

India
Post Tsunami Recovery Program
Preliminary Damage and Needs Assessment

Prepared by

Asian Development Bank
United Nations
and
World Bank

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Currency Equivalents

Currency Unit: Rupees (Rs.)

Exchange Rates

US\$1.00 = Rs.43.50

1 Crore = 10,000,000

1 Lakh = 100,000

Abbreviations & Acronyms

ADB	Asian Development Bank
ANT	Anti Retro-Viral Treatment
CEMP	Community Environmental Management Plan
CRZ	Coastal Regulation Zone
DRM	Disaster Risk Management
ECLAC	Economic Commission for Latin America and the Caribbean
FAO	Food and Agriculture Organization
FRP	Fiber Reinforced Plastic
GDP	Gross Domestic Product
GoAP	Government of Andhra Pradesh
GOI	Government of India
GoK	Government of Kerala
GoTN	Government of Tamil Nadu
GSDP	Gross State Domestic Product
HSC	Health Sub-Center
JAM	Joint Assessment Mission
ILO	International Labor Organization
MDR	Major District Roads
MHA	Ministry of Home Affairs
MTFP	Medium Term Fiscal Plan
NACO	National AIDS Control Program
NCCF	National Calamity Contingency Fund
NCMC	National Crisis Management Committee
NGO	Non Government Organization
ODR	Other District Roads
PHC	Primary Health Centers
PPCT	Prevention of Parent to Child Transmission
RMS	Rubble Mound Seawall
SHG	Self Help Group
UEVRP	Urban Earthquake Vulnerability Reduction Program
UNDP	United Nations Development Program
UNESCO	United Nations Education, Social and Cultural Organization
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
UT	Union Territory
VCT	Voluntary Counseling and Testing
WHO	World Health Organization

**India: Post-Tsunami Recovery Program
Preliminary Damage and Needs Assessment**

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Executive Summary

1. At the request of the Government of India (GOI), the Asian Development Bank, the United Nations and the World Bank put together a joint team which undertook an assessment of the socioeconomic and environmental impact of the December 26, 2004 tsunami in the states of Andhra Pradesh, Kerala and Tamil Nadu and the Union Territory (UT) of Pondicherry. As advised by the GOI, the joint assessment mission (JAM) did not include an evaluation of the impact and losses sustained in the union territory of the Andaman and Nicobar Islands.

2. A group of experts and specialists from different sectors and disciplines analyzed the damage and losses¹ as well as the needs expressed by the relevant state authorities, and UT administration, made field visits to the most seriously affected districts, and undertook - on a sample basis - consultations with local experts, members of civil society and NGOs. The damage and losses presented here reflect the available information, compiled during the Mission's duration (February 1-15, 2005), and the visits undertaken by the JAM to selected affected areas. This is not a final assessment of the damage (see Table 1) and needs (see Table 2) since it reflects information available at the time of the JAM, taking into account that at this time a number of surveys and specialist sectoral analysis are still underway.

Table 1. Preliminary Summary of Damage and Losses (\$ million)

	Damage and losses			Effects on Livelihoods
	Damage	Losses	Total	
Andhra Pradesh	29.7	15.0	44.7	21.2
Kerala	61.7	39.1	100.8	36.3
Tamil Nadu	437.8	377.2	815.0	358.3
Pondicherry	45.3	6.5	51.8	5.9
TOTAL (by sectors)	574.5	448.3	1,022.8	421.7
Housing	193.1	35.4	228.5	
Health and education	10.7	12.9	23.6	
Agriculture and livestock	15.1	22.4	37.5	26.0
Fisheries	229.6	338.2	567.8	338.2
Livelihoods (Microenterprises and other)	20.0	37.5	57.5	57.5
Rural and municipal infrastructure	28.0	1.6	29.6	
Transportation	35.2	0.3	35.5	
Coastal protection	42.8	0	42.8	
Relief a/		200.7	200.7	

a/ Relief provided by the local, state and national governments (not included in Total (by sectors)).

Source: JAM estimates on the basis of information made available by the governments and direct observation.

3. Overall damages are estimated to be \$574.5 million, and losses are estimated to be \$448.3 million. Whilst the largest proportion of the damages are concentrated in fisheries, housing and infrastructure, material private asset damages related to coastal fisheries, agriculture

¹ Damage (direct impact) refers to the impact on assets, stock, property valued at agreed replacement (as opposed to reconstruction cost) unit prices. Losses (indirect impact) refers to flows that will be effected, such as reduced income, increased expenditure over the time period until asset are recovered.

and micro enterprise livelihoods have been incorporated into the respective sectors. Losses related to livelihoods in these sectors are of particular significance because they accentuate the pre existing vulnerability to poverty of these coastal fisheries communities, agriculture and microenterprises.

4. The JAM's quantification of damages and losses neither supersede nor disregard assessments of damage and needs made locally. It presents a consolidated view, on the basis of relevant information received and the expertise of the multi-institutional and interdisciplinary JAM team. Certain observations on damages and losses suffered are apparent:

- a. the disaster is having a significant impact on the states' livelihoods (about 38% of the total damage and losses imposes negative consequences on livelihoods) in the coastal environment and the local economy. In particular, it provides a measure of the economic impact of the tsunami on the fisheries sector and related livelihood in coastal communities of the affected states and union territory. An effort has been made by the JAM to highlight some relevant social issues for the reconstruction process, in the context of the states' and national development strategies;
- b. at this juncture, the affected areas have already moved from relief to reconstruction – although for some sectors and groups of affected people, relief will still continue for several months. During this transition, the protection of the most vulnerable segments of the displaced population and the improvement of their living conditions in temporary shelters over the coming months deserves special attention;
- c. the JAM recommends that national and state authorities pursue a risk mitigating reconstruction process in the face of damages resulting from specific recurrent hazards that the tsunami has just put in clearer perspective. Disaster of this nature is a “wake up call” to better evaluate vulnerability and improve risk management;
- d. Such a risk mitigating reconstruction process can reduce vulnerability in the medium term, increase resilience to specific local multi-hazards, and inserts itself in the larger district, state and national development strategies. Seen in this context, disaster can be an opportunity to improve and accelerate the entire development process;
- e. given the damages to housing and infrastructure, the provision of permanent solutions to housing and restoration of infrastructure are an immediate priority and require commitment of resources that may not be delayed. Investment in these and location of the new infrastructure (in terms of relocation of housing, restoration or construction of urban and rural infrastructure and resilience increasing measures such as locally adapted and environmentally sound coastal protection) are tied to overarching policy decisions in terms of appropriate coastal regulation and risk management, some of which have significant costs and social and financial implications in the districts and states affected; and
- f. the impact of the disaster varies from state to state both in absolute terms and in terms of the relative weight it has on each of the local economies.

5. Table 2 reflects the short term needs (within one year) and medium term needs (up to three years). This table does not include longer term reconstruction needs which are significant in areas such as housing, rural and municipal infrastructure, transportation, and coastal protection; these can only be undertaken reliably after further detailed studies.

Table 2. Preliminary Post Tsunami Reconstruction Needs (\$ million)

	Reconstruction needs		
	Short term reconstruction	Medium term reconstruction	Total
Andhra Pradesh	26.0	46.6	72.6
Kerala	83.8	73.9	157.7
Tamil Nadu	248.6	619.7	868.3
Pondicherry	41.6	72.8	114.4
TOTAL (by sectors)	400.0	813.0	1,213.0
Housing	160.0	329.0	489.0
Health and education	11.9	5.5	17.4
Agriculture and livestock	10.4	11.3	21.7
Fisheries	54.5	229.6	284.1
Livelihoods (Microenterprises and other)	70.6	108.1	178.7
Rural and municipal infrastructure	23.5	74.0	97.5
Transportation	41.5	27.7	69.2
Coastal protection	19.5	18.6	38.1
Hazard risk management	8.1	9.2	17.3

Source: JAM estimates on the basis of states' statements and memoranda.

6. Overall rehabilitation and reconstruction needs are estimated at \$1.2 billion, requiring financing over the short and medium term. The estimates take into account that damaged assets need to be replaced with new ones, not only of equal value, but with upgrades to services and infrastructure in order to reduce the previous inherent vulnerability.

7. The sudden and unexpected tsunami has highlighted underlying vulnerabilities to recurrent hazards and the major negative social consequences of such disasters on the livelihoods of the poorest population groups. The negative impact on the livelihoods of the worst affected productive sectors (fisheries and, to a lesser extent, agriculture) spill over to the rest of the community, beyond the actually physically affected areas.

8. The JAM analysis highlights the cross-cutting nature of the disaster's impact, and thus the multi-sectoral, inter-institutional, and multidisciplinary approach needed for the reconstruction process. The disaster points out the need to undertake cross cutting interventions, with a participatory, equitable, flexible, decentralized, and transparent approach beyond livelihood restoration. Better management of the coastal environment and reinforced risk reduction should be seen as part of the overall social and economic strategy, resulting in adoption of realistic, attainable goals in the short and medium term. Effective hazard risk management in the future should be less dependent on relief and assistance, which draws valuable resources from other development goals. Instead, there is a need to promote increased participation of the community in risk transfer insurance, community level risk management and disaster prevention, while giving assistance to those affected.

PART - I

A. INTRODUCTION

1. This report provides an assessment of damages and needs resulting from the tsunami that struck the eastern and southwestern coast of India as well as the Andaman and Nicobar Islands on December 26, 2004. It provides a preliminary estimate of the total cost of damages, identifies the needs for reconstruction and outlines some strategic considerations and guiding principles for implementing a reconstruction program and strengthening disaster risk management as part of a medium term development process.

2. The report was prepared in response to the request of the Government of India (GOI), and was undertaken jointly by the Asian Development Bank (ADB), the United Nations (UN), and the World Bank. The three institutions put together a team and organized a joint assessment mission (JAM) to the affected areas in the mainland part of India. As advised by the GOI, the Andaman and Nicobar Islands were not part of the scope of the assessment.

3. The JAM (joint assessment mission) team comprised experts and specialists from different sectors and disciplines from all three institutions in order to be able to produce a comprehensive, multi-sectoral assessment of both damage and losses, as well as evaluating requirements for recovery and reconstruction. The team was organized jointly by the Asian Development Bank (ADB) and the United Nations, under the coordination of the UNDP; team membership included representatives from several agencies (such as ILO, UNDP/BCPR, UNDP/GEF and UNICEF), and the World Bank. The assessment of damage and losses was done with technical support on assessment methodology from the United Nations Economic Commission for Latin America and the Caribbean (UN/ECLAC).

4. The team leaders were: Arjun Goswami (ADB), Pascal Girot (UN/UNDP), and Shyamal Sarkar (World Bank). The ADB team comprised: Tyrrell Duncan, Madhumita Gupta, Alex Jorgensen, Takeshi Nakazaki, Ashok Sharma, Tamotsu Tamura, and Kenichi Yokoyama, and technical support staff from the ADB India Resident Mission. The United Nations group included Periasamy Amudha, Sultana Bashir, Kamal Kishore, and Jayasankar Krishnamurthy as well as support from staff of UN agencies in the respective states. Team members from the World Bank included: M. Balasubramanian, Robert Buckley, Mayank Choudhary, T. Moth-Poulsen, Meena Munshi, Mario Pedini, Bilal Rahill, Laura Vecvagare, Farah Zahir, and Ricardo Zapata. Technical comments and editorial support were provided by Sumir Lal, Tom Blinkhorn, Charles Delfieux, Mamata Baruah, and Lilian MacArthur.

5. The JAM team met with various stakeholders representing the government, members of academia and locally based non governmental organizations (NGOs) involved in the emergency relief and reconstruction. In addition to discussions with state governments in Chennai, Thiruvananthapuram, Hyderabad and Pondicherry, the JAM also participated in field visits to the districts of Cuddalore, Nagapattinam, Kanniyakumari and Chennai in Tamil Nadu; the districts

of Kollam and Alappuzha in Kerala; the districts of Nellore and Prakasam in Andhra Pradesh; and the Karaikal region in Pondicherry.

6. The JAM expresses its appreciation to the national and state authorities for their support and assistance in terms of information access and availability for discussion of the results. Meetings were held with the Chief Secretaries in each state and their teams and relevant line department officials. Particular thanks are expressed to the district collectors visited and their teams for organizing the appropriate visits and meetings not only with their staff - who in many instances accompanied and guided the JAM team members - but also with the relevant civil society organizations and NGOs.

7. The findings of the joint assessment, which was conducted from February 1-15, 2005, are presented in this report. The team's analysis is based on discussions with the central, state, and local governments, and relies on information available at the time of the mission. Since many assessments, surveys and specific sectoral analyses are still ongoing, the figures should be considered as the best estimate possible given incomplete data and time constraints.

8. The needs assessment is derived from figures provided by the state governments adjusted by the mission on the basis of direct observations, expert opinions and feasibility considerations, given the resource availability and other implementation considerations. Project formulation and project needs will be predicated on pending policy decisions and surveys as well as consultation and participation of the affected population.

9. The report was presented to the GOI on March 3, 2005.

B. THE DECEMBER 2004 TSUNAMI

The Disasters

10. For the first time in half a century, India experienced the devastating effects of a tsunami, caused by a series of earthquakes in the Bay of Bengal². The first and strongest earthquake occurred off the west coast of northern Sumatra, Indonesia at 6.29 AM Indian Standard Time on December 26, 2004 (magnitude and intensity 9.0 USGS), followed by one 81 kilometers (km) west of Pulo Kunji Great Nicobar, India (7.3 USGS) some three hours later. 115 aftershocks were reported, of which the magnitude of 103 tremors was between 5.0 and 6.0 USGS and 12 were over 6.0 on the Richter scale. The earthquakes set off giant tsunami tidal waves of 3 to 10 meters in height, which hit the southern and eastern coastal areas of India and penetrated inland up to 3 kms, causing extensive damage in the Union Territory (UT) of the Andaman & Nicobar Islands, and the coastal districts of Andhra Pradesh, Kerala and Tamil Nadu and the UT of Pondicherry. Approximately 2,260 km of the coastal area besides the Andaman & Nicobar Islands were affected.

Human Toll³

11. **All India.** According to Government reports 10,881 people in India lost their lives and 5,792⁴ persons were reported missing with 6,913 injured.

12. **Tamil Nadu.** In Tamil Nadu over 7,983 deaths were reported. Of the 13 coastal districts⁵ affected in Tamil Nadu, Nagapattinam, where 6,051 people died, was the worst affected. Over 824 died in Kanniyakumari and 612 were reported dead in Cuddalore district.

13. **Kerala.** In Kerala 171 deaths were reported. Of the four affected districts of Kannur, Ernakulam, Alappuzha and Kollam, Kollam district accounted for the highest death toll of 131 followed by Alappuzha with 35 and Ernakulam with 5.

14. **Andhra Pradesh.** In Andhra Pradesh 105 deaths were reported and 11 people were reported to be missing. Of the affected districts⁶, Krishna and Prakasam were reported to be the worst affected in terms of human toll with 27 and 35 deaths respectively.

² The last time a tsunami hit the coast of India was in 1945. The other Asian countries affected are Indonesia, Maldives, Myanmar, Sri Lanka and Thailand. Several countries in East Africa have also been affected.

³ The human toll data are taken from the United Nations Disaster Management Team (UNDMT) Situation Report dated February 11, 2005 which is based on Government reports.

⁴ The most recent reports indicate that 2,812 people out of the 5,792 reported missing are dead.

⁵ The affected districts in Tamil Nadu are Thiruvallur, Chennai, Kancheepuram, Viluppuram, Cuddalore, Thanjavur, Nagapattinam, Pudukkotai, Ramanathapuram, Toothukudi, Tirunelveli, Thiruvarur and Kanniyakumari.

⁶ The affected districts in Andhra Pradesh are Visakhapattanam, East Godavari, West Godavari, Krishna, Guntur, Prakasam and Nellore.

15. **Pondicherry.** In Pondicherry 591 deaths were reported and 75 persons were reported missing for the coastal areas of Pondicherry and Karaikal. In Karaikal 484 persons were reported dead and 66 missing.

The Relief Effort

16. **Government response.** Although the GOI and the state governments in Tamil Nadu, Kerala and Andhra Pradesh and the Pondicherry Administration were caught unawares by the tsunami, they responded quickly.

17. **Government of India.** At the national level, a number of steps were taken. The Ministry of Home Affairs (MHA) of the Government of India was designated as the nodal agency for coordinating relief in the affected states and union territories and formed a control room with a public help line. A National Crisis Management Committee (NCCM) was established under the Cabinet Secretary to draw up an emergency relief plan and to review those efforts together with secretaries of the relevant ministries/departments and chiefs of the armed forces. A National Crisis Management Group was formed under the chairmanship of the Secretary, Border Management, MHA, and teams of representatives of various ministries led by a Joint Secretary visited the affected states. Individual ministries also undertook ministry specific efforts. Rs. 2,731 crore (\$627.81 million) of funds were allocated to the affected states and union territories from the National Calamity Contingency Fund (NCCF)⁷. Other funds have also been announced⁸. In recognition of the need for transition from relief to reconstruction, the GOI is now focusing mainly on preparing a comprehensive framework for rehabilitation and reconstruction coordinated by the Planning Commission.

18. **State and UT Governments.** In the various affected states and union territories the respective Chief Ministers directed officials of the Revenue Department under the Relief Commissioner to coordinate search, rescue and relief efforts through relevant district collectors with assistance from the police force, fire and rescue services, medical and health services and all other associated departments. The State Relief Commissioners opened control rooms with a view to disseminating information to the public and state government. Websites relating to tsunami rescue and relief operations were opened. Supported by the army, navy, air force and coast guard, and senior civil servants deputed to affected areas, the district administration in the various affected states identified and disposed of dead bodies, moved obstacles, rescued people, moved people to safer locations, and worked to prevent outbreak of epidemics and restore basic services like power and water supply. In addition, relief camps were opened. In Tamil Nadu 44,207 persons were placed in 58 relief camps. In Kerala 24,978 people were placed in 29 relief camps. In Pondicherry 48 relief camps had been opened initially but are no longer inhabited. In Andhra Pradesh 65 relief camps had been opened but all the inhabitants have returned and the camps have since been closed. State governments and UT administration have also disbursed financial assistance and relief material to families of the deceased, affected families and the injured, and announced certain house damage repair subsidies.

⁷ This tsunami-related NCCF amount consists of allocations for both relief and reconstruction and recovery. Some initial state/UT specific allocations from NCCF have been made. Rs. 250 crore (\$57.5 million) has been allocated to Tamil Nadu, Rs. 100 crore (\$23.0 million) to Kerala and Andhra Pradesh respectively and Rs. 35 crore (\$8.0 million) has to Pondicherry. Additional NCCF allocations are due to be made.

⁸ These include the Prime Minister's National Relief Fund (which announced an ex gratia payment of Rs. 1,00,000) related to relief.

19. **NGO/civil society response.** Community members, private individuals and non governmental organizations (NGOs) across India mobilized to respond to the needs of the affected states and UT. Bilateral donor agencies have supported such NGOs. NGOs operating in sectors ranging from health, psycho social counseling, shelter, sanitation and water, education, livelihood and environment include agencies such as World Vision India, CARE (India), Catholic Relief Services (India), Project Concern International, Echo, Oxfam, Dhan Foundation, League for Education and Development, Tamil Nadu Voluntary Health Association, and Jesuits in Social Action.

20. **Private sector response.** The affected states and UT have received corporate donations of funds and relief material of unprecedented scope. The United Nations Development Program (UNDP) estimated that the corporate sector in India may have contributed more than \$8 million worth of cash donations, food and medicine, emergency relief supplies and other humanitarian services. Indian companies, including established business houses, banks, insurance, medical and information technology companies and public sector entities, have already contributed over Rs. 40.0 crore (\$9.2 million) to the Prime Minister's National Relief Fund (see footnote 7) and have also provided donations to established relief NGOs like Oxfam, CARE and Dhan Foundation. Fundraising efforts by sports and media persons have also taken place.

21. **International Community response.** The United Nations Disaster Management Team designated the United Nations Children's Fund (UNICEF) as the focal point for relief activities. UNICEF deployed rapid action teams and sent reports within 72 hours of the disaster. Other UN agencies supported UNICEF to carry out relief activities. In addition, the UNDP has helped coordinate UN system efforts in terms of rehabilitation and recovery. UN agencies involved include the International Labor Organization (ILO), United Nations Industrial Development Organization (UNIDO), Food and Agriculture Organization (FAO), World Health Organization (WHO), UNICEF, United Nations Population Fund (UNFPA), United Nations Education, Social and Cultural Organization (UNESCO). A UN Team for Recovery Support has also been established in Chennai.

C. GUIDING PRINCIPLES OF THE DAMAGE AND NEEDS ASSESSMENT

Methodology Used for the Damage Assessment

22. The guiding principles for this evaluation are to: (a) identify the damage and losses incurred; (b) show the inter-relationship among the effects in the different sectors, highlighting the cross cutting elements among them; and (c) provide an appropriate framework for the recovery and reconstruction effort. This approach helps support a strategy that seeks to pursue three critical actions: sector prioritization, time sequencing, and resources required. This last element defines whether there is a resource gap to be filled.

23. The damage and losses assessment is intended to quantify the consequences of the disaster, and to provide a first attempt at identifying immediate and medium term reconstruction needs. The assessment's conceptual basis is the standard internationally accepted methodology developed by the United Nations Economic Commission for Latin America and the Caribbean (ECLAC)⁹ which uses a stock/flow analysis that evaluates effects on: (i) physical assets that will have to be repaired/restored/replaced or discounted in the future; and (ii) income flows that will not be realized until the asset is repaired or rebuilt.

24. A sector-by-sector analysis of the damage and losses was undertaken, utilizing specific templates for information recording and gathering in order to ensure consistency of information, non duplication and comparability of the data. An effort has been made to distinguish between public and private sector damages and losses, and where relevant, reference is made to external components of both damage and losses.

25. Sectoral teams were organized with members from the three institutions (ADB, the United Nations, and the World Bank), with the appropriate mix of sectoral expertise (housing, agriculture, fisheries, infrastructure, livelihoods, social sectors, environment, as well as fiscal and financial aspects), that undertook field visits to the three affected states and union territory. Team members visited the severely affected districts and a sample of sites and locations that exemplified the type and extent of damage, losses and emerging needs. Meetings were held with the respective Chief Secretaries and their staff in each state and union territory and the visits had the valuable cooperation of the line departments, the district collectors and their teams. Community level organizations and NGOs, as well as local experts and relevant technical and scientific institutions were also contacted.

⁹ Reference: *Handbook for the evaluation of the socioeconomic and environmental impact of disasters* (LC/MEX/G.5, July 2003) available at the following web pages: www.eclac.cl/mexico, (“disasters”) www.worldbank.org/hazards/knowledge/other_res.htm and www.proventionconsortium.org/toolkit.htm.

Data covered (Damages, Losses and Reconstruction Needs)

26. The figures presented reflect in the first instance damage (direct impact) estimates. These refer to the effects on assets/stock/property, valued at agreed replacement unit values (as different from actual or possible reconstruction costs). The assessment considers the level of damage, i.e., whether an asset can be rehabilitated/ repaired, or was completely destroyed. The total damage and loss assessment also gives close attention to losses (indirect impact) which refer to income flows that will be affected, such as reduced or lost income, increased expenditures, etc. until the assets are recovered. These are quantified at the present value of such flows.

27. Given the short time available for the JAM, and the focus of local authorities on rapid emergency response with the need for a quick response in terms of reconstruction needs, the figures presented here should not be considered definitive, but rather a preliminary understanding to guide the recovery efforts. This quantification provides a basis for determining the impacts on relevant economic variables (by use of macroeconomic analysis and scenario modeling under different assumptions for the reconstruction potential and needs); and on the resource gap that these reconstruction scenarios imply.

D. PRELIMINARY DAMAGE AND NEEDS ASSESSMENT

Introduction

28. This section provides a preliminary estimate of the damage and losses (refer to section C for methodology) and the recovery by evaluating the social, environmental, and economic impacts of the disaster and then summarizing the damage, losses and the needs for the following sectors: housing, health, education, fisheries, agriculture and livestock, microenterprises, rural and municipal infrastructure, transportation, and coastal protection. The damage and losses presented here reflect the available information, compiled during a brief period of time (February 1-15, 2005), and the visits undertaken by the JAM to selected affected areas. This is not a final assessment of the damage and needs since it reflects information available at the time of the visit.

Summary

29. **Damages and Losses.** Overall damages are estimated to be \$574.5 million, losses are estimated to be \$448.3 million. Whilst the largest proportion of the damages are concentrated in fisheries, housing and infrastructure, material private asset damages related to coastal fisheries, agriculture and micro enterprise livelihoods have been incorporated into the various sectors. Losses related to livelihood in these sectors are of particular significance because they accentuate the pre existing vulnerability to poverty of these coastal fisheries communities, agriculture and microenterprises.

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Agriculture and livestock	15.1	22.4	37.5	26.0
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Rural and municipal infrastructure	28.0	1.6	29.6	
Transportation	35.2	0.3	35.5	
Coastal protection	42.8	0	42.8	
Relief a/		200.7	200.7	

a/ Relief provided by the local, state and national governments (not included in Total (by sectors)).

Source: JAM estimates on the basis of information made available by the governments and direct observation.

30. This quantification of damages and losses neither supersedes nor disregards assessments of damage and needs made locally. It presents a consolidated view, on the basis of relevant information received and the expertise of the multi-institutional and interdisciplinary JAM team.

31. **Short and Medium Term Needs.** Overall needs (Table 2 below) are estimated to be approximately \$400.0 million for the short term (within one year) and approximately \$813.0 million for the medium term (up to three years). This table does not include longer term reconstruction needs which are significant in areas such as housing, rural and municipal infrastructure, transportation, and coastal protection; these can only be reliably undertaken after further detailed studies.

Table 2. Preliminary Post Tsunami Reconstruction Needs (\$ million)

	Reconstruction needs		
	Short term reconstruction	Medium term reconstruction	Total
Andhra Pradesh	26.0	46.6	72.6
Kerala	83.8	73.9	157.7
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Transportation	41.5	27.7	69.2
Coastal protection	19.5	18.6	38.1
Hazard risk management	8.1	9.2	17.3

Source: JAM estimates on the basis of states' statements and memoranda.

Crosscutting sectors

Social Impact (Annex I)

32. **Social Impact Human Toll.** The disaster has devastated communities with its high toll of human lives, injuries, adverse effect on family networks, homes and livelihood. There are long term consequences for families torn by the death or disability of a member, such as for widows, single parents and their children, orphans, children separated from their families, the elderly and the disabled. In all the tsunami-affected states and the union territory, more women and children have died than men. Special attention needs to be paid to the shelter, livelihood, social security and legal requirements of vulnerable groups like orphaned and separated children, widows and female-headed households, single parents, the disabled and the elderly besides socially marginalized groups like the scheduled castes and the poor.

33. **Vulnerability of affected communities.** The majority of those affected on the coast were fisherfolk who suffered the most damage in terms of housing and livelihoods with loss of dwelling units, household assets, and productive assets like boats and nets.

34. The disaster has most adversely affected the livelihoods of those that were already poor. The vulnerability of these communities is accentuated by their indebtedness to big merchants and informal money lenders with whom many had current borrowings, lack of access to markets and credit, absence of social security nets, and socio-political marginalization.

35. The immediate need is the provision of livable temporary shelters for displaced people, and creating income-generating opportunities.

36. **Relocation.** Relocation of affected people is an important question that must be addressed immediately. A key concern is that the impact of relocation on livelihoods should not increase vulnerability and thus defeat the very purpose of the relocation. Thus the states' recovery strategy will need to strike a balance between short and long term social security, livelihood and hazard risk reduction needs.

37. In the short-term, households living in temporary shelters should move to permanent housing on the basis that relocation should be avoided unless it is clear that (a) staying in the same place is unsafe, and (b) the villagers clearly express a preference to stay where they are rather than shift to a new location. A transparent and participatory approach involving the communities should be followed in assessing options and then in planning and implementing agreed decisions.

38. Unaffected communities that might need to be relocated because of risk of future disaster should be consulted and given a key role in decision making. Care should be taken to minimize secondary displacements caused by relocations or building of new infrastructure.

39. **Community participation.** Local communities will need to be actively involved in planning, decision-making and implementation in most sectors if reconstruction is to be successful. Experience with disaster reconstruction all over the world has shown that community participation is a fundamental requirement that helps in reducing trauma, ensuring appropriate solutions, equity, community ownership, transparency and accountability. It will also be essential to set up a fair and accessible grievance redress system.

Environmental Impact (Annex II)

40. **Tsunami Environmental Impacts.** The tsunami affected about 2,260 km of coastline, causing extensive damage to the coastal areas of Tamil Nadu and Pondicherry, and more localized damage to the coasts of Kerala and Andhra Pradesh. Several factors make it difficult to assess the specific environmental impacts in the short-term, including the lack of comprehensive baseline ecological data and the fact that many impacts will only manifest themselves in the medium to long-term.

41. **Pre Tsunami Environmental Impacts.** High human population densities and development activities have contributed to considerable degradation of many components of the Indian coastal and marine ecosystem, including coral reefs, sea grass beds, mangroves, beaches,

sand dunes, mud flats, lagoons and the east coast tropical dry evergreen forests. There is also significant localized pollution of near shore marine habitats due to sewage and industrial emissions.

