediment management up to an agreed safety level. A review of the current situation and arrangements of flood management in the state and the constraints and barriers to the improvement of practices needs to take place. Building on the existing situation with flood and sediment management and the identified constraints and barriers, the master plan should be prepared that will guide government and agencies during the next two decades towards sustainable flood and sediment management in the state.

- Additional measures like flood warning are required to minimize the risk of damage and casualties caused by a flood event. Flood forecasting significantly enhances the accuracy and increases the lead time of forecasts. Building on the completed and ongoing activities by the Bank-funded Flood Management Information System (FMIS) Cell within WRD, the flood forecasting and early warning capacity in the state will be enhanced. Such activities could include the preparation of a digital elevation model (DEM) for the Kosi River Basin to enable the preparation of hazard and risk maps and assessments, setting up and automatic hydro-meteorological monitoring system (field stations, observer and communication), development of rainfall-runoff and flood routing models including data collection (topography, river profiles, historic data, etc.), development of a flood risk forecasting system and the related institutional development for its operation; and development of flood warning and emergency management capacity.

- Managing Disaster Response and Preparedness: This should include development of standard operating procedures to be activated by all agencies and the coordination mechanism for its

observance. It should also include training and capacity building of GoB functionaries at all levels in the methodology and techniques of disaster risk reduction and in post-disaster needs assessments.

- Managing Vulnerability to the Residual Flood Risks: This should include such activities as developing and implementing programs for community awareness building and engagement in flood risk management, and provision of adequate community-owned and community-operated flood warning and emergency response systems;

- Conducting study tours to study successful flood management and erosion control measures in river systems such as the Yellow River (China) and Mississippi River (USA). In addition, researchers at the Center and engineers from the Water Resources Department should explore opportunities to participate at courses and other training events at specialized international technology centers and universities.

Productive Sectors

3.5 Agriculture (Crops, Livestock)

Crops

The floods caused significant damage in the agriculture sector with damage to standing crop and sand-casting of cultivable land. GoB has estimated that 350,000 acres of paddy, 18,000 acres of maize and 240,000 acres of other crops were adversely affected, impacting close to 500,000 farmers.

Detailed district wise breakups of the crop damage and sand-casting are below. District wise, the majority of damage was in Madhepura, followed by Supaul. The Assessment Team verified that sand-casting has occurred at different places from 3-4 feet to 3-6 inches. The northern blocks of Supaul have the maximum level of sand-casting although farmers have re-started cultivation in spite of sand-casting with higher labor and irrigation inputs and lower yields. Discussions with farmers revealed a significant drop (up to 50%) in productivity and increase in input costs. A high number of private tube wells were also damaged by the floods but no baseline data was available to ascertain damage.

Districts	**Paddy (ha)**	**Maize (ha)**	**Other (including (ha)**	**Total (ha)**
Supaul	75,342	642	49,896	125,880
Madhepura	138,320	14,511	106,519	259,350
Saharsa	55,822	15	15,524	71,361
Araria	56,884	0	37,470	94,354
Purnea	27,849	2,739	30,554	61,142
Total				**612,087**

Table 10. Damage to crops by district

Livestock

The floods also affected livestock with GoB reporting 10,000 milk animals, 3000 draught animals, and 2500 small ruminants (e.g. goats and sheep) perishing in the floods. The substantial increase in the price of milk is a direct effect of the drop in supply.

Fisheries

In terms of fisheries, GoB has reported that 519 private and public fish ponds were fully or partially damaged.

Needs

Crops

Recovery requirements in the agricultural sector break down into short-, medium-, and long-term needs. The immediate needs must support the restoration of incomes of small/marginal farmers and the landless. The long-term needs need to be aimed at revitalizing agriculture. The latter may be prioritized for flood-prone districts and eventually extended to all areas.

The overall strategy for recovery in agriculture needs to be tailored for the varying degrees of sand-casting (high, medium and low). In areas with high sand casting, de-siltation would not be financially viable in terms of available technology and cost implications. GoB estimates that 6,000 cubic meters per hectare of sand needs to be removed in such areas. This is impractical as the cost would be exorbitant and large areas would be required for storing removed sand, which would have its own environmental and social implications. Heaping into mounds would not be feasible as sand would continue to scatter over adjacent fields. The cost-benefit of such investments is negative: high costs (Rs. 45,000 per ha, US$1,000) and uncertain benefits.

Therefore, alternative cropping systems such as horticultural and plantation crops (e.g., mango and litchi) is recommended. As fruit crops have long gestation, this would require intermediate support through inter-cropping like fodder for livestock (e.g., *Kash* is a local fodder and grows on sandy soil). However, this would require quality planting material and other inputs for these high-value cash crops. The farmers would also need to be supported with proactive agricultural extension services, technological and marketing support and timely and adequate credit support.

In medium sand casting areas, recovery requirements relate to supporting farmers in shifting to alternate cropping patterns. A start has already been made by some of the farmers who have moved out of the conventional paddy-wheat cropping cycle to gourds and melons that grow better in sandy soil. Extension support services, marketing and credit support would be needed. In addition, restoration of shallow tube wells for groundwater irrigation would be needed. Water user groups (WUGs) should be promoted for optimal utilization, operation and maintenance. Several WUGs can be federated and serve as a node for dissemination of new technologies (e.g., seed drill).

In low/no sand casting areas, efforts need to be made to increase agricultural productivity by strengthening agricultural support services. The focus should be on providing access to critical inputs and disseminating improved technologies for the main crops grown in the area by organizing effective farmer training programs and demonstration farms. This would also require upgrading the knowledge and skills of extension functionaries in the line departments.

Livestock

Most of the farmers and landless own livestock whose productivity is low due to poor genetic potential, inadequate nutrition and poor animal health due to weak systems of disease surveillance and control. While improvement of genetic potential is time-taking, immediate support for improving livestock

potential must be provided through extension services like fodder demonstrations and animal health camps for vaccinations and de-worming.

3.6 Livelihoods

Approximately 2.3 million people were affected by the floods. Of this, approximately 90 percent of the flood affected population's livelihood was dependent on agriculture.[12] With significant damage to agriculture and livestock, livelihoods were severely affected. The floods also affected the households deriving their income from non-farm sources (e.g., potters, basket weavers, etc) and small micro-enterprises due to damage to their productive assets.

Interactions with communities revealed that households have resorted to coping strategies that include:

- **Outward migration:** The decrease in cultivable area and productivity has forced outmigration to labor-deficit areas like Delhi, Punjab and Haryana for wage labor. The affected landless have less access to agricultural labor options and have been compelled to migrate in large numbers.

- **Relying on remittances:** The assessment team's interactions with communities revealed that intra-country remittances form a large part of their income. There were some reports of informal remittance networks that were charging exorbitant rates for money transfer mushrooming in the aftermath of the disaster.

- **Borrowing funds:** In terms of access to credit, the public sector banking system does not have adequate mechanisms to cater to the needs of the population. This has led to local and informal usury. Interactions with communities revealed that the disaster has resulted in an increase in the level of indebtedness. In most cases, debts were taken out for consumption needs like food and healthcare. Interest rates as high as 10 percent per month have been reported in some affected areas. The conjunction of depressed incomes and increased expenditures are forcing affected households into debt traps.

The Assessment Team also learnt that household expenditure on healthcare has gone up after the floods. Sand-casting and lower productivity have also impacted food security among the poorest.

Needs

Overall, there is a need to build a strategy that includes increasing agricultural productivity for small and marginal farmers and helping them diversify their income sources by promoting income from livestock, as well as developing alternative livelihood options in the non-farming sector. The landless who are already involved in micro-enterprises and specialized crafts like pottery or basket-making need to be provided with access to credit and other value chain support like technical support in procurement, design and marketing for reviving their enterprises. Households that are purely dependent on agricultural labor and migration need to be provided with alternative livelihood options like dairy, goat-rearing, nonfarm options including skill-building to enable them access to jobs in the service sector. Livelihood revival must also occur in conjunction with better access to credit, better food security, and a reduction of health-related expenditure

[12] Economic Survey, GoB 2009-10

Immediate needs include focusing on recovery of rural livelihoods of small/marginal farmers and the landless. In Bihar, an ongoing Bank-financed rural livelihoods project, "Jeevika" has been operating since 2007 and is focused on enhancing social and economic empowerment of the rural poor in Bihar. Key project activities include community institutional development, a community investment fund for restoring and improving livelihoods, and improving the quantity of quality of services provision.

This project, aimed at livelihood regeneration, can be extended to the most affected blocks of these districts. The estimated cost of doing so would require an investment of Rs. 147.5 million (US$ 3.4 million) per block. There are an estimated 11 blocks in the Kosi affected areas that require livelihood support. This would cover about 18,000 households per block under the program.

A tentative costing per block is below in Table 11. At 11 blocks, the total cost of the program is Rs. 1622.5 million (US$36.9 million)

Item	**Unit cost per Self-Help Group**	**Number per block**	**Cost per block (INR million)**	**Total cost (11 blocks) (INR million)**
Promoting and building the capacity of community institutions	15,000	1500	22.5	
Revolving fund for restoring and improving livelihoods	80,000	1500	120	
Technical assistance funds	NA	1500	5	
Total Investment			**147.5**	**1622.5 (US$36.9 million)**

Table 11: Estimates for livelihoods support activities per block

Social Sectors

3.7 Education

Educational infrastructure and scholastic calendars were affected in all five districts, mostly in Madhepura and Supaul. The schools in the path of the new river course got completely washed away. About 1428 (19 percent) of total schools in the affected districts were fully or partially damaged. GoB has reported 173 government schools as fully damaged, 481 as partly damaged, and 774 with minor damages. More extensive damage has occurred to elementary and secondary schools than to higher and technical education institutions. Private schools are excluded from these damage estimates.

