

Gujarat Earthquake Recovery Program

Assessment Report

A Joint Report by
the World Bank and
the Asian Development Bank

To the Governments of Gujarat and India

March 14, 2001

Currency Equivalentents

Exchange rate effective February 12, 2001

Currency Unit = Rupee (R)

Rs. 1.00 = \$.0215

\$1.00 = Rs. 46.5

1 Crore = 10,000,000

1 Lakh = 100,000

Abbreviations and Acronyms

AC	Asbestos Cement
ADB	Asian Development Bank
AMC	Ahmedabad Municipal Corporation
ANM	Auxiliary Nurse Midwife
ATC	Air Traffic Control
BMTPC	Building Materials and Technology Promotion Council
CBO	Community Based Organization
CDPO	Chief District Project Officer
CEPT	Center for Environmental Planning and Technology
CHS	Community Health Centers
CMAG	City Managers Association of Gujarat
CMIE	Center for Monitoring the Indian Economy
CMSO	Central Medical Stores Organization
CWC	Central Water Commission
DFID	Department for International Development, UK
DG	Diesel Generator
DI	Ductile Iron
DOHFW	Department of Health and Family Welfare
EMCB	Environmental Management Capacity Building
EMF	Environmental Management Framework
EPC	Environmental Planning Collaborative
ETC	Earthquake Technical Cell
FWWB	Friends of World Women's Banking
GDP	Gross Domestic Product
GEB	Gujarat Electricity Board
GI	Galvanized Iron
GIDC	Gujarat Industrial Development Corporation
GIDE	Gujarat Institute for Desert Ecology
GIS	Geographical Information System
GMB	Gujarat Maritime Board
GOG	Government of Gujarat
GOI	Government of India
GP	Gram Panchayat
GPCL	Gujarat Power Corporation Limited
GSDMA	Gujarat State Disaster Management Authority
GSDP	Gross State Domestic Product
GSHP	Gujarat State Highway Project
GUDCOL	Gujarat Urban Development Corporation Ltd.
GWSSB	Gujarat Water Supply and Sewerage Board
HDPE	High Density Polyurethane Pipes
HUDCO	Housing and Urban Development Corporation
ICDS	Integrated Child Development Services
ICOR	Incremental Capital-Output Ratio
IFRC	International Federation of Red Cross and Red Crescent Societies

Abbreviations and Acronyms (*continued*)

IFFCO	Indian Farmers Fertilizer Cooperative Ltd.
ILFS	Infrastructure Leasing and Financing Services
IMD	India Meteorological Department
KFTZ	Kandla Free Trade Zone
KNA	Kutch Navnirman Abhiyan
KPT	Kandla Port Trust
MCH	Maternal and Child Health
MDR	Major District Roads
MM	Modified Mercalli Intensity Scale
MOA	Ministry of Agriculture
MS	Mild Steel
MT	Metric Tons
NGO	Nongovernmental Organization
NH	National Highways
NICD	National Institute of Communicable Diseases
NSDP	Net State Domestic Product
O&D	Detailed Origin Destination
OCHA	Office for the Coordination of Humanitarian Affairs
ODR	Other District Roads
ORS	Oral Rehydration Solution
OSOCC	On-Site Operations Coordination Center
PHC	Primary Health Center
PVC	Polyvinyl Chloride
PWD	Public Works Department
RBI	Reserve Bank of India
R&B	Roads and Buildings Department
RCC	Reinforced Cement Concrete
RITES	Rail India Technical and Economic Services
RWS	Rural Water Supply
RWSS	Rural Water Supply and Sanitation
SAR	Search and Rescue
SEWA	Self-Employed Women's Association
SH	State Highways
SPV	Special Purpose Vehicle
SY&C	Sports, Youth and Cultural Activities
TISS	Tata Institute of Social Sciences
UDD	Urban Development Department
UHF	Ultra High Frequency
UNDMT	United Nations Disaster Management Team
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
VHF	Very High Frequency
VR	Village Roads
VRS	Voluntary Retirement Scheme
VSAT	Very Small Aperture Terminal
WB	World Bank
WFP	World Food Programme
WHO	World Health Organization
WMA	Ways and Means Advances
WRD	Department of Water Resources

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PREFACE

This report is an assessment of damages and needs resulting from the earthquake that struck the state of Gujarat, India on January 26, 2001. The report provides a preliminary assessment of the damages, identifies the needs for reconstruction and recovery, and outlines a strategy for implementing a recovery program. The main text, provided in Part I of this report, is supplemented with annexes on each sector in Part II.

The report was prepared by a joint assessment team from the World Bank and the Asian Development Bank, in collaboration with the Government of Gujarat and the Government of India. Team members from the World Bank include: Robert Maurer and Keith Oblitas (Team Leaders), Sham Abhyankar, Syed Ahmed, Margaret Arnold, D. Baxi, Meera Chatterjee, Prema Clarke, Margaret D'Costa, Maxx Dilley, Manuela Ferro (Leader, Economic Team), Fabio Galli, Preeti Kudesia, Reider Kvam, Sumir Lal, R.K. Malhotra, Meera Mehta, Deepak Mishra, Smita Misra, Edward Mountfield, Rajat Narula, Jelena Pantelic, Enrique Pantoja, R.S. Pathak, Navaid Qureshi, Bilal Rahil, N. Raman, Shaymal Sarkar, and consultants from the National Institute of Public Finance and Policy (NIPFP): Ashok Lahiri, Tapas Sen, Kavita Rao, and Pratap Jena. The ADB team consisted of: Klaus Gerhaeusser (Team Leader); M. Alam, S.C. Chander, Ajay Guha, M. Hamano, Alex Jorgensen, T. Kondo, Hiranya Mukhopadhyay, Natin Patel, V.V. Subramanian, Sujatha Viswanathan, Joseph Weinstock, and consultants on disaster management, Jean W. Parker, A.J. Rego, and Richard Sharpe. James Stein and A. Dasgupta representing USAID, and Jaap-Jan Speelman representing the Government of the Netherlands, also participated. The UK's Department of International Development provided financial support for World Bank consultants. The report was processed by Maria Pinto, and copyedited by A.M. Ruiz-Esparza. Reidar Kvam provided the photographs.

In conducting the assessment, the joint team worked closely with the Governments of Gujarat and India, and consulted widely with nongovernmental organizations, other bilateral and international agencies, academic institutions, and the private sector. The assessment team would like to express its sincere thanks to the Government of Gujarat for coordinating the work, and for their tremendous effort in producing a Preliminary Report on the Earthquake Damage in Gujarat in advance of this assessment. The Preliminary Report was done in a comprehensive and expeditious manner, and forms a key input into this assessment report.

The findings of the joint assessment, which began on February 12 and concluded on February 26, 2001, are presented here. Interim results based on the assessment team's analysis and discussion with the Government of Gujarat's departments were shared and discussed with the Government of Gujarat on February 22, 2001. The draft report was forwarded to the Governments of Gujarat and India on February 28, and a revised draft

was further discussed on March 2, 2001. The document was further revised and shared with the Governments of Gujarat and India on March 3, and again on March 8, 2001. The report was finalized on March 14, 2001.

It should be emphasized that this report is the best assessment possible as of end February 2001. As a more detailed review of the damage is undertaken by the Government of Gujarat, understanding and data will naturally evolve and be updated.

INDIA

Gujarat Earthquake Recovery Program

Assessment Report

EXECUTIVE SUMMARY

India suffered a devastating earthquake on January 26, 2001. The loss of life and nearly all of the destruction of physical assets took place in western and central Gujarat, where around 20 million people live and work. At the time of finalizing this report, the death toll stands at over 20,000, and about 167,000 people have been injured. Nearly one million homes were damaged or destroyed. Small enterprises—especially single family artisans, shopkeepers and rural industries were also affected. Health and education infrastructure was severely damaged, with two district hospitals destroyed, and over 1,200 health clinics (mostly in rural areas), and over 11,600 schools destroyed or damaged. There was similar destruction of both rural and urban water supply schemes. Over 240 earthen dams for small reservoirs providing water for irrigation, rural and urban domestic needs, and industry were also damaged. Other infrastructure services like electricity and telecommunications, were extensively damaged.

Although Gujarat is relatively richer and has grown faster than other Indian states, the area most severely affected by the earthquake is poor. It includes the district of Kutch (where over 90 percent of the deaths and 85 percent of asset losses occurred) and the districts of Jamnagar, Rajkot, and Surendranagar. It is a sparsely populated, resource poor, arid region, vulnerable not only to earthquakes but also to cyclones and drought. The earthquake struck in the wake of two consecutive years of drought in 1999 and 2000. The main sources of employment are agriculture, animal husbandry, salt mining and refining, handicrafts, and trade. Kutch accounts for less than 2 percent of industrial employment in the state and there is little large-scale industry. Agriculture is largely rain-fed and there are few perennial crops. The agriculture and dairy sectors are extensive, with little mechanization and thus low levels of capital intensity. Although some households benefit from transfers from relatives working in Mumbai and abroad, poverty is higher and social indicators worse in the earthquake-affected areas than in the rest of the state. Kutch also has the largest proportion of scheduled caste people in Gujarat, 12 percent, compared with 7 percent in Gujarat as a whole.