42. The need to better protect and manage coastal ecosystems led to the Coastal Regulation Zone (CRZ) notification of 1991. This notification requires the coastal zone (defined as the area up to 500 meters of the High Tide Line) to be classified into one of four categories, and then regulates the types of activities and land uses permitted in each. However, there has been considerable variation in its interpretation and application and a general lack of integrated coastal zone management, which the government had been taking steps to rectify prior to the tsunami. The post-tsunami rehabilitation and reconstruction phases provide an opportunity to give added impetus to studies and analyses towards improved integrated coastal zone management.

43. **Tsunami Impact.** The tsunami has had a number of primary impacts, including: i) the generation of debris and rubble; ii) erosion or accretion in numerous places along the coast as well as associated sedimentation of lagoons and waterways; iii) salinization of agricultural land and of ground and surface freshwater resources, and deposition of sea-bed organic deposits on land; iv) impacts on fishery resources, including aquaculture, and v) impact on coconut and other plantations. There is considerable variation in the extent and severity of impacts between sites and their likely permanence.

44. A number of secondary impacts are likely to occur, including: i) impacts and damages caused by relief camps and temporary shelters and other temporary structures; ii) poor water and sanitation practices; iii) changes in land use brought about by loss of agricultural lands and need for new land for new housing sites; and iv) increase in water and chemical usage during reclamation and reconditioning of affected agricultural land.

45. The direct environmental impacts of the tsunami have varied according to various factors, notably the bathymetry and geomorphology of the coastline, as well as the presence of various natural and man-made features. Changes in the coastal geomorphology were recorded by the national Department of Ocean Development and also reported by fishermen. Many coastal wet lands have been affected, at least temporarily, by the large inflow of salt water and silt load. There has been some terrestrial and aquatic pollution, both in terms of physical debris as well as sewage and chemical effluents. Pollution will be more problematic on land and in closed systems such as lagoons, ponds and streams.

46. **Major Protected Areas.** No significant ecological changes have been reported from the major protected areas along the coast such as Point Calimere Sanctuary or the Gulf of Mannar Marine National Park. Though no major mortality has been reported so far in larger and more visible species, there is a need for more detailed assessments and longer-term monitoring of the impacts of the tsunami on coastal and marine biodiversity.

47. **Reconstruction Strategy.** Four principles are offered here for consideration during the recovery and reconstruction phase: i) environmental considerations should be mainstreamed into all other sectoral interventions; ii) lessons drawn from studying the nature, causes and distribution of major impacts should be used to guide further development of disaster risk management strategies for the coastal zone; iii) recovery and reconstruction should be framed

within the context of an integrated coastal zone management strategy; and iv) solutions should be localized and site-specific as far as possible.

48. A number of actions are proposed as part of the environmental management framework for the reconstruction phase. Short-term priorities should include: i) development of guidelines for **rubble** and debris removal and disposal; ii) development of environmental management plans for temporary shelters; iii) an assessment of the potential impacts of increased siltation on drainage and thus increased risks of flooding during the coming monsoon; iv) development of appropriate site selection criteria for new housing sites; v) development of environmental and social criteria for sectoral reconstruction efforts, in particular for infrastructure; and vi) targeted rapid environmental assessments, both non-field and field based, to better guide the reconstruction strategy.

49. Medium-term priorities should include: i) environmental management plans for the newly organized community housing/settlements; ii) effective integration of environmental consideration in coastal zone management; iii) more detailed studies of environmental impacts and monitoring programs building on the findings of all preliminary rapid assessments; and iv) identification of opportunities and priorities for ecosystem restoration.

Macroeconomic Impact (Annex III)

50. **Localized Impact.** The tsunami has had no impact on India's GDP or that of the affected states. The states' GDP are unaffected because economic activity along the coastline contributes very little to the states' income. A marginal impact in the short run on the balance of payments can be expected to the extent that exports of shrimp are adversely affected along with coastal tourism.

51. **Expenditures Impact.** The impact on the public finances of the states is limited to the expenditure side only. There is no impact on state revenues because the economic activity along the coastline is largely in the informal and unorganized sector. The contribution of the affected coastal regions to consumption taxes like sales tax, excise etc is relatively insignificant. The impact of additional expenditures, in turn, varies across states depending on the requirement of rehabilitation and reconstruction activities. Much also depends on the fiscal space and the absorptive capacity of the states to incur such expenditures. This impact could be mitigated by alternative sources of financing (such as assistance from the center, external agencies or by accessing funds from the market) to meet additional expenditures. However, the overall finances will be affected by the terms and conditions on which the states are likely to borrow funds to meet the additional expenditures.

52. The fiscal costs in terms of additional expenditures can be divided into two categories - (i) immediate and temporary relief, falling in 2004-05; and (ii) reconstruction cost - short-term (2005-06) and medium term (2006-07 and 2007-08), spread over a couple of years. On the basis of preliminary estimates of reconstruction costs submitted by the states, tsunami-related expenditures are likely to strain the finances of Tamil Nadu and Kerala. In the case of Andhra Pradesh, the rehabilitation expenditure is manageable (a mere 0.1 percent of state GDP) and well within its overall budget. It is difficult to assess the fiscal gap in Pondicherry since this is filled by the Centre.

**Table 3. Impact of Tsunami related Expenditures on Finances
Tamil Nadu and Kerala (% GSDP)**

	2003-04	2004-05	2005-06	2006-07	2007-08
		R.E	B.E	Projection	Projection
TAMIL NADU					
Status Quo Scenario					
Fiscal deficit	3.7	3.8	3.3	2.8	2.5
Interest	2.8	2.9	3.0	3.0	3.0
Debt stock	28.5	30.1	31.0	31.2	31.0
New Scenario: Additional expenditures: Relief Rs. 350.0 crore (\$80.46 million) and Reconstruction Rs. 3,772.0 crore (\$867.13 million)					
Fiscal deficit	3.7	4.0	3.9	3.5	3.2
Interest	2.8	2.9	3.0	3.1	3.2
Debt stock	28.5	30.3	31.8	32.7	33.1
KERALA					
Status Quo Scenario					
Fiscal deficit	6.1	5.3	4.6	3.8	2.4
Interest	3.7	3.6	3.5	3.4	3.3
Debt stock	41.5	42.6	42.6	41.9	39.6
New Scenario: Additional expenditures of Rs. 666.0 crore (\$153.1 million)					
Fiscal deficit	6.1	5.3	4.9	3.9	2.6
Interest	3.7	3.6	3.5	3.5	3.4
Debt stock	41.5	42.6	43.0	42.3	40.2
Memo: Impact of Tsunami					
Fiscal deficit (Tamil Nadu)		0.2	0.6	0.7	0.7
Fiscal deficit (Kerala)			0.3	0.1	0.2

R.E. – Revised Estimates/B.E. - Budget Estimates

53. **Fiscal Deficit.** For Tamil Nadu, it is estimated that the ratio of fiscal deficit to GSDP expands during the reconstruction period (2005-06 – 2007-08) by more than the tsunami-induced expenditures due to an additional interest burden attributable to the additional debt stock caused by tsunami-related expenditures. The spiral effect of debt-deficit dynamics through a higher interest burden will spill over beyond 2007-08 till it stabilizes as a percentage of GSDP.

54. In case of Kerala, in 2005-06, the ratio of fiscal deficit to GSDP in the new scenario increases by 0.3 percentage points compared to the status quo. In the medium term, the fiscal deficit to GSDP in the new scenario is higher by 0.1 percentage points in 2006-07 and 0.2 percentage points in 2007-08 compared to status quo scenario. In 2007-08, fiscal deficit to GSDP in the new scenario is higher than the tsunami-induced expenditure (as percentage of GSDP) because of the underlying debt-deficit dynamics through additional interest burden on the accumulated debt stock due to tsunami related expenditures.

Hazard Risk Vulnerabilities

55. **Hazard Risk Vulnerabilities.** The tsunami tidal waves of 3 to 10 meters and inland penetration of waves of 300 meters to 3 kilometers affected 2260 kilometers of mainland coastal areas of Andhra Pradesh, Kerala, Tamil Nadu and Pondicherry in varying degrees of intensity. Present conditions vary from state to state and district to district. However, there are certain

common cross sectoral hazard risk vulnerabilities in different states and the union territory that go beyond physical damage and particular sectoral impact and that need to be appropriately mitigated in any reconstruction process.

56. **Hazard Risk.** Certain underlying vulnerabilities are physically or scientifically determined (i.e. the period of return of a certain type of phenomenon, such as a tsunami, or the recurring risk of seasonal cyclones, monsoon or drought), taken in conjunction with perceived fears of natural disasters by vulnerable communities and the local (district and state) governments. There is a need for reconstruction to therefore go beyond the focus on the immediate and short term consequences of the tsunami and the immediately affected area, in order to ensure appropriate incorporation of hazard risk management principles over the medium term. The reinforcing and cross-cutting hazard risk management actions are designed to increase resilience in terms of infrastructure, housing, coastal protection and environmental management social and livelihood strengthening and economic performance and competitiveness.

57. **Housing and Infrastructure.** A situation of multi-hazards in a highly vulnerable structural, economic and social context (most hazards are related to the cyclone/drought cycle), require mitigation measures for infrastructure and housing reconstruction that are not exclusively or predominantly tsunami related as outflow of flooded low lying areas is more probable and frequent than salt water intrusion and tidal wave-related damages from the sea. Water management (conservation, channeling and pumping in small check dams and water deposits) is the key to sustainability of agricultural production. Given the high level of the water table in many coastal areas, handling of liquid and solid waste is a crucial aspect that must be considered even in the short term as interim sanitation measures are taken for semi-permanent housing while reconstruction of proper habitations is made.

58. **Livelihoods.** The application of hazard risk mitigation principles to the revival of livelihoods requires sensitive balancing of a number of different considerations. There are indications of a long term declining path of natural-resource based activities, not only in fishing as catch is declining and over fishing is a looming danger¹⁰, but also in terms of water supply in a semi-arid tropical area with variable and insufficient monsoon cycles adversely affecting agriculture. However, this has to be balanced by the need to consider short and medium term needs for subsistence fishing communities and women focused self help groups which will continue to depend on fishing given, for example, natural resource constraints on alternative livelihoods such as aquaculture, which is intensive in water demand, and ought to be appropriately scaled to the water supply.

59. A gap exists between the existing supply of labor (a high percentage of which is insufficiently qualified or trained in technical jobs with little demand) and employment needs (demand) of potential growth activities in services. This is especially acute given the drop out rate of young men and limited opportunities for women in rural and semi-urban areas. In some districts in Tamil Nadu and in Kerala state tourism has a high potential linked to different attractions going from beach resorts to religious pilgrimage and multi-interest sites, including archaeological and historical richness and natural reserves such as the existing bird and wildlife sanctuary in Nagapattinam. Transport, processing activities and port upgrading over the short

¹⁰ See *Tenth Five Year Plan 2002-2007*, Government of India, p. 575 et passim.

and medium term could provide a useful base for longer term development of such services activity which supports new employment opportunities.

60. **Environment.** The impact of the tsunami on the environment is unclear in terms of medium to long term effects but in the short term it poses immediate negative consequences in terms of soil contamination, salt and sand intrusion of water sources, leading to foreseeable effects on at least two crop cycles (the current one is destroyed as it was ready to be harvested in the case of rice and other products, and the next plantation period is affected as washing of salt and sand deposits will not be completed in time and natural dilution will not occur before the next monsoon).

61. The presence of shelter belts comprising the exotic Casaurina species are reported to have reduced damage and injuries and loss of life in some places along the coast, notably in Nagapattinam. The role of shelter belts in providing protection against storm surges and other natural hazards needs to be documented more systematically. Shelter belts can be a potential option to reduce coastal vulnerability to natural hazards. However, their use should be governed by the results of the disaster risk analysis and their social, economic and environmental costs and benefits should be evaluated against other potential options. The use of exotic species and the planting of such belts on the beach itself should be avoided unless the social and economic benefits are shown to greatly outweigh the environmental costs.

Sector by Sector Assessment Report

62. The following section describes the findings of the damage, losses and needs assessment for each individual sector, with more detailed descriptions available in the attached annexes (except for Education sector).

Housing (Annex IV)

63. **Damage and Losses.** The tsunami fully or partially damaged more than 150,000 housing units in the three states and Pondicherry causing estimated damages of Rs. 994.0 crore (\$228.5 million). However, reconstruction costs are estimated to be much higher, and, based on the states and Pondicherry government estimates, may reach Rs. 2,127.0 crore (\$489.0 million). This is mostly due to envisaged upgrading of the damaged housing from *kachcha* (temporary) to *pucca* (permanent) and cyclone resistant structures.

64. **Recovery Needs.** The costs of addressing the immediate as well as the longer terms housing needs will also be fundamentally affected by decisions taken with regard to the Coastal Regulation Zone (CRZ) rules (see para. 42) For immediate relief, determination of vulnerable locations should be among the first steps at least for the purposes of defining priorities as to who should be assisted first.

65. As the housing situations and needs are very different in the affected areas, they will require different responses and a flexible and dynamic approach. In Kerala and Andhra Pradesh, reconstruction requirements are small and appear to be easily absorbable. In Tamil Nadu, in contrast, it will take time to fully address the needs. Therefore, it is important to develop a plan for the steps to be taken not only in provision of permanent housing, but also addressing the sorts

of problems that will arise due to the very basic current temporary housing conditions for so many.

66. Furthermore, both the immediate and the longer term housing issues cannot be looked at in isolation from the broader context of the fishing industry, environment and livelihoods. Due to the fact that most fishermen live in close proximity to their boats and the coast, the link between housing and employment is very strong. This is particularly important when considering the continuous decline in the industry's profitability and share in the states' GDP decline. Ensuring that the relocation compensation has the highest value for the beneficiaries will be very important in ensuring effective relocation. Thus, consideration should be given to a variety of instruments, including monetary and voucher schemes, and provision of property titles to the current locations. Consideration could also be given to the possibility of developing a specific hazard insurance scheme, beyond current schemes provided by the Government.

67. According to the estimates made by the assessment team Rs. 696.0 crore (\$160.00 million) (Andhra Pradesh Rs. 4.0 crore (\$0.9 million), Kerala Rs. 196.0 crore (\$45.0 million), Tamil Nadu Rs. 416.0 crore (\$95.7 million) and Pondicherry Rs. 80.0 crore (\$18.4 million)) will be required for the short term, and Rs. 1,431.0 crore (\$329.0 million) (Tamil Nadu Rs. 1,273.0 crore (\$292.7 million) and Pondicherry Rs. 158.0 crore (\$36.3 million)) will be required for the medium term.

Health (Annex V)

68. **Damage and Losses.** In Tamil Nadu, a few government hospitals and health centers in the districts of Nagapattinam, Cuddalore and Kanniyakumari were damaged badly, and there was loss of equipment and amenities in many more health facilities. The total damages and losses in the sector are estimated at over \$15.7 million. Preventive and curative healthcare to relief camps was provided by district authorities through mobile teams. Almost all the camps have been closed now with people either having returned to their villages or moving to temporary shelters.

69. **Recovery Needs.** The immediate need is to strengthen basic health services to the communities, restart outreach services including to the shelters, maintain vector and water borne disease control, and repair the damaged district hospital and other health facilities. However, renovation of other government hospitals is needed in the short term to accommodate increased patient turnover.

70. Provision of basic sanitation, monitoring of water quality, surveillance for epidemic prone illnesses, psycho-social support, measures to protect against trafficking of children and young women and prevention of HIV/AIDS are also crucial in these communities.

71. In the medium term, a health sector disaster mitigation plan for all the disaster prone districts is required. This should be taken as an opportunity to strengthen the existing health system in the affected districts. The planned renovation of government health facilities in Tamil Nadu could be re-prioritized to start with the tsunami-affected districts. Improving communication facilities, providing health staff mobility and strengthening human resources are some steps that could be undertaken. A preliminary estimate of the cost for the short and medium term interventions is \$8.5 million.

72. The damage to life and property in Kerala was limited to the three districts of Kollam, Alappuzha and Ernakulam with Kollam the worst affected. The estimated damages and losses from Kerala are \$2.8 million. Short term needs have been estimated at a little over \$2.2 million.

73. No major damages to the health system were reported in Pondicherry and Andhra Pradesh. The main losses are expenses of providing emergency preventive and curative services to the displaced population. All relief camps have been closed and routine health services have been re-established in the affected communities.

Education

74. **Damage.** Kerala is a leader in literacy in India with a 90 percent overall literacy rate and 100 percent enrolment rate at every level of schooling. Tamil Nadu, with a literacy rate of 73 percent, is well above the national average. Among the affected districts, Kanniyakumari and Chennai lead the state across several education indicators.

75. According to very preliminary estimates prepared in Kerala, one government school in Kollam requires complete reconstruction and five need major repairs. But this excludes aided and private schools. In Tamil Nadu, a government rapid assessment indicates that 252 schools need complete reconstruction, 19 major repairs and 49 minor repairs. A field visit to Nagapattinam revealed that at least six schools, all located within 500 m of the shore, needed reconstruction.

76. In both states, authorities in collaboration with NGOs have acted promptly in ensuring that most children have returned to school, replacing books and uniforms, making minor repairs, organizing alternate sites for holding classes, and providing transport. NGO volunteers have organized interactive sessions with children beyond school hours and helped to clean and beautify the classroom environs.

77. **Recovery Needs.** Issues that need to be addressed in the immediate term include:

- Schools still being used as relief camps need to be relieved.
- Lack of potable water is a problem in many schools.
- Special monitoring of girl students – those from families which have lost adult females may be forced to drop out to help with housework and care of siblings or elderly relatives.
- Continuing and expanding the partnership with NGOs to provide counseling to children, especially orphans and separated children, those traumatized by loss of family members, those still in relief camps, and adolescent girls who, anecdotal evidence suggests, are the most traumatized group.
- Addressing the needs and concerns of teachers, many of whom are under family pressure to transfer out of the coastal districts.
- Linking schools to the hazard risk reduction strategy both by rebuilding schools to function as shelters, and by training teachers and children as part of community preparedness.
- Ensuring communities are consulted and issues of access, especially of girls, are taken into account when relocating schools.

- Locating out of school children and dropouts – especially adolescent boys working as members of fishing crews – to provide alternative livelihoods training.

78. In the medium term, a vision can be developed to rebuild schools as child-friendly social centers to retain and psychologically restore children in communities whose lives and social networks have been shattered. Coordination between the education and social welfare departments to link schools and ICDS centers, for example, can be strengthened.

79. According to the estimates made by the JAM Team, an amount of \$6.7 million will be required to address the short terms and medium term needs.

Agriculture and Livestock (Annex VI)

80. **Damage and Losses.** The damage to the agricultural sector, though not significant in overall terms, has had a great impact on the livelihoods of small and marginal agricultural land-holders, especially poor women. Damage is mainly confined to the destruction of standing crops like paddy, groundnut, coconut, cashew, mango, banana, *ragi* (millet) and vegetables.

81. Sea water intrusion and the deposit of infertile sediments have also affected adversely agricultural lands in varying depths ranging from 5 cm to 24 cm in low lying areas, leading to problems of water logging and salinity. A total of 8,154 ha of paddy land and other field crops, and 628 ha of horticultural land have been damaged.

82. Intrusion of seawater to productive fields up to 3 km inland has induced salinity of varying degrees, and the affected farmers will not be able to grow crops effectively for the next two to three years until seasonal monsoon rains naturally flush out the salts. The damage caused to the soil is of semi-permanent nature.

83. Other impacts include damage to home flower and vegetable gardens, grazing lands, salt pans and micro ecosystems required for adequate plant growth, erosion of cultivable lands, sand casting and uprooting of perennial trees. A total of 8,069 ha of current fallow land has been damaged.

84. The loss of livestock, and damage to grazing lands and fodder supply have particularly hurt poor families, especially women, since income derived from livestock sector serves as a safety net against the vulnerability of crop failures. About 19,200 head of cattle and other livestock, and 42,715 farm and poultry birds are reported to have been killed.

85. The total damage to the agriculture and livestock sector is estimated to be about Rs. 163.2 crore (\$37.5 million).

86. **Recovery Needs.** The estimated recovery needs for agriculture and livestock are Rs. 93.9 crore (\$21.7 million). In the short-term (\$10.4 million), priorities should include:

- assisting the affected families to recover with cash grant assistance;
- surveying agricultural lands in all affected villages to estimate extent and grades of salinity/sodicity;
- establishing model reclamation fields;

- reviving horticultural crops with and without soil amelioration; and
- restoring affected pasture lands, farm ponds and dug wells.

87. Mid-term (\$11.3 million) priorities should include restoration and promotion of sustainable management of coastal land and water resources; rehabilitation of lands in rain-fed areas where water shortage prevents natural flushing; further land reclamation and soil improvement; fodder development; risk mitigation through diversification into non-farm activities, local post-harvest value addition; crop and livestock insurance as an integral component of productive activity; and capacity building of farmers, including women.

Fisheries (Annex VII)

88. **Damage and Losses.** India's marine capture fisheries sector has been stagnating for some time due to over-exploitation of fishery resources and overcapacity of both mechanized and traditional fishing fleets. The affected states have limited potential for increasing production. Andhra Pradesh and Tamil Nadu had imposed a 45-day fishing ban from 2001. The mechanized fleet contributes most of the catch.

89. Due to limitations in the quality and methodology of data presented to the assessment team, only crude estimates of damage were possible. The tsunami destroyed or damaged nearly 5,000 mechanized boats causing damage valued at Rs. 663.1 crore (\$152.4 million); a total of 7,933 fiber-reinforced plastic boats/*vallams* valued at Rs. 50.1 crore (\$11.5 million); about 24,580 boats of other categories, mainly motorized, valued at Rs. 121.0 crore (\$27.8 million); and 35,483 wooden catamarans valued at Rs. 90.0 crore (\$20.7 million).

90. In addition, 2,342 outboard motors worth Rs. 10.1 crore (\$2.3 million) were damaged or lost. This figure is expected to increase substantially after revision. Net sets valued at Rs. 44.4 crore (\$10.2 million) were damaged or lost. Boat seines worth Rs. 19.9 crore (\$4.6 million) were lost in Kerala.

91. Some issues of importance are:

- the need to separately assess damage to shrimp farms, hatcheries and their ancillaries as this subsector will require a specific support policy;
- a similar approach is needed for small-scale aquaculture run by vulnerable sections;
- a need to refine assessment methodology to better address gaps in evaluations which tend to affect data on asset losses but not losses in livelihoods, support services and ancillary industries. If not addressed, this could skew compensation policies as well; and
- the need for qualified personnel to assess damage and loss of boats; otherwise, there is a danger that repairable, non-operational and older boats could all be compensated at new-boat value leading to an excessive payout and further overcapacity.

92. Only a crude estimate of production losses has been possible for Tamil Nadu and Kerala. Nevertheless, it provides an idea of the dimension of losses, which are particularly important for Tamil Nadu. These amount to Rs. 1,304.0 crore (\$299.8 million) for Tamil Nadu and Rs. 117.8 crore (\$27.1 million) for Kerala.

93. **Recovery Needs.** The sudden elimination of a large operational fleet is rare in the fishing industry. However, the disaster presents an opportunity to redesign the capture fisheries industry in a better and more sustainable way, especially in Tamil Nadu and Pondicherry.

94. Short term activities should include: (a) completion and revisions of the assessments; and (b) evaluation of options for reconstructing the sector in a sustainable way, in particular and for mechanized boats. The cost estimate would be around Rs. 237.7 crore (\$54.6 million), of which Rs. 152.5 crore (\$35.0 million) would be for Tamil Nadu, Rs. 30.7 crore (\$7.1 million) for Pondicherry, Rs. 26.3 crore (\$6.0 million) for Andhra Pradesh and Rs. 28.3 (\$6.5 million) for Kerala.

95. In the medium term, activities of the short term would be expanded and continued after they have been discussed and agreed. Reconstruction of the fleet of larger boats can be expected to be completed. If simple replacement of assets is the strategy chosen, then the cost estimate would be around Rs. 998.6 crore (\$229.6 million), of which Rs. 801.3 crore (\$184.2 million) would be for Tamil Nadu, Rs. 94.7 crore (\$21.8 million) for Pondicherry, Rs. 51.8 crore (\$11.9 million) for Andhra Pradesh and Rs. 50.8 crore (\$11.7 million) for Kerala.

Livelihood (*Annex VIII*)

96. **Damages.** It is estimated that the livelihoods of about 645,000 families (about 3.2 million persons) have been directly and indirectly affected in Tamil Nadu, Kerala, Andhra Pradesh and Pondicherry. Of them, about one-third (220,784) are directly linked to the fisheries sector, about one-fourth (143,000) to micro-enterprises, while the remaining 281,216 are engaged in agriculture, livestock, seasonal employment or intermittent activities. The disaster hit the livelihoods of those that were already poor with the hardest hit including women, scheduled castes and scheduled tribes.

97. Damage to the fisherfolk is the most widespread with long-term consequences as loss of livelihood is compounded by loss of lives, homes and fishing equipment. This has accentuated the damages to micro-enterprises due to the marked interdependency in coastal economies. The vulnerability of micro-enterprises to disruptions in sources of supplies and markets has led to loss of income and employment, especially for women. The damage to agriculture and livestock, though not significant, has also affected the livelihoods of coastal communities, mostly women. Landless and other casual laborers engaged in seasonal employment and other intermittent activities for subsistence have suffered loss of employment opportunities and consequently wages. This group has a preponderance of scheduled castes, tribes, and disabled and vulnerable (orphans, widows, etc).

98. **Recovery Needs.** The short-term priorities include: (i) wage earning opportunities through employment generation programs; (ii) replacement of lost or damaged assets; (iii) forming and strengthening of self-help groups, both for men and women, and providing them seed capital to facilitate bank linkages; (iv) income transfers and social assistance to vulnerable groups who are not immediately capable of undertaking economic activities; and (v) effective implementation of relief measures announced by public sector banks.

99. These interventions need to be undertaken in consultation with, as well as the active participation of the affected communities to ensure effective targeting and transparency. While

continuing with short-term activities, as required, medium term interventions will prioritize value addition through appropriate investments in technology and related marketable skills. These need to be undertaken through a demand driven process. In addition, reducing vulnerability of poor and low-income families through risk mitigation measures such as insurance, targeted social transfers, and development of social protection measures need to be mainstreamed overtime. Over the longer term, income expansion and its equitable distribution will require progressive broadening of sustainable economic opportunities in the affected areas.

100. The estimated cost of the interventions, excluding asset replacement and employment generation cost, for the short term is \$70.6 million and for the medium term it is \$108.1 million. Asset replacement cost for fisheries, agriculture and livestock are estimated under each relevant sector annex. Most of the employment generation will be covered by the ongoing government programs and through the infrastructure reconstruction in the affected areas.

Rural and Municipal Infrastructure (Annex IX)

101. **Damage Assessment.** Though the tsunami was very destructive in terms of damage to housing and fishing boats, there was little infrastructure in the worst hit shore/beach fishing communities. The total damages across the three states and Pondicherry is estimated at Rs. 122.0 crore (\$28.0 million).

102. The damage to water supply comprises salination of thousands of shallow wells, sand damage to hundreds of pumps, destruction of a few hundred public stand posts, and loss of a few thousand meters of small diameter pipe. These damages were assessed to be Rs. 36.5 crore (\$8.4 million).

103. As these areas did not have formal sanitation/sewerage systems, damage was limited to loss of thousands of pit latrines, a few septic tanks and public toilets, assessed at Rs. 3.5 crore (\$0.8 million). Hundreds of local drainage channels, both manmade and natural, were partially filled/silted and or washed away with damages assessed to be Rs. 13.0 crore (\$3.00 million).

104. Many village/rural roads were partially washed away, but the damage was limited to a few hundred meters from the shore. Damages were assessed as Rs. 52.2 crore (\$12.0 million). Public buildings near the shore were either fully destroyed along with much of the surrounding houses or damaged extensively, and are assessed at Rs. 7.6 crore (\$1.7 million). Numerous electrical poles were broken or dislodged by the tsunami and many thousands of meters of line were lost, though only a few transformers needed replacement. Damages were assessed at Rs. 9.0 crore (\$2.1 million).

105. Losses incurred by the local governments include provision of emergency and interim water supply, estimated to have cost Rs. 3.3 crore (\$0.7 million); clean up of residential areas using rental vehicles at a cost of Rs. 3.3 crore (\$0.7 million); and renting of generator sets to provide power for emergency operations and water pumps in the first few days at a cost of Rs. 0.47 crore (\$0.1 million).

106. **Recovery Needs.** The overall reconstruction strategy for urban and rural infrastructure is to rebuild the basic services within the medium to long term development framework of the respective states. The reconstruction will be done to 2005 standards, specifications and norms in

India with a 10 year design horizon. This means that reconstruction costs will be substantially higher than the assessed damages.

107. The strategy proposes to provide the almost 900 affected villages with more permanent water sources from deep bore wells inland away from the shore and the annual salinization problem. While conventional piped sewerage is not envisaged in the medium term, it is proposed to expand basic pit latrines to more dwellings. Also many new public toilet facilities should be constructed to serve slum, commercial and tourist areas. Concurrently, the drainage will be improved.

108. Internal village roads and interconnecting roads will be rebuilt with double carriageways. Many of these will also have improved drainage and be raised to provide all weather access. Each village will have a community building along with children's playgrounds and basic sport facilities. Electrification will be expanded to connect the hundreds of new colonies arising from any resettlement program.

109. The three states and Pondicherry provided the joint assessment mission with longer term plans for all subsectors that were more developmental in nature than directly related to the tsunami. While these proposed works are justified within the longer term developmental strategy of the states, this report believes they are beyond the scope of tsunami reconstruction. However, as indicated above, the reconstruction will be planned to smoothly fit into these longer term plans.