District-wise Education Sector Damages

The lives of educational administrators, teachers and students were impacted both physically and emotionally. While difficult to quantify, the floods caused psychological trauma and social impact on many students, especially girl students, teachers and educational administrators. In addition, the annual academic calendar was disrupted with a serious impact on students in certifying years for Secondary and Higher Secondary education in India.

Needs

Immediate needs in the education sector are: (a) to reconstruct destroyed educational institutions and repair damaged classrooms in primary, secondary, and all other educational institutions; (b) to set in place a counseling program to address the psycho-social needs of students and teachers; and, (c) to re-distribute pedagogic materials to students that were lost in the floods.

For (a), the need for reconstruction and repair has been estimated at Rs 1.25 billion (US$28.4 million). A summary of needs are in Table 12 below.

Sector	Affected Schools/ Colleges	Total estimated cost of reconstruction/repair (INR, million)
Primary Education	1428	917.26
Secondary Education	105	290.50
Higher Education	7	43.86
Total	**1540**	**1251.63**

Table 12: Estimates of Needs in Education Sector

Access to education is strongly dependent on good roads infrastructure. Connecting each school with a *pukka* (all weather) road from the service villages may improve educational levels by encouraging continued enrollment. In addition, provision of mid-day meals to school children should be strengthened, as well as grants-in-aid to secondary schools.

3.8 Health

The affected districts have inadequate health infrastructure in comparison to Bihar state averages, with the primary health care (PHC) availability ratio at 0.65 per 30,000 persons. Similarly, the sub-centre availability ratio is 0.51 per 5,000 persons. Total health facilities coverage per 100,000 persons in the affected districts is between 9 and 11 while the state average is 11 per 100,000. Thus, basic health indicators such as the crude birth rate, crude death rate, infant mortality rate, and total fertility rate are considerably above the state and national averages.

Already stretched health infrastructure and regular curative and preventive health services were disrupted by the floods. Supaul, Madhepura and Saharsa were the most severely affected. However, no building was completely damaged in any affected district.

The floods jeopardized the health of affected people through food shortages, depleted purchasing power, and the spread of water-borne or food deficiency-related diseases. Casualties were mostly caused by water-borne diseases and drowning. GoB reports state that 11 pregnant mothers perished due to the lack of emergency health facilities. Ailments like viral fever, cough and cold were pervasive. GoB reports indicate that gastro-enteric, dermatological and viral diseases were rampant during and after the floods.

Estimated damages in the health sector are detailed below:

No	**District**	**Partially Affected Units**	**Equipment/Stocks** (INR, Million)
1	Supaul	36	67
2	Madhepura	57	36.5
3	Araria	0	0
4	Saharsa	70	8.8
5	Purnea	8	0
	Total	**171**	**11.23**

Table 13: Damages in the health sector. Source: Estimates provided by GoB

Needs

The immediate need in the affected areas is to strengthen basic health services in the communities, increase outreach services, maintain vector- and water-borne disease control, repair damaged hospitals, and fill the gap need of doctors and paramedical staff. Approximately 48 percent of sanctioned doctors' positions are vacant in the flood-affected districts.

The medium term objective is to eliminate the gross shortages of hospitals as per National Rural Health Mission (NRHM) norms. Post-disaster recovery should be seen as an opportunity to strengthen the existing health system in the affected districts. Provision of basic sanitation, monitoring of water quality, surveillance for epidemic prone illnesses, psycho-social support, measures to prevention of HIV/AIDS are also crucial in these communities. Deployment of mobile medical teams in the most-affected villages is also desirable. A preliminary estimate of the cost for the short and medium term interventions is estimated at Rs.730.2 million (US$16.6 million). These services would be rendered by the public sector.

(INR, Million)

Sl	Item	Supaul	Madhepura	Araria	Saharsa	Purnea	Total
1	POL for Ambulance Service & Vehicles, Engagement of Technician & Medicine	4.7	4.7	4.2	4.2	3.2	16.8
2	POL for Ambulance Service & Vehicles, Engagement of Technician & Medicine includes medicine cost received from GoI	18	18.6	13	17	23	89.6
3	Mobile Medical Teams (Additional medical staff)	13.5	16	14	23	12.6	79.1
4	Control of Vector Borne and Water Borne Diseases and Surveillance	2	18.6	0.69	0.74	0.51	5.8
5	Healthcare in Relief Camps	2.3	2.2	1.5	4.8	4.8	15.6
6	Immunization Campaigns	2.3	2.2	3.2	2.3	4.8	14.8
7	Repair of health infrastructure	103.5	222	0	143.5	39.5	508.5
Total							**730.2**

Table 14: Needs in the health sector. Source: Estimates provided by GoB

3.9 Social

The population of Bihar is 82.8 million.[13] Scheduled Castes and Scheduled Tribes (socially disadvantaged groups) comprise 15.7 percent and 0.9 percent of the total respectively. Approximately 90 percent of Bihar resides in rural areas and depends on agriculture. Bihar's literacy rate is 47.5 percent as compared to a national rate of 65.4 percent. Its sex ratio is 921 compared to the national ratio of 933. Three out of four villages in the affected districts did not have electricity. Bihar scores low on all human development indices and is a low-income state of India with considerable regional disparity in income distribution and a distinct rural-urban divide.

The flood-affected districts are amongst the poorest in India. The total population of these districts is 9.4 million. Araria and Purnea have significant minority community populations while Madhepura and Saharsa have a high density of Scheduled Castes. Work participation rates in all five are higher than the state average, which confirms widespread poverty and depressed wages. Out-migration is a regular cause of poverty. Only 7 to 10 percent of people are engaged in non-agricultural activities. Demographic, occupational, socio-economic and infrastructural factors aggravate the social vulnerability of the area.

Flood-related deaths, diseases and injuries have impacted the social fabric of the affected areas. Livelihoods have been distorted, especially for the poorest. Floods have accentuated pre-existing vulnerabilities with long-term implications in the affected communities, especially weaker sections like women, widows, children, orphans, adolescent girls, the elderly, and socially disadvantaged groups. The fear of future floods further intensifies these prevailing insecurities.

Some other psycho-social impacts are high social costs of homelessness, psychological trauma, poor health, fear of dwelling in damaged houses, and loss of earnings for the homeless. Loss of property documents adds difficulties as proof of title/possession is linked with compensation and reconstruction eligibility.

A very large number of working population of these districts migrates to other parts of India for work due to lack of local employment opportunities and depressed wages. Sand-casting has further reduced agricultural wage labor opportunities. The proportion of out-migration and the duration of such migration have both shot up after the floods. This has increased stress on women, children and the elderly as the migrating workers are generally male heads of households.

Needs

Recovery in the social sector requires holistic integration of human development into disaster preparedness and response, as well as post-disaster reconstruction. Special attention needs to be paid to shelter, livelihoods, social security and the legal requirements of vulnerable groups like orphans, separated children, widows, woman-headed households, single parents, the disabled and the elderly, as well as marginalized groups like scheduled castes and the minorities.

Post-disaster needs include but are not limited to the following:

- Psycho-social counseling initiatives for flood-affected children to help recover from trauma
- Expansion of immunization programs

[13] All figures in this section are from Census of India, 2001.

- Distribution of milk and other basic nutrients
- Regular health check-ups
- Extra classes to cover education losses and the distribution of books and other pedagogic materials to students
- Free health and housing facilities to the elderly and support to sick and disabled
- Social safety nets, pensions and free rations through the public distribution system
- Special monitoring of girl students to stem drop-outs triggered by death of adult females
- Addressing the needs of doctors and teachers, many of whom are under family pressure to permanently relocate out of the flood affected districts
- Restoration of records of property rights for homestead, commercial, and other lands, especially of the poor, scheduled castes, and those living in informal settlements
- Coordination between the education and social welfare departments to attain optimum convergence between schools and ICDS centers
- Involvement of local communities in planning, decision-making, implementation and supervision of post-disaster reconstruction plans. Community participation ensures longer-term community ownership, reduces trauma, and enhances transparency and accountability. An accessible and reliable public grievance redressal system is recommended
- Urgent restoration of public services, including health, education, water supply, power, communications, municipal and environmental infrastructure
- Rapid and targeted support to restore the livelihoods of vulnerable people in the affected areas.

Crosscutting

3.10 Environment

Ganga is the main drainage system of Bihar, bisecting the state into South Bihar and North Bihar with eight major river basins - Ghaghra, Gandak, Burhi Gandak, Bagmati, Adhwara group of rivers, Kamala, Kosi, and Mahananda. The flat terrain and major seasonal variation in the discharge of the rivers cause extensive flooding in the North Bihar plains. Gradients vary from 22 cm per km at the Indo-Nepal border to 7.5 cm per km at the confluence of the Kosi and Ganga. Their minimum and maximum discharges differ widely – 10 to 20 times more in the monsoon causing soil run-offs, swift current and high sediment loads. The rivers decelerate in the plains and deposits sediment loads, causing recurrent shifts in river courses. Kosi has moved westwards by 120 km over time from Purnea to Saharsa and flowed in 12 distinct channels.

The Kosi barrage, afflux bunds and embankments confine the river to flow within embankments. Approximately 246 km of downstream embankments have been constructed to thwart the westward movement of the river. The embankments are 12 - 16 km wide and serve as a silt trap.

In spite of these, Bihar is the most flood-prone states in India with the highest at-flood risk population in India. The recurrent shifts in course of the Kosi cause flooding, water-logging, erosion, sand casting and the emergence of new alluvial land. These new *char* (low-lying diluvia) remain waterlogged for years before they become productive. The Kosi accounts for 25 percent of the total river run-off and 50 percent of total sediment loss of Nepal. Embankments, canals, roads, and railway tracks planned with insufficient geo-technical studies impede the natural drainage of the basin. GoB estimates show that one million hectares of land in Bihar is water-logged, 85 percent of it in North Bihar.