Economic Impact

The economic impact of the earthquake includes: (a) asset losses (direct damage); (b) output losses (indirect damage); and (c) fiscal costs (secondary effects). Destruction of private assets in the affected districts has been massive. Of the estimated Rs. 9,900 crore (\$2.1 billion) total asset losses, Rs. 7,400 crore (\$1.6 billion) are private assets. While the impact of the earthquake on India's gross domestic product is insignificant, in

the areas where it struck, the earthquake devastated lives, social infrastructure, and economic foundations.

(a) **Preliminary estimates total Rs. 9,900 crore (\$2.1 billion) in asset losses and Rs. 10,600 crore (\$2.3 billion) in improved-standard reconstruction costs** (see Table). The assessment team distinguished between same-standard replacement costs (i.e., the costs for restoring assets to the standard that existed before) and improved-standard reconstruction costs (i.e., the costs for rebuilding to a standard that responds to local conditions, including the risk of natural disaster). These totals are likely to be revised significantly as more detailed on-site damage assessments are completed by qualified experts in the coming weeks and months.

Preliminary Estimate of Asset Losses and Reconstruction Costs, as of February 23, 2001

Sector	Asset Losses		Reconstruction Costs 1/	
	(\$ million)	(crore Rs)	(\$ million)	(crore Rs)
Housing	1,111 /2	5,166 /2	1,107	5,148
Health	47	219	60	279
Education	144	670	180	837
<i>Subtotal: Social sectors</i>	1,302	6054	1,347	6,264
Irrigation	40	186	90	419
Rural water supply	50	233	97	451
Municipal infrastructure	30	140	45	209
Public buildings and monuments	73	339	95	442
Power	40	186	98	456
Transport /3	69	321	77	358
Ports	21	98	26	121
Telecommunications	11	51	26	121
<i>Subtotal: Infrastructure</i>	334	1,553	554	2,576
Agriculture and livestock *	117	544	74	344
Industry *	73	339	44	205
Services *	250	1,163	200	930
<i>Subtotal: Productive sectors</i>	440	2,046	318	1,479
<i>Subtotal: Environment /4</i>	55	256	55	256
Grand Total	2,131	9,909	2,274	10,575
<i>Of which public assets /5</i>	537	2,497	831	3,864
<i>Of which private assets /6</i>	1,594	7,412	1,443	6,710

/1 Replacement of immovable assets, with improved earthquake/cyclone resistance.

/2 Includes value of household contents such as consumer durables; reconstruction excludes replacement of these assets.

/3 Includes roads and bridges, railways, and airports.

/4 Includes costs of rubble removal in urban and rural areas.

/5 Public assets above include: health, 70 percent of education assets, irrigation, rural water supply, municipal infrastructure, public buildings and monuments, power, transport, ports, and telecommunications; plus the environment.

/6 Private assets above include housing, 30 percent of education assets, and production assets in agriculture and livestock, industry and services.

*Asset losses and reconstruction costs to agriculture, industry, and services, exclusive of sectors listed above.

Source: Government of Gujarat and Assessment Mission Estimates

The totals in each column above combine private sector and public sector asset losses. Asset losses to the private sector are estimated to total about Rs. 7,400 crore (\$1.6 billion), including losses of private housing and property (Rs. 5,200 crore or \$1.1 billion); private schools (Rs. 200 crore or \$43 million); and production assets in agriculture, livestock, industry, and services (Rs. 2,000 crore or \$440 million).

Losses in public sector assets are estimated to total Rs. 2,500 crore (\$0.5 billion), and include asset losses in health (Rs. 220 crore or \$47 million), education (excluding private schools, some 70 percent of the total, a loss of Rs. 470 crore or \$101 million), municipal infrastructure (Rs. 140 crore or \$30 million), public buildings and monuments (Rs. 339 crore or \$73 million), rural water supply (Rs 233 crore or \$50 million), irrigation (Rs. 186 crore or \$40 million), power (Rs. 186 crore or \$40 million), roads, bridges, railways, and airports (Rs. 321 crore or \$69 million), ports (Rs. 98 crore or \$21 million), and telecommunications (Rs. 51 crore or \$11 million). In addition to the public and private losses set out above, there are some \$55 million of identified damages to the environment. These consist of the cost of rubble removal in urban and rural areas, and further environmental impacts may later be identified. The costs of tackling these problems are likely to accrue to the public sector.

Estimates of reconstruction costs are preliminary, as specialists have only just begun to identify and cost out effective risk-reducing strategies for sectoral activities in the affected areas. Moreover, the definition of improved standards and the decision whether to rebuild to these standards can only be determined by assessing the exposure of the relevant asset to catastrophic losses, the economic and social impacts of these losses, and the affordability of reconstruction efforts.

(b) Loss of output due to the earthquake is estimated to be small, ranging between Rs. 2,300 to Rs. 3,000 crore (\$491 to \$655 million), or 2 to 3 percent of Gujarat's 1999-00 gross state domestic product in aggregate over three years. This is due to the fact that the area most affected by the earthquake is not a major contributor to overall state output. The output loss is likely to take place mostly in 2000-01, while in 2001-02 and 2002-03 reconstruction is likely to accelerate growth. These estimates are the upper bound for output losses and exclude the likely positive impact of reconstruction on output growth.

(c) The impact on the fiscal deficit is estimated to be as much as Rs. 10,100 crore (\$2,170 million) in aggregate over three years. The deterioration in the fiscal balance will be due mostly to increased expenditure pressures related to relief, reconstruction of public assets, and assistance to reconstruction of private assets (the largest component of which is assistance to reconstruction of housing). It is expected that much of the reconstruction expenditure will take place in 2001-02 and 2002-03. This can increase the fiscal deficit, currently at 5.1 of gross state domestic product, by as much as 2.5 percentage points in 2000-01, 3.3 percentage points in 2001-02, and 1.7 percentage points in 2002-03.

The extent to which the earthquake will have a negative impact on the state's overall balances in coming years depends on the: (a) terms on which the government obtains financing for earthquake-related expenditures; (b) extent to which it rationalizes expenditures and improves own revenue collections in nonearthquake affected areas; (c) standards used for reconstruction of housing and other assets; and (d) extent to which beneficiaries and the private sector share the costs of reconstruction. Public-good related considerations provide strong reasons to suggest that reconstruction costs in health, education, and infrastructure should be borne by the government. The other areas are less clear. While, in principle, the private sector's losses can be left entirely for the private sector to bear, the poverty profile of the affected areas, along with the serious risk of a further increase in destitution, argue in favor of burden-sharing by the public sector, especially for the poorest.

The pressure for additional expenditures consequent to the earthquake also provides an opportunity for the government to rationalize public expenditure priorities and improve tax and nontax revenue collections in the nonaffected areas. Furthermore, a natural disaster is often followed by recovery and reconstruction. The construction boom following the disaster can be a source of additional revenue inflows, which could improve revenue performance overall.

Social Impact

The social fabric of the earthquake-hit areas has been devastated by the large number of human deaths and injuries. In addition to the immediate suffering caused, it is likely that an equally large number of families have been torn by the death or serious disability of a member (though family-based data are not yet available). This will have long-term consequences on the well-being of other members, particularly widows, single parent children, orphans, and the elderly. Other social impacts of the earthquake include deep insecurity among those who have lost assets, including property, and increased vulnerability among them to poverty. The livelihoods of many families have been disrupted. The loss of lives, and loss of or damage to homes, productive assets, and workplaces, has caused more severe disruption; while temporary disruption has occurred in the wake of the shock and fear caused by the earthquake, and of disruptions in financial services, markets, and distribution channels. About 19,000 handicraft artisans in the district of Kutch appear to be the most severely affected group. In addition, several thousand salt farmers are faced with the collapse of their brine wells, destruction of salt fields, and damage to their refineries. Another important source of livelihood in Kutch is cattle—about 20,000 cattle deaths have been reported. The Government of Gujarat, as well as a large number of nongovernmental organizations including philanthropic groups, development agencies and private businesses have stepped in to provide food, medical services, clothes, blankets, utensils, basic supplies, and tents.

Immediate Needs

The first and most urgent need is the provision of temporary shelter before the onset of the monsoon season in July. Simultaneously, the reconstruction of the

devastated housing stock needs to be launched. An owner-driven, *in situ* housing reconstruction process is likely to lead to fast reconstruction and genuine acceptance by beneficiaries. Implementation should be decentralized, while the quality control of earthquake and cyclone resistant construction, financial management and procurement procedures, would be coordinated by the newly created Gujarat State Disaster Management Authority.