110. The reconstruction cost for the municipal and rural infrastructure across the three states and Pondicherry for the immediate and medium term would be Rs. 424.0 crore (\$97.5 million) (Andhra Pradesh Rs. 122.6 crore (\$28.2 million), Kerala Rs. 113.6 crore (\$26.1 million), Tamil Nadu Rs. 165.3 crore (\$38.0 million), and Pondicherry Rs. 22.5 crore (\$5.2 million))

111. Improved and expanded water supply is by far the largest need, running from 30% of the total in Tamil Nadu, to 45 % in Andhra to 65% in Kerala. Internal roads are next, averaging 25% in Tamil Nadu, Andhra and Pondicherry. Sanitation was a major reported need in Kerala at 30%, though comparatively minor in the other states. These varying needs may, to some extent, reflect ongoing focus in the states, which may have influenced what the states requested in the medium term.

Transportation (Annex X)

112. **Damage and Losses.** More than 100 km of national highways, state highways and district roads, including six bridge sections, were damaged by the tsunami in Tamil Nadu, Pondicherry and Kerala. Estimation of road damage is based on the cost of restoring assets to good condition, which works out to Rs. 58.3 crore (\$13.4 million).

113. In the ports sector, eight ports, 15 fishing harbors and a number of fish landing sites were damaged in Tamil Nadu, Pondicherry and Kerala. The tsunami destroyed breakwaters and caused huge amounts of sand to drift into the basins and channels of ports and fishing harbors, leading to navigation problems. Damage cost was estimated on the basis of restoring the ports and harbors to their original capacity. This works out to Rs. 95.0 crore (\$21.8 million).

114. **Recovery Needs.** The immediate need is to repair badly damaged coastal roads and bridges to avoid the present costs of traffic diversion onto other routes, and to quickly restore transport links in areas that are vulnerable to hazards. In the damaged ports and fishing harbors, the immediate needs are to restore breakwaters and carry out dredging. A total of Rs. 180.4 crore (\$41.5 million) is the estimated requirement of funding for the short term. This is an opportunity to systematically evaluate the effectiveness of these coastal defense infrastructure projects (within the context of a multi-hazard risk analysis) and improve their siting, design and implementation.

115. Over the medium term, other affected roads and infrastructure in ports and fishing harbors also need to be restored. The work will need to take into account future traffic patterns and the role of the facilities in coastal protection, and where appropriate designs should be integrated with improvements in coastal protection works. Appropriate evacuation and relief paths also need to be included in the medium term reconstruction measures, particularly in ports, fishing harbors and isolated villages. A total of Rs. 120.3 crore (\$27.7 million) will be required for the medium term.

116. Over the longer term, further requirements for roads, ports, and harbors should be subject to further study to examine their technical and economic justification, and their environmental and social impacts.

Coastal Protection (Annex XI)

117. **Damage and Losses.** About 28 km out of a total of 300 km of rubble mound seawalls (RMS) were damaged by the tsunami. Many existing flood banks near the mouths of rivers were also damaged, especially in Nagapattinam district. Estimates of the cost of damage are based on the cost of restoring damaged coastal protection infrastructure to sound working condition. This amounts to Rs. 186 crore (\$42.8 million), comprising Rs. 104 crore (\$23.9 million) in Tamil Nadu, Rs. 42 crore (\$9.7 million) in Kerala, and Rs. 40 crore (\$9.2 million) in Andhra Pradesh.¹¹

118. **Recovery Needs.** The immediate focus should be on restoration of damaged infrastructure for protection against normal coastal hazards such as cyclones, storm surges and river floods. Especially in Nagapattinam district, serious damage was reported at river and drain banks, and these need to be restored immediately. A total of Rs. 85.0 crore (\$19.5 million) is the estimated requirement of funding for the short term. This is an opportunity to systematically evaluate the effectiveness of these coastal defense infrastructure projects (within the context of a multi-hazard risk analysis) and improve their siting, design and implementation.

119. The medium term support covers the more vulnerable areas to be protected within one to three years. Longer term support covers areas that require improved coastal protection within 3-5 years. A total of Rs. 81.0 crore (\$18.6 million) will be required for the medium term.

120. In the longer term, it is essential that the selection of technical options and design of additional infrastructure be based on thorough studies and environmental consideration which take into account the lessons learned from the recent tsunami and other recorded events. The

¹¹ Based on information available at the time of the assessment, no requirements for immediate restoration were identified for Pondicherry, although medium term reconstruction and recovery estimates of Rs 147 crore were identified.

design of coastal protection works will need to be closely coordinated with the recovery and rehabilitation works for highways, ports and fishing harbors, using an integrated approach to design of facilities where possible. In instances where coastal hamlets will now be relocated to lowland areas, the extent of coastal protection may be reduced, but other anti-flood measures will be needed, such as raising the ground level of relocation sites and construction of embankments.

Hazard Risk Management (Annex XII)

121. While the tsunami was a low frequency, high impact event, it exposed the vulnerability of coastal populations in the affected states to other natural hazards such as floods, cyclones, drought, lightning strikes, earthquakes and landslides. Combined with growing populations, higher population densities in coastal zones, continued dependence of a large section on primary sectors vulnerable to extreme climatic events, inadequate systems to assess and reduce risk, and moderate emergency response capacities, this part of the country faces moderate to high disaster risk.

122. It is important to integrate disaster risk management into the development process. Post-tsunami reconstruction provides a strategic opportunity to strengthen institutional mechanisms, policies, procedures and capacities to manage disaster risk both in the affected areas and other vulnerable areas. The following critical issues need to be addressed:

123. In the short term (\$8.1 million)

- A state-wise comprehensive multi-hazard risk assessment of the affected (and adjoining) talukas/districts which will identify the population, and physical, economic and cultural assets exposed to natural hazards; and inform reconstruction decisions and future development plans.
- Set clear risk reduction guidelines for reconstruction in each sector.
- Appropriate community consultation and participation mechanisms to be developed in collaboration with civil society organizations to enable the affected communities to articulate their concerns and participate in decision making processes so that reconstruction decisions not only reduce future disaster risks but also meet their social, economic, environmental and cultural needs.
- Synergies between different sectors must be explored to reduce future disaster risk. An integrated multi-sector and where possible area-based approach can help address all dimensions of vulnerability.
- It is important to set up an information, communication and public awareness program at an early stage to meet the information needs of the affected communities as well as propagate risk reduction practices.

124. In the medium term (\$9.2 million)

- It is important that at the local level, early warning systems be looked at in a multi-hazard context, and the scientific and technical efforts on generating improved forecasts and warnings be matched with equal (if not greater) emphasis on effective communication systems, public awareness, social infrastructure and preparedness at the community level.

- The post tsunami recovery efforts should be used as an opportunity to repair and strengthen existing cyclone shelters, assess the need for additional shelters and put in place a community based system for their maintenance.
- There is a need to establish systems for tracking existing and emerging patterns of disaster risk in the affected states to help formulate development and disaster risk management policies.
- There is a clear need to strengthen emergency services at the district, block and village levels in the affected states.
- There is need to establish linkages between environmental and disaster risk management efforts.
- The post-tsunami reconstruction and recovery efforts provide an opportunity to explore how access to risk transfer mechanisms such as insurance, micro-credit schemes can be improved for the lower socio-economic strata.

E. ISSUES FOR RECONSTRUCTION

125. As the transition from the emergency and relief moves to reconstruction, several key issues emerge for the short to medium term period. The quantification of damage and recognition of needs received, given its sector by sector nature, allows for concrete, specific proposals for action in sector or geographic terms. However, certain cross cutting issues need to be considered in the design of the reconstruction strategy. A guideline on such cross cutting issues can act as tool for determining priorities (importance vs. urgency) and sequencing (timeline for reconstruction process), i.e. restore livelihood conditions while physical reconstruction of housing, production, and infrastructure proceed.

126. These guidelines on cross-cutting issues for a medium term reconstruction strategy can be summarized in the following box:

Table 4. Cross - cutting guidelines for the medium term reconstruction process

1. Post disaster relief
 - Protecting the most vulnerable
 - Making temporary shelters more livable
2. Moving from relief to reconstruction
 - Getting people back to work
 - Restore and upgrade infrastructure and services wherever possible
 - Secure livelihoods with value added
 - Maximize the use of local procurement in recovery efforts
3. Prospective risk reduction
 - A healthy environment for long term security and sustainability
 - Prospective risk management for a multi-hazard context
 - Organize communities to respond to emergency situations
 - Provide timely information on risk and early warning accessible to local communities
4. Governance and policy framework
 - Nationally and local driven recovery
 - Short term rehabilitation and medium term reconstruction not hinged on long term development
 - Balance between government and participation
 - Respect for cultural diversity and specificities
 - Improve equity of access rights and the distribution of productive assets
 - Transparent and effective monitoring of the recovery process (ensure accountability)

127. Timely phasing out of relief into recovery will be closely associated with the release of the “reconstruction packages” for livelihoods, and productive activities (e.g. fisheries and housing) as soon as possible. Since the recovery of livelihoods is the foundation of reconstruction, getting people back to work (either return to pre-tsunami activities or income generation through participation in public works, work for food programs, such as rebuilding infrastructure, clean up of silted soils and water sources, etc.) is key to getting the local economy moving again.

128. Recovery and reconstruction are opportunities to improve living and livelihood conditions—to this end, interventions and program in infrastructure, both public and private, should strive to provide employment and training to those affected, increase energy efficiency, and provide the structures needed for supply and market chain efficiencies; thus recovery in a sense involves the broader community beyond the strict limits of the affected physical area and the directly affected population. Likewise, livelihood interventions that seek to increase value added in the production processes, to improve return to the producer, provide opportunities for skill up gradation and training, and minimize production and transaction costs will be commensurate with broader development goals. This is to say that recovery and rehabilitation do not wholly concern replicating previous livelihoods. Rather, traditional livelihoods should be improved, and where needed, alternative livelihoods, particularly among women, should be supported. Recovery and rehabilitation phases provide opportunities to increase equality within communities, more evenly distribute ownership of assets, and improve the condition of women and other vulnerable groups.

129. The environment of the region is both a resource of national importance and the basis for the livelihoods of a substantial number of people in the affected areas. In this context the process is to find the appropriate balance between environmental rehabilitation/conservation and sustainable livelihoods.

130. Participatory planning will result in plans that meet the needs and have the support of the affected community, and will therefore be the most effective. As an example, tribal groups and fishers that have distinctive lifestyles which are in themselves a part of the cultural heritage of India, will require solutions that are responsive to these societies' need to maintain their integrity, at the same time developing programs that result in the improvement of the quality of their lives.

131. For all the interventions, knowledge of scientifically tested and accepted methods in keeping with internationally agreed values and principles will facilitate the adoption of appropriate solutions. Monitoring mechanisms put in place to assess and advise would facilitate the implementation of these interventions.

132. Local recovery efforts, already begun, should not be tied to the lengthy process of approval of international loans and the development of all encompassing “master plans”. In other words an incremental process of local recovery already in its initial stages is moving in parallel with decision making on more strategic issues (such as vulnerability reduction, sea protection, relocation of affected/displaced households, and restoration of livelihoods).

133. Recovery will be more effective if it maximizes the use of locally available inputs (labor, materials, and services) so that it contributes to the recovery of the local economy. Cash for work programs used in areas such as rebuilding of houses and local infrastructure, cleanup remaining activities, soil recovery, reforestation of mangroves etc. are a way of kick-starting the local economies.

134. Sectoral needs analysis suggests to carefully apply certain principles in detail and further examine certain issues which the JAM considers cannot be resolved in such a short timeframe. These include the need to:

- Embed community participation and apply equity based principles to the reconstruction process in vulnerable communities;
- Consider locational setback taking into account the challenges in the application of the coastal regulation zone;
- Consider the feasibility of uniform building standards across different affected states and union territories (to be further applied to all states and union territories).
- Enable flexible assistance for creative and diversified changes in economic activities, balanced against local realities in such a change process; and
- Provide financial solutions to bridge short-term lack of income / resources due to job and productive capital losses.

India
Post Tsunami Reconstruction Program
Preliminary Damage and Needs Assessment

PART - II: Annexes

Annex I: SOCIAL IMPACT

A. Introduction

1. This annex addresses the social impact of the tsunami, which caused massive destruction and casualties in the coastal regions of Tamil Nadu, Andhra Pradesh, Kerala and Pondicherry. It is based on field visits to the worst hit areas of Cuddalore district of Tamil Nadu; Kollam and Alappuzha districts of Kerala; Pondicherry and Karaikal. Team members met with government officials at the state and district levels, funding agencies and NGOs working in the affected areas, and with affected people themselves.

B. Damage Overview

2. The tsunami waves struck the mainland with a height of three to 10 meters and penetrated 300 m to 3 km inland, affecting approximately 2,260 km of coastline with varying intensity. The largest number of villages impacted was in Tamil Nadu (376), followed by Andhra Pradesh (301), Kerala (187) and Pondicherry (33). The disaster devastated communities with its high toll of human lives, injuries, family networks, homes and livelihoods. There are long term consequences for families torn by death or disability of members, and for widows, single parents and their children, orphans, children separated from their families, the elderly and the disabled. In all the tsunami-affected states and union territories, more women and children have died than men. The majority of those affected on the coast were fisherfolk who suffered the most damage in terms of housing and livelihoods with loss of dwelling units, household assets, and productive assets like boats and nets.

Shelter and Livelihoods

3. Overall, more than 150,000 houses have been fully or partially damaged¹². Of these, nearly 80 percent of the families belong to fishing communities, and 70% of them lived in *kachcha* (temporary and lightweight) structures.

4. Immediately after the disaster, displaced people moved to relief camps provided by the government and NGOs. They will soon be shifted to temporary shelters until permanent housing can be built. People currently occupying schools and other public buildings will need to be relocated first to enable resumption of public services. Meanwhile, those in camps need to be protected from health, sanitation and environmental hazards, and women and girls in particular face a lack of privacy.

5. The disaster hit hardest the livelihoods of those that were already poor, affecting directly or indirectly nearly 645,000 households¹³. Fishermen, farmers, landless and casual laborers, small businesses and micro-enterprises, and other categories of workers in the informal sector have been badly hit. Disruptions in sources of supplies and markets have led to loss of income and employment, especially for women who played a big role, for example, in the cleaning, drying and selling of fish, besides the making of rope, shell-craft and pickles. This vulnerable group has a preponderance of scheduled castes and tribes.

¹² For state-wise breakup of loss of housing refer to Annex IV.

¹³ For state wise breakup of loss of livelihood refer Annex VIII. Data does not include Pondicherry.

6. The vulnerability of these communities is accentuated by their indebtedness to big merchants and informal money lenders with whom many had current borrowings, lack of access to markets and credit, absence of social security nets, and socio-political marginalization.

7. Conversations with fishermen revealed that even those who were in a position to repair their boats were not going back to sea as they were prevented by local community leaders who feared they would then become ineligible for government compensation. The community also felt that the sudden demand for boats combined with lack of skills and non-availability of raw material would delay the process of replacement or repair.

8. For households depending on agriculture, horticulture and aquaculture, especially small and marginal farmers and agricultural laborers, saline water intrusion has destroyed standing crops while damaging the land for at least a couple of seasons. These and related households have also suffered from the loss of other productive assets, especially livestock.¹⁴

Orphans, Female-headed Households and Single Parents

9. A large number of children are left without their parents and this category requires special protection both immediately and continuing into the medium and long term. The respective state governments have for now declared special compensation and care programs for orphaned children and adolescents. Similarly, female-headed households present a particular vulnerability as the women have to deal with their own psycho-social distress, loss of livelihood and the care of their dependents. Discussion with the communities revealed that many female-headed households were not included in the relief beneficiary lists, and care should be taken to ensure they are not left out of rehabilitation schemes. At the same time, the loss of the male head or income earner increases the family's economic vulnerability and significantly reducing its coping ability. Single-parent households will therefore also need to be enumerated and provided special support.

Legal Aspects

10. A large number of affected households had been living on government land and technically were encroachers, which may complicate the process of housing rehabilitation. This situation was more pronounced in Tamil Nadu and Pondicherry. Other than this, many legal owners have lost their property documents.

Resettlement

11. In order to protect coastal populations from future disasters in areas identified as vulnerable, a number of households either affected by the tsunami or unaffected but living in unsafe locations, might have to be relocated. This issue is compounded by the current discussion in government about implementing the Coastal Zone Regulations (CRZ); this decision will have significant implications for the scale and scope of relocation and resettlement. If CRZ is implemented strictly, the scale of resettlement could increase multifold. Discussions with affected households, community leaders and district officials indicate that relocation should not only be viewed in the context of disaster prevention but

¹⁴ See Annex VI on Agriculture and Livestock.

also in relation to its impact on livelihoods. The need for fishing communities to be near the sea is an obvious example. A recurrent feedback from fishermen interviewed was: “*We cannot live far away from the sea; we keep a watch on the tide and decide when we can fish. If we go far away how will we survive?*”

12. A detailed assessment needs to be carried out for every vulnerable village in close consultation with the affected communities with special attention on the marginal among them, NGOs and local governments (panchayats) to understand their needs, priorities, options, site preferences, and impacts of any decision. Conversations with affected persons in Tamil Nadu, Kerala and Pondicherry revealed that most of those who had lost their homes wanted to be return to the same location; if it was necessary to move, it should be no more than 800 m to 1 km from the existing location. Fishermen spoke of no more than 500 m. In either case, they would like to rebuild their homes to better standards than before, and fishing communities would like additional facilities such as boatsheds and stores. Those in Kerala mentioned that land availability would be a problem as most villages are between the sea and the backwaters.

13. Displaced households with legal title were of the opinion that if they had to relocate, the government should provide them the new land with title, while allowing them to retain the rights to their original property. While this is anecdotal feedback, important issues are raised. The most important is that the impact of relocation on livelihoods should not increase vulnerability and thus defeat the very purpose of the relocation.

C. Reconstruction Strategy

14. Immediate and medium-term recovery and reconstruction, particularly related to temporary shelter, housing, livelihoods, legal aspects, protection of women and children, education, health, drinking water, civic services, community participation and safeguard issues will require incorporation of a number of social issues and needs.

(a) *Shelter and Relocation of Affected and Displaced Households*

15. The immediate need is the provision of livable temporary shelters for displaced people. The temporary shelters already in place turn into furnaces during the day, making it difficult for the families to stay indoors. This will worsen as summer peaks. Privacy is a major issue, especially women and children. Adequate and properly maintained water and sanitation facilities and solid waste management systems need to be in place. Restoration of educational, mother and childcare, and health facilities in the affected areas is an urgent necessity.

16. In the short-term, households in temporary shelters should return to permanent housing on the principle that *relocation should be avoided unless it is clear that: (a) staying in the same place is unsafe; and (b) the villagers clearly express a preference to shift to a new location.* A transparent and participatory approach involving the communities will be key to assess their options, and then to plan and implement their decision.

17. In the medium to long term, households whose structures were not damaged but who are known to be staying in a risk-prone area need to be consulted extensively about their choices and

options, and assisted in selection of relocation sites and reconstruction of houses whether they opt for self-relocation or as a group. New construction and repair of existing sea-walls wherever feasible can also be thought as long term prevention measure. Community disaster and risk prevention and management training can also be provided to all households living along the coast¹⁵.

(b) Livelihoods

18. Discussions were held with different affected groups to identify their livelihood needs and priorities. Almost all fisher households, especially men, wanted to go back to fishing. Women were more open to undertake training for alternate income generation activities. Small and marginal farmers and agricultural laborers felt they should be compensated for their losses, and support be provided to help them restore damaged land and get back to their livelihood as soon as possible. Others who lost productive assets, small shops and livestock also expressed the need for compensation. Households who had taken loans to purchase these assets or residential units felt the loans should be waived.

For a detailed discussion on restoring livelihoods, see Annex VIII.

(c) Women, children and disabled

19. Priority needs to be given to uniting separated children with their families. Orphans need to be provided with culturally sensitive care options, and psycho-social support and legal protection. Awareness raising and training on child rights and child protection should be carried out with relevant stakeholders. Female-headed households and disabled persons should also be provided with psycho-social support, livelihood restoration, and legal protection on matters related to property and inheritance rights and child custody. Vulnerable groups that cannot immediately undertake economic activities need to be assisted through targeted social transfers and social protection measures.

(d) Legal Issues

20. Restoration of lost property records is an urgent need, with special assistance to the poor, widows and orphans. Particular attention needs to be paid to children's inheritance rights, and identifying legal guardians. Any new housing should be jointly registered in the names of both husband and wife.

(e) Safeguarding against secondary displacement or other negative impacts of the reconstruction effort

21. Secondary displacement and resettlement should be avoided where possible, and assistance should be given to enable people to rebuild their homes to better standards in their old location. This would also minimize the need for new land acquisition, which may displace those whose land is acquired. As a general principle, to the extent possible, relocation should be avoided. Where it is unavoidable, the following need to be kept in mind:

¹⁵ See also Annex XI on Coastal Protection and Annex XII on Hazard Risk Management.

- Where temporary relocation is unavoidable, such shelters should be built on government land wherever possible.
- If permanent housing is to be constructed in new sites, the affected population should be given financial and technical support to choose locations and housing based on their own preferences.
- If acquisition of private property is unavoidable, the government should assist in purchasing the necessary land as far as possible through the principle of willing seller - willing buyer, rather than resorting to land acquisition under law.
- If land acquisition and secondary displacement become unavoidable, a social assessment process involving all stakeholders should be undertaken and those affected should be compensated and resettled through best practice procedures.

(f) *Community Consultation and Participation*

22. Local communities will need to be actively involved in planning, decision-making and implementation in most sectors if reconstruction and recovery is to be successful. Experience with disaster reconstruction all over the world has shown that community participation is in fact a fundamental requirement that helps in the following manner:

- *Reducing trauma*
Trauma and depression are not always visible immediately after a disaster but may occur weeks or months later. Active involvement in work and participation in community affairs can reduce psychological problems.
- *Appropriate solutions, equity and ownership*
Involving communities in needs assessments and decisions on choices helps ensure appropriate solutions as well as giving socially disadvantaged sections a voice. Participatory mechanisms have the potential to iron out inequalities without exacerbating social tensions. Community participation in decisions on school and health center locations, and water supply and sanitation infrastructure, for example, would ensure better access, increase utilization, and give users a stake in their repair and maintenance. Moreover, using local resources and labor fosters a greater sense of ownership while reducing dependency on relief and handouts.
- *Transparency and accountability*
Disaster reconstruction involves the flow of large sums of money within a short period to a large number of people. Targeting, transparency and accountability become key. The more decentralized the process, the less the scope for irregularities and corruption. Communities should be involved in identifying beneficiaries, reviewing damage assessment reports, monitoring the progress of reconstruction, verifying transfers of material and cash (ideally made only in public settings), and certifying accounts and records which should be publicly displayed.

Partnerships between Government, Donors, NGOs, and Community Organizations

23. Involving communities in their own reconstruction and rehabilitation will require a well-coordinated effort between government, NGOs, aid agencies, commercial organizations and existing

community institutions, including panchayats. External partners need to ensure that they do not undermine the drive and initiative of the communities, that local leadership, as well as poor, vulnerable and marginalized sections participate, and to be mindful of the communities' dignity, traditions and practices. Collaboration among these agencies was excellent during the relief phase. This effort needs to be carried into the recovery and reconstruction. Not only must physical activities be coordinated, but all must follow common technical and finishing standards and harmonized policies. Only a continuous two-way communication and dialogue interface between the communities, external partners, and the government will ensure this.

Monitoring and Grievance Redress

24. An effective, accessible monitoring and grievance redress mechanism must be established, and the public should be informed of their right to redress and of the procedures to invoke it.

Annex II: ENVIRONMENT

A. Introduction

1. The tsunami caused extensive damage to the coastal areas of Tamil Nadu and Pondicherry, and more localized damage to the coasts of Kerala and Andhra Pradesh, affecting in total about 2,260 km of coastline. The tidal waves on the mainland reportedly reached heights of 3 to 10 meters and penetrated 300 meters to 3 km inland.

2. A number of factors make it difficult to assess the specific environmental impacts of the tsunami in the short-term, including the lack of comprehensive baseline information on most coastal and marine ecosystems in the region and the absence of on-going systematic monitoring of such systems. Additionally, and understandably, the priority in the short-term has been immediate relief to the affected populations. Nevertheless, several governmental and non-governmental agencies initiated rapid assessments, with many proposing more comprehensive studies in the medium and long-term.¹⁶

3. This rapid review of environmental issues is based on a series of very short field visits to the most seriously impacted sites in Tamil Nadu, Pondicherry and Kerala. It was not possible to conduct a direct assessment of environmental impacts, and even direct observations are clearly biased towards large-scale visible, terrestrial impacts. Moreover, many environmental effects will only manifest themselves over the medium to long-term. Apart from the site visits, discussions were held with state and local government officials and some key research institutions and agencies.

4. Given these limitations, the following provides a preliminary assessment of the known and possible primary and secondary environmental impacts of the tsunami in the short-term, and key environmental considerations for the short to medium-term reconstruction and recovery phase. No attempt is made to quantify environmental damage in monetary terms at this stage because of inadequate reliable and quantitative information on most aspects of the impacts. Some of the costs of the damage to the environment are captured in other chapters, notably agriculture and fisheries.

B. Overview of the Damage to Biological and Physical Environment

5. **Pre-tsunami Situation.** The coasts of the Indian subcontinent have high human population densities, which in Kerala exceeds 2,000 people/km². Thus, there had been considerable degradation of typical coastal ecosystems such as coral reefs, sea grass beds, mangroves, beaches, sand dunes, mud flats, lagoons and the rare and endangered tropical dry evergreen forests of the east Coromandel coast. Mangrove forests have declined by 40% in the past 120 years, while the indigenous tropical dry evergreen forests have been reduced to 1% of their earlier distribution along the east coast as a result of land conversion for different purposes including, human settlement, economic activities and infrastructure development. There is also significant pollution of near shore marine habitats due to sewage and industrial emissions. Coastal geomorphology has been altered through the development of large infrastructure such as highways, industries, ports and harbors. Other disturbances include sea-defenses such as breakwaters and groynes as well as defenses to

¹⁶ These include: the Centre for Earth Science Studies (CESS), Thiruvananthapuram, Suganthi Devadasan Marine Research Institute (SDMRI), Tutticorin, among others.

protect coastal settlements. In Kerala, for example, there has been extensive use of rubble mound seawalls to protect against coastal erosion.

6. In some places, both human settlements and major infrastructure are located extremely close to the high tide line, up to within 20 meters, partly as a result of coastal erosion. The effectiveness of such defenses has varied, while some have had clear adverse environmental impacts as they alter natural patterns of coastal erosion and accretion, which can increase the vulnerability of human settlements elsewhere along the coast. ‘Shelter belt’ plantations established on the beach itself have been documented to adversely affect biodiversity, for example by reducing nesting sites for endangered marine turtles.

7. **Coastal Regulation Zone Notification.** Another key feature of the pre-tsunami situation was the incomplete and inconsistent implementation of the Coastal Regulation Zone (CRZ) notification of 1991 and the associated state Coastal Zone Management Plans. The CRZ notification is the principle legislation governing development activities and land use along India’s coasts in the area falling within 500 meters of the high tide line and in the inter-tidal zone. Under the notification, all areas within this zone are to be classified as CRZ I (i), I (ii), II, III or IV based on geomorphology and various other criteria, including ecological significance, existing developments and other features.¹⁷ The nature and kinds of land uses permitted vary according to the specific zone within which an area falls, with greater restrictions on CRZ-I areas, fewer on CRZ-II areas and variable restrictions in CRZ-III areas, where there is considerable scope for varied interpretation as well.

8. Generally, the notification is complex (this is compounded by 17 amendments since 1991) and has been interpreted and applied in different ways by both Centre and states. The lack of systematic application of the notification or any effective integrated coastal zone management has reduced the resilience of natural systems and increased the vulnerability of populations and infrastructure to natural disasters.

9. **Impacts on Settlements, Natural Resources and Human Production Systems.** The tsunami has had a number of impacts on settlements and human production systems, as follows:

- Salination of Ground Water and other Freshwater Resources. Seepage of sea water into shallow aquifers, wells and other freshwater sources has been reported from Pondicherry, Kerala and Tamil Nadu which have implications for immediate human health and agriculture. The permanence of such contamination must be assessed and remedial action taken in cases where salinity will not be flushed out rapidly through rainfall and other natural processes. This could be especially problematic in drought-prone areas.
- Debris and Rubble. There is a significant amount of debris and rubble requiring disposal, possibly as much as 500,000 metric tons (initial estimate). There is also the potential for more rubble and debris once the disposal of damaged housing (estimated at about 140,000 units), fishing vessels (over 50,000 boats destroyed or damaged), and other damaged

¹⁷ CRZ I (i) comprises ‘ecologically sensitive or important’ areas such as wildlife sanctuaries, national parks, government forests, mangroves, coral reefs, breeding and spawning grounds of fish and sites of historical importance. CRZ I (ii) comprises areas between the low tide line and the high tide line. CRZ II consists of areas that are already quite developed up to or close to the shoreline, such as major coastal settlements, ports and other large infrastructure. CRZ III consists of areas that are less developed than CRZ II areas or undeveloped but which do not merit being classed as CRZ I. CRZ IV covers the coastal stretches of the Andaman and Nicobar Islands, Lakshwadeep Islands and some other islands except where these have already been classified as CRZ I, II or III.

infrastructure is accounted for. The debris, including plastics and other toxic and non-biodegradable wastes, requires proper handling and disposal to prevent long term impacts to land and water resources. The cost for proper disposal is estimated at \$5 million.