The direct environmental impacts of the floods include: (a) sand casting; (b) soil erosion; (c) debris disposal; (d) damage to water management resources; and, (e) damage to plantations.

The indirect impacts include: (a) pressure on environmental resources in areas receiving the out-migration; (b) environmental degradation due to pollution caused by reconstruction; and, (c) change in land-use due to sand casting. Lack of baseline ecological data and slow onset of impacts make it difficult to assess the specific environmental impacts immediately. Long-term impacts on the ecosystem would require a detailed assessment. Table 15 summarizes the key environmental impacts.[14]

[14] The impact on environmental services such as carbon sequestration, water flow regulation, fishery habitat and agro-forestry is not quantifiable due to paucity of data.

Type of Impact	Severity	Extent	Recovery	Cost
Physical/Natural Environment				
Sand Casting	Very Severe	Extensive	Long Term	Vey High
Soil Erosion/ Destabilization	Severe	Extensive	Long Term	High
Sedimentation of water bodies	Moderate	Extensive	Long Term	Incalculable
Washing of debris onto land water	Low	Local	Medium Term	Moderate
Water Contamination	Moderate	Local	Medium Term	Moderate
Biological/Social Environment				
Impact on human health	Very Severe	Extensive	Medium Term	High
Loss/damage of vegetation cover	Moderate	Moderate	Medium Term	Moderate
Impact on livestock	Severe	Extensive	Medium Term	High

Table 15: Summary of key environmental damages

Sand Casting: Sand casting has rendered about 4,828 sq. km barren. The impact is intractable as there seems to be no financially viable solution for heavy sand casting. Table 16 provides the details.

S. No.	District	Affected Area (Ha)
1	Sapaul	74,000
2	Madhepura	58,000
3	Saharsa	97,000
4	Purnea	15,000
5	Araria	40,000
	Total	284,000

Table 16. Area affected by sand casting

Sanitation and Waste Management: Open defecation is a common practice as most households do not have latrines. Safe defecation was a key issue during the floods. Villagers generally used *tila*[15], road and railway embankments or boats for defecation. Hygiene, modesty, and water quality suffered.

Debris: No baseline or damage data was available on this. In rural areas, debris was less concentrated. However, as a large number of buildings were destroyed or damaged, the cumulative debris is significant. Its hazardous disposal would create unwarranted environmental impacts.

Vegetation Cover: People depend on timber, bamboo and fuel wood for various needs. Tree-felling for fuel wood and transitional shelter needs during and after the floods also added to the loss of vegetation cover that used to arrest erosion. In Birpur Forest Division, 66.4 percent of the saplings planted along canals and roads in 2008 were destroyed. Damages in other divisions were not available to the Assessment Team.

Impact to Water and Water Management Resources: Environmental impacts of damages to water infrastructure include (a) contamination of surface water; (b) contamination of shallow ground water due to poor sanitation, waste management and improper disposal of animal carcasses.

Environmental Degradation linked to Reconstruction: Reconstruction would require production, transport and usage of vast quantities of construction materials (cement, bricks, earth, water etc). This will further strain the environment.

[15] Village high lands

Changes in Land Use: The above factors would combine to force change in land use patterns. This is specifically true for areas where extensive sand casting and water logging have rendered reclamation unviable. The involuntary outmigration from degraded areas will also force a change in the land use of the receiving areas where exploitation of land would intensify due to demographic pressure.

Needs

Environmental degradation, settlement patterns, livelihood options and behavior contribute to disaster risk. This in turn adversely affects human development and generates a vicious circle of environmental degradation. Inadequately planned recovery processes that fail to take into account the state of environment and ecosystem services may aggravate existing vulnerabilities or create new ones. Several issues pertaining to post-disaster reconstruction in housing, infrastructure and livelihood restoration have environmental implications. Therefore, sound environmental planning and management must be integrated into the short-, medium- and long-term reconstruction plans.

Immediate needs

- Identification of location-specific sustainable options for reconstruction of housing and infrastructure and for livelihood restoration in consultation with communities, NGOs and experts
- Development and implementation of guidelines for of debris/rubble disposal to prevent hazardous disposal to minimize environmental impact
- Development of environmental and social guidelines for sectoral reconstruction efforts
- Establishment of an empowered co-ordination mechanism to facilitate dovetailing of the environmental priorities into various sectoral reconstruction programs.

Medium-term needs

Needs in the medium term include: (a) a comprehensive environment and social impact assessment, including analysis of alternative livelihood options in affected areas; (b) assessment and monitoring of environmental and health risks, specifically during infrastructure reconstruction; and; (c) strengthening of the institutional capacity to better manage environmental risks.

Long-term needs

The complex nature of the Kosi Basin necessitates integrated planning and management, including water resource management, sediment control, livelihood diversification, maintaining ecological balance, food security, safe water supply and over-all socio-economic development of the vulnerable population. In the longer-term, strategies need to be developed and executed for reducing vulnerability from future disasters and better disaster response preparedness. Scientific flood hazard mapping and appropriate land use planning in flood-prone areas is recommended.

Recommendations for DRR-led Reconstruction

The following recommendations have the objective of facilitating an environmentally sustainable rehabilitation and reconstruction program for flood-affected areas in Bihar:

Mainstreaming environmental considerations into sectoral interventions: There are environmental dimensions to every sector affected by the Kosi flood. This implies that environmental issues should be

factored in the sectoral reconstruction plans, particularly in the Roads, Bridges and Water Resources Management sectors. Such plans must ensure that the broader ecosystem is not jeopardized as an unintended spin-off. Ideally, the plans should improve the ecosystem for long-term sustainable development. 'Soft' options with minimal impact on environment should be preferred over 'harder' options as far as possible.

Lessons Leant: Lessons from historical trend analyses of the nature, causes and effects of disaster impacts should inform a cross-sectoral disaster risk reduction strategy. The disaster offers an opportunity to assess and monitor the resilience of natural and modified ecosystems. This will help plan customized disaster risk mitigation strategies.

Focus on socially acceptable solutions: Economic, environmental, psycho-social and cultural factors must be considered in devising disaster risk mitigation strategies. Solutions must be contextualized to local situations.

Need for an integrated water resource management planning: Human interventions to control river systems have many consequences, as these are organic systems and any interference can have unintended impacts. Thus, integrated planning for sustainability of environmental goods and services is of paramount importance. This in turn will assist poverty reduction, reduce vulnerability to natural hazards and improve livelihood systems to promote equitable development. The entire reconstruction plan should also be framed within the broader context of an integrated water resource and flood management plan.

Section 4 Crosscutting Challenges and Opportunities

A number of factors, including high population density, low socio-economic development, inadequate maintenance of existing flood infrastructure, and weak institutions for water resources and disaster risk management, pose both challenges as well as opportunities for holistic development in post-disaster reconstruction; effectively, a window of opportunity for "building back better" and accelerating economic development in Bihar.

The following are key major challenges for recovery in the region:

4.1 Enhancing economic development

Bihar is the third most populous state in India with nearly 8.5 percent of the country's population. Although there have been many positive developments in the areas of economic growth, female literacy, infant mortality, and other areas, the state remains one of the poorest in India with 42 percent living below the poverty line and a rural poverty ratio of 45 percent. The average annual per capita income of Bihar at $148 is a third of the national average of $997. The state is also highly rural with 89 percent of the population living in rural areas and a rural poverty ratio of 44.3 percent in 2004, the second highest after Orissa. Even with low urbanization, urban poverty in Bihar stood at 32.9 percent as compared to the national average of 23.6 percent.

The economy of Bihar is service-oriented with an agricultural base. The state has a small industrial sector. In 2008, agriculture accounted for 35 percent, industry 9 percent, and services 55 percent of the economy of the state. Manufacturing performed poorly between the period 2002–2007 with an average growth rate of 0.38 percent compared to the national rate of 7.8 percent. Bihar has the lowest GDP per capita in India but there are pockets of higher per capita income: Patna, the capital city, has a per capita income greater than that of Bangalore or Hyderabad. The GSDP today stands at Rs 1124.24 billion (Rs. $21 billion nominal GDP). The current annual growth in GSDP is 11.44 percent and per capita GSDP is Rs.10,415. In terms of GSDP, Bihar is ranked 14th out of 28 Indian states in 2008. Transparency International India has found corruption to be an important challenge for the government to overcome. GoB has taken many measures to enhance transparency and accountability and has also initiated economic and social reforms. These measures have had a salutary impact on the economy. The Doing Business Report 2009 ranked Patna as the second best city in India to start a business, after Delhi. It also ranked Patna second in enforcement of contracts, ninth in dealing with construction permits, fifteenth for paying taxes and registering property, tenth for trading across borders, and fifteenth for closing a business. Overall, the city was placed 14th.

Year	GSDP (Rs. billion)	% change
2000-2001	572.79	+14.10
2001-2002	578.04	+0.92
2002-2003	651.17	+12.65
2003-2004	669.61	+2.83
2004-2005	737.91	+10.20
2005-2006	796.82	+7.98
2006-2007	942.51	+18.28

Table 17. GSDP at Current Prices 2000-2007
Figures as of Feb 2008. Source: Ministry of Statistics & Programme Implementation, GoI

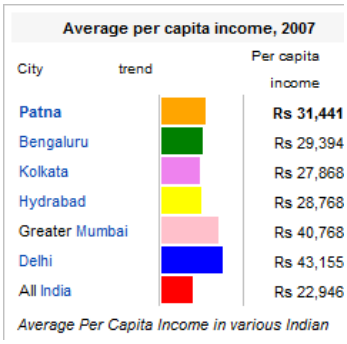


Figure 5. Average per capita income in select Indian cities

There is a North-South dichotomy in Bihar's human development. The southern districts have far larger income profiles than the at-risk north Bihar districts which include the flood-affected areas of Saharsa, Madhepura, Supaul, Araria, and Purnia. These five districts were amongst the least developed even before the 2008 floods. Available district-level indicators show that they lagged behind the state as a whole: literacy rates were lower than the state average of 47.5 percent, and lower than in neighboring districts (apart from Katihar and Kishanganj which lie further east). Female literacy rates were even lower, less than 20.5 percent on average. Since the 2001 Census, gains were made in elementary education, with near-total enrollment in Grades 1-5 but continuing low enrollment, ranging from 28 to 33 percent, in upper grades (VI-VII), according to the monitoring system of the SSA scheme (NUEPA 2009). Neighboring districts performed marginally better with almost total enrollment in lower grades and enrollment in upper grades ranging from 30 to 40 percent.