Essential to the success of reconstruction is the restoration of lost records of property rights to housing, commercial property, and land, with special efforts made to assist the poor, scheduled castes, and squatters, who may have greater difficulty demonstrating legitimate property rights. Appropriate levels of indemnity will need to be identified for different income groups.

Second, there is an urgent need to restore public services, including health, education, water supply, power, communications, municipal and environmental infrastructure, and state administration. Careful prioritization of this reconstruction will be necessary. Even with substantial external financing, rebuilding everything at once is unlikely to be affordable or necessarily desirable. Appropriate standards for reconstruction need to be identified, which take account of the area's natural hazards but are not over-specified.

Third, efforts will need to be made to secure the livelihoods of vulnerable people in the earthquake-affected areas. Such support will need to be rapid if it is to be effective. It will need to be well-targeted if it is to be affordable. It will need to be designed so as not to displace private enterprise and self-help if it is to be sustainable. Cash grants or wages in return for rubble removal, production of building materials such as bricks or concrete blocks, and reconstruction work would be options to consider.

An Approach to Recovery

Cross-country experience from other disaster-hit areas suggests that the following core principles should be followed in the approach to reconstruction:

- **Revival of the economy:** There is an urgent need to restart the economy of the affected areas, which can be done in part by providing wage employment to local people for debris removal, construction, and the restoration of heritage sites. This type of program, if well designed, minimizes the potential for mistargeting. Transfers to households, for consumption or investment purposes, could also be envisaged.
- **Empowering individuals and communities:** While relief and charity are important in the immediate aftermath of a natural disaster, they should be replaced as soon as possible with efforts to foster ownership and involvement by the people. There are some instances encountered indicating that relief assistance is sometimes creating competition for handouts, community conflict, and dependency. Greater local participation and contributions to the reconstruction

effort could reduce social tensions and lead to more sustainable development efforts. The majority of reconstruction efforts should be undertaken by the affected population themselves.

- **Affordability, private sector participation, and equity:** Reconstruction of private and public property and efforts to revive the economy should take into account (a) potential impact on public finances; (b) use of available private sector participation and financing; and (c) relatively greater public assistance to those most in need. The impact of the earthquake will further strain Gujarat's public finances. It is important, therefore, for the Government to seek to rationalize expenditures and carefully evaluate standards at which reconstruction of both public and private buildings will take place. While it is the government's intention not to crowd out private sector and individual initiative, it is important that it continue to leave room for private initiatives on the part of the surviving victims themselves, as well as for businesses wishing to share their burden. Public assistance and reconstruction efforts should prioritize those in greater need, and it is important to ensure that public policies and the incidence of public expenditures is pro-poor.
- **Decentralization:** Community-driven reconstruction must be at the heart of the state's recovery program. Therefore, the development of effective networks that facilitate a necessarily decentralized system for recovery will be key to the success of the program. Decisions to relocate or rebuild *in situ* destroyed villages, for instance, should follow a clear, transparent and participatory approach to assess the wishes of the villagers and discuss the costs of different options. Locally elected bodies, where these exist, should be given a significant role.
- **Communication and transparency:** Communication and information dissemination are important to the successful and harmonious implementation of the earthquake recovery and reconstruction program. Policy initiatives, financial assistance, and technical know-how will not be effective without a system to convey their content swiftly and equitably to the public, to hear of and assess their suitability and sustainability within communities, and to make appropriate adjustments based on community feedback. There is thus also a need for the Government to devise a communication strategy to support the recovery program and ensure effective dialogue between the government, the public and other partners.

INDIA

Gujarat Earthquake Recovery Program

Assessment Report

SECTION 1: BACKGROUND

A. The Earthquake and Emergency Response

1.01 On January 26, 2001, at approximately 8:46 a.m. local time, an earthquake occurred in western India measuring 6.9 on the Richter scale; possibly higher according to other sources (para 1.02). While the earthquake was felt as far away as Nepal and in neighboring Pakistan, its most severe destruction was unleashed in the state of Gujarat. The earthquake caused substantial loss of life, injury and damage to private property and infrastructure. At the time of finalizing this report, the death toll stands at over 20,000, and about 167,000 people have been injured. It is estimated that nearly one million homes were damaged or destroyed. Health and education infrastructure was severely impacted, with two district hospitals destroyed, over 1,200 smaller health clinics (mostly in rural areas), destroyed or damaged; and in education, destruction or damage to 9,600 primary schools, 2,040 secondary schools and over 140 technical and higher education institutes. There was similar destruction of both rural and urban water supply schemes. Over 240 earthen dams for small reservoirs providing water for irrigation, rural and urban domestic needs and industry were damaged, over 20 of which will need complete reconstruction. About 3,000 small-scale industries and over 20 medium- to large-scale enterprises and thousands of cottage industries such as handicrafts were affected. Roads sustained relatively minimal damage, but other infrastructure services like electricity, and telecommunications were extensively damaged. Civil administration was greatly affected, with office buildings and records destroyed, and a number of staff killed, or suffering the loss of family members.

1.02 Estimates of the earthquake magnitude vary from 6.9, reported by the India Meteorological Department (IMD) to 7.6 (Geological Survey of India) and 7.7 (U.S. Geological Survey) due to differences in observational data incorporated into each and the method of calculation. The epicenter (estimated position of the main energy release) was about 23.4 north, 70.3 east at a depth of 10 to 25 km (again, estimates vary). This is about 20 km northeast of the town of Bhuj. Within the first fortnight there were two large aftershocks of magnitude 5.9 and 5.3, respectively. The energy released from each of these is approximately 100 times less than that from the main earthquake. Preliminary results from a single, newly installed, seismograph in Ahmedabad indicate a peak ground acceleration of 1 m/s^2 (0.1 g), and a peak in frequency content at around 1.1 cycles per second (1.1 Hz). Typically, certain high-rise buildings resonate at frequencies of this order. There are less sophisticated instruments in other parts of the affected region which

may yield indicative peak values of shaking after examination and analysis. Widespread liquefaction (quicksand forming) of soils has been reported. Liquefaction occurs only in soils of particular particle size and where there is groundwater present. There are, however, no reports of houses collapsing because of fault movement through them, liquefaction or landslide.

1.03 Government emergency response: While the government was taken unawares by the magnitude of the catastrophe, and initially there was not even a telephone communication link, they subsequently quickly rallied to respond to the situation. At the district level, the physical damage to the administrative infrastructure and communications was almost total, destroying the normal lines of operation and greatly impairing response capabilities. However, *ad hoc* response arrangements were made. Indeed, there are many accounts of district and taluka-level administrators putting their personal sufferings aside to assist the victims. The state government quickly began emergency rescue operations and initiated efforts to restore lost communication links, electricity, water supply and civil supplies. Medical personnel were rushed to the affected area on the same day. The state and central government mobilized 36 units of army engineers, 34 companies of paramilitary personnel, over 3,000 police, 2,600 homeguards, 480 engineers, over 120 senior administrative officers, and 11,000 employees from different departments in the relief operations. Over 1,700 excavators and bulldozers, and 2,800 trucks were used for debris removal and transporting relief supplies.

1.04 The relief effort is centrally coordinated by the Natural Disaster Management Control Room, which works closely with the Government of Gujarat (GOG). To coordinate the longer-term relief and reconstruction, the state government also established the Gujarat Disaster Management Authority (GSDMA), headed by the Chief Minister. The central Government has also set up a high-level Disaster Management Task Force to advise the Government on relief and reconstruction policy and activities.

1.05 Community/civil society efforts. As is typical in disasters, the community members immediately mobilized to help themselves, digging out neighbors from the rubble, and providing whatever assistance they could. Local government response was impaired due to the severity of the damage, particularly in the district capital of Bhuj. Many local officials lost family members and their homes, yet returned to work quickly to salvage what office facilities could be recovered and coordinate relief activities. In Bhuj, the District Collector's office suffered severe damage, and the Collector and Relief Coordinator were operating out of a tent next to the building.

1.06 There is a strong nongovernmental organization (NGO) network in Gujarat which quickly rallied to support community efforts. Several well known local and national NGOs such as the Self-Employed Women's Association (SEWA) are active in the area and are helping people restore livelihoods and meet other needs. Kutch Navnirman Abhiyan (Abhiyan), a local NGO network, was nominated as the coordinator of NGO activities and has developed a plan for reconstruction based on "*a fundamental belief in self-help....*" The Abhiyan has set up 22 local subcenters in Kutch to coordinate information and assistance, with encouragement and formal endorsement from the

Government. Cooperation between international and national NGOs has also been extensive. The state Government has encouraged partnerships between international and local NGOs in order to leverage resources and better respond to disaster relief needs. Many of the international NGOs had existing relationships with Indian NGOs. The assessment team found that collaboration among these agencies was excellent during the relief phase.