- Erosion and Sedimentation. There has been extensive erosion of the beach/coastline in some areas, including the complete disappearance of large sand banks and changes in the shape of estuaries. Given the dynamic nature of coastal systems and natural patterns of coastal erosion and accretion, the permanence of such changes and their associated social, economic and ecological implications are unclear at present.
 - Impacts on Production Systems. Certain environmental impacts have implications for production systems such as fisheries and agriculture. The most visible is the salination of agricultural land and ground and surface freshwater sources, including ponds, tanks, irrigation canals, lakes, streams and rivers. Total affected crop land has been estimated at about 8,000 ha, with much of the damage occurring in Tamil Nadu, although both Pondicherry and Kerala reported damages in the order of 500-1,000 ha. Livestock losses were severe in Kerala while damage to salt pans amounting to over 1,400 ha was reported in Andhra Pradesh¹⁸.
 - The tidal waves left significant amounts of what appears to be sea-bed organic deposits of a sodic nature. This material settled after the tidal waves lost their forward momentum from about 200 meters inland. In some places these deposits are close to 30 cm in thickness. The affected land is unusable in its current state. Salinization of agricultural land as well as yellowing of leaves and premature nut fall in coconut trees was reported on the Kerala coast.
 - Impact on Fishery Resources. The precise impacts of the tsunami on fishery resources will only become clear in the medium to long-term. Scientists at the Centre for Advanced Marine Studies (Peringapettai) mentioned that the few fishermen who had been out fishing reported catches of non-local species. There is therefore a need to monitor whether these species persist and cause displacement of indigenous species. Damage to coastal aquaculture was also reported, with initial estimates of some 400 ha of shrimp ponds having been affected across the impacted area. Over 100 small-scale oyster farms established by self-help groups were destroyed in Kerala.
 - Damage to Plantations. Additionally, some amount of damage to plantations has been reported by individual states. The Tamil Nadu forest department has reported damage to 2,581 ha of shelterbelt, mangrove and teak plantations and associated nurseries. The estimated cost to replace these is Rs. 6.50 crore (about \$1.5 million). Figures for damage to government plantations have not been reported by the other states.
10. The most significant secondary environmental impacts are likely to be as follows:
- Impacts and damages caused by relief camps, temporary shelters and other temporary structures. The construction of numerous relief camps and temporary shelter sites (about 500 in all) may have impacts on the long-term productive capacity of the land, including the possibility of permanent land use change. Initial estimates suggest that more than 1,500 ha would be required for reconstruction of damaged housing. Emergency measures taken after the tsunami have led to hastily constructed structures that will require removal and disposal, such as the temporary land bridge at Nagapattinam port.

¹⁸ See also Annex VI on Agriculture and Livestock.

- Water and sanitation issues are an integral part of the design of temporary shelter sites, and the proper design of temporary facilities is critical in minimizing the risks of long term impacts. There are indications that waste management is rapidly becoming a concern.
- Energy sources. The inhabitants of temporary shelters will require energy, and both the forms of energy and the sources of supply are unclear. This could exert pressure on natural resources locally.
- Changes in land use. There is an increased risk of land use change if affected agricultural lands are not rehabilitated to their earlier productive capacity or if new road segments are required
- Increase in water and chemical usage. Reclamation of agricultural land will require significant amounts of water for flushing out the salinity and some chemicals to reestablish the land's buffering abilities.

11. **Primary Impacts on Coastal and Marine Ecosystems, including Changes in Coastal Geomorphology and Pollution.** The direct environmental impacts of the tsunami varied according to various factors, notably the bathymetry and geomorphology of the coastline, as well as the presence of various natural and man-made features. Thus, areas adjacent to relatively steep continental shelves were generally less damaged than coasts with an extensive shallow continental shelf, such as Nagapattinam district in Tamil Nadu, which was severely impacted. There are anecdotal reports of the buffering role of mangroves, reefs, sand dunes and plantations (primarily of *Casuarina*) as well as the rubble mound sea walls in Kerala. The precise nature and extent of this buffering need to be ascertained more systematically.

12. Changes in the coastal geomorphology have been recorded by India's Department of Ocean Development and reported by fishermen, although a full picture is yet to emerge including a comprehensive assessment of the nature and implications of these changes. Many coastal wetlands will have been affected at least temporarily by the large inflow of salt water and silt load, while there may be longer-term impacts relating to changes in hydrology caused by physical changes to coastlines.

13. Damage to mangrove saplings was observed in the Pichavaram mangroves (1,400 ha) in Cuddalore district of Tamil Nadu. Such physical damage is also likely in other mangrove areas. The backwash created as each wave retreated was potentially more damaging as sediments and other land debris were deposited on coastal and shallow-water habitats, including mangroves, seagrass beds and corals. The district forest officer of Cuddalore reported heavy siltation in the Pichavaram mangrove, and the team observed considerable debris in the mangroves (plastics, nets and other household articles). Large movements of sand were also reported in Kerala, including the black sand mined for thorium.

14. An obvious environmental impact of the tsunami is the terrestrial and aquatic pollution that has resulted from the waves and backwash. The most visible of these is the physical debris, particularly more slowly degrading waste such as plastics, and to a lesser extent rubble from damaged houses, sea walls, and other materials.

15. The Tamil Nadu government has identified seven pollution hotspots along the coast: Cuddalore, Manali, Ennore, Kasimedu, Tuticorin, Nagapattinam, and the confluence of the Cooum river near Chennai. Effluents from chemical industries, petroleum refineries, power plants and

sewage are the main pollutants. The concerns in this area are largely due to the backwash of the tsunami carrying inorganic materials and other pollutants into the sea from the human settlements. Data from the other states could not be obtained in the time available.

16. **Impacts on Protected Areas in the Coastal Zone.** The general perception is that there has been no major impact on wildlife because no significant mortality has been reported so far in larger and more visible species, particularly mammals, birds and large reptiles in the tsunami-affected mainland states. However, this does not mean that there are no significant impacts on wild flora and fauna, whether immediate or longer-term, particularly due to salinity ingress in soils and water bodies.

17. Limited information was obtained for three protected areas in Tamil Nadu. The Point Calimere Sanctuary and adjoining area was flooded for two days after the tsunami. An increase in the salinity of some water bodies has been reported and this has resulted in the death of numerous fishes, but there are indications that the salinity levels are beginning to decrease. At least in the short-term many aquatic birds seem to have moved further inland, especially flamingos. Sand and silt has been extensively deposited up to 500 m inland. Authorities believe there were no significant impacts on Pulicat Bird Sanctuary which lies north of Chennai. The Gulf of Mannar Marine National Park was sheltered to an extent by the Sri Lankan land mass.

18. There seem to be no large-scale impacts on the globally significant coral reefs and associated habitat and resources, including reef-associated fishes. Preliminary assessments indicate physical damage to some 2 percent of the total available corals, comprising table corals and branching corals, and to seagrass beds. Monitoring will be required to see how well these corals regenerate.

19. The above preliminary information underscores the need for more systematic and comprehensive assessments of the impacts of the tsunami on biodiversity along the Indian coast. Wetlands International has identified a number of important sites that should be assessed and monitored for such impacts in all tsunami-affected countries, including India.

C. Reconstruction Strategy

20. This section proposes key principles to be considered in the design and implementation of an environmentally sustainable rehabilitation and reconstruction program for tsunami-affected areas. These principles propose a framework for considering issues, remedial options and opportunities to enhance environmental management and outcomes associated with man-made and natural systems.

21. Mainstreaming environmental considerations into sectoral interventions. There are environmental dimensions to practically every sector affected by the tsunami. This requires the consideration of environmental issues in all sectoral reconstruction planning and action, particularly the siting of temporary and permanent settlements. Actions related to reconstruction and recovery should seek to ensure that the sustainability of coastal and marine ecosystems is not compromised, and is ideally enhanced as the goods and services they provide underpin the livelihoods and immediate welfare of large coastal populations. Wherever possible, 'soft' options with fewer adverse environmental impacts should be favored over 'hard' options that may involve changes to coastal hydrology and other natural processes.

22. Learning lessons from the tsunami event. Tsunamis occur relatively infrequently in the Indian Ocean. The present situation offers an opportunity to assess and monitor the resilience of natural and modified ecosystems to such extreme events, which in turn will help plan mitigation of the potential impacts of a range of natural risks and hazards, which affect coastal areas periodically. Such monitoring can also help plan against the anticipated adverse impacts of climate change. In the short-term, such monitoring is key to identifying environmental damage and prioritizing environmental restoration¹⁹.

23. Need for a comprehensive coastal zone management strategy. Such a strategy would reflect the dynamic nature of the coastal and marine environment and support multiple-use objectives, without compromising the sustainable supply of environmental goods and services. These objectives would reflect livelihood needs, reduce vulnerability to natural hazards, and the conservation of biodiversity and ecological services.

24. Focus on localized site-specific solutions. The extent of the damages along the coastline and the fear of a tsunami recurring must not lead to uniform strategies being applied across the board without full consideration of the different variables such as climatic factors, bathymetry and coastal topography associated with vulnerability to natural hazards. Economic, environmental, social and cultural factors must all be taken into account when developing disaster risk mitigation strategies, and solutions must be anchored in the prevailing circumstances of local situations.

D. Reconstruction Needs

Short-term Priorities

25. With emergency relief operations largely over, attention is shifting to short and medium term recovery actions and strategies. The most pressing issues are likely to be linked to the relocation of a large number of affected people from temporary shelters to permanent housing sites, and the need to reestablish the productivity of affected areas. It is likely, however, that a significant number of people may be using temporary shelters beyond six months. Careful planning and management are required to mitigate adverse environmental impacts, particularly in relation to waste management and natural resource use for energy, water and other household needs²⁰.

26. Equally important, because of long-term implications for local livelihoods and human welfare, is the need to initiate a series of systematic rapid environmental assessments, and to develop environmental and sustainability strategies that can be integrated into the varied activities proposed under the reconstruction and recovery phase. Short-term priority actions include the following:

- Development of guidelines for rubble, debris and other waste removal and disposal: As there will be significant amounts of debris both in the water and on land, a concerted debris management strategy and management plan will be required. The plan should include guidance on the proper management of reconstruction related debris and waste materials. This should reduce the risks associated with strewn debris to people, livestock, equipment

¹⁹ Such assessments and monitoring should be linked with the comprehensive vulnerability mapping and analysis proposed in the chapter on disaster risk management.

²⁰ See related Annexes on Housing, Livelihoods, and Rural and Urban Infrastructure amongst others.

and the environment. Debris management should be supported by a concerted effort to clean up affected areas.

- Temporary-shelter Community Environmental Management Plans (CEMPs): A generic CEMP should be developed and then adapted to each relief shelter site to provide basic guidance on the proper management and maintenance of sanitary infrastructure, including the management of household waste and regular monitoring of drinking water quality.
- Assessment of impacts on drainage and increased risk of flooding: There is an immediate need to assess whether the risk of flooding, or severity of usual floods, may increase as a result of changes in coastal geomorphology and heavy sedimentation in estuaries, canals and other waterways along the coast²¹.
- Relocation site selection criteria: In case of relocation of affected or at-risk villages to alternate permanent resettlement sites, the populations should be supported by site selection criteria that incorporate appropriate environmental and social provisions.
- Development of environmental and social criteria for reconstruction efforts: Work should begin immediately on the development of environmental and social criteria for reconstruction work.
- Rapid environmental assessments: A number of assessments are required to better guide the reconstruction strategy and ensure long-term sustainability. These should include the following:
 - *Non-field based assessments of the damage and impacts*: An assessment of the physical damage caused by the earthquakes and tsunami to the coastline by comparing satellite imagery before and after the event. Ecologically significant sites need to be given particular attention.
 - *Field-based assessments*. Based on the results of the initial non-field-based techniques, an intensive field-based rapid assessment should be conducted. In addition to assessing the direct environmental impacts on ecosystems and habitats, impacts on ecological goods and services that underpin local livelihoods and human welfare should be assessed. These would include natural resource related direct production changes, such as impacts on fishing grounds and fish catch as well as losses relating to decline in tourism.

Medium-term Priorities

27. Community Environmental Management Plans (CEMPs): A generic CEMP should be developed and then adapted to each new permanent relocation site. CEMPs should provide basic guidance on the proper management and maintenance of sanitary infrastructure, including the proper management of household waste.

28. More effective integration of environmental considerations in coastal zone planning and development: There is urgent need to upgrade coastal zone management practices in general, and to factor in much more proactively the environmental dimensions associated with development, natural resource use, protection of environmental services, and conservation of biodiversity.

²¹ This was mentioned as a particular concern in Kerala in relation to the coming south-west monsoon by the Centre for Earth Science Studies (CESS) in Thiruvananthapuram.

29. On-going monitoring and studies: The rapid assessment phase will help identify locations and communities that require the most attention, and determine key issues that require addressing during the recovery phase. A range of experts from various sectors should be consulted at this stage. During the second phase, ecologically sensitive areas and other severely impacted regions need to be revisited to establish the full extent of the damage with more comprehensive studies. Where required, baselines will have to be established for sustained monitoring of ecological recovery, and mitigation measures should be devised for ecosystems that may not recover to their former state without management intervention. The results of these more detailed assessments and systematic monitoring will provide invaluable inputs for an adaptive approach to integrated coastal zone planning and management.

30. Opportunities for ecosystem restoration and management for better coastal zone protection and biodiversity conservation: The rapid and longer term environmental assessments proposed here should lead to the identification of priorities and opportunities for environmental restoration and improved management of coastal and marine ecosystems to generate multiple benefits for different natural resource user groups. Two clear opportunities for ecosystem restoration were identified during this damage assessment:

- The first relates to the opportunities for mangrove restoration along both the east and west coast. Kerala, for example, has over 40 major estuaries and numerous coastal lagoons. Improved management of its existing mangroves which cover some 1,700 ha, and the establishment of new mangroves over 200 ha can be considered. The establishment of new mangroves is already taking place in Pichavaram and other parts of Tamil Nadu.
- The second opportunity is the possibility of restoring the tropical dry evergreen forest, which is indigenous to the eastern coast from south of Andhra Pradesh to just north of the Gulf of Mannar. From a biodiversity perspective, this forest type has been identified as both globally significant and highly endangered. Restoration of this forest is already being undertaken in one area of Tamil Nadu. There is need to assess the potential for restoring this forest in other areas along the coast and to evaluate its potential for reducing vulnerability to cyclones, flooding and other natural hazards.

Annex III: FISCAL IMPACT

A. Introduction

1. Though the tsunami and its associated destruction constitute one of the worst humanitarian tragedies in the coastal history of India, its economic impact is highly localized and felt most starkly at the level of the numerous affected communities. The estimated total financial losses in the mainland states and the union territory of Pondicherry reported by the Government of India (GOI) are \$1.2 billion, but the disaster will have no impact on the GDP growth of either the country or even the affected states. There will be some impact, however, on the finances of Tamil Nadu and Kerala, and on the Center's fiscal deficit depending on the nature of its assistance to the affected states. A marginal impact in the short run on the balance of payments can be expected to the extent that shrimp exports and coastal tourism are hit.

B. Impact Analysis

Tamil Nadu

2. The total estimated cost of reconstruction²² according to the Government of Tamil Nadu is Rs. 3,772.1 crore (\$867 million). This amounts to about 2.1 percent of the Gross State Domestic Product²³ (GSDP). Besides this, immediate and temporary relief is expected to be about Rs. 600.0 crore (0.3 percent of GSDP). This expense is partly offset by a central grant of Rs. 250.0 crore (\$57.5 million) from the National Calamity Relief Fund²⁴. Thus, since the tsunami hit in the last quarter of fiscal 2004-05, the state's additional expenditure amounts to Rs. 350.0 crore (after deducting the central grant) or 0.2 percent of GSDP on immediate and temporary relief.

3. There is no impact on the growth rate of the Tamil Nadu economy even though economic activity in the affected coastal districts has been severely hit. In these districts, the fisheries sector, agriculture, and micro enterprises and small businesses have been very adversely affected²⁵. But this will not make any dent on the state's growth rate as economic activity along the coastline contributes very little to state income. The coastal economy is not well integrated with the overall economy and is not perceived as a key driver of growth. For instance, fisheries contribute a mere 0.6 percent to state GSDP and no major industry is located in the affected coastal districts.

4. **Fiscal Impact.** The tsunami will have no impact on the revenues of the state as those worst hit by the disaster – fishermen, small entrepreneurs, vendors and agriculturists – belong to the informal sector. Their contribution to the consumption tax is also relatively insignificant. However, the tsunami will have an impact on the expenditure side given that the reconstruction cost is over 2

²² Reconstruction includes short-term rehabilitation cost falling in the year 2005-06 and medium term reconstruction spread over the next two years.

²³ The total reconstruction costs are estimated as a percentage of 2004-05 GSDP.

²⁴ National Calamity Relief Fund is a mandated Finance Commission grant for natural calamities such as droughts, famine, floods, etc. For tsunami, center released an additional amount for the affected states under this fund in order to meet immediate relief and rehabilitation expenditures. Southern states tend to spend more than the mandated allocations because of their drought prone nature. Center had to release additional amount for meeting tsunami expenditures.

²⁵ For details of the impact on these sectors, see Annex VI on Agriculture and Livestock, Annex VII on Fisheries and Annex VIII on Livelihoods.

percent of the GSDP. The state cannot spend the entire amount in one single year and much depends on the fiscal headroom available to it after meeting its committed expenditures such as salaries and wages, pensions and interest. In addition, the reconstruction of physical infrastructure to pre-tsunami levels itself will need to be spread over a period of two to three years. It is estimated that the short-term rehabilitation cost which is expected to fall in 2005-06 is Rs. 1,077.0 crore (\$248 million), about 0.6 percent of GSDP. The medium term reconstruction needs of Rs. 2,695.0 crore (\$619.5 million), about 1.2 percent of GSDP are spread over the next two years (Table 1).

5. **Status Quo versus New Scenario.** To analyze the impact of these additional expenditures on the finances of Tamil Nadu, the state's existing Medium Term Fiscal Plan is used as a baseline or status quo (SQ) scenario. A new scenario is built on the assumption that Tamil Nadu itself will bear all the costs of relief and reconstruction (Rs. 350.0 crore in relief after deducting the calamity relief grant and Rs. 3,772.0 crore in reconstruction). In 2004-05, the additional expenditure will be 0.2 percent of GSDP, which is the amount spent for immediate and temporary relief. As a result, the fiscal deficit in 2004-05 will increase to 4.0 percent of GSDP in the new scenario compared to 3.8 percent of GSDP in the status quo (Table 1).

6. During the reconstruction period (2005-06 and 2007-08) the fiscal deficit to GSDP ratio in the new scenario is higher than that in the status quo, which clearly shows the impact of tsunami-induced expenditures on state finances (Table 1). It may also be noted that fiscal deficit as a percentage of GSDP expands more than the actual tsunami-related expenditure in the new scenario due to additional interest burden. Debt stock will increase from 30.3 percent of GSDP to 33.1 percent of GSDP in the new scenario during 2004-07 as against 30.1 percent to 31.0 percent in the status quo over the same period. The spiral effect of debt-deficit dynamics because of higher interest burden will spill over beyond 2007-08 till it stabilizes as a percentage of GSDP.

Table 1: Impact of Tsunami on Tamil Nadu Finances (% GSDP)

	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
			Budget Estimate	Projected	Projected	Projected
Status Quo Scenario : Medium Term Fiscal Plan (MTFP)						
I. Revenues	13.3	13.6	13.7	13.7	13.7	13.7
II. Current expenditure	16.3	15.7	15.4	15.2	14.5	14.1
Interest	2.7	2.8	2.9	3.0	3.0	3.0
III. Capital outlay	1.3	1.4	1.9	1.7	1.8	2.0
IV. Total expenditure (II+III)	17.7	17.1	17.3	16.8	16.3	16.1
V. Net lending	0.2	0.1	0.1	0.1	0.2	0.1
VI. Fiscal deficit (IV+V-I)	4.5	3.7	3.8	3.3	2.8	2.5
VII. Debt stock	25.4	28.5	30.1	31.0	31.2	31.0
New Scenario : Additional Expenditure - Relief Rs. 350 crore (\$80.46 million) and Reconstruction Rs. 3,772 crore (\$867.13 million)						
VIII. Revenues	13.3	13.6	13.7	13.7	13.7	13.7
IX. Current expenditure	16.3	15.7	15.4	15.2	14.5	14.2
Interest	2.7	2.8	2.9	3.0	3.1	3.2
X. Capital outlay	1.3	1.4	1.9	1.7	1.8	2.0
XI. Tsunami related expenditure			0.2	0.6	0.6	0.6
XII. Total expenditure (IX+X+XI)	17.7	17.1	17.5	17.4	17.0	16.8
XIII. Net lending	0.2	0.1	0.1	0.1	0.2	0.1
XIV. Fiscal deficit (XII+XIII-VIII)	4.5	3.7	4.0	3.9	3.5	3.2

XV. Debt stock	25.4	28.5	30.3	31.8	32.7	33.1
MEMO: Impact of Tsunami						
Fiscal deficit (XIV-VI)			0.2	0.6	0.7	0.7
Debt stock (XV-VII)			0.2	0.8	1.5	2.1

ASSUMPTIONS

1. The short term reconstruction needs as estimated by the team for 2005-06 is Rs. 1,077 crore (0.6 percent of GSDP).
2. The medium term reconstruction cost is spread over 2 years (2006-07 and 2007-08) in the ratio 50:50.
3. GSDP is assumed to be the same in both scenarios and is taken from the MTFP of GOTN.
4. The average effective interest is assumed over 10 percent.
5. Debt stock from 2004-05 onwards is projected as debt stock in year t-1 plus the fiscal deficit in year t, where t=time
6. The estimates will be revised once the Government publishes its revised MTFP of 2005-06.

Source: Government of Tamil Nadu MTFP (2004-05), Staff Estimates.

Kerala

7. The revised estimates submitted to the joint assessment team by the Kerala government put the total cost of reconstruction at Rs. 666.0 crore (\$153.1 million), about 1.6 percent of GSDP. Out of this, the short term rehabilitation cost is estimated to be about Rs. 363.0 crore (\$83.4 million) while the total medium term reconstruction which is likely to be spread over 2006-07 and 2007-08 is about Rs. 303.0 crore (\$70.0 million). The short term reconstruction cost which will be incurred in 2005-06 is about 0.3 percent of GSDP while the medium term reconstruction cost is 0.1 percent of GSDP each year in the subsequent years. Bulk of the expenditure on immediate and temporary relief estimated as Rs. 173.0 crore (\$400 million) in 2004-05, is met by a central grant under the National Calamity Relief Fund. The immediate and temporary relief is about 0.2 percent of GSDP.

8. **Growth.** There is no impact on Kerala's GSDP growth for similar reasons as in Tamil Nadu – loss of life, damage to physical infrastructure and economic foundations in the coastal districts have had a localized impact but do not make a dent on the state's overall growth as the affected areas are poorly developed and contribute little to Kerala's economy.

9. **Fiscal impact.** Again, as in the case of Tamil Nadu, no impact is expected on the revenues of Kerala. However, the fiscal deficit is expected to widen because of the impact on the expenditure side. The debt stock will worsen as annual accretions to the stock in the form of fiscal deficit are expected to increase. This in turn will set in motion deficit-debt dynamics, impacting the interest outgo and worsening the composition and quality of expenditure to that extent.

10. **Status Quo and New Scenario.** The status quo scenario is the Medium Term Fiscal Plan (MTFP) of the Government of Kerala presented in the latest Budget (2005-06). In the new scenario, while the short-term rehabilitation cost is expected to fall in 2005-06, the medium term cost is spread evenly in the next two years. This assumption is made keeping in view the absorptive capacity of the state and the fiscal space available to the state in the medium term. The average effective interest rate on debt is assumed to be about 9 percent. In both the scenarios GSDP remains the same. The impact of additional tsunami-related expenditure is shown in the total expenditure since it is too early to say whether the state will spend this money as current or capital expenditure.

Table 2: Impact of Tsunami on Kerala Finances (% GSDP)

	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
			Revised Estimate	Budget Estimate	Projected	Projected
Status Quo Scenario : Medium Term Fiscal Plan (MTFP)						
I. Revenues	13.2	13.1	14.3	14.8	15.5	16.1
II. Current expenditure	18.3	17.2	18.8	18.4	18.0	17.2
Interest	3.6	3.7	3.6	3.5	3.4	3.3
III. Capital outlay	0.9	0.7	0.6	1.0	1.0	1.0
IV. Total expenditure (II+III)	19.1	17.9	19.4	19.4	19.0	18.2
V. Net lending	0.2	1.4	0.1	0.0	0.2	0.2
VI. Fiscal deficit (IV+V-I)	6.2	6.1	5.3	4.6	3.8	2.4
VII. Debt stock	38.4	41.5	42.6	42.6	41.9	39.6
New Scenario : Additional Expenditure of Rs. 666 crore (\$153.1 million)						
VIII. Revenues	13.2	13.1	14.3	14.8	15.5	16.1
IX. Current expenditure	18.3	17.2	18.8	18.4	18.0	17.3
Interest	3.6	3.7	3.6	3.5	3.5	3.4
X. Capital outlay	0.9	0.7	0.6	1.0	1.0	1.0
XI. Tsunami related expenditure				0.3	0.1	0.1
XII. Total expenditure (IX+X+XI)	19.1	17.9	19.4	19.7	19.2	18.5
XIII. Net lending	0.2	1.4	0.1	0.0	0.2	0.2
XIV. Fiscal deficit (XII+XIII-VIII)	6.2	6.1	5.3	4.9	3.9	2.6
XV. Debt stock	38.4	41.5	42.6	43.0	42.3	40.2
MEMO: Impact of Tsunami on						
Fiscal deficit (XIV-VI)				0.3	0.1	0.2
Debt stock (XV-VII)				0.3	0.4	0.6

Source : MTFP 2005-06, Government of Kerala and Staff Estimates

11. In 2005-06, the ratio of fiscal deficit to GSDP in the new scenario increases by 0.3 percentage points compared to the status quo. The impact of additional expenditures in 2005-06 is on the debt stock and not on interest payments (interest would rise in the next year). In the medium term, the fiscal deficit to GSDP in the new scenario is higher by 0.1 percentage points in 2006-07 and 0.2 percentage points in 2007-08 compared to status quo scenario. In 2007-08, fiscal deficit to GSDP in the new scenario is higher than the tsunami-induced expenditure (as percentage of GSDP) because of the underlying debt-deficit dynamics through additional interest burden on the accumulated debt stock due to tsunami related expenditures (Table 2).

Andhra Pradesh

12. In its memorandum to the Government of India, Andhra Pradesh has estimated the total cost of reconstruction as Rs. 315.0 crore (\$72.4 million), about 0.2 percent of GSDP. The Government of Andhra Pradesh has received Rs. 100.0 crore under the National Calamity Relief Fund in order to meet temporary and immediate relief needs. The short-term reconstruction is estimated to be about Rs. 114.0 crore (\$26.0 million), 0.1 percent of the GSDP. The estimated medium term reconstruction cost is Rs. 201.0 crore (\$46.2 million), also 0.1 percent of GSDP. The short-term reconstruction cost is likely to be borne in 2005-06 while the medium term reconstruction cost is estimated to be incurred in 2006-07. It may also be the case that unspent amounts under the calamity

relief fund will be able to meet part of the short term costs. As noted earlier, there is no impact on the state growth rate.

13. **Fiscal Impact:** There is no adverse fiscal impact of the tsunami on the state. The revenues are completely unaffected, and the additional expenditure in 2005-06 is estimated to be less than 0.1 percent of GSDP offset by the unspent balances in the calamity relief fund. In 2006-07, additional expenditure due to Tsunami is estimated to widen the deficit by 0.1 percentage points of GSDP. The additional expenditure is expected to have only a marginal impact on the state's Medium Term Fiscal Plan projection for 2005-06 and 2006-07, and unlike Tamil Nadu and Kerala, there is no spiral effect of additional expenditures in subsequent years. The assessment team thus does not feel a need to develop status quo and new scenarios for Andhra Pradesh.

Pondicherry

14. The Government of Pondicherry has estimated the cost of reconstruction in the union territory at Rs. 522.0 crore (\$120 million). As in the other affected regions, coastal fishing communities, poor artisans and agriculturists living in the coastal regions are the worst affected. Fishing contributes about 2 percent to the territory's income. While there is no direct impact of the disaster on the growth rate of the local economy, it might suffer in the short run a loss of perception as an attractive tourist resort.

15. **Fiscal Impact:** It is difficult to talk of fiscal impact on a union territory, which by definition is an administrative division of the Government of India. The territory generates some of its own revenue and the gap between its revenues and expenditures is met by the central government. The question of a 'deficit' thus does not arise and the fiscal impact in terms of additional expenditures is on the central government rather than the union territory. The total tsunami related expenditure, which will be spread over two to three years, is roughly 8.6 percent of Pondicherry's gross domestic product and 0.02 percent of national GDP.

C. Conclusion

16. The impact of tsunami-induced additional expenditures on the finances of the affected states varies depending on the extent of rehabilitation and reconstruction activities required in each state. Nevertheless, this impact could be mitigated by alternative sources of financing (seek additional assistance from the center, from external agencies or access funds from the market) to meet the additional expenditures. It needs to be noted that the overall balances will be affected by the terms and conditions on which the various state governments obtain financing for the additional expenditures.

Annex IV: HOUSING

A. Introduction

1. The tsunami impacted fishing families most severely, causing extensive damage to shelter and housing. As the link between housing and employment in fishing is very strong, any measures that affect housing location have immediate implications for the livelihoods of fisher families, and vice versa. This is particularly important when considering the industry's ongoing decline in terms of profitability and share in the states' GDP.

