

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.