1.07 Private sector support. Local industries donated equipment and personnel for the search and rescue operation. The state Government has also received a number of offers from private companies willing to “adopt” towns and villages for the reconstruction phase (local communities have expressed their preference for the term “partner with”).

1.08 International community response. While the Government of India (GOI) never formally issued an appeal for international assistance, the international community responded in a generous way with support. The Office for the Coordination of Humanitarian Affairs (OCHA) sent a five-member UN Disaster Assessment and Coordination team on January 27, the day following the disaster. The UN Disaster Management Team (UNDMT), boosted with staff from the United Nations Development Programme (UNDP) Emergency Response Division, was also deployed immediately to coordinate the UN response. The team established an On-Site Operations Coordination Center (OSOCC) within the District Collector’s compound in Bhuj. This has enabled the development of a close working relationship and a continuous exchange of information between the Chief Relief Coordinator, the Collector and the UN system. The OSOCC includes a World Health Organization (WHO) Disease Surveillance desk to monitor outbreaks of illness. The World Food Programme (WFP) initiated an emergency operation of more than Rs. 19 crore (\$4 million) to provide relief food rations to 300,000 people for four months. All other UN organizations have sent assessment teams to the affected area. For the rehabilitation and recovery phase, UNDP will be the focal agency for the UN system.

1.09 A number of countries sent search and rescue (SAR) teams and equipment to assist the search and rescue operation. In addition, a long list of countries have either pledged or provided cash and in-kind contributions on a bilateral basis, through NGOs, or the UN system. The International Federation of Red Cross and Red Crescent Societies (IFRC) established a team in the town of Anjar and an emergency response unit hospital in Bhuj. The IFRC also issued an appeal for more than Rs. 70 crore (\$15 million) to address the immediate needs of affected communities, including shelter, medical services and supplies, and water and sanitation equipment.

1.10 A number of donors and multilateral institutions have also pledged support to the longer-term recovery efforts. This joint assessment, conducted jointly by the World Bank and the Asian Development Bank (ADB) in partnership with the governments of India and Gujarat, is a preliminary contribution to helping the development of a comprehensive recovery strategy.

B. Assessment Team Site Visits and Consultations

1.11 The World Bank and the ADB jointly undertook a preliminary assessment of damage and reconstruction needs resulting from the earthquake. The assessment also included a review of reconstruction priorities, the most urgent needs, and outlined a comprehensive recovery strategy. The assessment encompassed extensive field visits in rural and urban areas throughout the disaster area, and widespread consultation with villagers, urban dwellers, NGOs, industries, and UN and bilateral agencies working in the area. It was carried out in close collaboration with the GOG and the GOI, also involving all GOG line departments in detailed working sessions.

1.12 The field visits were conducted between February 12 to 22, 2001, and covered the districts most affected by the earthquake. These include Kutch, by far the most severely damaged; and other seriously affected districts such as Ahmedabad, Jamnagar, Patan, Rajkot, and Surendranagar. These six districts account for almost all of the over 20,000 deaths caused by the earthquake. In total, 21 out of 25 districts in Gujarat sustained some level of damage. Only four districts (Dahod, Dangs, Narmada, and Panch Mahals) were spared any serious impacts of the disaster.

SECTION 2. ASSESSMENT OF DAMAGES

A. Overview of Gujarat and the Earthquake-Affected Area Prior to the Disaster

2.01 The state of Gujarat lies on the west coast of India. In addition to its coastline on the Arabian Sea, it has common borders with Pakistan, and the states of Rajasthan, Madhya Pradesh, and Maharashtra. The state consists of 25 districts and has a total population of around 48 million (see map of Gujarat).

2.02 Gujarat ranks third among the major states in per capita income after Maharashtra and Punjab. The state has achieved an impressive growth rate, averaging almost 10 percent during the 1991-97 period. Although its inhabitants constitute less than 5 percent of India's population, it contributes nearly 11 percent of India's industrial output and 10 percent of the total private consumption (see "Gujarat at a Glance"). The state is a major producer of chemical and pharmaceutical products, cement, steel, lignite, diamond jewelry, salt, soda ash, and handicrafts. It is the home of India's first free trade zone at Kandla Port, and is a major manufacturing base for many of India's exports. With nearly 40 large and small ports, the state handles over 20 percent of the country's trade, and Kandla alone accounts for 17 percent of the country's maritime traffic.

2.03 With 24 percent of households below the poverty line in 1993/94, compared to 36 percent for the country as a whole, Gujarat is one of the least poor states in India. Gujarat is also one of India's better off states in terms of social indicators. Literacy averages 61 percent overall, and 49 percent for females, compared with 52 percent and 39 percent for India as a whole. Only 7 percent of the population of Gujarat belong to scheduled castes, compared with 16 percent of the population of India as a whole. Infant mortality rates are 64 per thousand births compared with 72 per thousand births for India as a whole. Sixty percent of people in rural areas, and 87 percent of people in urban areas of Gujarat have access to safe water, compared with 56 percent of people in rural areas, and 81 percent of people in urban areas of India as a whole. Other indicators of poverty (child malnutrition levels) show that the poor—especially women and children—may be more disadvantaged than the figures above suggest. The National Family Health Survey (1998-99) found that over 45 percent of children in Gujarat were wasted, and over 50 percent were stunted (an indicator of chronic malnutrition).

Economic and Social Structure of the Earthquake Affected Area

2.04 The area most directly affected by the earthquake is vast. It includes the Kutch district, where over 90 percent of the deaths and an estimated 85 percent of asset losses occurred, and the districts of Ahmedabad, Bhavnagar, Jamnagar, Rajkot, and Surendranagar [Centre for Monitoring the Indian Economy (CMIE), 2001]. Kutch itself is sparsely populated, with a population in 1991 of 1.2 million and an area of 45,652 square km, larger than either of the states of Haryana or Kerala. Only 31 percent of the population live in urban areas. Major urban centers of Kutch include Anjar (51,000), Bhuj (121,000), and Gandhidham (104,000).

2.05 The area is relatively poor in natural resources and, as detailed in the following sections, is highly vulnerable not only to earthquakes, but also to other hazards including both drought and cyclones. The main economic activities in the area are agriculture including livestock and rain-fed cultivation, industries including handicrafts, salt production and refining, and services, largely trade.

2.06 **Industry.** As far as industrial production is concerned, the earthquake damage was almost entirely limited to Bhavnagar, Jamnagar, Kutch, Rajkot, and Surendranagar. These five districts include almost 75 percent of India's salt production, and a range of small-scale manufacturing subsectors including chemicals, textiles, ceramics, diamond cutting and polishing, and handicrafts. In the past few years, there has been steady industrial growth in this area. However, this is not the industrial heart of Gujarat. The main industrial belt spreads from Ahmedabad down the railroad corridor to Surat in south Gujarat.

2.07 According to the economic census, in 1998 these five districts employed 357,000 people in the industrial sectors. They accounted for 41 percent of Gujarat's mining employment, 22 percent of manufacturing employment, 13 percent of electricity, gas and water supply employment and 36 percent of construction employment. Across the sectors, these districts accounted for 23 percent of Gujarat's overall industrial employment. Kutch, where over half of the industrial damage took place, accounted for less than 2 percent. Across the five districts, 45 percent of industry is in rural areas. Even 42 percent of manufacturing is rural. Kutch has a very strong crafts tradition, with many thousands of women in rural villages engaged in embroidery, patchwork, vegetable dyeing, batik, and other cottage industries.

2.08 **Agriculture.** Climatically, the areas most severely affected by the earthquake are arid and semiarid. Agriculture is largely rain-fed (the gross irrigated area in Kutch as a percentage of gross cultivated area is 19 percent compared with 34 percent for Gujarat as a whole) and there are few perennial crops. The agriculture and dairy sectors are extensive (the average size of holding in Kutch is 5.1 ha compared with a Gujarat average of 2.9 ha), with little mechanization and thus low levels of capital intensity. The region has been severely affected by two consecutive years of drought, with production already depressed at the time of the earthquake.