2. Many of the occupants of the damaged housing did not have titles to their property. Instead, "ownership" rights are essentially vested in the community and the value of housing derives mostly from its proximity to the fishing area, than from the specifics of the dwelling. Under such circumstances, it is difficult for such families to move away from their location or to shift to different forms of employment because the wealth they have accumulated in fishing gear or housing has mostly been lost.

3. The issue is complicated by the fact that most fisher families live within the Coastal Regulation Zone (CRZ), promulgated in 1991, which proscribes construction within specific distance of the sea. At the same time, the rights of those having dwellings within the CRZ prior to its adoption need to be examined.

B. Damage Assessment and Government Response

4. **Asset Losses.** Almost 154,000 houses were either destroyed or damaged entailing losses of about Rs. 994.0 crore or \$228.5 million²⁶ (Tables 1 and 2). In the hardest hit state, Tamil Nadu, housing losses are estimated to reach 130,000 units. Pondicherry, though small in coastal exposure, suffered disproportionately higher damage due its high population density, with an average 2,029 people/km² versus the 324 people/km² average for India.

5. The type of housing affected varied widely from state to state. While almost all the affected housing in Kerala was indicated to be *pucca*²⁷, it was less than half in Andhra Pradesh, and only an estimated 13 percent in Tamil Nadu. The rest was thatch huts or mud wall houses with thatch roofs. While specific numbers for Andhra Pradesh, Pondicherry and Kerala were not available, in Tamil Nadu 24,222 of the damaged houses were located in urban areas, mostly in Chennai, but also in the district towns of Cuddalore, Nagapattinam and Kanniyakumari.

²⁶ For the purposes of currency conversion an exchange rate of Rs 43.5 / US\$ is used.

²⁷ In India, the terms *pucca* and *kachcha* are used to denote, respectively, permanent and light/temporary structures.

Table 1. Estimated Number of Damaged Houses

State/UT	Pucca	Kachcha	Total
Andhra Pradesh	216	265	481
Kerala	13,042 ^a	0 ^a	13,042
Pondicherry	1,312 ^b	8,749 ^b	10,061
Tamil Nadu	16,957 ^a	113,043 ^a	130,000
TOTAL	N/A	N/A	153,585

^a Estimated by the mission based on the state government's indications.

^b Due to lack of detailed information the same share for *pucca* housing was applied as in Tamil Nadu.

6. Based on information and discussions with the state governments, and the estimated unit costs, the total damages to the housing units could amount to as much as Rs. 841.0 crore or \$193.3 million, of which Tamil Nadu accounts for \$165.3 million (Table 2.). In addition, the loss of personal property is estimated to account for an additional Rs. 154.0 crore or \$35.2 million.

Table 2. Estimated Housing and Personal Property Damages (Rs. crore)

State/UT	Housing damages			Losses	Total	\$ million
	Fully	Partially	Total			
Andhra Pradesh	1.0	1.0	2.0	N/A	2.0	0.45
Kerala	51.0	28.0	79.0	13.0	92.0	21.15
Pondicherry	39.0	2.0	41.0	10.0	51.0	11.73
Tamil Nadu	677.0	41.0	718.0	131.0	849.0	195.17
TOTAL	768.0	72.0	840.0	154.0	994.0	228.50

ASSUMPTIONS: The average cost of pucca housing was assumed to be Rs. 120,000 in Andhra Pradesh and Tamil Nadu, Rs. 180,000 in Kerala and Rs. 160,000 in Pondicherry. The cost of a kachcha house was assumed to be equal to 30 percent of the cost of a pucca house in the respective state. In Andhra Pradesh, Pondicherry and Tamil Nadu, all kachcha houses were assumed to be fully damaged, while half of the pucca houses were assumed to be only partially damaged in Andhra Pradesh, Tamil Nadu and Pondicherry. Kerala provided a specific break up between partially and fully damaged housing units. The cost of partially damaged house was assumed to be equal to 35 percent of the total cost of a pucca house, except in Kerala where the specific numbers were provided by the state (Rs. 35,000 in the case of major damage and Rs. 25,000 in the case of minor damages). The costs of lost household items were assumed to be Rs. 10,000 per family on an average and to have occurred to all families who had their houses damaged.

7. Because the level of basic services in most villages prior to the disaster was minimal or non-existent, including an almost complete lack of sanitation, the damage to such infrastructure has been considered negligible²⁸. Even simple pit latrines were limited to a few relatively affluent families residing in villages further away from the beach.

8. **Immediate government emergency response.** Different levels of governments have responded quickly and effectively to the crisis. People have quickly been re-housed, and various forms of relief assistance have been provided. These include a wide range of relief packages, shelter provision in relief camps and temporary housing, as well as financial assistance for immediate housing and personal needs (Table 3.). Extensive additional assistance has also been provided by a number of other organizations such as UNICEF, Oxfam, and other major NGOs. In addition, governments have made assessments and proposals of longer term assistance to restore or replace housing as discussed below.

²⁸ See Annex IX on Rural and municipal infrastructure.

Table 3. Summary of Immediate Housing Relief Steps Taken by the States

State/UT	Housing		Losses		No. of relief camps
	No. of families	Assistance (Rs./family)	No. of families	Assistance (Rs./family)	
Andhra Pradesh	481	1,871*	N/A	375	N/A
Kerala	> 1 lakh persons	7,500 per person in Ernakulam	N/A	N/A	>100
Pondicherry	5,562	10,000	13,758	2,000	48
Tamil Nadu	N/A	N/A	150,000	3,000	416

* While the announced relief packages were Rs. 1,500 per fully damaged house and Rs. 750 per partially damaged house, the total cost of Rs. 900,000 and 481 damaged houses indicates that the average per unit subsidy has been of Rs. 1,871. (Government of Andhra Pradesh, February 9, 2005. Tsunami Tidal Waves in Andhra Pradesh. Presentation to the mission).

C. Reconstruction Needs

9. Housing needs have been divided into immediate and medium term needs. The governments of Andhra Pradesh and Kerala have also provided estimates for the long term needs for relocation of housing from areas that are vulnerable to recurring hazards such as cyclones and related storm surges. However, the assessment of such needs was beyond the scope of work of the present team and would require further work in conjunction with studies on environment and risk management, livelihoods and resettlement issues.

10. Immediate Needs. The various state governments have already carried out the immediate emergency steps with regard to housing – partial compensation for housing damage, provision of temporary housing, debris removal, salvaging and so on. In most areas, the process of community consultation and participation, through village/community associations and leaders, and some NGOs, has been initiated to consider broader immediate to medium term recovery requirements.

11. *Temporary shelter.* Due to the much larger number of families rendered homeless by the tsunami in Tamil Nadu relative to the two other states and Pondicherry, there will be a need to improve the basic temporary living conditions for the tens of thousands residing in the relief camps. Once it becomes warmer and the monsoon arrives, health concerns and possible social discontent could arise unless a specific and tangible plan to improve the temporary housing and living assistance is pursued. There are already a number of effective instruments in the state to address these concerns – NGO initiatives, the government’s Indira Awas Yojana program, and the Slum Clearance Board. Since it will take time to relocate or replace the permanent housing, it will be necessary to provide reasonably comfortable temporary shelter for a one to two year period. For example, it may be possible to develop a voucher scheme to encourage families residing in the relief camps to stay with relatives or use the rental housing market. It may also be important to consider how *in situ* assistance could be used to reduce the numbers in the relief housing. These steps could also have major implications for the cost of addressing the permanent housing needs.

12. *CRZ regulations.* The costs of addressing housing needs will be even more fundamentally affected by decisions taken with regard to the enforcement of the CRZ regulations. For instance, these regulations are closely tied up in the issue of whether *in situ* assistance can be provided. It appears that a choice has been made in some cases to move some communities en mass, as in

Chennai, where the Slum Clearance Board proposes to relocate the affected families into apartment blocks. While this may be tried in urban areas, such multiple housing schemes are not likely to work in rural/coastal villages and hamlets.

13. *Priority assistance.* It should be possible in the short term, perhaps within the following few months, to make determinations of which locations are clearly unsafe and which are not, at least for the purposes of defining priorities as to who should be assisted first. Any such determination should include local officials and community representatives. The construction of a large number of new housing units in other locations will not only increase the costs due to required land purchases, but also are likely to cause delays common with such acquisitions.

14. *Costs.* The basis for estimating the housing reconstruction needs are the proposed programs prepared by the state governments. The different states have proposed varying house sizes and unit costs. These are: Kerala 430 sq ft, Andhra Pradesh 200 sq ft, Tamil Nadu 250 sq ft and Pondicherry 300 sq ft. The respective state estimates of cost per sq ft are Rs. 698.0, Rs. 200.0, Rs. 234.0 and Rs. 333.0. Due to the large housing needs in Tamil Nadu in absolute terms and in Pondicherry in relative terms, it is estimated that during the immediate phase (i.e. the first year) it would be possible to provide the temporary housing and repairs to the partially damaged housing and build about 20 percent of the new permanent housing. The remaining 80 percent of the new construction is estimated to be finalized during the medium term (see below). Based on these parameters, the estimated costs, including temporary housing, land and infrastructure would be Rs. 696.0 crore or \$160.0 million (Table 4).

Table 4. Estimated short-term financing needs (Rs. crore)

State/UT	Temporary Housing	Housing repairs	Permanent housing			Total	\$ million
			Housing	Land	Infrastr.		
Andhra Pradesh	0.4	0.3	1.0	0.3	2.0	4.0	0.90
Kerala	7.0	28.0	79.0	65.0	17.0	196.0	45.05
Pondicherry	37.0	3.0	24.0	5.0	11.0	80.0	18.40
Tamil Nadu	80.0	18.0	143.0	30.0	145.0	416.0	95.65
TOTAL	125.0	49.0	247.0	100.0	175.0	696.0	160.00

ASSUMPTIONS: The costs of temporary housing are assumed to be Rs. 8,000/unit in Andhra Pradesh and Pondicherry, and Rs. 26,880/unit in Kerala. The total costs of temporary housing in Tamil Nadu were provided by the state government. Costs of repairs were either those provided by the state (Kerala) or assumed to compose 35% of the unit cost. The cost of land was assumed to be Rs. 250,000/plot in Kerala, Rs. 12,000/plot in Andhra Pradesh and Tamil Nadu, and Rs. 24,000 in Pondicherry, based on the information provided by the state governments. Infrastructure costs were estimated to be Rs. 59,000/unit, across all states, and would include a share of the common property and infrastructure such as water and sanitation, roads and drainage, and power supply.

15. Estimates for land and infrastructure are based on an assumption that all of the fully damaged houses would be rebuilt in new safer areas. *In order to assess the actual needs for additional infrastructure investments and land acquisition a more in-depth survey is required of land availability, household willingness to relocate and other factors.* Decisions will also need to be made with respect to the use of the remains of the damaged housing, the land in the existing damaged areas, and how to discourage people from moving back to their previous locations in vulnerable areas. This will require close coordination with livelihood, environmental and resettlement issues and policies, and the longer term development strategy of the states.

16. Since at least part of the housing will require household relocation, consultations, transparency and flexibility in housing assistance will be important to ensure widest beneficiary support. For example, given the trauma they have experienced, those who want to move from the coast should be given that option. However, they should also be given the option to determine how they would like to use their assistance. For instance, many may be willing to construct a more modest house than that provided by the government and use the remaining assistance for new livelihood opportunities, education or other purposes. This may be particularly relevant for those who were living in *kachcha* housing in what is determined to be relatively safe locations.

17. There are obviously a host of questions related to providing direct financial assistance rather than in-kind compensation, and the process requires further study and consultation with those affected. For this sort of housing-related assistance to be most successful, it might be accompanied by training for those who were crew members of trawlers as well as formal titling for the properties of those who want such titles. The lack of property title appears to be one of the aspects of the poverty trap faced by the low-income fisher communities. All their assets are related to fishing, which has value only as long as they have access to a near-by beach to keep their boats. However, without title they cannot sell their property. Therefore, it may be useful to assess whether the establishment of property rights could be one way for those who want to exit the industry to do so.

18. Medium Term needs: In the medium term, the total financing needs for construction of permanent housing for the remaining 97,000 families in Tamil Nadu and 7,500 families in Pondicherry who had their houses fully damaged by the tsunami are estimated to reach Rs. 1,431.0 cr. or \$329.0 million (Table 5).

Table 5. Estimated medium term financing needs (Rs. crore)

State/UT	Housing		Land	Infra-structure	Total	\$ million
	No. of units	Amount				
Andhra Pradesh	-	-	-	-	-	-
Kerala	-	-	-	-	-	-
Pondicherry	7,524	94.0	19.0	45.0	158.0	36.3
Tamil Nadu	97,217	574.0	120.0	579.0	1,273.0	292.7
TOTAL	104,741	668.0	139.0	624.0	1,431.0	329.0

NOTE: For assumptions see Table 4.

19. Long Term needs. Perhaps the most important long term step is a rigorous evaluation and determination of the vulnerability of the different locations and the eventual application of CRZ rules. Any such rules will have much broader effects on the land markets in the coastal areas. A uniform restriction all along the coast will result in unnecessary restrictions on land use in areas that may be safe, while not providing a sufficient safety zone in those areas that may be very susceptible to cyclones and other sea hazards. Thus, the need for new housing for families in vulnerable areas can be assessed only after the determination of vulnerable coastal areas and CRZ rules have been finalized, and affected households have been consulted on relocation.

20. Consideration should also be given to some type of housing hazard insurance. At present, fishermen bear most risk directly with some part assumed by the government when it supports people afflicted with disasters as frequent as cyclones and as rare as a tsunami. The viability of such a scheme, possibly modeled on the current insurance operated through fishermen's co-operatives, would have to be assessed through extensive studies of the risks involved as well as interest and

willingness to pay. But even more importantly, it would require the government to be willing to facilitate the transfer of hazard risk from itself and vulnerable populations to the insurance industry.

Annex V: HEALTH

A. Introduction

1. Healthcare in Tamil Nadu, Andhra Pradesh, Kerala and Pondicherry is mainly provided through well-organized curative and preventive healthcare networks, with Kerala ranking as the best in the country on many health indicators. The tsunami has damaged health-related infrastructure, including equipment and amenities, and disrupted routine health services in the affected areas. Moreover, with pressure on district health delivery systems increasing manifold, regular curative and preventive care in unaffected areas of the same districts has been disturbed.

2. The needs assessment team held consultations with state and district government personnel, numerous affected people, NGOs, and donors assisting the management of temporary shelters. The team visited Cuddalore, Nagappattinam and Kanniyakumari districts in Tamil Nadu; Alappuzha and Kollam districts in Kerala; as well as sites in Andhra Pradesh and Pondicherry, including Karaikal.

B. Pre-tsunami Situation

3. Healthcare has been provided through a well-organized state health system and by private providers. In the rural areas, services were provided through government hospitals and a network of primary health centers (PHCs), health sub-centers (HSCs) and outreach clinics. In urban areas, government hospitals, dispensaries and mother and child care centers offered health services. The private sector, providing mainly outpatient and curative care, accounted for about half of health services provided.

4. The health status of Tamil Nadu, Kerala and Pondicherry is among the best in the country. Basic health indicators such as the Crude Birth Rate, Crude Death Rate, Infant Mortality Rate, Total Fertility Rate and Female Literacy Rate have been well above the national average as indicated in Table 1.

Table 1. Basic health indicators

Indicator	Tamil Nadu	Kerala	Pondicherry	India
Crude Birth Rate (CBR)	17.8	17.9	17.8	24.8
Crude Death Rate (CDR)	6.9	7.8	6.5	8.9
Infant Mortality Rate (IMR)	30.1	14	23	63
Total Fertility Rate (TFR)	2	1.8	1.8	3.2
Female literacy percentage	64.6	87.9	74.1	54.2

Source: Reproductive Child Health (RCH) Survey, GoTN and the MoH&FW, GoI

Status of HIV/AIDS in the Tsunami-affected States

5. HIV prevalence in the tsunami-affected states is considered by the National AIDS Control Program (NACO) as being among the highest in India (Table 2), with the affected districts in Tamil Nadu and Andhra Pradesh identified as high prevalence districts. A rate above 1 % indicates a generalized epidemic. AIDS is already the second largest killer of Indian adults, second only to TB.

Table 2. Prevalence of HIV/AIDS in the tsunami affected states

HIV Prevalence rate % 2003 - NACO	General Population (Antenatal Consultations)	STD Patients Consultations	Female Sex Workers (FSW)	Injecting drug users (IDUs)
Andhra Pradesh	1.25	19.6	19.4	n/a
Kerala	0.33	4.0	2.2	n/a
Tamil Nadu	0.75	9.2	8.8	63.8
A&N Islands	0.50	1.6	n/a	n/a
Pondicherry	0.13	2.6	n/a	n/a

6. Voluntary counseling and testing (VCT), counseling for prevention of parent to child transmission (PPCT) and free anti retro-viral treatment (ART) is being provided through the national program. But loss of livelihood and clustering of population in temporary shelters increases the likelihood of transmission of HIV/AIDS. Therefore, prevention of sexually transmitted diseases (STDs) and HIV/AIDS in the tsunami-affected communities needs to be addressed.

C. Damage Assessment

7. **Tamil Nadu:** The tsunami affected 13 out of Tamil Nadu's 14 coastal districts to varying degrees with Nagapattinam, Kanniyakumari and Cuddalore worst affected in respect of loss of life and damage to health infrastructure.

8. Three PHCs, 16 HSCs and the government district hospital in Nagapattinam were severely damaged. Other government facilities were also damaged to some extent. The state government's estimates for damages and losses in the health sector are summarized in Table 3. These include the costs of specific health activities in response to the disaster. There are no estimates yet of the damages to private sector institutions.

9. Following the tsunami, the displaced population was sheltered in relief camps all along the coast in the affected districts. The state mobilized doctors, health and sanitation inspectors, and village health nurses from the affected and other districts to form mobile medical teams. These helped provide both preventive (immunizations, vector control and water quality monitoring) and curative (treatment of illnesses and trauma care) services during the first month in the camps. Several NGOs pitched in with emergency care.

10. With assistance from UN agencies, adequate steps were taken by the districts to control vector borne and water borne diseases, and prevent and manage childhood illnesses. Except for sporadic occurrence of measles, chicken-pox and gastroenteritis, no major outbreak has been reported. With assistance from WHO and the National Institute of Communicable Diseases, a post-disaster disease surveillance system was established in four districts.

11. **Kerala:** Two PHCs and two HSCs were damaged in Kollam. No other hospitals or health centers were damaged. The affected communities are sheltered in relief camps and preventive and curative healthcare are being provided. The damage to health infrastructure and losses incurred through relief activities is summarized in Table 3.

12. **Pondicherry:** No hospitals or dispensaries were destroyed. The main losses are due to the expenditure on health and preventive care provided to the 23 relief camps.

Table 3. Estimate of damages and losses in the government health sector (\$ million)

Item	Damage	Loss
Tamil Nadu		
District and government hospitals	2.10	--
Primary Health Centers and Health Sub Centers	0.46	--
Equipment and commodities (including drugs, equipment and patient amenities)	2.70	--
Relief measures (personnel, fuel costs and drugs)*	-	3.28
Control of vector borne and water borne diseases	-	3.46
Immunization campaigns	-	0.12
Disease surveillance	-	0.42
Total Tamil Nadu	5.26	7.28
Kerala		
Health infrastructure	0.45	--
Relief measures	--	2.75
Total Kerala	0.45	2.75
Pondicherry		
Relief measures including immunization campaigns (not estimated)	--	--
Total Pondicherry	--	--
GRAND TOTAL	5.71	10.03

Sources: Fund allocation documents from the Directorate of Public Health & Preventive Medicine and the Directorate of Medical & Rural Health Services, Government of Tamil Nadu. Report from the Government of Kerala.

* These losses only include the expense for preventive and curative relief services provided, and not those due to disruption of health services.

D. Current Situation

13. Most relief camps have been closed now in Tamil Nadu, with affected people either returning to their villages or in the process of shifting to temporary shelters. Provision of healthcare services is in a transition phase, moving from the emergency relief teams approach to re-establishing primary healthcare services. Vector control and water quality monitoring is being carried out in the temporary shelters and villages. Psycho-social support is also being provided by the government with assistance from the UN and local NGOs.

14. In Kerala, the population is still clustered in relief camps with 12,192 such inmates in Kollam alone. The government is in the process of building temporary accommodation. Medical care is being provided by the district health services with support from NGOs. Control of vectors and water quality monitoring is continuing.

15. In Karaikal (Pondicherry), all the camps have been closed and the government is in the process of building two relief shelters in TR Pattinam and Kotancherry.

E. Relief and Rehabilitation

Tamil Nadu

Short term needs

16. The following have been identified as short term needs to be addressed on a priority basis:

- Since the timeline for reconstruction of damaged houses is uncertain, the affected population will be residing in temporary shelters for an extended period. The need, therefore, is to strengthen provision of basic healthcare services, including RCH and immunization services, to the communities. This could be provided through the regular health system and by restarting outreach services. Provision of basic sanitation, vector control, water quality monitoring, surveillance for epidemic prone illnesses, and psycho-social support are also crucial.
- The state is renovating the damaged district hospital, PHCs and HSCs, and replacing lost equipment and other amenities with support from the National Calamity Relief Fund, Health System Development Project, RCH II program and UNICEF. Renovation of other damaged sub-district hospitals has been planned at a later stage. With the loss of livelihood, patients will not be able to seek healthcare from private providers. This will increase the patient turnover in government facilities. There is therefore a need to renovate the sub-district hospitals (Sirkali and Tharangampadi hospitals in Nagapattinam; Cuddalore, Chidambaram and Parangipettai hospitals in Cuddalore; and Kanniyakumari and Kollachal hospitals in Kanniyakumari) and upgrade existing PHCs.
- An in-depth assessment of the needs and priorities of the health sector needs to be conducted on a priority basis.
- Addressing the needs of the vulnerable population: information, education and communication (IEC) for prevention of HIV/AIDS, malnutrition and anemia.

Medium term needs:

- A long term health sector disaster mitigation plan, including specific training for health staff at all levels in disaster prone districts, is required as part of the community-based disaster and risk management program being envisaged for the state. (Funds to be allocated in the proposed state Disaster Risk Mitigation Plan.)
- The state has planned a phased renovation and upgrading of rural and urban hospitals and centers through the Health System Development Project, RCH II project and NABBARD (the national agriculture bank for reconstruction and development) project. Hospitals and centers in the tsunami affected districts need to be taken up on a priority basis.
- Health system strengthening in the affected districts:
 - Human resource issues in the health sector in the affected districts need to be addressed, including capacity building of staff, filling of vacancies and mobility support – only 50% of PHCs have vehicles, and fresh loans to village health nurses for two-wheelers should be considered.

- Improving communication facilities (phones, fax machines etc.) at all levels in the affected districts.
- Building public-private partnerships so that the private health sector, civil societies and NGOs complement government healthcare services.
- Health financing: Provision of financial protection (such as health insurance schemes) to the affected communities against catastrophic illness, and augmentation of health financing by the state for a disaster mitigation program.
- Newer initiatives like accreditation of health facilities for standardization of the quality of healthcare services.

Table 4: Summary of health sector resource needs in Tamil Nadu (\$ million)

Item	Estimated Cost
Short-term needs:	
District and government hospitals	2.10
Primary Health Centers and Health Sub Centers	0.05
Equipment and commodities (including drugs, equipment and patient amenities)	2.70
Provision of basic health care and psychosocial support*	3.00
Renovation of damaged hospitals and health centers	0.45
Addressing the needs of the vulnerable population: IEC for prevention of HIV/AIDS, malnutrition and anemia.	0.05
Medium term needs:	
Development of health sector disaster mitigation plan**	--
Improving communication facilities	0.15
Total	8.50
Other items to be supported	
Health system assessment	0.050
Human resource development	0.600
Building public private partnerships	0.050

* Plans for psycho-social support (approximate cost \$500,000) is being addressed by the UN team for Recovery support.

** Cross-sectoral issue. Budget included in Disaster Risk Mitigation plan

Kerala

17. The short, medium and long term needs for health sector rehabilitation as indicated by the state are stated below.

Short and medium term needs: (in the three affected districts)

- Reconstruction and refurbishing of damaged health institutions
- Control of vector and water borne diseases
- Disease surveillance
- Provision of psycho-social support
- Drugs and supplies
- Information, education and communication (IEC) campaign for prevention of communicable diseases, including HIV/AIDS

Long term needs:

- Integrated coastal health projects in all the other districts
- Trauma care and accident management project in all nine coastal districts

Table 5: Summary of health sector resource needs in Kerala (\$ million)

Item	Estimated Cost
Continued Relief Measures	
Control of vector and water borne diseases	0.07
Disease surveillance	0.03
Drugs and supplies	0.11
Short-term needs	
Reconstruction and refurbishing of damaged health institutions	1.80
Provision of psycho-social support	0.13
IEC for prevention of communicable disease including HIV/AIDS	0.02
Sub Total	2.16

Pondicherry

18. A detailed assessment is required before identification of short- or long-term needs.

Annex VI: AGRICULTURE & LIVESTOCK

A. Introduction

1. Agriculture is a dominant sector in the economy of all three tsunami-affected states and the union territory of Pondicherry. In Tamil Nadu, the most severely affected state, the share of agriculture in GSDP (gross state domestic product) at constant prices is 10 percent; in Kerala, Pondicherry and Andhra Pradesh, it is 12, 4 and 21 percent respectively.

2. In Tamil Nadu, about 50 percent of the state's population is still dependent on agriculture. The poorest rural quintile (approximately 1.5 million households with about 7.5 million people) derives more than 75 percent of its income from agriculture, with agriculture wage labor accounting for 50 percent of household income. Agriculture thus feeds a majority of the population, provides employment and livelihood to a majority of the labor force, and supplies raw materials to industries. Marginal and small farm holdings account for 89 percent of total holdings and constitute 52 percent of the agricultural area. The situation is similar in Andhra Pradesh, Kerala and Pondicherry.

3. The livestock sector in the affected districts is mostly a secondary source of income, especially for women. The cost of cattle feed and availability of quality fodder are common limiting factors

4. The coastal region in all three states and the union territory often suffers both in the monsoon and post-monsoon seasons. In monsoon, excess rainwater, prolonged water stagnation, high water table, high humidity and loss of nutrients are common. In the post-monsoon season, high salinity of soil and ground water along with scarcity of freshwater affect crops and animal productivity. The situation in the coastal region is often aggravated by natural calamities such as cyclones. In Tamil Nadu, the tsunami-affected districts faced a grim situation for the third consecutive year due to drought, flood and tsunami.

5. While the tsunami-related agriculture and livestock damage is insignificant relative to the overall size of the sector in all three states and Pondicherry, they have disproportionately affected the poor and marginal groups in the affected areas for whom the impact is catastrophic.

B. Damage Overview

6. This assessment is based on the data survey conducted and collated by the Departments of Agriculture, Horticulture and Animal Husbandry of all the state governments, and field visits made to Cuddalore and Nagapattinam districts of Tamil Nadu, Nellore and Prakasam districts of Andhra Pradesh, and Karaikal region of Pondicherry.

7. Damage to the agricultural sector is mainly confined to the destruction of standing crops like paddy, groundnut, coconut, cashew, mango, banana, ragi and vegetables. Intrusion of seawater into productive fields – as far as two to three km inland – and deposition of infertile sediments in depths ranging from 5 cm to 24 cm in low lying areas has induced salinity and water logging of varying degrees. The damage caused to the soil is of a semi-permanent nature; affected farmers will not be able to grow crops effectively for the next two to three years until seasonal monsoon rain naturally flushes out the salt. In addition, micro eco-systems required for adequate plant growth have been

affected while cultivable lands have suffered erosion and sand casting. Many perennial trees were uprooted; home flower and vegetable gardens, public grazing lands and salt pans were damaged.

8. Poor families in particular have suffered from loss of domestic livestock. The death of animals and damage to pastures are direct impacts. Availability of fodder is also affected since paddy straw was inundated and salinated. This will have a negative impact on the livelihoods of these families, especially of women, since income derived from livestock served as a safety net against the vulnerability of crop failures. It also provided supplementary income and added nutritional value to the diet.

Tamil Nadu

9. Poor families in particular have suffered from loss of domestic livestock. The death of animals and damage to pastures are direct impacts. Availability of fodder is also affected since paddy straw was inundated and salinated. This will have a negative impact on the livelihoods of these families, especially of women, since income derived from livestock served as a safety net against the vulnerability of crop failures. It also provided supplementary income and added nutritional value to the diet.

10. In the livestock sector, in Tamil Nadu, a total of 18,448 animals are reported to have died in the disaster. The production loss of milk, meat and draught work due to this death toll is estimated at Rs. 37.1 crore (\$8.52 million). In Pondicherry, livestock loss is valued at Rs. 3.80 crore (\$0.87 million); whereas in Andhra Pradesh and Kerala, the livestock loss is valued at Rs. 0.24 crore (\$0.06 million) and Rs. 5.08 crore (\$1.17 million), respectively. More than half of agricultural operations and 90 percent of livestock operations are undertaken by women, on whom the livelihood impact is considerable. The impact on landless laborers who work on agriculture and livestock activities is also immense²⁹.