The state of infrastructure was poor in these districts. Rural connectivity levels were extremely low, with less than half of the villages in each district having access to a paved road (Census 2001). In addition, a recent World Food Program report, using data from 1998-2005, classifies three out of the five districts (Araria, Madhepura, and Purnia) as priority districts for food security intervention on the basis of a food security index which aims to measure availability, access, and absorption.

Therefore, there is a need for addressing low human development in these districts through reconstruction activities aimed at reducing long-term vulnerabilities of affected and at risk communities.

4.2 High Disaster Risks

The State of Bihar is highly flood prone: 30 of its 38 districts comprising 73 percent of its geographical area are flood prone and afflicted by floods almost annually, especially from the rivers west of the Kosi River. Bihar's hydrological vulnerability is aggravated by its flat topography, high rainfall (more than 2,500 mm annually and up to 80 percent of annual precipitation from June to

Figure 6. Hydrological Map of the Ganga Basin in Bihar

September), and high sediment loads of rivers.

Figure 7. Silt deposition near Kosi embankment at Navbhata, Saharsa, Bihar

The plains of north Bihar are drained by many rivers with catchments in the Himalayas. Kosi, Gandak, Burhi Gandak, Bagmati, Kamala Balan, Mahananda and Adhwara Group of rivers originate in Nepal and carry very high discharge and sediment loads. Since independence, Bihar had four other catastrophic flood events, in 1954, 1974, 1987, and 2004. However, the 2007 monsoon floods were Bihar's worst natural floods in 20 years, affecting more than 24 million people, killing nearly 1,000 people, and destroying over 700,000 homes. Historical flood damage data in 1979-2006 can be found in Annex 4.

The Kosi River is the main cause of recurrent floods in north Bihar. The river runs through a steep gradient in Nepal. Rainfall in the Kosi catchment in Nepal overloads the barrage compelling release from the Barrage which causes floods and water-logging in north Bihar. The heavy discharge from the Barrage causes downstream Bagmati, Burhi Gandak and Ganga rivers to inundate. In addition, the discharge carries enormous amounts of sandy silt that gets deposited over arable land and renders it fallow.

The timeline of past floods in Bihar is as follows:

Figure 8. Flood risks in Bihar

1998: Embankment damage along Burhi Gandak, Bagmati, Adhwara and Kosi rivers accounted for 381 deaths, asset damage worth Rs 1 billion and crops damage of Rs 3.67 billion.

1999: Excessive precipitation in the catchments caused flooding of Kamala Balan and Kosi rivers. Crop damage was estimated at Rs 2.5 billion and property damage another Rs 0.5 billion.

2000: Eastern Kosi Afflux Bund breached due to excessive discharge caused by heavy rainfall. This flooded 12351 villages. Crop damage was estimated at Rs 0.8 billion.

2001: Breaches in Kosi, Bhutahi Balan, Bagmati and Burhi Gandak embankments. Crop and property damages were estimated at Rs 2.6 billion and Rs 1.8 billion respectively.

2002: Kamala Balan left and Khiroi right embankment overtopped. The floods caused 489 deaths. Crop and property damages estimates stood at Rs 5 billion and Rs 4 billion respectively.

2003: Ganga surpassed the 1978 HFL at Bhagalpur and the 1994 HFL at Patna.

2004: Heavy rainfall caused 53 embankment breaches in Bagmati, Burhi Gandak, Kamala Balan, Bhutahi Balan and Adhwara rivers. 885 deaths were reported. Crop and property damages were assessed at Rs 5 billion and Rs 10 billion respectively.

2007: Heavy rainfall caused 28 breaches in Burhi Gandak and Bagmati embankments causing extensive damage to life and property.

2008: Eastern Kosi Afflux Bund breaches upstream and Kosi river floods five districts in north Bihar

In addition to floods, North Bihar is also vulnerable windstorms. The at-risk from floods districts are also exposed to geo-morphological risks from earthquakes. Araria and Supaul lie in seismic hazard Zone V while Madhepura, Saharsa and Purnea lie in Zone IV.

High hazard risk compounded by low human and economic development in the State, relatively insufficient capacity and other resources for proper planning and execution of disaster risk reduction programs, significantly increase vulnerabilities.

4.3 Flood Risk Management

Embankments

The Kosi embankments were built in late 1950s to contain the Kosi River, one of the largest tributaries of the Ganga. At this time, Bihar had approximately 160 km of embankments and 2.5 million hectares of flood prone areas. Approximately 50 years later in 2004, Bihar had 3,465 km of embankments but its flood risk has increased 2.5 times.

Close to 86 percent of the state's embankments (2952 km) are in north Bihar. Their purpose is to protect 61 percent of the flood prone area in Bihar, however, in actuality, the rivers that have been embanked, (including the Kosi) have reduced channel capacity due to increased siltation which, in turn, has resulted in more frequent and severe floods from infrastructure-related issues. Approximately 16 percent of north Bihar is susceptible to protracted water-logging.

Furthermore, embankments fail with regularity during each major flood. The following breaches have occurred in the past:

1963: The first breach on the western embankment in Nepal

1968: Five breaches in north Bihar

1971: Collapse of the 1969-built Bhatania Approach Bund

1980: Eastern Embankment breach

1984: Eastern embankment breach

Box 4. The Kosi River and its Catchment

Kosi originates at 7000 m above mean sea level (MSL) in the Himalayas. It enters India at Hanuman Nagar, Nepal and drains into the Ganga in Bihar, India. Its total catchment is 74,030 sq km of which 11,410 sq km is in India. The catchment area is home to 6.6 million people. The catchment has an annual average rainfall of 1456 mm and total discharge of 52219 million cubic meters. Its main tributaries are Bagmati, Kamala Balan, Bhutahi Balan, Trijuga, Fariani Dhar and Dhemama Dhar.

Tectonic forces are elevating Kosi's gradient by 1 cm per year, aggravating erosion, inundation and sedimentation. Its annual sediment load is currently estimated at 100 million cubic meters. This is projected to grow six-fold to gradient elevation.

As the gradient flattens in north Bihar, the river decelerates and deposits the sediment to on its bed. This elevates the bed progressively, forcing the river to break out to lower terrain, which it again begins to elevate by siltation. Thus, one of the world's largest conical alluvial fan over 15,000 sq km has evolved over centuries. Kosi records a flow of over 25,000 cubic meters per second (cumecs) where it exits the Himalayan foothills – enough to flood the entire alluvial fan with 1.5 meters in a week. This is a rough index of the flood vulnerability of the Kosi catchment.

1991: Breach in the western embankment near Joginia in Nepal
2008: Breach in eastern embankment

A cornerstone for effective recovery in the Kosi affected area and mitigation of future flooding is a comprehensive flood control plan for embankments including better planning, execution, operations and maintenance.

Upstream disaster risk management and flood management measures

The flooding of the Kosi river is less a national issue than a transnational one. Lack of adequate upstream containment and mitigation measures in neighbouring Nepal comprises a large part of the disaster risk profile of north Bihar. Although this Needs Assessment has focused only on Bihar, there is a need to connect upstream flood management activities to ensure that there is a comprehensively planned flood risk management system.

Going forward

Bihar has extensive resources (land, water and human) and economic potential. In order to catch up with the national growth rates, Bihar needs to manage its flood risk in a holistic and outcomes-driven manner. It is essential that immediate steps are planned and executed to prevent and mitigate the impacts of future floods and to improve the state's adaptation given the hydrological and tectonic inevitability of more frequent and more devastating floods in the future.

Short-term flood management activities in Bihar should focus on the Kosi basin. It should emphasize: (i) risk reduction from future flooding of the Kosi through a combination of structural and non-structural measures; and, (ii) development of an overall state-wide holistic flood risk management master plan.

The long-term measures should scale the Kosi-specific measures to the entire State of Bihar. It should also see the implementation of priority activities of the integrated flood risk management plan formulated under the short-term. Indicative examples of activities (some of which were already detailed in Section 3.4) are briefly described below.

- Institutional Priority Measures include the implementation of the optimum institutional structure for future flood management. One agency should be responsible for the design, construction, management, operation, and maintenance of flood management infrastructure. However, for fully integrated flood management, it is essential to establish effective partnerships with other technical and administrative agencies to coordinate flood management planning on an ongoing basis, not just during and immediately after floods. Agency restructuring will have to be kept to a minimum and will include a program of capacity building and a comprehensive training and awareness program to be able not only to carry out the needed functions, but also to raise the exposure of staff at all tiers of government about integrated flood management.

- Structural Priority Measures need to be technically feasible and economically and environmentally viable. Examples that could possibly be implemented are construction of new embankments or reconstruction and/or rehabilitation of existing embankments, linking of rivers, and catchment rehabilitation.

- Managing Exposure to Flood Hazards can include the development of detailed flood hazard maps by application of hydrological and hydraulic modeling, coupled with digitally available terrain data and GIS. This will have to be linked to the development of a program to enforce compliance with the flood hazard mapping, which is typically a task for district administrations.

