

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.

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.

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
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.

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	Proj.	Proj.
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 crore (\$80.46 million) and Reconstruction Rs. 3,772 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 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.