Pondicherry

11. In Pondicherry, the impact of the tsunami on the crop and soil varied widely according to location, and was especially severe in Karaikal. The affect from the coast ranged from 0.5 km to one km in Kottucherry Commune up to three km in T.R. Pattinam Commune. The standing crop was totally lost. A total area of 330 ha was cultivated in the coastal villages during the September-October season. About 80 ha of standing crops – paddy, groundnut, banana, vegetables and coconut – were damaged. An area of 687 ha suffered intrusion of seawater and submergence scorching crops such as direct sown paddy, transplanted paddy, and groundnut. In addition, about 316 ha of already saline lands were further deposited with salts and have become saline-sodic. The estimated loss in the agricultural sector is Rs. 4.49 crore (\$1.03 million).

12. Livestock loss is reported to be 560 cattle and 700 poultry birds, and is valued at Rs. 3.80 crore. (\$0.87 million)

²⁹ For the impact of this damage on livelihoods, see Annex VI.

Andhra Pradesh

13. About 333 ha of agricultural crops (160 ha of paddy, 120 ha of groundnut and 53 ha of other crops, including ragi) was affected in Nellore, Prakasam and Krishna districts. The extent of damage to standing crops was about 50 percent. The total estimated loss is Rs. 0.90 crore (\$0.21 million). The total animal death was 86 (buffaloes 9; sheep and goat 75; and pigs 2) with the loss valued at Rs. 0.24 crore (\$0.06 million).

14. About 1,410 ha of salt pans were damaged, including loss of the salt crop, silting, and damage to beds, bunds and oil engines. Salt societies and private owners maintained these pans. The total loss in the agriculture and livestock sector is Rs. 3.79 crore (\$0.87 million).

Kerala

15. Damage to crops in Kerala is mainly in the district of Alappuzha and reported as 949 ha. The main affected standing crops are paddy, banana and coconut. Some damage to agriculture infrastructure has been reported in the form of shutters of the spillway which guards paddy cultivation in Kuttanadu from saline water intrusion. The total estimated loss in agriculture is Rs. 15.81 crore (\$3.63 million). Livestock loss includes 105 cattle, 16,600 ducks and 25,310 poultry birds, with another 50 cattle and 2,820 poultry birds reported missing. The total loss in livestock is Rs. 5.08 crore (\$1.17 million).

Table 1. Estimate Damage and Loss Assessment (Rs. crore)

Description	Quantity	Estimated Damage	Estimated Loss	Total
Tamil Nadu				
Crops (ha)	6,105	35.00	24.40	59.40
Paddy (irrigated)/rainfed				
Oilseeds (groundnut and coconut);				
Pulses				
Other field crops				
Current fallow lands	7,733		13.91	13.91
Horticultural Crops	628	1.98	7.60	9.58
Irrigation/Drainage				
Farm ponds/shallow dug ponds	552	0.55	2.10	2.65
SubTotal: Agriculture		37.53	48.01	85.54
Livestock	18,448	3.00	34.26	37.26
Cattle and other livestock				
Total (Agri. & Livestock)		40.53	82.27	122.80
Andhra Pradesh				
Agriculture-Crops	333	1.00	0.50	1.50
Livestock (nos)	86	0.55	1.10	1.65
Salt Pans	1,400 ha	0.44	0.20	0.64
Total		1.99	1.80	3.79
Pondicherry				
Agriculture (crops)	767	2.00	2.25	4.25
Current fallows	316		0.24	0.24
Livestock (nos) cattle	560	1.70	2.10	3.80
Poultry	700			
Total		3.70	4.59	8.29
Kerala				
Agriculture (ha)	949	13.11	2.70	15.81
Livestock (nos) (cattle	105	1.48	3.60	5.08
ducks	16,600			
Poultry &	25,310			
Others)				
Infrastructure damage (shutters)		5.00	2.40	7.40
Total		19.59	8.70	28.29
GRAND TOTAL (Rs. crore)		65.81	97.36	163.17
GRAND TOTAL (\$ million)		15.13	22.38	37.51

C. Reconstruction strategy

16. The reconstruction and recovery strategy should include:

- Release of funds for the immediate relief and short term needs outlined above, and necessary to mobilize the inputs required to reclaim the salt-affected lands for crop and livestock production for the ensuing cropping season.
- Involving farmers and other community members, especially women, in identifying needs and immediate priorities of the sector and in decision making in reconstruction activities.
- Completing the analysis of salinity hazards and preparing a reclamation plan with active involvement and participation of the farmers.
- Linking farmers with the formal banking sector and private sector for providing inputs and services related to agriculture and livestock improvement.

D. Reconstruction Needs

17. Rehabilitation depends on severity and extent of damage and on the capacity to flush out salts and reestablish irrigation and drainage. The reconstruction and recovery should be undertaken in two phases.

Short term

18. The first or short-term phase should focus on:

- Restoring livelihoods of affected farmers and landless farmers through cash grants, provision of micro-credit, food for work programs, etc.
- Surveying the affected agricultural lands to estimate the extent and grades of salinity/sodicity.
- Reclamation of agriculture land to restore soil fertility by agronomic rehabilitation; scraping and removing marine/mud sediments and sand deposited lands; establishing model reclamation fields; mobilizing saline tolerant seeds, planting materials and green manure crop like Dhaincha, (*Sesbania aculeata*); and introducing bacterial strains like Rhizobia, Azospirillum, Pseudomonas and Phosphobacterium which have the property of nitrogen fixation and phosphate mobilization. Rehabilitation of agricultural lands with little damage will also take place naturally through seasonal monsoon rain and re-leveling of fields.
- Reviving horticultural crops with and without soil amelioration.
- Restoring affected pasture lands, farm ponds and dug wells.
- Estimating the quality of water from shallow tube wells, farm ponds, open wells and other irrigation sources; and identifying the pockets where ground water can still be tapped.
- Providing fodder for animals and arranging vaccination for livestock.
- Re-establishment of home gardens with salt tolerant vegetables like eggplant and tomato, and flowers like crossandra.

Medium-term

19. Agriculture and livestock production capabilities have to be enabled by restoring and promoting sustainable management of coastal land and water resources. The rehabilitation of lands in rainfed areas where water shortage is a limiting factor for flushing of lands is a priority as observed in Nagapattinam district of Tamil Nadu.

20. Other required interventions include: Land reclamation and soil improvement; rainfed agriculture on watershed basis; fodder development; risk mitigation through diversification into non-farm activities; local post-harvest value addition, including setting up of rural godowns and bringing crop and livestock insurance as an integral component of productive activity; capacity building of farmers, including women, through lateral learning and demonstration of environmentally sustainable farm techniques; strengthening coastal saline management research and development activities, and initiating a coastal bio-shield with a suitable combination of trees.

Table 2. Needs Assessment for Agriculture and Livestock Sector (Rs. crore)

Sl. No	Activity	Tamil Nadu		Pondicherry		Andhra Pradesh		Kerala		TOTAL
		Short term	Medium term	Short term	Medium term	Short term	Medium term	Short term	Medium term	
1	Replacement cost to crop and live stock losses	10.85	10.85	1.33	1.33	0.47	0.47	4.06	4.06	33.42
2	Rehabilitation of soil resources (Soil reclamation)	17.66	17.66	0.69	0.69	0.72	0.72	8.12	8.12	54.38
3	Strengthening marketing and support services	0.37	3.76	0.15	0.45	0.03	0.05	0.67	0.94	6.42
	TOTAL (Rs. crore)	28.88	32.27	2.17	2.47	1.22	1.24	12.85	13.12	94.22
	TOTAL (\$ million)	6.64	7.42	0.50	0.57	0.28	0.29	2.95	3.01	21.66

Annex VII: FISHERIES

A. Background

1. India is the world's fourth largest fishing nation, accounting for over 4.39 percent of global output. Its fish exports reached \$1.2 billion in 2002, about 1.21 percent of GDP while production rose from 5.9 million tons in 2001-02 to 6.2 million tons in 2002-03. However, this growth was mainly due to aquaculture and inland fisheries – marine capture fisheries have been stagnating in recent years in spite of an increased fishing effort.

2. Marine capture fisheries production for 2003 was stable at 2.58 million tons. Of the total landings, 66 percent were by the mechanized sector, 27 percent by the motorized sector and 7 percent by the artisanal sector. Trawl net (mechanized) and gill net (motorized) are the important gear operating throughout the Indian coast.

3. In 1999, the Central Marine Fisheries Research Institute (CMFRI) reported that marine fisheries production had moved from 500,000 tons in 1950 to 2.7 million tons in 1997. But by 1997, production from inshore waters (depth below 50 m) had reached its potential (2.2 million tons), and the scope for increasing production appeared to be limited. The catch rate of vessels had declined, with catches for trawlers in Chennai decreasing from 110.8 kg/hour in 1991 to 29.7 kg/hr in 1997. This declined further to 27 kg/hr in 2003. From 2001, Andhra Pradesh and Tamil Nadu imposed a 45-day fishing ban.

4. India's 10th Five Year Plan (2002-07) expresses concern about the level of over-exploitation and overcapacity of the Indian fishing fleets, both mechanized and traditional, and advocates better regulation measures, the need to diversify fisheries and aquaculture and upgrade the traditional fishing sector with new boat designs for offshore fishing, and the necessity to manage the resource in a more sustainable way.

5. Andhra Pradesh. Pre-tsunami information indicates a total catch of 264,000 tons of marine fish/shrimp by various types of boats, and this fleet was manned by 130,000 sea-going fishermen who operated from four harbors and 508 coastal fishing villages with 423 landing places.

6. Tamil Nadu. Marine catches remained stable at around 375,000-380,000 tons between 1999-00 and 2003-04. The catch is diverse with 26 to 44 different fish species/categories. Rameswaram, Nagapattinam, Pudukottai, Tuticorin and Kanniyakumari are the most important fishing districts. The share of Nagapattinam and Kanniyakumari fell during this period probably due to rapid and excessive expansion of the fleet.

7. During this period, the active-fisherman population increased from 117,214 to 197,490 while active fisherwomen – involved mainly in selling and processing fish – increased from 30,500 to 34,000.

8. **Pondicherry**. Of the total coastal villages, 11 are in Pondicherry, and 10 in Karaikal. The total catch is to the order of 28,400 tons with Karaikal's contribution increasing from 14,796 tons in 2000-01 to 18,238 tons in 2003-04. Seventy percent of the catch is by mechanized boats. Karaikal has 2,271 active fishermen and over 1,100 fisherwomen. Pondicherry also possesses shrimp farms, data about which was not available

8. **Kerala.** Kerala is India's second-most important fishing state after Gujarat. Of the state's 223 coastal villages, 26 are in Kollam and 29 in Alappuzha. There were estimated to be 177,068 active fishermen in the state in 2001. Total fish landings have varied due to the importance of the small pelagic component. From 1995-06 to 2001-02, landings ranged between 660,000 tons and 511,000 tons, but more normal values were in the 530,000-560,000 ton range. In Kollam and Alappuzha, total catches increased respectively from 111,780 and 91,626 tons in 1998-99 to 142,373 and 121,900 tons in 2001-02.

B. Damage Assessment

9. *Methodology.* The team visited a limited number of districts in the affected states where it discussed the methodology followed by the authorities to estimate physical damages. It assumed that other districts in that state followed the same procedure. However, at the time of the team's visit, data on damages was still being collected for the aquaculture industry while in some districts damage assessments for the capture fisheries sector were being substantially revised. The different governments organized and presented information in different formats, and it was not possible to visit every location to clarify how the estimates had been prepared. Further, the same level of aggregation of detail was not available in all states. Data for assessing damage and needs for the sector is limited, and our estimates are based on various assumptions, and do not pretend to be more accurate than those prepared by the states. However, in order to use common evaluation standards to arrive at a global picture of the impact, the results presented here are slightly different from those presented by the individual states. Clearly, more accurate damage estimates will be available in the future.

10. *Damage.* The tsunami destroyed or damaged nearly 5,000 mechanized boats causing damage valued at Rs. 663.1 crore (\$152.4 million) - a total of 7,933 FRP boats/*vallams* valued at Rs. 50.1 (\$11.5 million); about 24,580 boats of other categories, mainly motorized, valued at Rs. 121.0 crore (\$27.8 million); and 35,483 wooden catamarans valued at Rs. 90.0 crore (\$20.7 million). In addition, 2,342 outboard motors worth Rs. 10.1 crore (\$2.3 million) were damaged or lost. This figure is expected to increase substantially after revision. Net sets valued at Rs. 44.4 crore (\$10.2 million) were damaged or lost. (This has been calculated after converting the tonnage provided by Tamil Nadu into individual nets, though this figure may have to be re-evaluated since the unit values used by Andhra Pradesh appear to be very low.) Boat seines worth Rs. 19.9 crore (\$4.6 million) were lost in Kerala.

11. Damages have been reported on both coasts to about 388 ha of shrimp ponds (worth Rs. 8.4 crore or \$1.9 million) and five hatcheries (Rs. 0.25 crore or \$57,500), and to 102 small-scale oyster farms in Kerala valued at Rs. 0.102 crore (\$23,500).

12. *Shrimp culture.* The shrimp culture sector is of considerable importance as a foreign currency earner particularly in Andhra Pradesh but also in Tamil Nadu. It has a downstream industry (feed manufacturing plants, equipment and service providers, and processing plants) dependent on it. It is suggested that damage to shrimp farm infrastructure, equipment, stocks, production inputs, and hatchery facilities and stocks be assessed and estimates of recovery time be prepared as this sub-sector would require a specific support policy for its recovery.

13. *Small-scale aquaculture.* Smaller but socially important forms of coastal aquaculture such as oyster projects implemented by women's self-help groups in Kerala have lost their infrastructure and potential harvest. A separate damage assessment should be made for this category as well, and compensation and other forms of support be provided quickly so that these disadvantaged groups can regain the momentum they had developed.

14. *Gaps in evaluations.* In their evaluations, the governments have focused on the damage to productive assets but paid less attention to damages caused to livelihoods in fishing villages, and to those who provide support services. Compensations tend to favor boat and equipment owners but do not take into sufficient consideration jobs and income lost, for example, by fishing crew and fish sellers. Moreover, compensations for lost jobs do not cover the period required for the sector to recover.

15. Collection of damage information appears to have been constrained several factors, such as:

- the forms distributed to fisheries officers, which mainly sought information on boats, engines and nets but did not have the flexibility to include local realities and account for damages to assets or services related to fishery operations;
- the lack of complete and accurate registers of boats, particularly traditional and FRP boats. Many have been claimed as washed away. While this might be possible for FRP boats and, to a lesser extent, for mechanised boats which have more often been grounded, catamaran logs should be retrievable as they are returned by the sea;
- the exact damage valuation for the mechanized boat category appears to be a difficult task. Compensation claims have been based on the cost of a new boat regardless of age depreciation of the lost asset or the fact that some boats were not operational;
- the accurate damage evaluation of FRP boats. In Tamil Nadu, more than 4,400 FRP boats have been classified as totally damaged but a good proportion of these can be easily repaired, and indeed some repair is occurring with the assistance of NGOs as was observed in Seruthur village in Nagapattinam district. A better method would be to collect damaged hulls in open workshops for inspection by qualified personnel, which can be done relatively quickly, and would cost much less;
- damage classification of outboard engines presents similar problems. In some cases, fishermen have tried to restart recovered engines without dismounting and cleaning them properly, ruining those which could have been repaired, and finally,
- different approaches adopted for the state for paying compensation. Kerala pays the boatyards, while other states will pay fishermen directly. This may lead to disbursement of funds in excess of what is really needed.

Evaluation of losses.

16. A proper assessment of losses in production and wages is still to be done. The length of the recovery period will have an impact on production and livelihood of coastal communities as well as those inland who depend totally or partially on the fishing and aquaculture industries. Evaluating losses by estimating the value of the catch which could have been obtained had the tsunami not occurred or the value of wages lost by the crews is difficult for the following reasons:

- The actual number of boats of various categories fully and partially in operation before and after the tsunami is not yet clear. It is necessary to have a correct estimate for the operational fleet that has disappeared in order to reduce the catch value by the correct proportion.
- It is not clear, but quite likely, that fishermen from other states will enter the fishing grounds of the affected states in the absence of local activity. Hence, some catch that would be accounted as lost might actually be produced by migrant fleets.
- The period required to restart production by larger boats is related to the residual capacity of boatyards in both affected and other states, which has not yet been fully assessed. Recovery time will also be influenced by how repair work will be organized. The three to six month recovery time voiced by many fisheries officers appears optimistic particularly for the mechanized fleet, and does not take into account the abnormal pressure on boatyards, some of which themselves are damaged.
- Manning boatyards might also be an issue as owners may be reluctant to recruit additional skilled hands knowing that the flood of orders will be temporary.
- Sufficient quantities of properly cured wooden planks and logs are required. The time to log and cure these will depend on stocks and the supply strategy adopted. This also has an environmental dimension as catamarans source *Albizzia* sp logs from Kerala forests, and each boat requires four to five trees.
- Since the collection of tsunami-impact data on aquaculture has not been completed and evaluated, this prevents a discussion on pond reconstruction times, stocks lost and shortage of post-larvae for the next cycles, which are also linked to the availability of broodstock. The governments should be alerted to the possibility that broodstock or post-larvae imports risk the introduction of diseases like the white spot virus.
- It has not been possible to discuss the time and cost implications of possible alternative reconstruction scenarios and their effect on estimated losses.

17. Losses to production are estimated in Table 1 below. It has been possible to make this crude estimate, based on the present government thinking to reconstruct assets to pre-tsunami levels, only for Tamil Nadu and Kerala where there was at least enough data to attempt a theoretical calculation. It speculates on the number of operational vessels and presumes a rather optimistic one year for the reconstruction of wooden boats. Nevertheless, it provides an idea of the dimension of the production losses, which are particularly important for Tamil Nadu.

Table 1: Assessment of Damages to Assets and Losses in Production and Income (Rs. crore)

	Kerala	Tamil Nadu	Andhra Pradesh	Pondicherry	Total
Damages to Assets	50.8	801.3	51.8	94.7	998.6
Losses³⁰	117.8	1,304.0	36.8	12.6	1,471.2
Total (Rs. crore)	168.6	2,105.3	88.6	107.3	2,469.8
Total (\$ million)	38.8	484.0	20.4	24.6	567.8

³⁰ Includes losses to fisheries production and crew incomes.

C. Recovery strategy

18. The sudden elimination of a large operational fleet is rare in the fishing industry. But the disaster presents an opportunity to redesign the capture fisheries industry in a better and more sustainable way – and, in fact, to address the concerns raised by the 10th Five Year Plan. This applies mainly to Tamil Nadu and Pondicherry, which are the worst affected.

19. Replacing mechanized boats with new ones of the same design will certainly accelerate over-exploitation and increase conflicts with the traditional sector. New activities related to deep sea fishing and aquaculture could be promoted instead, with boats and gear designed to tap resources in deeper waters and to reduce operational expenses while being less damaging to the resource.

20. Efforts should also be made to diversify and expand employment. For example, a wooden trawler costing Rs. 2 million and employing 10 men could be replaced at the same cost with 10 fully equipped FRP boats that would employ 40 to 50 fishermen, or by new boats intermediate in size between FRP boats and trawlers, such as bottom gill-netters or longliners which can operate beyond the range of the FRP boats. This opportunity could be captured through an Integrated Coastal Zone Management Program.

D. Recommendations

Short Term (12 months)

21. Short term activities should comprise:

(a) Completion and revisions of assessments, including for the capture fishery sector and its ancillaries; aquaculture sector and its ancillaries; livelihood losses; national-level boatbuilding capacity. This is expected to cost Rs. 235.2 crore (\$54.1 million) (including assistance for salaries to crews) of which Rs. 150.5 crore (\$34.6 million) is required for Tamil Nadu, Rs. 28.3 crore (\$6.5 million) for Kerala, Rs. 30.1 crore (\$6.9 million) for Pondicherry and Rs. 26.3 crore (\$6.0 million) for Andhra Pradesh.

(b) Evaluation of options for reconstructing the sector, in particular for mechanized boats. Financial needs are estimated at roughly Rs. 1.4 crore (\$0.3 million), of which Rs. 0.8 crore (\$0.18 million) would be for Tamil Nadu and Rs. 0.6 crore (\$0.14 million) for Pondicherry. The evaluation should include:

- A look at alternatives to reorganize the fisheries sector with special attention on the protection of the resource base for future generations. This should be completed before disbursing funds for larger boats.
- Evaluate the legal and regulatory implications of the alternative scenarios in relation to fishing rights, access, monitoring, control and surveillance.
- Address issues related to the registration and control of the operation of boats and the marine capture sector in general, including satellite tracking of boat operations.
- Evaluate the possibilities offered by new boat designs to tap resources in deeper waters or to replace trawler operations in a more efficient and sustainable way.
- Discuss with fishing associations schemes to buy boat owners out of the sector and invest compensations in other activities.

(c) Identification of new forms of livelihood in coastal villages, especially for women and youth. Costs are estimated at Rs. 1.15 crore (\$0.26 million) as a common fund for the four affected areas. The activities here would include:

- Studies to identify alternative forms of coastal livelihoods which could complement fishing such as group activities to support the industry, value addition through processing, aquaculture, social forestry linked to coastal and hazard risk management, etc.
- Prepare projects for pilot testing of alternatives identified.

Mid term measures (24-36 months)

22. This is a continuation and expansion of activities outlined in the short term strategy after they have been discussed and agreed. Reconstruction of the fleet of larger boats can be expected to be completed in the mid-term period. The financial needs for this will depend on the course of action decided in the short term. If simple replacement of assets is the strategy chosen, then the cost estimate would be around Rs. 998.6 crore (\$229.6 million), of which Rs. 801.3 crore (\$184.2 million) would be for Tamil Nadu, Rs. 94.7 crore (\$21.8 million) for Pondicherry, Rs. 51.8 crore (\$11.9 million) for Andhra Pradesh and Rs. 50.8 crore (\$11.7 million) for Kerala.

23. It can also be envisaged that in this period all aspects related to the new regulations of the fishery sector will be put in place. Training programs on more sustainable exploitation of the resource and complementary income generation activities will have a major role. Pilot testing of the new approaches will commence in this period.

Annex VIII: LIVELIHOOD

A. Introduction

1. The objective of livelihood restoration and improvement in the context of the tsunami disaster is to restore “local economies”, generate employment/ wage labor through public employment programs executed in coordination with post-tsunami reconstruction work, enhance skills and technology to upgrade and diversify means of livelihood, and support vulnerable groups (widows, orphans, and disabled). The scope of livelihood restoration extends to households affected by the tsunami either directly or indirectly³¹.

2. This annex tries to capture the income and wage loss of directly and indirectly affected households by drawing on the data and strategy of the environment and social impact assessments as well as sector assessments, particularly of fisheries, agriculture and livestock. Data is severely limited, and the impact of the tsunami on the livelihoods of poor and low-income households remains largely unreported. Accordingly, the figures provided here are best estimates based on field observations in Tamil Nadu, Kerala, Andhra Pradesh discussions with government, civil society and community representatives, and disaggregation of state or district averages wherever available. Since livelihoods are mostly in the private domain and spread over a large number of households and enterprises, the assessment of loss and damage would need to be confirmed through household and enterprise surveys. Damages incurred by enterprises relating to tourism and forestry have not been assessed.

B. Damage Overview

3. The major livelihood activities in the coastal areas are fishing, agriculture, livestock and non-farm activities. While fishing is the most obvious and noticeable livelihood on the coast, all other livelihoods could actually employ as many or more people than fishing. The indirect damage takes the form of loss of market demand for enterprises and individuals working in the directly affected area or in the vicinity, leading in turn to job losses. For example, the drastic reduction in the fish catch in the immediate aftermath of the tsunami will have impacts on fish preparation and processing, storage and trade extending well beyond the immediate impact area.

4. It is estimated that 645,000 families (about 3.2 million persons) are directly and indirectly affected in the states of Tamil Nadu, Kerala and Andhra Pradesh, and the union territory of Pondicherry. Of this total, about one-third are directly linked to fisheries, about one-fourth to micro-enterprises, and the remaining are wage earners with seasonal employment or are engaged in intermittent activities. Based on the scope of livelihood discussed in this annex, Table 1 below gives the broad livelihood patterns and damages.

³¹ “It has been estimated for every person who goes out to the sea, there may be up to four persons employed in allied land based activities” quote from International Fund for Agricultural Development, *India: Rural Poverty among Coastal Fisheries: Profile and Possible Interventions*, Report No.1447, October 2003, p.39.

Table 1. Estimated Breakup of Livelihood Pattern, Damages, and Wage Losses

	Kerala	Tamil Nadu	Andhra Pradesh	Pondicherry	Total
I. Breakup of Livelihood Patterns					
Fisherfolk	42,700	120,000	48,000	10,000	220,700
Microenterprises	15,000	90,000	35,000	3,000	143,000
Agriculture and Livestock	6,500	29,000	700	1,330	37,530
Others	20,800	161,000	46,300	15,600	243,700
Total Affected Livelihoods	85,000	400,000	130,000	29,930	644,930
II. Damages (Assets) \$ million					
Fisherfolk	11.7	184.2	11.9	21.8	229.6
Microenterprises	2.1	12.6	4.9	0.4	20.0
Agriculture and Livestock	3.4	9.3	0.5	1.0	14.0
Total Damages	17.2	206.1	17.3	23.2	263.8
III. Wage Losses (per month) \$ million					
Fisherfolk	3.5	8.0	3.0	1.0	15.0
Microenterprises	0.5	3.0	1.0	0.0	4.5
Agriculture and Livestock	0.2	1.0	0.0	0.0	1.0
Others	1.0	5.0	1.5	0.5	8.0
Total Wage Losses (per month)	5.2	17.0	5.5	1.5	28.5

Note: Number of affected households includes directly and indirectly affected households

Wage losses have been estimated for all categories using income or wage approximations.

5. As is evident from Table 1, (as more than 30% are in that category) the disaster has hit hardest those that were already poor and other informal traders and micro-enterprises. Nearly two-fifths to half the population in the affected areas may have been under the poverty line and about a third would be from the scheduled castes or scheduled tribes, who are heavily represented among the poor. The broad pattern of losses is described below.

6. *Fisheries:* This sector provides significant employment opportunities, including the entire gamut of persons employed in net-mending and weaving, supply and repair of fishing equipment and gear, boat building and supply, vessel repair and maintenance, provision of ice, marketing, processing and transport of fish, fish exports, etc. Laborers engaged in boat repair, transport of ice and related activities are likely to have suffered more, having little reserves to fall back upon. Loss of homes, destruction of village infrastructure, and loss of livelihood is compounded by loss of lives. These damages are accentuated by prevailing issues in the fisheries sector that relate to rising input cost, especially fuel, declining profitability of small boat owners, inequitable distribution of the market value of produce, and in some instances depleting fishing stocks. The fisheries sector also remains largely unregulated. While these aspects can only be addressed over the long-term, for the short and medium term, fishing remains the main source of livelihood for the coastal community.

7. *Microenterprises:* A considerable number of affected families were engaged in micro-enterprises that include a broad range of activities requiring small investments primarily in the range of Rs. 5,000 to Rs.10,000. Much like the fisheries sector, involvement of women in microenterprises is quite high³². In general, these micro-enterprises cater to the local markets and the lower segments of population both for inputs and outputs. This shows interdependence and vulnerability of these enterprises, and they have been affected severely through loss of equipment and other assets,

³² Women are mostly involved in fish processing (cleaning, drying, salting, etc) and marketing activities.

loss/damage of plants and shops, loss of employment, etc. Most women in this sector have benefited from the growing network of self help groups (SHGs)

8. *Agriculture and Livestock*: Damage to agriculture and livestock is not that significant and is mostly confined to the immediate vicinity of the coast. Damage includes loss of standing crops, and death or injury to livestock which has a significant impact on the livelihoods of the poor, especially women. In addition, salinity of land and groundwater will have medium to long-term impacts on productivity and profitability of agriculture, horticulture and pasture lands.

9. *Others (including casual labor)*: This group includes wage laborers, seasonal workers and other subsistence activities, This group has a preponderance of scheduled castes, tribes, other backward castes, disabled and vulnerable (orphans, widows, etc.). The poverty incidence in the affected area is much higher than the national or state averages. As a result, damages to this segment are primarily due to loss of employment opportunities and consequently wages. In the event of natural disaster, this group is the most vulnerable. Part of this deep-seated vulnerability is primarily related to the socio-economic structure of the affected areas, ownership of economic assets, land-holding patterns, and lack of skills to benefit from economic opportunities.

C. Reconstruction Strategy and Needs

10. Considering the livelihood patterns as described above, the strategy should include the following elements:

- *Priority for the poor and low income families, especially in “other” category* because of their inability to regain livelihoods without special targeted interventions.
- *Building and strengthening organizations of the poor* such as self-help groups (SHGs) and cooperatives, which are well represented in the affected areas.
- *Building partnerships with the private sector* including non-governmental organizations for diversification of livelihood with focus on sustainable options.

11. In order to meet the immediate livelihood needs, it will be important to implement the strategy in a phased manner over short, medium and long-term.

12. **Short-term Interventions (up to 12 months)**: The short-term objective should be to restore livelihoods of the affected families. Achieving this objective would require:

- Giving the affected communities an opportunity and forum (mainly through SHGs) to decide on their immediate, short and medium-term priorities through a participatory and community driven approach;
- Providing wage earning opportunities through the government’s on-going public employment generation programs, including restoration of tsunami-damaged infrastructure, for which immediate skill building could be provided (such as boat repair, house construction, rebuilding of roads, etc.).
- Commencing replacement of assets keeping in view the supply capacity, impact on prices, and precise identification of the beneficiary. High value assets such as boats and nets should be provided in kind.