- East Kosi Main Canal. WRD has proposed the lining of the main canal and its distributaries at a great cost. Before this can be considered by the World Bank under a separate project a detailed technical feasibility study would have to be carried out to determine the technical applicability, technical and environmental benefits (reduction in seepage, water savings, easier operation and maintenance, etc.), the economic and financial cost-benefit analysis, and a detailed implementation program.

4.4 Disaster Risk Management

Disaster risk management, in particular, flood risk management in Bihar has suffered from multiple weaknesses. The absence of comprehensive data and knowledge management systems on water and land is one the central challenges leading to delayed or inadequate decision-making capacity in GoB. In terms of data, inaccessibility to topographic data has curtailed attempts at detailed surveys that are essential to map and forecast inundations. With the trans-border nature of Kosi river, timely dissemination of information is essential as well as the sharing of real-time and historical gauge data obtained through bilateral arrangements with neighbouring country, Nepal, as well as vulnerable communities. Past efforts, even when implemented, have been inadequate and have resulted in less-than-effective and even counterproductive outcomes.

The absence of an effective asset management system has also curtailed effective disaster management in the state. The embankments are old and there are currently no adequate asset inventory or operations and maintenance systems in place.

Finally, adding to the difficulties in the growth of preparedness and risk reduction is the system of disaster relief and humanitarian aid which are event-driven and highly responsive to catastrophic events. Knowing that disasters will be taken care of through emergency funding – either internally or externally – has been a powerful incentive against prevention and mitigation in the State.

Therefore, effective recovery needs to include the development of optimal institutions for state-wide flood management. There is a need to streamline the disaster management institutional framework and one agency should be responsible for the design, construction, management, operation, and maintenance of flood management infrastructure. However, for fully integrated flood management, it is essential to establish effective and empowered coordination mechanisms with other technical and administrative agencies to better coordinate flood management planning on a routine basis which has been, until now, limited to periods during and after floods. Agency restructuring should be minimal and must include a program of capacity building, and training and an awareness generation to sensitize government staff and communities about integrated flood management

Going forward

Reducing Disaster Risk

This includes various mechanisms including the development of detailed flood hazard maps by application of hydrological and hydraulic modeling, coupled with digitally available terrain data and GIS. This will have to be linked to the development of a program to enforce ground compliance with the flood hazard mapping, which is typically a task for district administrations.

Managing Disaster Response and Preparedness

This includes the development of standard operating procedures to be activated by all agencies and the coordination mechanism for its observance. It should also include training and capacity building of GoB functionaries at all levels in the methodology and techniques of disaster risk reduction and in post-disaster needs assessments.

Managing Vulnerability to the Residual Flood Risks

This includes activities such as developing and implementing programs for community awareness building and engagement in flood risk management, and provision of adequate community-owned and community-operated flood warning and emergency response systems.

4.5 Conclusions

Repeated large-scale loss events in Bihar have brought significant destruction, hindering economic performance and depriving communities of their assets, livelihoods, and labour force, all too often locking them into endemic poverty cycles. And each year, the State is plagued with the same disasters, impacting thousands of people, destroying lives and livelihoods, and necessitating the externalization of disaster response.

The devastation wrought by disasters in the region, however, has also presented an opportunity to initiate improvements in quality of life and changes in attitudes about risk while undertaking reconstruction tasks. As seen in examples across the region, good reconstruction after a disaster can help revive the local economy, restore livelihoods, and improve access to housing, its quality and safety, as well as social and community infrastructures. Peoples' participation in reconstruction activities such as through owner-driven reconstruction, reinforces equity and strengthens community networks.

While the measures in the needs assessment point to a number of specific interventions and activities, the real challenge in the region is to ultimately achieve institutional paradigm shifts towards mainstreaming disaster risk management in the State rather than one-time initiatives focusing on small groups of people, or led through short-term project approaches. There is an urgent need for long-term transformations on how we manage risk to ensure that the normal stay of development interventions is not put in jeopardy.

Section 5 Recovery Framework

Proposed recovery framework

In order to address the short-, medium-, and long-term needs of recovery, a phased approach for reconstruction is recommended. The objectives of this approach are to provide timely and focused support to Bihar's reconstruction efforts in the short-term while developing and comprehensive program of support for the state's longer term needs on overall disaster management, in particular, for flood risk management and sustainable interventions in the areas of agricultural productivity and roads.

In April 2010 during a World Bank mission, the GoB agreed on the proposed Recovery Framework. Essentially, the agreed Framework stipulates that in Phase-I, the Bank would provide funds for reconstruction and restoration of priority infrastructure, housing reconstruction and livelihoods restoration of the affected population in the Kosi Command Area. GoB would dovetail its own resources and those of GoI (like IAY, TSC etc) to obtain higher synergies. Phase-II of the Recovery Framework envisages the enlargement of the interventions to the entire disaster-prone areas of Bihar in and beyond the Kosi Command Area.

Table 18: Proposed Recovery Framework

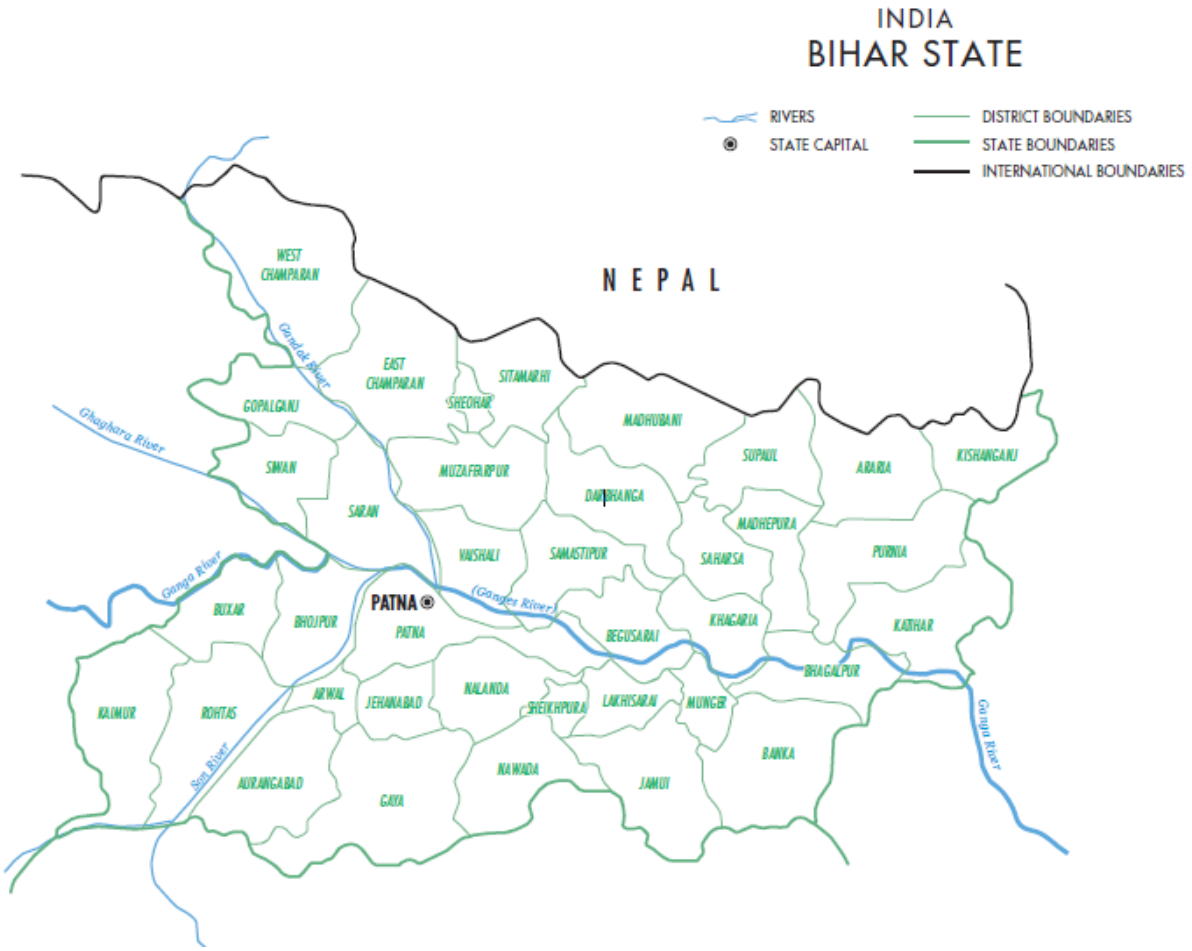
Draft Framework for World Bank Assistance	
Phase I: Short and Medium Term	**Phase II: Medium and Long Term**
• Housing • Roads / Bridges • Livelihood Support • Kosi related Flood Management • Technical Assistance & Capacity Building, Project Management Support	• Gaps from Phase I • State-wide Flood Risk Management • Disaster Management • Agriculture Productivity • Roads

The phased strategy integrates recovery and reconstruction tasks as part of a larger multi-sectoral dialogue on disaster risk and vulnerability reduction, increased agricultural productivity and connectivity and overall development. The framework is based on the following considerations:

- Phase-I would allow faster delivery of short-term reconstruction assistance, which is particularly urgent as considerable time elapsed between the disaster and posing of the project to the Bank
- Phase-I would ensure that an effective implementation structure is established for delivery of project objectives and would be available for longer-term engagements in Phase-II
- Phase-I would include critical technical assistance for capacity development to deliver Phase-II satisfactorily.
- The phased approach allows faster delivery of reconstruction assistance which is particularly important as considerable time has elapsed since the Kosi floods