2.09 **Services.** The earthquake affected region has a large number of trade and commerce establishments, with wholesale and retail shops, restaurants, and hotels constituting the largest segment of the service sector, both in terms of employment and number of enterprises. Some of the largest shopping centers in the affected region are in the Gandhidham area, where the large number of imported goods brought through the Kandla port are sold. Some of the richer native Kutchis living in Mumbai are known to have made large investment in shopping centers in Gandhidham and nearby places. Community, social, and personal services constitute the second largest segment of the service sector in the affected region, with a large number of NGOs in the drought affected parts of the Kutch district. With more than 20 percent of the country's trade being handled through the 40 large and small ports located in Gujarat, transport and communication is the third biggest service sector employer in the affected region. Many

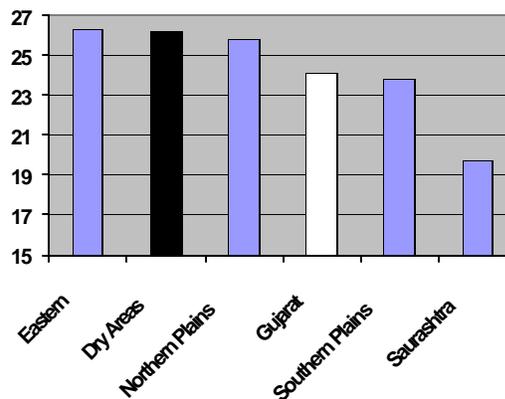
of the workers in the port areas, especially in Kandla port, are migrant laborers from Uttar Pradesh and Bihar.

2.10 **Remittance income.** Besides earned income, remittances to households, both from family members working abroad and in other parts of India, are high. This is reflected in the low credit-deposit ratio: 10.9 in Kutch, versus 85.7 in Ahmedabad, for instance (CMIE, 2001). This serves as an important source of income and as a safety net for households in the earthquake affected area.

Poverty in the Earthquake Affected Areas

2.11 The earthquake affected areas are among the poorest in the state. Reliable consumption-based measures of poverty incidence are available from the National Sample Survey only at the regional level; sample sizes are not large enough for district-level analysis. However, the bulk of the earthquake damage was in the “dry areas” region which comprises Kutch, Surendranagar, and Banas Kantha (Figure 1). In 1993/94, the percentage of households below the poverty lines in these dry areas as a whole was 26 percent; higher than the Gujarat average. The earthquake-affected areas are also worse off than the rest of Gujarat in terms of social indicators. Literacy rates in Kutch are 53 percent overall, and 41 percent for females—only slightly above the India averages. Kutch has the largest proportion of scheduled caste people in Gujarat, 12 percent of the population of Kutch are scheduled castes, compared with 7 percent in Gujarat as a whole.

Figure 1: Percentage of Households below the Poverty Line in Regions of Gujarat



Source: National Sample Survey

2.12 Gujarat appears to have fewer village-level organizations than some other parts of India. The earthquake affected areas, and Kutch in particular, do not have many of the producer (e.g., dairy) cooperatives for which the state is renowned, and sectoral associations and committees, such as water users' associations, forest management committees, and village education committees also appear to be less developed than in

many other states. In addition, the Panchayati Raj structure is currently missing its most important layer, the village-level Gram Panchayats. However, there are large numbers of community, religious or secular philanthropic organizations, and service or development oriented NGOs in the state.

2.13 Most urban and rural settlements contain a mix of communities, with the range of socioeconomic levels and average being determined largely by the quality of natural resources (primarily land) and the degree of development of infrastructure ("access"). Among the earthquake-affected areas in the state, Kutch is more remote, more poorly endowed, and hence poorer in the aggregate, although it is also home to a sizeable, wealthy business community that has social networks in other parts of the state, in Mumbai, and indeed in many parts of the world. This social capital has proved invaluable in the aftermath of the earthquake and will continue to be important in the reconstruction period. Even among poorer communities, including some nomadic pastoralists, for example, family and clan ties are reputed to be extensive and strong.

Environment, Natural Hazards, and Vulnerability

2.14 The state of Gujarat can be divided into three broad regions based on geographical position and drainage characteristics: south Gujarat, north, and central Gujarat (mainland), and Kutch and Saurashtra. Most of the earthquake affected area is classified as seismic zone V (very high risk) or zone IV (high risk) (Table 2). The affected area is located in arid and semiarid agroclimatic zones where water resources are limited, even scarce. The state is exposed to hydrometeorological and geophysical hazards (Table 1).

Table 1: Gujarat: Multihazard Disaster History

Cyclones	1850, 1881, 1893, 1896, 1897, 1903, 1917, 1920, 1933, 1947, 1948, 1961, 1964, 1975, 1976, 1978, 1981, 1982, 1983, 1990, 1993, 1996, 1998, 1999
Drought/Heat Waves	1987, 1998, 1999, 2000 ¹
Floods	1980, 1989, 1991, 1993, 1994, 1996, 1997, 1998 ²
Earthquakes ³	1819, 1845, 1847, 1848, 1864, 1903, 1938, 1956, 2001

Notes:

/1 Drought data are incomplete; severe droughts were recorded during the second half of the 1980s.

/2 Flood data is from 1980 to the present.

/3 In and around Gujarat, magnitude 6.0 or greater on the Richter scale.

Sources (table and accompanying text): Vulnerability Atlas of India: Gujarat, Gujarat Cyclone Mitigation and Reconstruction Project 1998, India Meteorological Department (IMD), Centre for Research on the Epidemiology of Disasters *EMDAT* database.

2.15 Given the region's geography and geology, extreme events arising from all four of the hazards described below are inevitable. As population, economic development and environmental stresses grow, annual negative impacts from one or more of these hazards may be expected due to the vulnerability of exposed people, dwellings, infrastructure,

and economic activities. The following overview describes the major hazards in Gujarat, their causes, vulnerability and vulnerability-reduction factors.

2.16 **Cyclones.** In the past 25 years, severe cyclones in 1975, 1976, 1981, 1982, 1983, 1996 and 1998, affecting Gujarat killed nearly 3,000 people and over 350,000 livestock, and left over a million dwellings partially damaged or totally collapsed. The 1998 cyclone also damaged port facilities, ships, and power transmission infrastructure. Cyclone frequency is highest during October and November. Cyclone damage is caused by wind, heavy rains and associated flooding. In coastal areas, one of the most destructive aspects of cyclones are storm surges—ocean water that is pushed and dragged onto the coast by low pressure and winds, generating storm surges with waves 5 to 10 meters high. Five to six cyclones form annually in the Bay of Bengal and Arabian Sea, not all of which affect Gujarat, but two to three of which may be severe.

2.17 Cyclone damage risks are generally higher closest to the coast. The vulnerability of structures can be reduced through cyclone resistant design measures such as roof straps, storm shutters, and other reinforcements. Loss of life can be reduced with evacuation planning, cyclone tracking and early warning alerts.

2.18 **Drought.** Substantial portions of Gujarat are arid to semiarid. Historical annual rainfall totals from the IMD range from 300 mm in the western part of the state to 1,400 mm in the east. Seasonal rainfall amounts vary however, depending on the strength and persistence of the seasonal monsoon. The monsoon normally begins in June/July and ends in September/October, with little if any rainfall occurring during other months. In the past two years monsoon rainfall was near average for all of India but low in Gujarat (in 1999 it was 123 mm), contributing to a current drought emergency.

2.19 Drought affects agricultural production, water supplies, human health, and animal fodder, and can lead to human migration in search of water, food, and livelihood. Many drought-reduction measures are already in place in Gujarat, including drought codes that are reviewed annually, premonsoon seasonal long-lead rainfall forecasts, surface water catchment dams, and water harvesting at the level of individual subcatchments, farms, and households. Agriculture is a heavy sectoral water user in Gujarat, however, and water is being pumped from the aquifers at a rate far in excess of their recharge. Falling water tables put added stress on crops and water supplies.

2.20 **Floods.** Since 1953, floods have affected an average of over 300,000 hectares annually, with the heaviest flooding occurring in 1988, when some two million ha were flooded. Annual average damages include 37,000 houses damaged, 135 lives lost, and nearly two million people affected. Cattle losses average 13,000 annually. Damages caused by extreme events can be 10 times these averages.

2.21 Flooding is largely confined to the areas along large rivers such as the Mahi, Narmada, and Sabarmati. Flooding occurs seasonally in years when large quantities of rainfall enter a river basin. Disaster prevention largely depends on appropriate land use and timely warning and evacuation. Appropriate operational and flood management plans for basin management, and use of water harvesting techniques and water storages,

including dams, can reduce flood risks. Houses can also be designed to withstand moderate flooding.

2.22 **Earthquakes.** In addition to the current earthquake, major events occurred in Gujarat in 1819 (M 8.0) and 1956 (M 7.0). Although the 1819 event was of higher magnitude than the current one, losses were significantly lower due to lower exposure (i.e., fewer people and economic assets).

2.23 Gujarat is located in the Himalayan collision zone where the Indo-Australian tectonic plate slides under the more northern Eurasian plate in a predominantly northern direction at a rate of one to two centimetres per year. This process compresses the region and the crust is being forced into folds of young deposits. The Himalayas are the ruffle on the southern edge of the Eurasian plate. The process causes active fault lines below the surface of the ground known as “blind thrust faults.” These faults do not rupture the surface, but create rolling hills. There is evidence of at least four of these hill patterns in the region.