- Forming new self-help organizations SHGs (both men and women) and strengthening existing SHGs and cooperatives; providing seed capital to them to facilitate bank linkages; and building skills appropriate for the local economy.
- Providing income transfers and social assistance to vulnerable groups who are not immediately capable of undertaking economic activities.
- Revisiting sector development policies for sustainable livelihoods.

13. **Medium Term (1-3 years):** The medium term phase would emphasize promoting diversified livelihood/ allied activities for youth and women, especially among fisher-folks. The interventions during the medium-term should include:

- Continuing with short-term activities, as required;
- Improving and modernizing facilities and productive infrastructure (such as storage facilities, fish drying and chilling centers, sheds for livestock, etc);
- Upgrading or improving skills to adopt appropriate environmentally sound technologies;
- Reducing vulnerability of poor and low income families through risk mitigation measures such as insurance, targeted social transfers, and development of social protection measures that could be widely adopted.

14. Based on the above interventions, the estimated needs are in Table 2 below:

Table 2- Estimated Needs for Livelihood (\$ million)

	Kerala	Tamil Nadu	Andhra Pradesh	Pondicherry	Total
I. Micro-enterprise Restoration and Development Costs					
Short-term					
SHG Formation, Strengthening, and Seed Capital ¹	1.5	11.0	1.0	0.5	14.0
Skills Training	1.0	7.0	1.0	0.5	9.5
Vulnerable Groups Special Assistance	0.2	9.0	3.0	1.0	13.2
Asset Replacement Cost (only micro-enterprises) ²	5.5	22.0	5.0	1.4	33.9
Total Short-term	8.2	49.0	10.0	3.4	70.6
Medium-term					
SHG Formation, Strengthening, and Seed Capital	1.0	10.0	1.0	0.4	12.4
Skills Training	1.0	7.0	1.0	0.4	9.4
Vulnerable Groups Special Assistance	2.0	9.0	3.0	1.0	15.0
Risk Mitigation (group insurance premium)	0.0	1.0	0.3	0.0	1.3
Value addition/diversification	5.0	56.0	4.0	5.0	70.0
Total Medium-term	9.0	83.0	9.3	6.8	108.1
Total	17.2	132.0	19.3	10.2	178.7
II. Asset Replacement Costs (others)³	22.0	268.0	15.0	26.0	331.0
III. Employment generation (six months)⁴	8.0	44.0	16.0	4.0	72.0

Note:

¹ Higher units costs are assumed to ensure appropriate quality of SHGs and sustained upgrading of skills and income.

² Replacement costs relate to those in the private domain. While agriculture, livestock, and some fisheries activities also qualify as micro-enterprises by asset size, the related asset replacement costs have been taken to separate annexes.

³ Replacement cost for fisheries, agriculture, and livestock are included in related annexes. However, the value addition/diversification costs are part of the livelihood restoration package.

⁴ Most of the employment generation will be covered by ongoing government programs and through the infrastructure reconstruction in affected areas. As such, this cost will be captured under respective allocations.

15. **Long Term.** Beyond the short and medium term livelihood interventions, income expansion and its equitable distribution would require progressive broadening of sustainable economic opportunities in the affected areas. This would require policy and institutional reforms.

D. Institutional and Delivery Options

16. Considering the extent and severity of damage, pooling of development efforts of stakeholders will be essential for livelihood restoration and development. The success of livelihood restoration and development will depend on the active involvement and participation of affected people to ensure effective utilization of funds, timely delivery, proper targeting and transparency. Within this context, the institutional interventions should depend on the core competencies of the respective agencies. The following should be ensured while designing state specific delivery mechanisms:

- The administration of livelihood restoration and development would require household level assessment, and for this purpose, it is advisable to engage communities and other intermediaries for efficient delivery.
- The formal banking sector will have a crucial role to play in providing services tailored for medium and large enterprises, including those engaged in fisheries, agriculture, etc.(Guidelines for these have already been issued and the banking sector is well equipped to meet the expected demand.
- Government of India has already proposed mechanisms for delivery of grants for asset replacement, especially for the fisheries sector. To ensure equity, such replacement has been proposed for microenterprises in this annex. The delivery of these grants as well as those proposed for vulnerable groups should flow through community based organizations.
- Considering that asset replacement is also proposed for microenterprises along with seed capital for new SHGs, it will be important for banks, cooperatives and other sources (including NGOs) to provide immediate linkages for meeting incremental credit needs. For facilitating this, appropriate modifications need to be made in the relevant guidelines and rules.
- Since upgrading of skills is expected to be provided through a range of specialized agencies (both public and private), it needs to be ensured that these are coordinated, demand driven and related to marketable skills.
- Reducing the vulnerability of poor and low-income families through risk mitigation measures such as insurance, targeted social transfers, and development of social protection measures requires an integrated public-private response.

Annex IX: RURAL AND MUNICIPAL INFRASTRUCTURE

A. Introduction

1. This section includes damage and needs assessment of basic infrastructure under the control of local governments, whether in towns, villages or hamlets. The components include water supply, sanitation and drainage, electricity, including street lighting, public buildings such as community halls and storage facilities, and internal roads. This annex does not include the housing specific internal infrastructure (e.g. internal water connections, latrines, etc.), which is reviewed in Annex IV on Housing.

2. The destruction in the tsunami-affected areas was caused by three successive waves hitting the coastline, with the second being the most powerful. Major damage was caused to the housing and fishing sectors, and shore-related infrastructure including roads, public buildings, electrical distribution, fishing harbors and ports, and local water supply and sanitation.

3. Basic services such as electricity and water supply were restored within a few days, albeit on a makeshift basis. It is commendable that in spite of the huge loss of human life, coupled with extensive inundation of water supply sources and loss of livestock, there has been, to date, no apparent serious outbreak of water borne or communicable diseases.

B. Pre-disaster Situation

4. **Water Supply:** The water supply to most villages and hamlets in Tamil Nadu, Kerala and Andhra Pradesh has been provided by shallow wells, pumping to overhead tanks and distributed through small diameter lines to public stand posts. The supply level ranged between 35-40 liters per capita per day (lpcd), as compared to the standard of 70 lpcd. In Pondicherry, villages tend to be larger and the water supply is commonly provided from deep bore wells up to 300 meters deep, located 5-6 km inland, to overhead tanks with distribution to public hydrants. Many households have individual connections. A fixed water tariff of Rs. 15/month was charged.

5. Many fisher folk were heavily affected as they lived in simple thatch huts at the back of the beaches. Most of these thatch dwellings were encroaching on public lands and had only rudimentary water supply, usually from local/private shallow wells, but many also had stand posts for five to 10 dwellings connected to the village supply. Some fisher families did have more substantial brick and mortar houses, usually behind the tree line further from the beach, which had individual service connections from the local village water supply. The water sources in the coastal areas tend to be saline, with high content of chlorides, sodium, iron and dissolved solids. The shallow wells tended to become increasingly saline with continuous use as the fresh water table was depleted. This salinization was exacerbated by the cyclone driven storm surges which inundate the beaches every couple of years.

6. **Sanitation:** Among the affected areas in all states, sanitation in urban areas was provided by onsite facilities, mainly septic tanks and pit latrines, and coverage was over 50 percent in urban Tamil Nadu and Kerala. In northern Tamil Nadu districts, open defecation on the seafront and beaches was the norm with sanitation coverage less than 15 percent in most coastal villages, though better off fishermen did have latrines in their *pucca* houses. The Total Sanitation Campaign initiated in all districts in Tamil Nadu was slowly leading to improved hygiene practices in the coastal

hamlets. Public toilets had been constructed in some villages, but did not seem to have been used much or maintained or operated properly.

7. **Power:** All the villages were electrified and many households had individual power connections, even the encroaching huts on the beach.

8. **Public buildings:** Many public buildings such as schools, community halls, beach facilities including restaurants, hotels, public fountains, canopy shelters, play and entertainment areas, and a few historic and religious sites were located in the tsunami-affected area. The majority of the tourism-related infrastructure was in Pondicherry, Karaikal and Kanniyakumari. This annex limits damage assessment to community buildings.

9. **Internal village/rural roads:** The villages were all served by basic internal lanes and roads, mostly 3.5 meter width, usually with paved carriageway, though some were concrete. Damage to these is covered in this section. Inter-village and district rural roads are covered under the transportation component.

10. **Drainage:** All the villages had internal drainage channels. Many villages were constructed on the banks of major streams, tidal basins and channels, some of which were damaged or silted by the tsunami.

C. Damage to Assets and Losses³³

Water Supply

11. **Andhra Pradesh:** The main impact of the tsunami was salination of more than 300 hundred sand point wells in the coastal villages and towns. Drinking water is being tanked to 85 of the worst affected villages. The assessed losses are limited to the wells lost to salination costing Rs. 0.90 crore (\$0.21 million³⁴).

12. **Tamil Nadu:** In the most severely damaged districts of Nagapattinam, Cuddalore and Kanniyakumari, the town and village/hamlet water supply infrastructure did not suffer heavy damage. Minor damage was caused to some pumps and the distribution network due to the physical impact of housing and other debris smashing local water connections, stand pipes and shallow bury supply pipes. Many shallow sand point wells were silted and the pumps burnt due to sand clogging. Many of these small systems have already been restored as part of the relief works.

13. A major impact of the tsunami was ingress of salinity on many of these shallow wells. Potable water is being provided by public stand posts supplied daily from the village's elevated tank, while the saline water continues to be used for bathing and washing. The extent of salinity is not known as most of the thousands of wells have yet to be tested, in part because many of the people using them prior to the tsunami have not come back. Salination of these wells is common, occurring every few years when the coastline suffers from 3-7 m cyclone surges. While most water system

³³ This damage assessment relies on the basic information provided by each village/district/state, as confirmed through visits to dozens of affected villages and hamlets, and known unit costs in the states.

³⁴ For the purposes of currency conversion an exchange rate of Rs 43.5 / US\$ is used.

damage occurred in 176 villages and hamlets in seven of the 13 Tamil Nadu districts, 1,158 hand pumps in 376 coastal villages and hamlets were also lost.

14. The districts reported that an average of approximately Rs. 100,000 (\$2,300) was spent to restore basic water supply in each village, and to provide water to local temporary shelters/relief camps. This basic supply is limited to a bare subsistence level of 10-15 liters per capita / day. The damage to water supply in Tamil Nadu is assessed at Rs. 19.0 crore (\$4.4 million).

15. **Pondicherry:** As the water supply to most villages is from deep wells located several km inland, there was no damage to the main water sources. Damage to the distribution network was very minor. But a number of sand point wells were damaged, similar to those in Tamil Nadu. Damages in the 33 piped water supply systems and to hundreds of hand pumps are assessed at Rs. 3.54 crore (\$0.8 million).

16. **Kerala:** Pipelines, pumps and electrical installations in 187 villages were damaged. The shallow wells in all the coastal villages were affected by saline intrusion. Damages were assessed to be Rs. 13.02 crore (\$3.0 million).

Sanitation

17. Since no major sanitation facilities existed in the coastal villages in any of the affected areas, the damage is confined to a limited number of public toilets in some villages, and private latrines in some of the more substantial dwellings. Damages are assessed at Rs. 3.47 crore (\$0.8 million), including Rs. 0.47 crore (\$108,000) in Andhra Pradesh, 90 public toilet units amounting to Rs. 2.25 crore (\$0.52 million) in Tamil Nadu, Rs. 0.25 crore (\$57,500) in Kerala and Rs. 0.50 crore (\$115,000) in Pondicherry.

Power

18. There were no major power plants near the coastline, except the nuclear power plant in Kalpakkam, Tamil Nadu, where no damage has been reported. The local electrical distribution system did suffer some damages, including snapped power poles and lines, dislocation of poles and loss of some transformers. These have mostly been restored to the original levels. Damages are assessed to be Rs. 8.99 crore (\$2.1 million) including Rs. 5.12 crore (\$1.2 million) in Tamil Nadu, Rs. 2.91 crore (\$0.7 million) in Kerala, and Rs. 0.96 crore (\$0.2 million) in Pondicherry. Andhra Pradesh did not report any damage.

Public Buildings

19. Many public buildings such as schools and community halls have suffered partial damage in Tamil Nadu and Kerala. In Pondicherry damage was also caused to various beach tourism facilities. Total assets damaged are assessed to be Rs. 7.61 crore (\$1.7 million) including Rs. 5.23 crore (\$1.2 million) in Tamil Nadu, Rs. 2.00 crore (\$0.5 million) in Kerala and Rs. 0.38 crore (\$87,400) in Pondicherry. Andhra Pradesh did not report any damage.

Internal/rural roads

20. The tsunami waves coming ashore at high speed caused road beds to become saturated, and to lift and separate; the force of the water returning to the sea caused severe erosion of many sections. It is estimated that approximately 354 km of internal village roads and 17 km of urban roads were damaged in Tamil Nadu; this is assessed at Rs. 21.86 crore (\$5.0 million). In Kerala, it is estimated that 100 km of village roads were damaged, assessed at Rs. 5.00 crore (\$1.2 million). The damage to internal village roads in Andhra Pradesh was assessed at 10.31 crore (\$2.4 million). In Pondicherry, the villages were more developed and as a result more roads were damaged. One bridge was also damaged and has been included in the damage assessment. Total damage has been assessed as Rs.15.0 crore (\$3.5 million).

Drainage

21. The damage to drainage channels and allied structures was assessed to be Rs. 3.52 crore (\$0.81 million) in Tamil Nadu, Rs. 3.52 crore (0.81 million) in Kerala and Rs. 6.00 crore (\$1.38 million) in Pondicherry, totaling to Rs. 13.04 crore (\$3.0 million).

22. Total assessed damages are summarized in the table below:

Table 1. Rural and Municipal Infrastructure Needs (Rs. crore)

Sl. No	Items	Andhra Pradesh	Tamil Nadu	Pondicherry	Kerala	Total	
						Rs. crore	\$ million
		301 villages in 9 districts	376 villages in 13 districts	33 villages & 2 urban areas	187 villages in 3 districts		
1.	Water Supply	0.90	19.02	3.54	13.02	36.48	8.4
2.	Sanitation	0.47	2.25	0.50	0.25	3.47	0.8
3.	Power	0	5.12	0.96	2.91	8.99	2.1
4.	Public Buildings	0	5.23	0.38	2.00	7.61	1.7
5.	Internal Roads	10.31	21.86	15.00	5.00	52.17	12.0
6.	Drainage	0	3.52	6.00	3.52	13.04	3.00
	Total	11.68	57.00	26.38	26.70	122.04	28.0

Facilities for Relief Camps

23. A total of 42,000 family units are currently in temporary camps being run by NGOs, private sector and the governments across the three states and Pondicherry. In Pondicherry, affected families have also been given cash and many have constructed their own temporary shelters on land provided by the government. These camps are being provided with water supply, basic sanitation, power and drainage. Residents also have access to mobile health clinics and local schools. The cost of providing the minimal basic facilities to these temporary camps is estimated at Rs. 39.42 crore (\$9.1 million).

Losses

24. Because of the damages described above, the local governments had to immediately provide basic water supply to those areas where water supply was physically destroyed or unusable, and also to the temporary relief camps. This involved provision of 500 liter tanks to feed stand pipes and hiring of tanker trucks to fill these temporary tanks. Such interim measures were provided until these

stand pipes could be connected to the village supply. The local governments also hired equipment for 15 days to remove debris. Because of the damage to power poles and lines, the authorities had to hire a number of generator sets to supply electricity to operate the water pumps and other essential services until power could be restored. The losses, as detailed below are estimated at Rs. 7.07 crore (\$1.6 million).

Table 2. Rural and Municipal Infrastructure Losses (Rs. Lakh)

Item	Unit	Andhra Pradesh		Tamil Nadu		Pondicherry		Kerala		Total	
		Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost
Water Supply											
HDPE Tanks	Number	40	3	250	17	40	3	140	9	470	32
Tanker Supply	Trips	2,500	21	20,940	173	2,500	21	9,850	81	35,790	296
Debris cleaning											
Earth moving equipment	Number	12	16	76	103	18	24	42	57	148	200
Trucks	Number	20	27	52	62	15	18	20	24	107	131
Power											
Gensets	Number	10	2	200	30	15	2	90	14	315	47
Total			69		385		68		185		707

Note: The figures for Tamil Nadu are given by the government. All other figures are extrapolated

D. Needs Assessment

25. Restoration and reconstruction needs were estimated assuming the reconstruction of the assessed damages as the basic need, but rebuilt according to 2005 norms, standards and specifications. These immediate requirements were then combined with the necessary medium term measures essential to ensure sustainability and compliance with the state's recovery and developmental growth strategy. The medium term measures include provisions for upgrading the services and infrastructure to 2005 levels, in tandem with the proper servicing levels for the reconstruction of housing, with a reasonable 10 year planning horizon.

26. Longer-term measures will include expansion of all infrastructure to a normal 20-30 year design horizon, within a sustainable development framework and disaster preparedness approach. The estimate of reconstruction needs for the immediate, mid term and longer term are detailed in the table below.

Table 3. Rural and Municipal Infrastructure Needs (Rs. Crore)

S.No.	Items	Short Term	Medium Term	Total
Andhra Pradesh				
1.	Water Supply	0.90	49.10	50.00
2.	Sanitation	2.24	5.22	7.46
3.	Power	0	0	0
4.	Public Buildings	0	34.74	34.74
5.	Internal / Rural Roads	10.41	20.00	30.41
6.	Drainage	0	0	0
<i>Sub Total</i>		13.55	109.06	122.61
Tamil Nadu				
7.	Water Supply	9.63	40.46	50.09
8.	Sanitation	4.47	10.43	14.87
9.	Power	5.08	11.84	16.92
10.	Public Buildings	34.74	8.50	43.24
11.	Internal / Rural Roads	11.50	27.00	38.50
12.	Drainage	0.56	1.13	4.69
<i>Sub Total</i>		65.98	99.36	165.34
Pondicherry				
13.	Water Supply	1.06	2.48	3.54
14.	Sanitation	0.50	0	0.50
15.	Power	0.96	5.94	6.90
16.	Public Buildings	1.18	0.27	1.45
17.	Internal / Rural Roads	1.22	2.84	4.06
18.	Drainage	2.00	4.00	6.00
<i>Sub Total</i>		6.92	15.53	22.45
Kerala				
19.	Water Supply	1.90	65.98	67.88
20.	Sanitation	9.79	22.84	32.63
21.	Power	0.87	2.04	2.91
22.	Public Buildings	0.60	1.40	2.00
23.	Internal / Rural Roads	2.00	4.90	6.90
24.	Drainage	0.56	1.06	1.62
<i>Sub Total</i>		15.72	98.22	113.94
Total	(Rs. crore)	102.17	321.87	424.34
Total	(\$ million)	23.5	74.0	97.5

E. Recovery Strategy

27. The ongoing relief efforts have to some extent restored essential services such as water supply, sanitation and power to a basic level. A minimal level of shelter is also being provided in the temporary camps. However, water supply to these camps will need to be augmented during summer, since it is unlikely that resettlement can be carried out in only a few months. Based on the Gujarat earthquake experience, rehabilitation of displaced families could take up to three years. Therefore the immediate requirements include upgrading service levels in temporary shelters and also villages. Community toilets and hand pumps are being provided side by side in many temporary shelters; this is likely to contaminate ground water. Proper technological design suitable to the coastal high water table areas needs to be promoted.

28. The recovery strategy therefore should follow a three phased approach:

- immediate needs to provide essential services such as basic water supply and sanitation, repair to public buildings in villages, and resettlement;
- medium term, for the next three years, will include rehabilitation and reconstruction of infrastructure and basic services; and,
- longer term, to provide additional infrastructure to ensure sustainability and to enable the local communities and local governments to operate and maintain the systems for which they are responsible.

29. It is essential that the medium and long-term priorities are incorporated into the sector strategy/plan of the concerned governments at the state and the district levels, with due consideration of their cost-effectiveness, and institutional, social and environmental sustainability, including impacts of site selection of major facilities. These must proceed within the framework of ongoing policy and institutional reform principles, in terms of participatory planning, decentralized and transparent implementation, and active user participation.

30. **Immediate needs.** The temporary shelters and basic services already initiated will need to be upgraded to last for the duration of the reconstruction phase, which may be up to 2 years. This will include improvement of water supply systems, provision of a sustainable sanitation service and power supply arrangements. To achieve this, the following steps are envisaged:

- establish a reconstruction planning and monitoring committee at the village level, which will have representation from major interested groups, to assist the responsible line departments at district and state level, and the government in the case of Pondicherry, in identification, planning, design, construction and monitoring of the reconstruction work;
- public consultation and information campaigns to inform the beneficiaries of the reconstruction strategy and procedures;
- rapid examination of basic services and identification of additional works to be taken up immediately;
- implementation of the additional works required to maintain services at an adequate level during the reconstruction phase; and,
- removal of severely damaged buildings and other infrastructure that has become unsafe.

31. The cost of the immediate needs program in all tsunami-affected areas is estimated by the Joint Assessment Mission (JAM) at Rs. 102.17 crore (\$23.5 million).

32. **Medium term reconstruction.** This phase will continue for the next three years until all the displaced families are permanently settled, and will include provision of all the basic amenities and related infrastructure that will be required to meet the housing reconstruction and village services upgrading needs. Infrastructure will need to be expanded to incorporate future requirements though use of normal design parameters and horizons. During this period, works will be carried out to enable full restoration of the services and may include new buildings, new power lines, new water and

sanitation systems, and full restoration of tourism-related infrastructure. This phase will also incorporate initiation of capacity building of local governments and communities to efficiently operate and manage the reconstructed services. The cost of the medium term reconstruction program is estimated by the JAM as Rs. 321.87 crore (\$74.0 million).

33. The total required to put the tsunami affected communities back into a sustainable situation is therefore the sum of the immediate and medium term requirements and is assessed at Rs. 424.04 crore (\$97.5 million).

34. **Longer Term.** For the longer term, further investments in these sectors should be guided by the states' development strategies and frameworks to ensure the affected populations are permanently settled in sustainable communities with full services and access, and reduced vulnerability to disasters.

F. Environmental Aspects

35. Environmental impacts in the immediate and medium-term phases are expected to be minimal as no formal sewerage systems would be constructed. However, for the larger towns, the midterm and certainly longer term reconstruction programs will involve sewage collection, treatment plants and effluent discharges requiring environmental impact assessments and mitigation. Similarly, these towns should develop solid waste disposal sites, also requiring environmental mitigation and impact assessments. The overall environmental aspects and protection of the coastal villages, towns and ports through seawalls, tree shelters and other physical works, are addressed in the chapter on environment.

Annex X: TRANSPORTATION (Roads & Bridges, Ports and Inland Waterways)

A. Background

1. The transport sector, especially roads and ports along the coastline, in Tamil Nadu, Kerala and Pondicherry was seriously damaged by the tsunami. One railway line along the coast in Nagapattinam district of Tamil Nadu was also damaged, but was restored by the Indian Railways within one month of the disaster. No damage to the transport sector was reported in Andhra Pradesh except for village roads.

2. **Road Subsector:** Road transport accounts for 60 percent of freight movement and 80 percent of passenger traffic in the country. State, district and rural roads³⁵ which carry about 60 percent of total road traffic provide linkages with the national highways, district headquarters, important towns, tourist centers, and minor ports. Given that 70 percent of the total population lives in rural areas, improvement of rural roads is directly related to the economic activities and quality of life of the region. Tamil Nadu has a total road network of 57,407 km, of which 7,230 km, 7,383 km and 41,191 km are respectively state highways, major district roads (MDR) and other district roads (ODR). ODRs along the coast have traffic of 800 to 1,500 passenger car units (pcu). Kerala has a total road network of 22,335 km, of which 3,785 km, 11,711 km and 5,316 km are respectively state highways, major district roads and other district roads. Pondicherry has a road network of 1,310 km, of which 35 km and 507 km are state highways and other roads.

3. **Port Subsector:** Out of more than 160 ports in India, 12 major ports handle about three-fourths of the total traffic of 330 million tons. Major ports are managed by port trusts under the regulation of the Tariff Authority for Major Ports while minor ports are under state government control. In Tamil Nadu, there are two intermediate ports and 12 minor ports. The intermediate port, Nagapattinam, has been handling 30,000 to 40,000 tons a year importing oil and exporting cement. The fishing harbor located on the river upstream of the port is also under the jurisdiction of maritime board of the state. There are three intermediate ports and 14 minor ports in Kerala under the jurisdiction of the state government, out of which four ports have been damaged by the tsunami.

B. Damage Assessment

4. **Road Subsector:** In the districts of Nagapattinam, Kanniyakumari and Cuddalore of Tamil Nadu, and Pondicherry, more than 80 km of ODR and MDR, located within 800 m of the coastline, were seriously damaged. Damage to national highways and one state highway was reported in Tamil Nadu. Some bridges and embankments were totally destroyed or washed away, and other sections had damage to shoulder protections, beams and pavement. In Nagapattinam district, one bridge and two bridge structures under construction were destroyed. Within two weeks of the disaster, a temporary diversion road had been constructed on a temporary embankment across the river. However, this remains vulnerable to cyclones and floods, and reconstruction of the bridge is urgently needed, based on a design incorporating protection against cyclone surges and tsunami. In Kanniyakumari district, a bridge across the Pazhayar River was hit by the tsunami with four decks washed away and one deck partly damaged. In Karaikal, Arasalar bridge which provided the main link between Karaikal town and the southern part of Tamil Nadu was badly damaged – two spans

³⁵ This annex covers other district roads excluding Panchayat (village) roads.

and piers collapsed. The Indian Army, in a very short time, restored the connection by providing a bailey bridge. In Cuddalore district, district roads along the coast were seriously eroded.

5. In Kerala, roads along the coasts in Kollam and Alappuzha were worst hit with about 60 km of MDR as well as panchayat roads affected with shoulders and pavement damaged. The state government immediately removed debris and sand to make the breached roads passable for relief vehicles at a cost of Rs. 500,000 (\$11,500³⁶). It is urgent that damaged shoulders and pavement be restored before the advent of monsoon rain and storm surges.

6. Another affected sector in Kerala is inland waterways. The draft of the inland waterway has been reduced in several areas due to sand deposits. Although the state government carried out temporary dredging, capital dredging is required to restore the draft for river crossing ferries.

7. **Damage, roads and bridges:** It has not been possible to distinguish the damage attributed to the tsunami from any previous deterioration in road and port assets. The estimates of damage refer to the cost of restoring the assets to good condition. This does not reflect the cost of additional upgrading beyond normal standards. The total damage to the road sector is estimated by the joint assessment mission around Rs. 50.0 crore (\$11.5 million). Restoration costs were estimated based on market rates for pavement, shoulder improvement and bridges. The total restoration costs of the destroyed bridges are estimated by the districts at Rs. 0.90 crore (\$206,900) in Nagapattinam, and Rs. 8.6 crore (\$2.0 million) in Kanniyakumari. However, the design specification for the bridges will need to be based on studies of wave height, including that of the tsunami and future traffic of each area. Also, roads around ports, fishing harbors and city centers need to be upgraded in terms of width and height for both expected wave height and future traffic. It is assumed that the immediate restoration costs will increase by 30 percent as a result of this upgrading.

8. **Losses, roads and bridges:** As the damaged sections are passable except for a few bridges, the loss in most areas is limited to the increased travel time and vehicle operation cost caused by diversions and deteriorated surfaces. This is currently low because local traffic around the ports and fishing harbors has not yet recovered to the pre-tsunami level. The loss from the impassable bridge in Kanniyakumari is estimated at Rs. 130,000 (\$3,000) so far³⁷. It is reported that the cost of eight damaged rail cars in Cuddalore is Rs. 180,000 (\$4,140).

9. **Ports:** Nagapattinam Port located along the Kaduvaiyar River in Tamil Nadu was severely damaged. The two breakwaters at the mouth of the river were destroyed and one barge carried by the tsunami collided with a coastal protection groyne between the sea and river. This led to sand drifting from the sea to the channel and basins as well as reduction of calmness of the channel and basins. The tsunami waves came over the fishing harbor seawall destroying parts of wharfs, the fish market and the auction center. The waves also destroyed fishing boats and a dredger, and left them along the channel and on the wharfs of the port. As a result of reduced draft of the channel and basins, and the broken facilities, the port has suspended operation. This problem with the channel has also prevented fishing boats from plying to and from the fishing harbor. Similarly, Cuddalore Port, located at the confluence of the rivers Gadilam and Paravanar, suffered damage to breakwaters, the sea wall, equipment, the basin and the channel. In addition, Colachel port and Pondicherry port, and five fishing harbours (Pazhavar, Thirumullai Vasal, Chinnangudi, Nagore in Nagapattinam and

³⁶ For the purposes of currency conversion an exchange rate of Rs 43.5 / US\$ is used.

³⁷ Calculated as follows: Rs 10/hour @ 0.5 hour @500 pcu/day @ 51days.

Chinnamuttom in Kanniyakumari) were affected and need urgent dredging as well as restoration of jetties and retaining walls. In Kerala, sand drift caused by the tsunami has led to serious reduction of the draft in four minor ports (Vizhinjam, Neendakara, Beypore and Azhikkal) and eight fishing harbors and landing spaces.

10. **Damage - ports:** The cargo volume or fish catch of the damaged ports and fishing harbours are not expected to recover their capacities in the near future. Hence, the costs have been based on restoring the original level of capacity. As the damage behind Nagapattinam port was serious, the cost of extending breakwaters and reinforcing groynes were included in the mid term restoration cost. The restoration cost for each port was estimated based on market unit rates for reconstructing breakwaters, wharfs and buildings, dredging, and procurement of a dredger etc. The total damage is estimated around Rs. 95.0 crore (\$21.8 million).