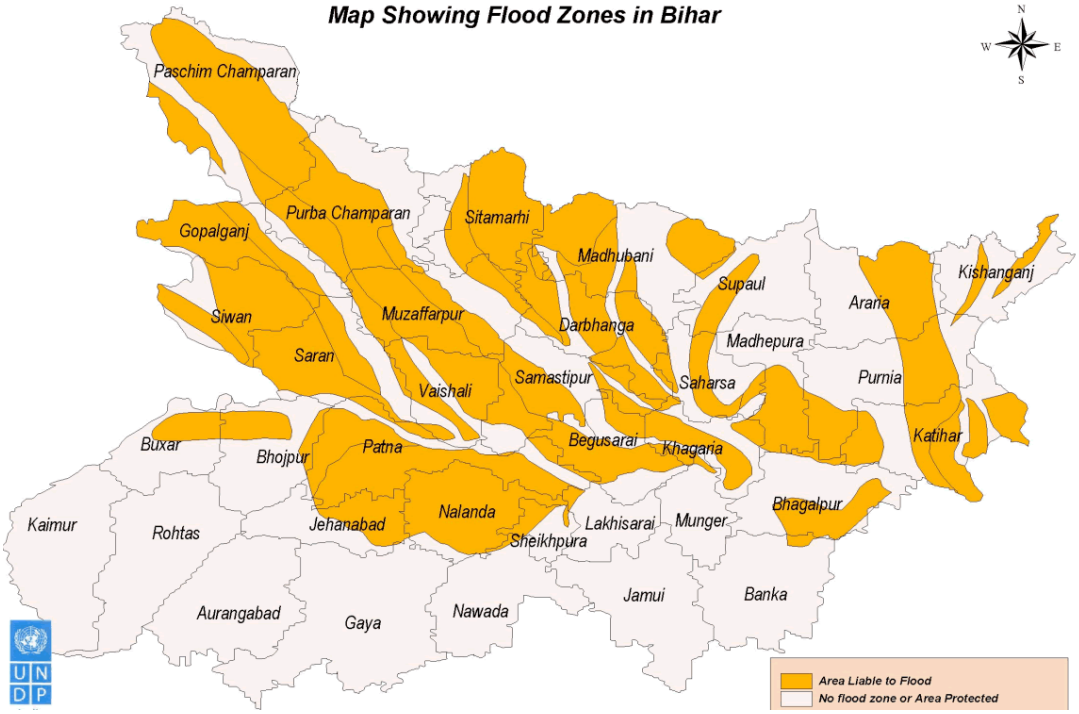
- The first phase facilitates an effective implementation structure to be set in place that will be responsible for the delivery of the project and would also engender larger future engagement
- The first phase includes key technical assistance programs that would assist in developing capacity, strategy, and activities for Phase II
- The preparation for Phase II can start simultaneously with the preparation of Phase I
- Given the nature of the activities envisioned, Phase II would not be limited to the Kosi affected areas but will have a state wide footprint in order to comprehensively address the targeted sectors and contribute to the overall economic development of the state

Annex 1


INDIA
BIHAR STATE
RIVERS
STATE CAPITAL
DISTRICT BOUNDARIES
STATE BOUNDARIES
INTERNATIONAL BOUNDARIES
NEPAL
WEST CHAMPARAN
Gandak River
EAST CHAMPARAN
SITAMARHI
SHEOHAR
GOPALGANJ
Ghaghara River
MADHUBANI
SUPAUL
ARARIA
KISHANGANJ
SIWAN
MUZAFFARPUR
DARBHANGA
SARAN
MADHEPURA
VAISHALI
SAMASTIPUR
SAHARSA
PURNIA
Ganga River
PATNA
(Ganges River)
BUXAR
BHOJPUR
PATNA
KHAGARIA
KATIHAR
BEGUSARAI
BHAGALPUR
KAIMUR
ROHTAS
ARWAL
JEHANABAD
NALANDA
SHEIKHPURA
LAKHISARAI
MUNGER
Ganga River
Son River
BANKA
AURANGABAD
NAWADA
JAMUI
GAYA

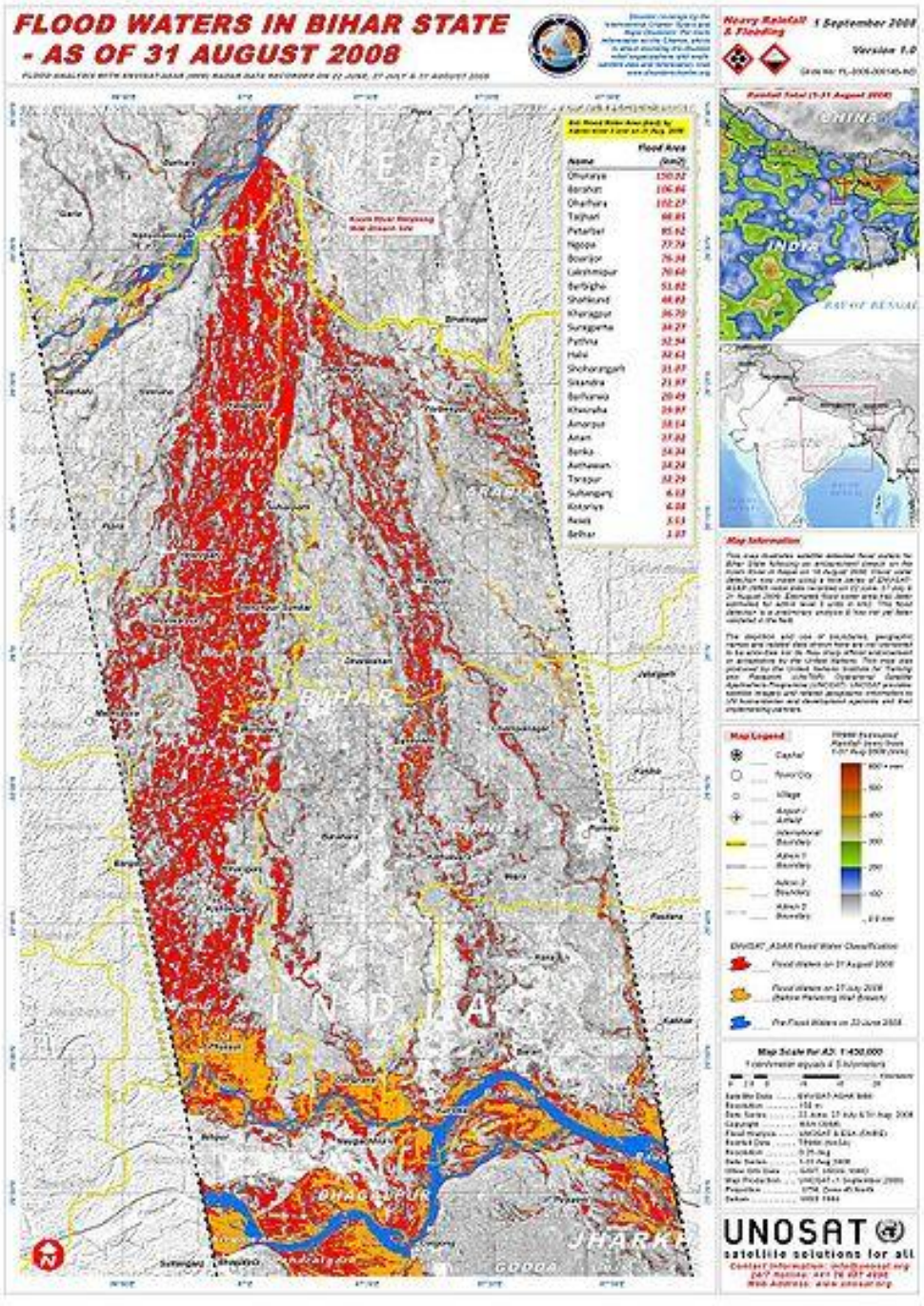
Annex 2

Visual of 2008 Kosi River Flooding in Bihar


Map Showing Flood Zones in Bihar
N
W
E
S
Paschim Champaran
Purba Champaran
Sitamarhi
Madhubani
Supaul
Kishanganj
Araria
Gopalganj
Siwan
Muzaffarpur
Darbhanga
Madhepura
Saran
Vaishali
Samastipur
Saharsa
Purnia
Katihar
Buxar
Bhojpur
Patna
Begusarai
Khagaria
Bhagalpur
Nalanda
Kaimur
Rohtas
Jehanabad
Lakhisarai
Munger
Sheikhpura
Jamui
Banka
Aurangabad
Gaya
Nawada
UN
DP
Area Liable to Flood
No flood zone or Area Protected

Annex 3

Satellite Imagery of 2008 Kosi Floods



Annex 4

Total Damage in Bihar due to floods in 1979-2006

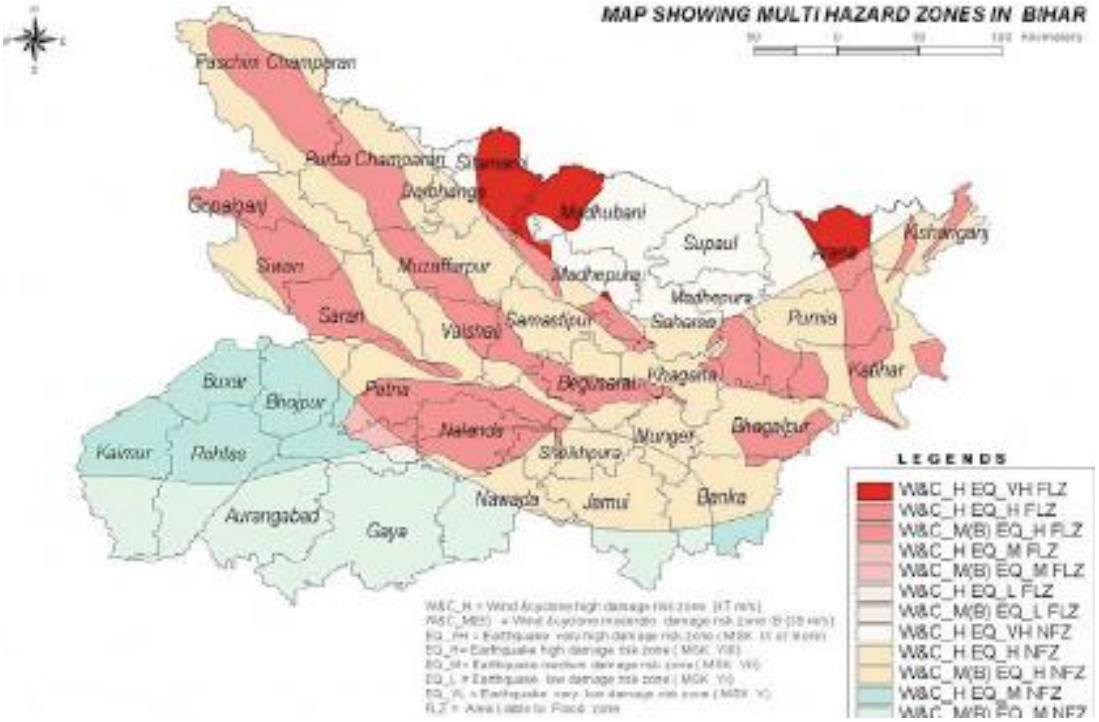
Total Affected and Damaged in Bihar due to flood 1979–2006[1][2]