2.24 The area worst affected by the current earthquake (Kutch district) is classified predominately as zone V in the Seismic Zoning Map of India, 1998. This is the highest risk zone and areas so classified are at very high damage risk. Ahmedabad lies in zone III (moderate damage risk). Zones III, IV, and V correspond to VII, VIII, and IX (out of XII) on the Modified Mercalli (MM) intensity scale (Table 2).

Table 2: Indian Seismic Zones Classifications and the Modified Mercalli (MM) Intensity Scale

Seismic Zone	MM Intensity	Description
III	VII	Everybody runs outdoors; negligible damage in buildings of good design and construction, slight to moderate in well built ordinary structures, considerable in poorly built or badly designed structures; some chimneys broken; noticed by persons driving cars.
IV	VIII	Damage slight in specially designed structures, considerable in ordinary but substantial buildings with partial collapse, very heavy in poorly built structures; panel walls thrown out of framed structures; falling of chimneys, factory stacks, columns, monuments, and walls; heavy furniture overturned; sand and mud ejected in small amounts; changes in well water; disturbs persons driving motor cars.
V	IX	Considerable damage in specially designed structures, well designed framed structures thrown out of plumb, very heavy in substantial buildings with partial collapse; buildings shifted off foundations; ground cracked conspicuously; underground pipes broken.

2.25 The intensity of shaking experienced at a particular location depends on many factors, including the magnitude of the event, the distance of the observer from the earthquake’s origin, and the characteristics of the soil or rock in the vicinity of the observer. A large, distant earthquake may produce the same intensity of shaking at a particular point as a small, near earthquake. The amount of damage caused by a

particular intensity of shaking will depend not only on the seismic strength of the structure, but also on how long the shaking continues. In general, larger earthquakes produce longer shaking.

2.26 Vulnerability reduction measures include antiseismic structural reinforcement measures and appropriate designs, restricting inappropriate land uses in microzones of highest risk, and preparedness measures.

B. Economic Impact of the Earthquake

2.27 The economic impact of the earthquake includes:

- (a) **asset losses (direct damage):** the value of the *stocks* of buildings, equipment, inventory and other property lost as a result of the earthquake;
- (b) **output losses (indirect damage):** the value of the *flows* of goods and services lost as a result of the asset losses and other disruption caused by the earthquake; and
- (c) **fiscal costs (secondary effects):** the net additions to the fiscal deficit as a result of revenue lost and additional expenditure incurred resulting from the earthquake.¹

2.28 Destruction of private assets in the affected districts has been massive. Of the estimated Rs. 9,900 crore (\$2.1 billion) total asset losses, Rs. 7,400 crore (\$1.6 billion) are private assets. Half of the total asset losses, Rs. 5,200 crore (\$1.1 billion), are due to losses of housing and household contents such as consumer durables and jewelry. The impact of the earthquake on India's gross domestic product (GDP) is insignificant. The impact of the earthquake on Gujarat's output is between Rs. 2,300 and 3,000 crore (\$0.5 and \$0.7 billion), or 2 to 3 percent of gross state domestic product (GSDP) over three years. These estimates represent the upper bound for output losses, as they exclude the likely positive impact of reconstruction on output growth. The impact on the state's fiscal accounts is likely to be large, amounting to around Rs. 10,100 crore (\$2,170 million) over three years.

Asset Losses

2.29 Preliminary estimates total Rs. 9,900 crore (\$2.1 billion) in asset losses, valued at same-standard replacement costs, and Rs. 10,600 crore (\$2.3 billion) in improved-standard reconstruction costs. A distinction is made between same-standard replacement costs (i.e., the costs for restoring assets to the standard that existed before) and improved-standard reconstruction costs (i.e., the costs for rebuilding to a standard that responds to local conditions, including the risk of natural disaster). Given Gujarat's high degree of exposure to natural hazards, particularly earthquakes and cyclones, same-standard replacement would not be the best approach. Against this, it needs to be borne in mind

¹ For a description of the methodology used in damage assessment reports, refer to "*Manual for Estimating the Socio-Economic Effects of Natural Disasters*", UN Economic Commission for Latin America and the Caribbean, 1991.

that financing is limited and there is a trade-off between construction standards on the one hand and the cost and speed of reconstruction on the other.

2.30 Damage totals in each sector are summarized in Table 3, and sectoral details are presented in the following section of this report. These totals are likely to be revised significantly as detailed on-site damage assessments are completed by qualified experts in the coming weeks and months. The totals in each column combine private sector and public sector asset losses.

Table 3: Preliminary Estimate of Asset Losses and Reconstruction Costs (as at February 23, 2001)

Sector	Asset Losses		Reconstruction Costs 1/	
	(\$ million)	(crore Rs)	(\$ million)	(crore Rs)
Housing	1,111 /2	5,166 /2	1,107	5,148
Health	47	219	60	279
Education	144	670	180	837
<i>Subtotal: Social Sectors</i>	1,302	6,054	1,347	6,264
Irrigation	40	186	90	419
Rural Water Supply	50	233	97	451
Municipal Infrastructure	30	140	45	209
Public Buildings and Monuments	73	339	95	442
Power	40	186	98	456
Transport /3	69	321	77	358
Ports	21	98	26	121
Telecommunications	11	51	26	121
<i>Subtotal: Infrastructure</i>	334	1,553	554	2,576
Agriculture and Livestock *	117	544	74	344
Industry *	73	339	44	205
Services *	250	1,163	200	930
<i>Subtotal: Productive Sectors</i>	440	2,046	318	1,479
<i>Subtotal: Environment /4</i>	55	256	55	256
Grand Total	2,131	9,909	2,274	10,575
Of which public assets /5	537	2,497	8,31	3,864
Of which private assets /6	1,594	7,412	1,443	6,710

/1 Replacement of immovable assets, with improved earthquake/cyclone resistance.

/2 Includes value of household contents such as consumer durables; reconstruction excludes replacement of these assets.

/3 Includes roads and bridges, railways, and airports.

/4 Includes costs of rubble removal in urban and rural areas.

/5 Public assets above include: health, 70 percent of education assets, irrigation, rural water supply, municipal infrastructure, public buildings and monuments, power, transport, ports, and telecommunications; plus the environment.

/6 Private assets above include housing, 30 percent of education assets, and production assets in agriculture and livestock, industry and services.

*Asset losses and reconstruction costs to agriculture, industry, and services, exclusive of sectors listed above.

Regarding asset losses to Housing and Industry, the GOG informed the assessment team on March 3, 2001, of adjustments in their estimates for asset losses and reconstruction costs. The Government's latest estimates are: Rs. 9,800 crore for housing losses, Rs. 900 crore for industrial asset losses, and Rs. 475 crore for industrial reconstruction.

Source: GOG and Joint Mission Estimates

2.31 Asset losses to the private sector are estimated to total about Rs. 7,400 crore (\$1.6 billion), including losses of private housing and property (Rs. 5,200 crore or \$1,111 million), private schools (Rs. 200 crore or \$43 million), and productive assets in agriculture and livestock, industry and services (Rs. 2,000 crore or \$440 million).

2.32 Losses in public sector assets are estimated to total Rs. 2,500 crore (\$0.5 billion), and include losses in health (Rs. 220 crore or \$47 million), education (excluding private schools, some 70 percent of the total, a loss of Rs. 470 crore or \$101 million), municipal infrastructure (Rs. 140 crore or \$30 million), public buildings and monuments (Rs. 339 crore or \$73 million), rural water supply (Rs. 233 crore or \$50 million), irrigation (Rs. 186 crore or \$40 million), power (Rs. 186 crore or \$40 million), roads, bridges, railways and airports (Rs. 321 crore or \$69 million), ports (Rs. 98 crore or \$21 million), and telecommunications (Rs. 51 crore or \$11 million).

2.33 Also, some Rs. 256 crore (\$55 million) of currently identified environmental damages are included in the public sector total. This includes the cost of rubble removal in urban and rural areas. The costs of tackling these problems are likely to accrue to the public sector.

2.34 Estimates of reconstruction costs are preliminary, as specialists have only just begun to identify and cost out effective risk-reducing strategies for sectoral activities in the affected areas. Moreover, the definition of improved standards and the decision whether to rebuild to these standards can only be determined by assessing the exposure of the relevant asset to catastrophic losses, the economic and social impacts of these losses, and the affordability of reconstruction.

Output Losses

2.35 Loss of value added due to the earthquake is estimated to be relatively small, ranging in aggregate between Rs. 2,300 to Rs. 3,000 crore (\$491 to \$655 million), or 2 to 3 percent of 1999-00 GSDP over three years. This impact is likely to fall mostly in 2000-01². In 2001-02 and 2002-03, the impact of reconstruction is likely to accelerate growth. Due to the current uncertainty about reconstruction policy and financing, the extent of these impacts remains indeterminate at this stage, but it is conceivable that the net impact on output in later years could be nil or even positive.