11. **Loss - ports:** The loss from the damage is significant because of complete or partial suspension of imports and exports, and fishing activities. Assuming that imports and exports for this region are transferred from Nagapattinam port to Chennai port, the additional transport cost in one year would be Rs. 1.4 crore (\$0.32 million) (30,000 tons @ Rs. 4500/ 10 tons) excluding warehouse and time costs. In Kerala, some maritime cargo is being transshipped offshore from vessels to small barges which can ply the shallow channels and basins. Other maritime cargo is now being transported by trucks at higher cost. There is a loss of port related services such as fuel and water supply. In Tamil Nadu, one vessel in Nagapattinam port and three vessels in Kanniyakumari had damage worth Rs. 0.30 crore (\$69,000) and Rs. 0.48 crore (\$111,500) respectively. In Chennai and Pondicherry, three and two vessels were respectively damaged. It is also reported that substantial numbers of the labor force are unemployed as a result of limited or suspended port operation.

12. The estimated restoration costs for damaged roads and bridges in the three states are in Table 1 below.

Table 1. Damage to transport sector in the three states (Rs. crore)

States	Tamil Nadu	Pondicherry	Kerala	Total
Roads and Bridges	27.66	24.45	6.14	58.25
Ports and fishing harbors	65.41	5.00	24.24	94.65
Total (Rs. crore)	93.07	29.45	30.38	152.90
Total (\$ million)	21.40	6.77	6.98	35.15

C. Reconstruction Strategy

13. The reconstruction program in the transport sector should follow the following principles which have been identified to guard against the risk of coastal disasters including tsunami, cyclone surges and monsoon floods.

- Protective works for ports and fishing harbors: Fishing activities such as landing, auction, and maintenance of nets and equipment will continue to be conducted at the fishing harbor or coastal space. Therefore, reinforcement of seawalls and extension of breakwaters are essential to protect major ports from future disasters. These improvements also reduce the requirement for frequent dredging of the channel after cyclones and floods, and improve the calmness of the channel and basins.

- Development of ports and fishing harbors can affect the littoral sand drift along the coast. For instance, extension of a breakwater or a groyne could encourage erosion of remote beaches. Hence, careful and comprehensive simulation will need to be carried out for planning the development of ports and fishing harbors. Coastal protection works also need to be considered in such plans.
- Evacuation path: In the event of a future disaster warning, appropriate evacuation paths are required, particularly in the port and fishing harbor area. One possible evacuation path is the cross-river bridge. Detailed analysis is necessary to design shortest paths for employees and residents in these areas. Multistorey buildings and high shelters should also be considered in these areas. In Alappuzha district of Kerala, a bridge between the villages and the mainland was proposed for emergency evacuation across the inland water. In Cuddalore, a bridge, proposed to fill the missing link, is expected to secure the evacuation and emergency path of the area. The characteristics of tsunami and cyclones waves should be reflected in the design of the bridges.

14. In villages where entire relocation is to be implemented, restoration of the damaged roads should be decided subject to whether the road is on the access route to the relocated villages. In villages where sea walls will be introduced, restoration of access roads needs to be completed as soon as possible to avoid further damage by cyclone surges and floods. When a road along the coast is widened or raised in restoration, the design should be carried out in coordination with coastal protection design.

15. The new bridge at Alappuzha district for evacuation, and the upgrading of coastal roads, were categorized into mid-term needs due to uncertainties in the relocation of villages and options for coastal protection works, and need for further studies.

16. In restoring damaged ports and fishing harbours, the immediate needs are for breakwaters and dredging to resume port operations and fishing activities as soon as possible. Remaining investment for restoring facilities and equipment can be implemented in the mid-term implementation schedule.

17. Reconstruction cost: Based on the proposed recommendations of the reconstruction strategy and the damage assessment, the tentative cost estimate for immediate, mid term and long term reconstruction is as follows.

18. Based on the proposed reconstruction strategy and the damage assessment, the cost estimate for short and medium term reconstruction is as follows.

Table 2. Transport Reconstruction Needs (\$ million)

TAMIL NADU		Short-term	Medium-term
Roads & Bridges			
	Road reconstruction	21.27	0.00
	Bridges reconstruction	14.69	25.85
	Studies and consulting services	1.00	4.00
	Sub Total	36.96	29.85
Ports and Fishing harbours			
	Port reconstruction	60.10	14.60
	Fishing harbour reconstruction	5.31	1.83
	Studies and consulting services	4.00	4.00
	Sub Total	69.41	20.43
Total	(Rs. crore)	106.37	50.28
Total	(\$ million)	24.45	11.56
PONDICHERRY			
Roads & Bridges			
	Road reconstruction	29.25	0.00
	Bridges reconstruction	2.54	0.00
	Studies and consulting services	1.00	1.00
	Sub Total	32.79	1.00
Ports and Fishing harbours			
	Port & Fishing harbour reconstruction	5.00	0.00
	Studies and consulting services	2.00	1.00
	Sub Total	7.00	1.00
Total	(Rs. crore)	39.79	2.00
Total	(\$ million)	9.15	0.46
KERALA			
Roads and Bridges			
	Road reconstruction	7.98	16.50
	Bridges reconstruction	0.00	15.00
	Studies and consulting services	1.00	5.00
	Sub Total	8.98	36.50
Ports and Fishing Harbours			
	Port reconstruction	9.84	11.50
	Fishing harbour reconstruction	14.40	15.00
	Studies and consulting services	1.00	5.00
	Sub Total	25.24	31.50
Total	(Rs. crore)	34.22	68.00
Total	(\$ million)	7.87	15.63

19. Over the long-term, state governments have proposed some roads, ports and fishing harbor projects. Although these projects have impacts on the recovery of the regional economy, it would be necessary that detailed studies for the cost, benefits and environmental and social impacts be carried out.

Annex XI: COASTAL PROTECTION

A. Introduction

1. The impacts of the tsunami were influenced by the differences in the topography of India's east and west coasts. The east coast is characterized by sand accretion. Most of the coast is covered by well-developed coastal dunes, sand slips and sand bars, and the slope of the beaches is gentle. Some part of the shoreline does not have any natural barriers such as mangroves or even sand dunes. The state of Tamil Nadu has a program to construct a rubble mound seawall (RMS) to protect the vulnerable coastal area from sea-related hazards, but only 40 km has been built at present.

2. In the east, 39 major rivers and drains meet the Bay of Bengal. Nagapattinam and Pondicherry, which were badly hit by the tsunami, are located in the middle of the Cauvery delta, a lowland area below sea level in parts and extending far inland, which is very vulnerable to flooding and storm surges – as well as tsunami inundation. The east coast was struck both directly by the tsunami with waves believed to have been more than 5 m in height and also through the reflection of waves by the island of Sri Lanka. Because of its vulnerable topography and limited coastal protection, the overall impacts were especially severe.

3. On the west coast, affected areas suffer from erosion problems; beach slopes are steep. Many coastal protection works have been undertaken, including groynes and seawalls. Groyne systems have been used in Kanniyakumari district, and seem to have worked well even in the face of the tsunami; they are believed to have saved the lives and property of many in coastal villages.

4. In Kerala, gentle slope-type coastal embankments that also work as buffers against beach erosion are the main protection structures. Because the beaches are steep, and this area is located behind Sri Lanka, the tsunami wave height is believed to have been relatively low and so its impact was less than on the east coast.

B. Damage Overview

5. Data for this damage assessment has been collected through field visits to each of the main affected stretches of coastline; review of state government damage assessment reports and technical reports; and consultation with relevant divisions in each district.

6. Although the overall impact of the tsunami on the east coast was severe, damage to coastal protection structures was limited. Most are designed to cope with high wind waves, and survived the tsunami with only minor damage. The Rubble Mound Seawalls (RMSs) survived and were reported to have saved many lives and properties. However, most of the small coastal embankments to protect roads and other infrastructure did not have sufficient depth to cope, and suffered severe damage. Many existing flood banks near the mouths of rivers were damaged, especially in Nagapattinam district.

C. Immediate Needs

7. The damage estimates in Table 1 are based on the cost of restoring damaged coastal protection infrastructure to sound working condition. The total estimated cost of damage is Rs. 186

crore, (\$42.8 million³⁸) comprising Rs. 104.0 crore (\$23.9 million) in Tamil Nadu, Rs. 42.0 crore (\$9.7 million) in Kerala, and Rs. 40.0 crore (\$9.2 million) in Andhra Pradesh. Estimates of losses are not included as these have been captured in the assessments for other sectors in this report.

Table 1: Immediate Restoration of Coastal Protection, Tamil Nadu and Kerala

Item^a	Description	Damage (Rs. crore)
1. Tamil Nadu		
Vedaranyam canal	Widening and strengthening of the bank	7
Buckingham canal	Widening and strengthening of the bank	3
Rivers and drains	Strengthening of 245 km banks of rivers and drains	75
Coleroon River Bank	Strengthening of river bank	6
Additional straight-cut from Vedaranyam canal to Buckingham canal	Restoration, strengthen and widening of rivers and canal banks	9
Rubble mound seawall	Restoration (Chennai and Madurai)	2
Coastal Protection Infrastructure	Equipment restoration (Chennai and Trichy)	2
Subtotal		104
2. Kerala		
Coastal Protection Infrastructure	Restoration of 28 km of RMS wall	42
Subtotal		42
3. Andhra Pradesh		
Sea wall tidal banks in Kruthivene Mandal	E.G. District and W.G. District	11
Tidal banks in Kruthivene Mandal	Krishna District	6
KET and Kona tidal banks	Krishna District	18
Study and survey etc.		5
Subtotal		40
TOTAL		186

^a Based on information available at the time of the assessment, no requirements for immediate restoration were identified for Pondicherry, although medium term reconstruction and recovery estimates were identified as discussed below.

8. The immediate focus should be on restoration of damaged infrastructure for protection against coastal hazards such as cyclones and subsequent storm surges and river floods. Especially in Nagapattinam district, serious damage has been reported at river and drain banks, and these need to be restored immediately. In the event that vulnerable coastal hamlets are relocated to lowland areas, anti-flood measures such as raising the level of relocation sites and constructing embankments are required.

9. In Tamil Nadu, the strengthening of the Vedaranyam and Buckingham canals, and of 245 km of river and drain banks at the confluence point with the Bay of Bengal are immediate necessities to prevent inundation in Nagapattinam district. The proposed restoration of coastal protection infrastructure indicated in Table 1 will be distributed all along the coastline. In Kerala, most restoration work will be in Kollam and Alappuzha districts. Although direct damage to coastal protection structures such as RMSs or groynes was relatively small in both Tamil Nadu and Kerala, an immediate survey of the safety of the structures, followed by restoration work, is needed.

³⁸ For the purposes of currency conversion an exchange rate of Rs 43.5 / US\$ is used.

D. Reconstruction Strategy

10. The aim of the reconstruction and recovery strategy is to strengthen coastal protection infrastructure in order to permanently reduce future damage and loss of life from sea-based hazards. In planning coastal protection measures, it is important to consider the land use of the coastal area concerned, as well as the status of coastal erosion. The coastal zone can be divided into three categories: (i) port and city area; (ii) fishery village or fishery and agricultural usage area and (iii) little human activity (as a village relocation or environmental preservation). Each category may require different measures.

11. Coastal protection work will need to be closely coordinated with recovery and rehabilitation works for highways, ports and fish harbors. In some cases, it may be appropriate to adopt an integrated approach to design these facilities. For example, a coastal highway might be built on top of a coastal protection embankment.

12. Since a range of different technical options are available, their relevance is location-specific, and the technical and other factors involved are complex, it is essential that the selection and design of additional infrastructure is based on thorough technical studies, and taking into account the lessons learned from the recent tsunami and other recorded events. A list of technical options is provided in Appendix 1.

13. The suggested technical studies should be closely coordinated with the ongoing government-financed study of ocean disasters being undertaken by the federal Department of Ocean Development.

14. In the case of Tamil Nadu, the studies should cover the entire length of the coast since it is mostly unprotected at present. Because the length of coastline to be protected is long, construction cost and period may be important factors in selecting the type of structure. The scope of the studies should include (see also Appendix 1):

- (i) Assessment of coastal hazards including tsunami effects. This will require statistical analyses of extreme natural hazards. Because cyclones, storm surges and high tides are regular phenomena in south India, existing research may be available though not for tsunamis.
- (ii) Beach erosion control studies for the southern Indian coast. These should include assessment of the characteristics of the coast such as long term and seasonal topographical changes of beaches, and the characteristics of littoral sand drift; and evaluation of technical options for erosion control work through modeling to predict coastal topographical changes caused by deployment of the coastal structure. Environmental and social impacts will also have to be examined.

15. With respect to the civil works for reconstruction and recovery, expert assistance should be provided to state governments for construction supervision, and monitoring of effectiveness and associated refinement of coastal protection that tends to be necessary for this kind of work. The suggestions for reconstruction and recovery works here are very tentative, and are in response to requests from the state governments. They incorporate preliminary expert inputs. A two-stage approach is envisaged:

16. The medium term covers the more vulnerable areas that require improvement in coastal protection infrastructure as soon as necessary studies have been completed. These works should be completed within 1-3 years. The longer term covers additional vulnerable areas where works should be completed within 3-5 years. It is likely that there are substantial requirements for longer term measures, but at the time of this assessment only very limited information of the requirements was available.

17. Pending the technical studies described above, the suggested coastal protection work in Tamil Nadu consists of construction of: (i) gentle slope-type RMS; (ii) retaining wall for parts of the RMS; and (iii) groynes for protection against beach erosion. These coastal works will also provide protection against cyclones, storms and depressions besides the rarity of a tsunami. In the medium term, this will involve construction of 40 km of RMS, 20 km of concrete retaining walls for parts of the existing RMS in urbanized areas, and 50 additional groynes. The longer term will cover construction of the remaining requirement of 415 km of RMS, 35 km of concrete retaining walls for parts of the RMS, and 426 additional groynes.

18. In Kerala, the medium term reconstruction and recovery work will address essential requirements for protection against tsunamis and sea erosion. This can consist of construction of: (i) 73 km of new RMS wall; and (ii) 97.45 km of RMS wall reformation work. The longer term will focus on completion of the remaining coastal protection that is needed. This can cover: (i) construction of a new RMS wall along 74 km of uncovered coast; and (ii) restoration of about 37 km of the existing RMS wall due to settlement of the structure.

19. The restoration of coastal protection works is proposed to be done within a period of 3 years – the immediate works of restoration (estimated to cost Rs. 85 crore) to be completed in the first year and the balance (estimated cost Rs. 81 crore) in year 2-3.

20. An important factor that will need to be considered, when comparing the RMS wall proposed by the state governments with other alternatives, is the impact on the surrounding coastal environment and on erosion.

21. Groynes are often not a very satisfactory countermeasure for beach erosion. Their purpose is to interrupt the littoral drift to try and maintain the beach. However, on their leeward side, the supply of sand is interrupted and erosion occurs. In an extreme case, in Kanniyakumari district, groynes were used as a kind of breakwater for fishing by extending the length seaward. The greater length has considerably accelerated the problem of leeward side erosion there.

22. Both Kerala and Tamil Nadu use the gentle-slope type RMS. These types of structures were developed to reduce the effect of wave reflection. However, if beach erosion should reach the RMS (if the RMS faces directly the sea), scouring will occur at the foot of the RMS and this may lead to its collapse. In such cases immediate reformation work is needed. In Kerala, where there is considerable seasonal topographical change, there are serious risks of erosion reaching the RMS, and costs of maintenance are high. It is in this context that Kerala has proposed 69 km of reformation work in the medium term, representing 11 percent of its existing RMS. In considering technical options, another issue is physical and visual access to the beach. Structures like RMS are an obstacle. An option is offshore submerged breakwaters with beach sand nourishment. This is especially appropriate where beach erosion is already serious. Although this method is more costly than RMS, its maintenance costs are generally less and the beach is maintained effectively.

Appendix 1: Options for Coastal Protection

Option	Description	Advantages	Disadvantages
1. Groyne	Construction of structure from the shoreline to the sea	Easy to implement Reliable trapping of sand on one side Less costly than offshore structures	Erosion to leeside Negative impact on the scenery
2. Seawall (Gentle Slope RMS)	Rubble mound made of rocks	Easy to implement Less costly than offshore structures	Less capacity to retain the shore line Regular maintenance cost Disruption of access to beach Negative impact on scenery and environment
3. Headland Defense Work	Comprehensive system of shorter groynes	Stable shore line balancing inflow and outflow of littoral sand drift	Longer time for studies and designs Negative impact on scenery
4. Beach Nourishment	Provision of sand to the beach	Instant effect on beach Easy to maintain	Regular maintenance cost
5. Offshore Breakwater	Detached Breakwater parallel to shoreline	Reliable trapping of sand Less maintenance cost	Most costly Risk of erosion at other beaches Negative impact on scenery Impact on water flows
6. Artificial Reef	Submerged detached break water parallel to shoreline	No impact on scenery Less maintenance cost	Costly Less capacity of trapping sand
7. Combination of Options 2-6			

The south Indian coast is prone to several water-related natural hazards such as cyclones, storm surges, depressions and flooding. In order to select a feasible coastal protection option, the following studies are required:

Analysis of water-related natural hazard

Statistical analysis of extreme wave and tide values for long period for more than 30 years, or simulated wave and tide data.

Assessment of littoral sand drift

Present and past topographical changes, and characteristics of littoral sand drift
Depth survey records including the topographical change, wave and climate data, deposited material properties, and sand and/or silt material supply from rivers etc

Annex XII: HAZARD RISK MANAGEMENT

A. Background

1. All the tsunami-affected states are vulnerable to a range of hydro-meteorological hazards such as floods, cyclones and drought, and geophysical hazards like earthquakes, landslides and tsunamis. Depending on location, the risk of hydro-meteorological hazards ranges from moderate to high and that of geophysical hazards from low to moderate. Combined with a growing population, a large section of which remains dependent on climate-sensitive sectors like agriculture and fishing, and other vulnerability factors, this part of the country is categorized as moderate to high disaster risk.

(a) Tamil Nadu

2. Cyclone data over the Bay of Bengal since 1891 indicates that on average, a moderate to severe cyclone hits the Tamil Nadu coast every two years. A number of the state's river basins are prone to floods during the northeast monsoon. Some parts of the state fall in Zone III of the seismic map of India indicating a moderate level of seismicity. The state's hill districts (Nilgiri and Dindugal) are prone to landslides. High population density in the coastal belt, dependence of a large proportion on primary sectors, and inappropriate environmental management in the coastal areas and river deltas make Tamil Nadu a high disaster risk state.

(b) Pondicherry

3. The Pondicherry and Karaikal regions are exposed to cyclones and floods. Climate fluctuations and over-exploitation of ground water resources have exacerbated the recurrence of drought. Although two-thirds of the population is urban, the dependence on agriculture and fisheries remains high and so climate fluctuations and extreme events have great damage potential.

(c) Kerala

4. More than 22 per cent of the state is exposed to flood and more than 8 per cent is landslide prone. Increasingly, despite significant annual rainfall, parts of Kerala are becoming vulnerable to drought. In addition, coastal hazards such as erosion, accretion and possible sea level rise emanating from local environment management practices as well as global changes put a large part of Kerala's coastal population at risk.

(d) Andhra Pradesh

5. Andhra Pradesh is exposed to cyclones, storm surges, floods and droughts. A moderate to severe intensity cyclone can be expected to make landfall every two to three years. About 44 percent of the state is vulnerable to tropical storms and related hazards. Along the coast, the section between Nizampatnam and Machilipatnam is the most prone to storm surges. Traditionally, the flood problem had been confined to the flooding of smaller rivers. But the drainage problem in the coastal delta zones has worsened, multiplying the destructive potential of cyclones and increasing flood hazards. A critical factor is maintenance of irrigation systems. On several occasions, deaths have been caused by breaches in tanks and canals as well as over-flooding caused by silting and growth of weeds.

B. Existing Institutional Arrangements and Capacity Building Efforts

(a) Tamil Nadu

6. The government constituted a state disaster management authority headed by the chief secretary in 2003. The Special Commissioner & Commissioner of Revenue Administration, Disaster Management & Mitigation Department, acts as the Relief Commissioner. In the districts, the district collector heads disaster response operations, drawing upon the human and technical resources of the revenue department, police, fire service and health department. Although a comprehensive “Anti-Disaster Plan” was prepared in 1978, its implementation needs to be strengthened. Emergency response mechanisms at the block and panchayat levels need boosting, and there is an urgent need for integrating disaster reduction in development planning.

7. Six Tamil Nadu districts are covered in the ongoing Government of India-UNDP Disaster Risk Management (DRM) program, whose main objective is to establish sustainable mechanisms for community-based disaster preparedness. The GoI-UNDP Urban Earthquake Vulnerability Reduction Program (UEVRP) focuses on two seismic zone III (moderate risk) cities of Chennai and Coimbatore. The state is host to a range of academic and research institutions focusing on disaster risk management disciplines. It also has a very active civil society.

(b) Pondicherry

8. The Development Commissioner acts as the Relief and Rehabilitation Commissioner. At district and taluk levels, the arrangements mirror those of Tamil Nadu. The fire service is currently upgrading its communication infrastructure and personnel skills.

(c) Kerala

9. The state has recently created a disaster management department headed by a secretary-level officer, and is considering introducing legislation to establish a state disaster management authority. In 2001, it appointed five sub-committees to develop state disaster management plans. The reports of those on water and climate related hazards and on geological disasters have brought together very useful research material. Some districts have prepared district-level disaster management plans.

10. Under UEVRP, three seismic zone III cities with half-million-plus populations – Kozhikode, Kochi and Thiruvananthapuram – are undertaking earthquake vulnerability reduction activities. The natural disaster management faculty at the Institute of Land Management conducts regular training programs for government officials, and the state is host to a number of academic and research institutions that work on coastal environmental management and development issues.

11. Kerala has been a leader in devolving powers and resources to local self-government institutions. Nearly 40% of development funds are spent through village, block and district panchayats, municipalities and corporations. This is an opportunity to integrate risk management with local development.

(d) Andhra Pradesh

12. Systematic efforts to build disaster risk management capacities in the state go back to the early 1980s when the state finalized its first Cyclone Contingency Plan and developed manuals, coordination procedures and training programs, which helped reduce fatalities in subsequent cyclones. In the last decade, the state has undertaken a number of projects and steadily worked towards building disaster risk management capacities in the state.

C. Reconstruction Recommendations

Immediate and short term

13. The tsunami was a rare but high impact phenomenon which has also exposed the vulnerability of coastal populations to other natural hazards. The recovery and reconstruction program is an opportunity to rebuild at higher standards of safety. Disaster risk emanates not only from natural hazards but also from a range of underlying factors – physical, social, economic and cultural – that contribute to people’s vulnerability. In order to enable speedy recovery while reducing future risk, the following may be considered:

Comprehensive multi-hazard risk assessment

14. The affected areas are exposed to a range of frequent natural hazards whose cumulative impact exceeds that of the recent tsunami. A comprehensive multi-hazard risk assessment that identifies the exposed population and physical, economic and cultural assets should form an essential basis for reconstruction planning. A state-wide multi-hazard risk assessment, with tsunami-affected areas being the first priority and corroborated with local assessments, should inform reconstruction decisions and underpin future development plans. These assessments should link with environmental and coastal zone management plans. The affected states possess the technical and human resources to conduct such assessments. A number of institutions are already undertaking this exercise; there is need to establish clear institutional arrangements and mainstream these efforts into the reconstruction planning and implementation process.

Sector guidelines

15. While a multi-hazard risk assessment will guide the overall reconstruction plan, clear risk reduction guidelines should be established sector by sector. Tamil Nadu has already initiated the process of setting design and safety guidelines for the housing sector. Similar guidelines need to be developed for settlement planning, infrastructure, health and education facilities, water and sanitation, and livelihoods.

Community involvement

16. Reconstruction decisions should not only reduce future disaster risks but also meet the day to day social, economic, environmental and cultural needs of the affected communities. Appropriate mechanisms must be developed at the local level to enable the people to articulate their concerns and actively participate in decision making. In Tamil Nadu, the government has already begun collecting primary source information on community preferences about resettlement. As the reconstruction program proceeds, there will be need for much more intensive dialogue at the habitation level.

Partnerships between civil society organizations and local governments could facilitate this process. A comprehensive public awareness and information program is also desirable to develop wider understanding of risks and mitigation options.

Building synergies among different sectors to achieve risk reduction

17. The scale of the recovery and reconstruction effort necessitates a sectoral approach to reconstruction planning and implementation, but it is important that synergies between different sectors are explored to reduce future disaster risk. An integrated multi-sector and where possible area-based approach can help in addressing different dimensions of vulnerability. For example, a community-based approach to shelter reconstruction can help create jobs and diversify livelihood options in the short and medium term. At the same time, it can help propagate disaster resistant building technologies.

Information, communication and public awareness

18. Mechanisms will have to be established that provide timely and relevant information to the affected communities on different aspects of the reconstruction program including policies, plans, procedures and entitlements; and also enable the communities to voice concerns and provide feedback. The reconstruction program also presents an opportunity to raise awareness of other natural hazards and promote appropriate disaster risk management practices.

Medium term issues

Early Warning Systems

19. Efforts are underway at the national and regional levels to establish effective tsunami warning systems. But all the tsunami affected states are prone to a range of hazards that occur with much greater frequency than tsunamis. It is important, therefore, that at the local level the development of early warning systems be looked at in a multi-hazard context. The efforts to generate improved forecasts and warning need to be matched with equal (if not greater) emphasis on effective communication systems public awareness and social infrastructure at the community level so that the warnings can be acted on.

Community based disaster risk management

20. Experience with natural disasters indicates that some of the most effective risk management actions – both anticipatory (reducing future risks) and compensatory (preparedness to respond) – need to be taken at the local level. The reconstruction program presents an opportunity to provide greater impetus to local level risk management and to enhance the emergency response preparedness of the communities.

Cyclone shelters

21. Some cyclone shelters in Tamil Nadu were damaged by the tsunami while most were in a dilapidated condition anyway. A snapshot of Cuddalore district revealed that all 21 cyclone shelters there require significant repair. The total cost of such work in Cuddalore district is estimated to be

Rs. 0.43 crore (\$98,400³⁹). The recovery effort should be used as an opportunity to repair existing shelters, assess the need for additional ones, and create a community-based system to maintain them.

Strengthening emergency response capacities at all levels

22. Fire and rescue services at the district level expressed a need for investment in improving the basic emergency infrastructure, response equipment, and skills of personnel. The recovery and reconstruction effort provides an opportunity to systematically assess the current capacities of emergency services, establish minimum standards based on local hazard risks, and upgrade accordingly. The India Disaster Resource Network (IDRN), a federal database that provides an inventory of disaster response resources available in every district, proved to be of limited use at the district level. The system needs to be re-assessed and in high risk areas, the possibility of devolving it down to the block level may be explored.

Linkages with environment management issues

23. Comprehensive environmental, multi-hazard, coastal zone management and water management assessment and monitoring systems and strategies need to be developed in tandem. Coastal zone regulations and multi-hazard risk assessments form a basis for higher scale planning and implementation, while sound environment and disaster risk management require local actions. The capacities of local governments must be built so that they can play an effective role in this.

24. In the short and medium term \$17.3 million is the estimated requirement for capacity development support as indicated in the table below:

³⁹ For the purposes of currency conversion an exchange rate of Rs 43.5 / US\$ is used.

Table 1. Hazard Risk Management Needs (\$ million)

Components/ Projects	Tamil Nadu	Pondi-cherry	Kerala	Costs
Short term				
Multi-hazard risk assessment in the affected areas in the coastal areas with priority on affected <i>talukas</i>	1.65	0.20	0.30	2.15
Preparation of sectoral risk reduction guidelines (technical guidelines, suggested techno-legal arrangements, process guidance)				0.80
Community based reconstruction planning	1.86	0.16	0.20	2.22
Information, communication and public awareness	1.30	0.20	0.40	1.90
Mechanisms for dissemination of Early Warning Systems in the coastal districts	0.52	0.08	0.40	1.00
Sub Total	5.33	0.64	1.30	8.07
Medium term				
Multi-hazard risk assessment in unaffected but vulnerable Areas	0.85	0.10	0.65	1.60
Capacity Building at the village, block and district levels for Early Warning Systems in the coastal districts	0.68		0.12	0.80
Community based disaster risk management programs	1.50	0.10	0.65	2.25
Disaster risk information systems	1.50	0.10	0.65	2.25
Studies/ pilots on state specific studies on risk transfer mechanisms	1.50	0.10	0.65	2.25
Sub Total	6.03	0.40	2.72	9.15
TOTAL	11.36	1.04	4.02	17.22

25. Funding will also be required for disaster risk management related infrastructure (communication system for early warning system, construction of cyclone shelters and strengthening emergency services in coastal districts). Quantification of such funding will have to be made through detailed risk and vulnerability studies and other studies on coastal management which the assessment mission has recommended.

Long term issues

Strengthening institutional, techno-legal and techno-financial arrangements for disaster risk management systems in the affected states

26. The reconstruction and recovery effort is an opportunity to strengthen existing or establish new institutional, legislative and financial arrangements for comprehensive disaster risk management building on the progress made in India and especially in the affected states in the last five years.

Integrated climate risk management

27. Analyzing the risks of negative outcomes of natural fluctuations in the climate and weather systems over a variety of time scales will allow a linkage to be made between present-day concerns over the alarming increase in climate-related losses and more nebulous but real concerns about potential losses in the future when climatic averages are expected to have shifted. Strengthening national and local capacities to manage existing climate risks is key to developing capacities for adapting to future climate change.