Year	District	Blocks	Panchayat	Village	Human (in Lakh)	Animal (in Lakh)	Total Area (in Lakh ha)	Cropped area (in Lakh ha)	Crop Damaged (in Lakh INR)	House Affected	Public Property Damaged (in Lakh INR)
2006	14	63	375	959	10.89	0.1	1.81	0.87	706.63	18,637	8,456.17
2005	12	81	562	1,464	21.04	5.35	4.6	1.35	1,164.50	5,538	305
2004	20	211	2,788	9,346	212.99	86.86	27	13.99	52,205.64	9,29,773	1,03,049.60
2003	24	172	1,496	5,077	76.02	11.96	15.08	6.1	6,266.13	45,262	1,035.16
2002	25	6	2,504	8,318	160.18	52.51	19.69	9.4	51,149.61	419,014	40,892.19
2001	22	194	1,992	6,405	90.91	11.7	11.95	6.5	26,721.79	222,074	18,353.78
2000	33	213	2,327	12,351	90.18	8.09	8.05	4.43	8,303.70	343,091	3,780.66
1999	24	150	1,604	5,057	65.66	13.58	8.45	3.04	24,203.88	91,813	5,409.99
1998	28	260	2,739	8,347	134.7	30.93	25.12	12.84	36,696.68	199,611	9,284.04
1997	26	169	1,902	7,043	69.65	10.11	14.71	6.55	5,737.66	174,379	2,038.09
1996	29	195	2,049	6,417	67.33	6.6	11.89	7.34	7,169.29	116,194	1,035.70
1995	26	177	1,901	8,233	66.29	8.15	9.26	4.24	19,514.32	297,765	2,183.57
1994	21	112	1,045	2,755	40.12	15.03	6.32	3.5	5,616.33	33,876	151.66
1993	18	124	1,263	3,422	53.52	6.68	15.64	11.35	13,950.17	219,826	3,040.86
1992	8	19	170	414	5.56	0.75	0.76	0.25	58.09	1,281	0.75
1991	24	137	1,336	4,096	48.23	5.13	9.8	4.05	2,361.03	27,324	139.93
1990	24	162	1,259	4,178	39.57	2.7	8.73	3.21	1,818.88	11,009	182.27
1989	16	74	652	1,821	18.79	0.35	4.71	1.65	704.88	7,746	83.7
1988	23	181	1,616	5,687	62.34	0.21	10.52	3.95	4,986.32	14,759	150.64

Source: GoB. Note: INR 1 lakh = INR 0.1 Million

Annex 5

Multi-hazard Risk Profile of Bihar




Map Showing Wind and Cyclone Zones in Bihar
Paschim Champaran
Purba Champaran
Sitamarhi
Gopalganj
Madhubani
Supaul
Kishanganj
Araria
Siwan
Muzaffarpur
Darbhanga
Madhepura
Saran
Vaishali
Samastipur
Saharsa
Purnia
Buxar
Bhojpur
Patna
Begusarai
Khagaria
Katihar
Bhagalpur
Kaimur
Rohtas
Jehanabad
Nalanda
Lakhisarai
Munger
Sheikhpura
Aurangabad
Gaya
Nawada
Jamui
Banka

Annex 6

Selected multilateral and bilateral support for Kosi Floods recovery activities

Donor	Channel	Description	Funding USD
Central Emergency Response Fund (CERF)	UNFPA	CERF rapid response grant to project: Humanitarian Response to Affected Children and Displaced Communities in Northern Bihar	281,196
Central Emergency Response Fund (CERF)	UNFPA	CERF rapid response grant to project: Supply of Dignity Kits and Psycho social counselling for Flood Affected women and adolescent girls in Bihar	342,400
Central Emergency Response Fund (CERF)	UNICEF	CERF rapid response grant to project: Humanitarian Response to Affected Children and Displaced Communities in Northern Bihar	2,266,319
European Commission Humanitarian Aid Office (ECHO)	Save the Children - UK	Emergency food relief to Bihar flood affected communities (ECHO/-FA/BUD/2008/01088)	261,999
European Commission Humanitarian Aid Office	Medcin sans Frontier	Emergency Medical Aid and Relief for displaced people and affected population by floods in Bihar State, Republic of India Sept08 (ECHO/ -SA/BUD/2007/03022)	264,151
European Commission Humanitarian Aid Office (ECHO)	Chr. Aid-UK	Emergency Food Relief in Madhepura District Bihar (ECHO/-FA/BUD/2008/01092)	290,990
European Commission Humanitarian Aid Office (ECHO)	MSF - Netherlands	Health and Medical - Bihar Flood Intervention (ECHO/-SA/BUD/2008/02005)	347,150
European Commission Humanitarian Aid Office (ECHO)	HI/France	Health and Medical - Support to Vulnerable Persons in the displaced camps of the Araria and Purnea districts in Bihar (ECHO/ -SA/BUD/2008/02001)	364,991
European Commission Humanitarian Aid Office (ECHO)	OXFAM GB	Food - OXFAM GB Floods response Proposal 2008, Bihar, India (ECHO/-FA/BUD/2008/01082)	369,276
European Commission Humanitarian Aid Office (ECHO)	ACTED	Emergency nutrition, therapeutic/supp.feeding to stranded people and IDPs in Supaul District, Bihar State (ECHO/-SA/BUD/2008/02002)	450,841
European Commission Humanitarian Aid Office (ECHO)	Action Aid	Food - Relief and Rehabilitation of people affected by floods in Bihar (ECHO/ -SA/BUD/2008/02008)	455,145
European Commission Humanitarian Aid Office (ECHO)	Caritas Germany	Emergency food relief for flood-affected people in 2 districts of Bihar State (ECHO/ -SA/BUD/2008/02009)	524,175

European Commission Humanitarian Aid Office (ECHO)	Chr. Aid-UK	Emergency Fod Relief in Madhepura District Bihar (ECHO/-SA/BUD/2008/02007)	622,050
European Commission Humanitarian Aid Office (ECHO)	CARE-UK	Water / Sanitation-Humanitarian Response for flood victims of Kosi Floods in North Eastern Districts of Bihar (ECHO/-SA/BUD/2008/02006)	726,174
European Commission Humanitarian Aid Office (ECHO)	OXFAM GB	Water / Sanitation - Emergency Response to Bihar Floods (ECHO/-SA/BUD/2008/02004)	732,064
France	ACTED	Assistance aux personnes deplacees	147,710
Hong Kong Special Administrative Region of the People's Republic of China	NGOs	To undertake relief projects for the flood victims in India	629,872
Ireland	HelpAge International	Flood relief	125,697
Ireland	Christian Aid	To alleviate the immediate humanitarian food needs of the flood affected people in Supaul District (CAID 08 01)	147,710
Ireland	Trocaire	Enable flood affected families to return to normality through the provision of relief assistance (TRO 08 08)	147,710
Italy	IFRC	To assist affected population	147,710
Luxembourg	CARITAS	Emergency relief for flood victims in the State of Bihar	147,710
Luxembourg	Indesch Patenschaften	Rehabilitation and reconstruction of 70 houses	401,493
Sweden	Church of Sweden	Community health (prev. and curative), intermediate shelter for 100 families, Psychosocial assistance	113,000 (pledged)
Sweden	Diakonie Emergency Aid	Humanitarian support to families affected by the floods	30,719
Sweden	SMR	Humanitarian support to people affected by the floods	105,769
Sweden	SMR	To provide food, water, emergency relief kits, temporary shelters and medical services including trauma counselling to 21 villages in the Madhepura district of Bihar	129,970
Sweden	SMR	Humanitarian support to people affected by the flooding	137,890
Sweden	InterAct	To provide assistance to flood affected people in Madhepura and Saharsa districts of Bihar with food and non-food items	156,740

		(candles, matches, hygiene kits, tarpauline sheets, bamboo mats & kitchen utensils	
Sweden	Diakonia, Sweden	Humanitarian support to people affected by the floodings	227,037
Sweden	Church of Sweden	Humanitarian support to people affected by the floods in Bihar	231,146 & 245,855
United States of America	USAID	India/Food Shortage - Logistics and Relief Commodities (386-G-00-08-00046-00)	50,000
United States of America	USAID	India/Floods - Disaster Response	100,000

Source: List of all commitments/contributions and pledges for India in 2008 as of 26 June 2010. http://www.reliefweb.int/fts