2.36 There are several reasons why the impact on GSDP is unlikely to be large. The area most affected by the earthquake is relatively poor and is not a major contributor to overall state output. Kutch accounts for less than two percent of industrial employment in Gujarat and there is little large-scale industry. The main economic activities are handicrafts, agriculture, animal husbandry, salt mining and refining, and trade. Agriculture is largely rain-fed and there are few perennial crops. The agriculture and dairy sectors are extensive, with little mechanization and thus low levels of capital intensity. Although the impact on GSDP is likely to be small, it is important to

² GOG and GOI fiscal year starts April 1 and ends March 31.

appreciate the considerable negative impact on employment and on incomes in the earthquake-affected areas.

2.37 Two different approaches were used to estimate the output loss (Table 4). The first approach, is a straightforward application of an incremental capital-output ratio (ICOR) to the asset loss, to obtain a measure of the output loss. Social capital and infrastructural capital have been assumed to have a lower bearing on output than fixed capital in the productive sectors. Assuming the ICOR for social, infrastructural and productive capital to be five, four, and three respectively, the loss of GSDP is estimated to be Rs. 2,300 crore (\$491 million) in aggregate over three years.

2.38 The second approach was to examine the output loss in a “bottom up” fashion, drawing on analysis of the primary, industry, and service sectors. The assumptions and methodologies used in estimating the output loss in these three sectors are discussed separately in the following section of this report. It is estimated that nearly Rs. 228 crore (\$49 million), Rs. 1,070 crore (\$230 million), and Rs. 1,748 crore (\$376 million) of output will be lost in primary, industry, and service sectors respectively on account of the earthquake related damages. In aggregate, output losses estimated through this method amount to 3,000 crore (\$655 million).

2.39 The above estimation does not take into account the stimulus effect of the rehabilitation and reconstruction activities. At the time of analysis, there was insufficient information about the size and modalities of these reconstruction activities to estimate their growth impacts. But reconstruction activities in the affected areas can not only lead to a restoration of much of the lost assets, but also give a considerable boost to economic activity and growth in income. Thus, the output losses identified above are the upper bound for output losses.

Table 4: Estimated Output Losses*

Approach	Rs. Crore	\$ million
<i>Based on ICORs</i>		
• Total, based on sector-specific ICOR	2,289	491
1. Social Sector	1,214	261
2. Infrastructure	391	84
3. Productive Sector	684	147
<i>Based on Sectoral Output Losses</i>		
• Total Output Loss, based on sectoral output loss	3,046	655
1. Primary Sector	228	49
2. Industry Sector	1,070	230
3. Service Sector	1,748	376
<i>Range of Output Loss</i>	2,289 - 3,046	491 - 655

*The stimulus effect of rehabilitation and reconstruction is excluded; thus these estimates represent the upper bound for output losses.

Source: Joint mission estimates, based on GOG data.

Fiscal Impact

2.40 The impact on the fiscal deficit is estimated to be as much as Rs. 10,100 crore (\$2,170 million) in aggregate over three years. The deterioration in the fiscal balance will be due mostly to increased expenditure pressures related to relief, reconstruction of public assets, and assistance to reconstruction of private assets (the largest component of which is assistance to reconstruction of housing). It is expected that much of the reconstruction expenditure will take place in 2001-02 and 2002-03. This could increase the fiscal deficit, currently at 5.1 percent of GSDP in 2000-01, by as much as 2.5 percentage points in 2000-01, 3.3 percentage points in 2001-02, and 1.7 percentage points in 2002-03.

2.41 The extent to which the earthquake will have a negative impact on the state's overall balances in coming years depends not only on the level of losses, but also on the terms in which the government obtains financing for earthquake related expenditures and on the extent to which the government chooses to subsidize reconstruction of private assets. On the expenditure side, revenue expenditure net of interest payments is projected to increase by 8 percent a year. All fiscal deficit is assumed to be financed out of borrowing and the average effective interest rate is assumed to be 12 percent, close to the actual observed rates. Public-good related considerations provide strong reasons to suggest that health, education, and infrastructure should be borne by the government. The other areas are less clear. While, in principle, the private sector's losses can be left entirely for the private sector to bear, the poverty profile of the affected areas, along with the serious risk of a further increase in destitution, argue in favor of some burden-sharing by the public sector, especially for the poorest.

2.42 The pressure for additional expenditures consequent to the earthquake also provides an opportunity for the government to rationalize public expenditure priorities and improve tax and nontax revenue collections in the nonaffected areas. Furthermore, a natural disaster is often followed by recovery and reconstruction. The construction boom following the disaster can be a source of additional revenue inflows, which could improve revenue performance overall. The overall fiscal scenario is presented in Table 5.

Table 5: The Overall Fiscal Scenario

(Rs crore)	Pre-earthquake			Post-earthquake		
	2000-1	2001-2	2002-3	2000-1	2001-2	2002-3
Own Tax Revenue	9,877	10,553	12,011	9,591	10,208	11,575
Own Non Tax Revenue	3,462	3,877	4,342	3,462	3,877	4,342
Shared Taxes	1,525	1,778	2,073	1,525	1,778	2,073
Grants	847	620	689	847	620	689
Total Revenue Receipts	15,711	16,828	19,115	15,425	16,483	18,679
Additional Receipts				650	1,300	0
Revenue Expenditure	18,959	20,697	22,987	19,556	21,057	23,875
Of which						
Interest	3,503	4,004	4,959	3,503	4,364	5,847
Capital Expenditure	2,815	3,554	4,458	2,815	3,554	4,458
Loans and Advances (net)	110	532	614	110	532	614
Relief Expenditure				649	0	0
Rehabilitation Expenditure				2,124	5,098	1,275
Fiscal deficit	6,173	7,955	8,944	9,179	12,458	11,543
Fiscal Deficit/GSDP (%)	5.1	5.8	5.8	7.5	9.1	7.5

Source: Joint mission estimates, based on GOG data.

2.43 Overall impact on revenues. The overall impact on revenues is likely to be relatively small. Although output has fallen and some tax records have been lost, the earthquake affected areas accounted for a small share of Gujarat's tax take, and the impacts on GSDP are small.

2.44 Tax revenues. Sales tax revenue losses of Rs. 115 crore (\$25 million) and Rs. 260 crore (\$56 million) may be expected during the fiscal years 2000-01 and 2001-02, respectively. Underlying this projection, there is an assumption of 10 percent and 25 percent revenue loss for the month of February and March of 2001, respectively. Stamp duty registration and fees have been adjusted down to reflect the fact that only 10 percent of the collections expected for February and March are likely to materialize. In the next fiscal year, collections from stamp duty and registration fees have been projected to decline by 50 percent. After the collapse of some high-rise apartment blocks in Ahmedabad, prospective buyers will likely be wary of buying apartments in multistoried buildings.

2.45 Regarding motor vehicle tax, actual collections for 1999-00 *vis-à-vis* the revised estimates for that year, as well as the trends up to January 2001 relative to budget estimates for 2000-01, show that revenue realizations have been falling short of expectations. The earthquake, together with the already observed trends, are likely to result in motor vehicle tax revenues falling short of budget estimates for 2000-01 by Rs. 640 crore (\$138 million). However, much of the loss is on account of the continuation of the pre-earthquake trends.

2.46 As can be seen from Table 5, the impact of the earthquake *per se*, on the state's tax revenue is Rs 286, 345 and 436 crore (\$62, \$74, and \$94 million) in the years 2000-01, 2001-02 and 2002-03, respectively. These are not very large numbers in relation to the size of the state's budget.

Table 6: Tax Revenue Projections

(Rs. Crore)	1997-98	1998-99	1999-00	2000-01	2000-01	2001-02	2002-03
	Actuals	Actuals	R. E.	B. E.	L.E.	Projected	Projected
Sales tax	4,402	4,796	5,400	6,300	6,185	6,173	6738
Stamp and registration	411	506	520	600	458	332	376
Motor vehicle taxes	434	522	815	1220	632	792	876
State excise	24	27	26	30	30	29	31
Electricity taxes	1,024	1,447	1,450	1,700	1,692	2,310	2946
Profession tax	62	75	100	125	120	141	176
Entertainment tax	60	63	68	75	67	24	25
Other taxes	174	180	273	407	407	407	407
Total Own taxes	6,591	7,616	8,652	10,457	9,591	10,208	11574
Total tax revenue	8,166	9,257	10,383	12,189	11,323	11,986	13647
As a percentage of GSDP (%)							
Total own taxes	7.12	7.45	7.93	8.56	7.85	7.46	7.56
Total tax revenue	8.82	9.06	9.52	9.98	9.27	8.76	8.91

Notes: R.E: Revised Estimates, B.E. Budget Estimates, L.E.: Latest Estimates

Source: Joint mission estimates, based on Government of Gujarat data.