Annex 7

Damages to Roads and Bridges by type and district

District	Road Type	Total length	Length (KM)		Damaged Bridges		Damaged Culverts	
			Fully	Partly	Fully	Partly	Fully	Partly
Supaul	NH							
	SH							
	MDR	105.30	25.70		13			
Madhepura	NH	36.00	16.00			7		
	SH							
	MDR	80.10	28.10	22.00	1		6	
Saharsa	NH	52.70	5.70	30.00		2		
	SH	24.00			10			
	MDR	59.05	55.25		2		8	
Araria	NH							
	SH							
	MDR	76.80	2.00		11		3	
Purnea	NH	61.00	10.00		2	2		
	SH							
	MDR	140.74	1.00		1		7	
Total	**NH**	**149.70**	**31.70**	**30.00**	**2**	**11**	**0**	**0**
	SH	**24.00**	**0.00**	**0.00**	**10**	**0**	**0**	**0**
	MDR	**461.99**	**112.05**	**22.00**	**28**	**0**	**24**	**0**

Annex 8

Damages to Roads and Bridges

District	Total length (KM)		Damaged paved roads (km)		Damaged unpaved roads (km)	No. of damaged - Bridges/Culverts			
			Fully damaged		Partly damaged	Fully damaged	Partly damaged	Fully damaged	Partly damaged
Supaul	470.39		136.15		44.35	232.01	37.80	298	19
Madhepura	922.25		104.05		33.80	692.70	71.15	490	4
Saharsa	125.62		12.73		79.35	0.00	0.00	15	65
Araria	80.25		13.61		66.46	0.00	0.00	5	34
Purnea	83.99		21.51		89.43	0.00	0.00	11	48
Total	**1682.50**	**288.05**	**313.38**	**924.71**	**108.95**	**819**			**170**

Annex 9

District-wise figures of sand-casting

Districts	**Baseline (acres)**	**Area silted (acre)**
Supaul	305758	116562
Madhepura	286520	146004
Saharsa	199020	5269
Araria	287632	5844
Purnea	290165	0
State Total	**1369095**	**273679**

Annex 10

Literacy Levels in Flood Affected Districts, 2001

Literacy Levels in the Flood Affected Kosi Districts, 2001							
Sl No	**District**	**All Communities**			**SCs**	**STs**	**Minorities**
		Male	**Female**	**Total**			
1	Araria	46.4	22.4	35.6	18.9	21.9	27.6
2	Madhepura	48.8	22.1	36.1	17.1	33.6	26.8
3	Purnea	45.6	23.4	35.1	18.5	24.5	25.9
4	Supaul	52.4	20.8	37.3	19.6	26.9	32.2
5	Saharsa	51.7	25.3	39.1	18.5	24.5	37.3
	Bihar	**59.7**	**33.1**	**47.0**	**28.5**	**28.2**	**41.9**
Source: Census of India, 2001, GoI							

Annex 11[16]

Details of Needs Reported in the Education Sector

Primary Education

District	Catogory of Schools	No. of affected Schools				Amount Required for reconstruction/ repair of Schools (Rs. Lakh)			
		total No of schools affected	Completely Damage	Major Damage	Minor Damage	For Completely Damage	For Major Damage (Rs. 5 lakh & 10 Lakh for Pr. & UP	For Minor Damage (Rs. 2 lakh & 5 Lakh for P & UP res.)	Total
Araria	Primary	132	0	0	132	0.00	0.00	264.00	264.00
	Upp. Pri	34	0	0	34	0	0.00	170.00	170.00
Madhepura	Primary	361	106	150	105	1803.80	750.00	210.00	2763.80
	Upp. Pri	174	57	72	45	1763.01	720.00	225.00	2708.01
Purnea	Primary	232	0	20	212	0.00	100.00	424.00	524.00
	Upp. Pri	65	0	7	58	0	70.00	290.00	360.00
Saharsa	Primary	86	0	37	49	0.00	185.00	98.00	283.00
	Upp. Pri	43	0	14	29	0	140.00	145.00	285.00
Supaul	Primary	185	6	117	62	102.10	585.00	124.00	811.10
	Upp. Pri	116	4	64	48	123.72	640.00	240.00	1003.72
Total	Primary	996	112	324	560	1905.90	1620.00	1120.00	4645.90
	Upp. Pri	432	61	157	214	1886.73	1570.00	1070.00	4526.73
	Total	**1428**	**173**	**481**	**774**	**3792.63**	**3190.00**	**2190.00**	**9172.63**

Secondary Education

District	Total No. of Blocks	No. of Blocks affected	Catogory of Schools	Total No. of Schools in District	No. of affected Schools		
					Completely Damage	Major Damage	Minor Damage
Araria	9	4	Primary	1071	0	0	132
			Upp. Primary	424	0	0	34
Madhepura	13	11	Primary	1050	106	150	105
			Upp. Primary	362	57	72	45
Purnea	14	8	Primary	1257	0	20	212
			Upp. Primary	474	0	7	58
Saharsa	10	6	Primary	849	0	37	49
			Upp. Primary	402	0	14	29
Supaul	11	5	Primary	1116	6	117	62
			Upp. Primary	475	4	64	48
Total	57	34	Primary	5343	112	324	560
			Upp. Primary	2137	61	157	214
			total	**7480**	**173**	**481**	**774**

[16] Needs in the education sector were not verified as part of the assessment.

Higher Education

Name of University/ Colleges affected	Item of Repair	Estimated cost for Repair (Rs. In Lakh)	Estimated cost of Library @2 lakh per college	Estimated cost of Laboratory @2 lakh per college	total
B. N. Mandal University, Madhepura	1-Boundary	102.79	2.00	2.00	106.79
Bhupendra Narain Vanijaya Mahavidyalaya, Shahuganj, Madhepura	Repair	26.76	2.00	2.00	30.76
Parvati Sceince College, Madhepura	Repair	141.12	2.00	2.00	145.12
Kamleshwari Prasad College, murliganj, Madhepura	Repair	22.95	2.00	2.00	26.95
Harihar Saha College, Uda Kishunganj	Repair	18.97	2.00	2.00	22.97
L.N.M.S. College Virpur, Sapaul	Repair	17.27	2.00	2.00	21.27
Thakur Prasad College, Madhepura	Repair	80.80	2.00	2.00	84.80
Total		410.65	14.00	14.00	438.65

District-wise Education Sector Damages

District	Total Blocks	Affected Blocks	Catogory	Total Schools	Completely Damaged	Major Damage	Minor Damage
Araria	9	4	Primary	1071	0	0	132
			U Primary	424	0	0	34
Madhepura	13	11	Primary	1050	106	150	105
			U Primary	362	57	72	45
Purnea	14	8	Primary	1257	0	20	212
			UPrimary	474	0	7	58
Saharsa	10	6	Primary	849	0	37	49
			U Primary	402	0	14	29
Supaul	11	5	Primary	1116	6	117	62
			U Primary	475	4	64	48
SubTotal	57	34	Primary	5343	112	324	560
			U Primary	2137	61	157	214
Total				**7480**	**173**	**481**	**774**

Annex 12

Reported needs in health sector[17]

(INR, Million)

Sl	Item	Supaul	Madhepura	Araria	Saharsa	Purnea	Total
1	POL for Ambulance Service & Vehicles, Engagement of Technician & Medicine	4.7	4.7	4.2	4.2	3.2	16.8
2	POL for Ambulance Service & Vehicles, Engagement of Technician & Medicine includes medicine cost received from GoI	18	18.6	13	17	23	89.6
3	Mobile Medical Teams (Additional medical staff)	13.5	16	14	23	12.6	79.1
4	Control of Vector Borne and Water Borne Diseases and Surveillance	2	18.6	0.69	0.74	0.51	5.8
5	Healthcare in Relief Camps	2.3	2.2	1.5	4.8	4.8	15.6
6	Immunization Campaigns	2.3	2.2	3.2	2.3	4.8	14.8
7	Repair of health infrastructure	103.5	222	0	143.5	39.5	508.5
						Total	730.2

[17] These needs were not verified as part of the assessment

Annex 13

Needs Assessment team composition and mission program

Core Mission Team

Prashant	Senior DRM Specialist
Deepak Singh	Infrastructure Specialist
Saurabh Dani	Disaster Risk Management Specialist
Ranu Sinha	Water Resources Specialist

Contributing members

Rakhi Bhavnani	Disaster Risk Management Consultant
Venkat Rao Bayana	Social Development Specialist
Neha Vyas	Environmental Specialist
M.K. Chatterjee	Bridge Expert
Vinay Kumar	Livelihood Specialist

Mission Program

Following and in keeping with the World Bank Scoping Mission of April 19-22, 2010, a Needs Assessment-cum-Project Preparation Mission arrived in Patna on May 24, 2010 and had a kickoff meeting with the Principal Secretary, Planning and Development.

After the kick-off meeting at Patna, Bihar, the Team held extensive discussions with Principal Secretaries of Planning, Water Resources, Minor Water Resources, Agriculture, Road Construction, Rural Works, Disaster Management and other relevant Departments on May 24, 2010. The filed team consisting of Prashant, Saurabh, Ranu, M.K. Chatterjee, Venkat and Vinay reached Supaul on May 25, 2010 for sample verification of damages to validate the data furnished by the Government of Bihar and to prepare the Needs Assessment that would form the basis for the Project Design and its Components. The Team returned to the Patna on May 27, 2010 after extensive field verification encompassing assets pertaining to the Water Resources, Roads, Rural Works, Housing, Agriculture and other sectors in Supaul District of India and upstream visit to the embankment sites in southern Nepal. Relevant officials of the State Government accompanied the Team and provided utmost cooperation and support. The Team acknowledges the cooperation and support of the District Magistrate Offices of Supaul and Madhepura, Water Resources Department, Rural Works Department, Rural Development Department, Disaster

Management Division (DMD), and Ministry of Planning, that assisted during the field verification surveys.