2.47 **Nontax revenues.** Discussions with the GOG indicate that as things stand now, there may be a marginal drop in royalties only, and the nontax revenues as a whole may not suffer a significant loss due to the earthquake. Own nontax revenue in Gujarat has remained fairly stable as a proportion of GSDP at about 2.5 percent. This level is assumed to remain constant, and with GSDP growing nominally at the rate of 12 percent per annum, the rate of growth of own nontax revenue too would remain the same.

2.48 **Capital receipts.** At the time of writing this report, there was uncertainty regarding the prospective inflow of earthquake related assistance. As of February 19, 2001, GOG had received Rs. 650 crore (\$140 million), of which Rs. 500 crore (\$108 million) from the National Calamity Compensation Fund, Rs. 110 crore (\$24 million) from the Prime Minister's Relief Fund, and Rs. 40 crore (\$9 million) from the Chief Minister's Relief Fund. Large amounts of additional support are expected, but the exact amounts or the terms are not yet known with certainty. The estimated proceeds of Rs. 1,300 crore (\$280 million) from the two percent surcharge on income tax imposed by GOI citing the Gujarat earthquake is expected to be passed on to Gujarat. The above amounts are by way of transfers. In addition, the Government has been permitted ways and means advances from the Reserve Bank of India beyond normal limits.

2.49 **Expenditure on immediate relief.** The relief measures, which follow the rules prescribed in the relief manuals of state administration, is expected to cost the state

government Rs. 838 crore (\$180 million). These expenditures are summarized in Table 7, derived from information provided by the Government.

Table 7: Expected Expenditure on Relief Measures (Rs. Crore)

Measure	Up to end-March 2001
Food supplies	
Direct	19
Indirect	0.5
Medical relief	
Medicines and supply	2.5
Staff	13.9
Debris removal	143.5
Cash compensation	
Doles	168.8
Household kits	138.1
Death	200.0
Injury	142.4
Cattle	9.3
Total expenditure	838.0

Source: Government of Gujarat

2.50 Estimated expenditure on rehabilitation. In the memorandum submitted to the GOI, as well as the documents submitted to the assessment mission, the GOG has indicated the urgent need for rehabilitation expenditures on education, health, roads and bridges, administrative buildings, drinking water, irrigation, and power. On the housing rehabilitation front, the Government has also announced a plan for reconstruction and repairs of houses, detailed and discussed elsewhere in this report.

2.51 The expenditure for rehabilitation of social and physical infrastructure along with the likely expenditures on the schemes announced for the housing sector is estimated at Rs. 8,496 crore, or \$1,827 million (Table 8). These measures do not include any compensation for the loss of asset base in the productive sectors, agriculture, industry, and services. Any decisions on these lines would contribute towards increasing the expenditure of the Government even further.

Table 8: Expected Expenditure on Rehabilitation

	\$ million	Rs. crore
Education*	180	837
Health	60	279
Rural water supply	97	451
Power	98	456
Municipal infrastructure	45	209
Public buildings and monuments	95	442
Roads and bridges	55	256
Housing*	1,107	5,148
Irrigation	90	419
Total	1,827	8,496

*Note: Sectors where private sector participation is possible.

Source: Joint mission estimates, preliminary.

Impact on Inflation and the Balance of Payments

2.52 The earthquake has not had, and is not expected to have, a perceptible effect on prices or the balance of payments. The comfortable supply position of essential commodities, and quick reopening of roads, contributed to the maintenance of inflation stability. Reportedly, prices in the affected areas did not spiral up in the immediate aftermath of the earthquake. The people in the affected areas were left with little purchasing power, and the rapid delivery of relief materials and restoration of transportation and communication channels helped to maintain price stability.

2.53 The stable exchange rate since January 26, 2001, indicates that the earthquake is not expected to have a significant impact on the balance of payments. The affected areas do not account for a large proportion of the exports of the country and the relief and reconstruction is unlikely to be import-intensive. The limited damage of the earthquake on the ports and jetties has helped to insulate the balance of payments from the disaster.

C. Overview of Sectoral Losses

2.54 The heaviest damages resulting from the earthquake occurred to housing and to social infrastructure. This underscores the huge social impacts of the disaster. Damages in each sector are summarized below. For a detailed description of assumptions and other factors taken into account when assessing each sector, refer to the sectoral annexes in Part II of this report.

Housing (*Annex 2*)

2.55 Housing is the sector most seriously affected by the January 26 earthquake. According to the preliminary estimates as of February 23, about 400,000 dwelling units collapsed, and about 500,000 were partially damaged (according to more recent GOG estimates, not assessed by the mission, 800,000 houses may have been partially damaged). Asset losses to housing amount to a total of about Rs. 5,200 crores (\$1,111 million) including the estimated value of household goods, while the cost of reconstruction, repair and strengthening to improved seismic and cyclone standards would require over Rs. 5,100 crore (\$1.1 billion). Reconstruction costs exclude the replacement of household goods.

2.56 Additional impacts include high social costs of homelessness, underscored by psychological trauma, poor health, fear of occupying damaged houses, and loss of earnings for those families whose home also doubled as a place of work. Loss of property related documents also presents an immediate problem for the victims, as documenting proof of home-ownership for compensation and reconstruction purposes may be difficult for many. Additionally, the collapse of many high-rise buildings precipitated, at least in the short run, a sudden drop in the demand for multistory apartment units and the prices of such properties.

2.57 In view of these staggering losses in a single, socially highly sensitive sector, it is important to look at the underlying causes for the huge number of collapsed and damaged

buildings in this earthquake. The main problems are associated with the quality of building materials used, predominant building techniques which were not sufficiently resistant to seismic forces, and the institutional processes of applications and approvals for building permits, enforcement of building codes, and construction supervision (Annex 2b).

2.58 Traditional, nonengineered, structures in the zone of impact—both in the rural and in the urban areas—are old, inadequately maintained, and feature a wide range of disparate construction materials. They are frequently combined in the same structures, which by and large were built over a long period of time. *Pucca* wall bearing structures, built of local, “soft” stone with slippery surfaces, and inadequately bonded (usually with only mud mortar), proved to be lethal when exposed to the lateral loads of an earthquake. Brick structures also performed poorly, mainly due to low quality brick and mortar, and the lack of necessary bracing of house walls to keep the walls together. Sloping roofs built with very sparse use of expensive and not readily available wood, were too light to support the weight of heavy ceramic roof tiles. In many instances, due to lack of bracing, outer walls fell out letting the roofs cave in, and killing the residents within. Similarly, *Kutch*a houses (constructed of mud brick and mud mortar, with bamboo and thatch roofs), performed very poorly.

2.59 More recently engineered multiapartment buildings also showed significant areas of weakness. Particularly vulnerable were reinforced concrete buildings with masonry infill walls, which collapsed in many cities and towns, most notably in Ahmedabad, Anjar, and Bhuj. Unauthorized construction of additional floors and heavy roof gardens to four or five story high buildings, contributed to the collapses of many such buildings, especially those of the so called “soft story” type (with slender columns on the ground floor allowing for car parking). The fast construction process in recent years, with relatively little building code enforcement, combined with poor construction materials, led to tragic consequences.

Health (Annex 3)

2.60 The earthquake has left behind a trail of death and disintegration of families, thousands seriously injured and handicapped, both physically and psychologically, and a severely damaged health infrastructure. At the time of writing, the number of confirmed human deaths was over 20,000 (of which over 17,000 have been reported from Kutch alone), and the number of persons injured is close to 167,000. Injuries include orthopedic and head injuries, tissue losses, abdominal and thoracic trauma, and amputations. A large proportion of these patients are likely to be left permanently disabled, requiring rehabilitation and care in the future.

2.61 There has been extensive damage to health infrastructure, with the total amount estimated at Rs. 220 crore (\$47 million). There has been disruption in the provision of routine curative and preventative care, while at the same time the sector has been called upon to provide emergency curative (particularly surgery and orthopedics) and preventative care much beyond its capacity. A total of two district hospitals (Bhuj and Gandhidham), 21 community health centers (CHCs), 48 primary health centers (PHCs),

227 subcenters, about 800 Anganwadi centers, six integrated child development services scheme (ICDS) go-downs, 11 chief district project officer (CDPO) offices, 96 Ayurvedic dispensaries, 21 homeopathic dispensaries and one food laboratory have been completely destroyed. In addition, nearly all types of facilities at different levels of health care have suffered major and minor damages.

Education (*Annex 4*)

2.62 Educational infrastructure and processes were affected in 18 districts, especially in Ahmedabad, Kutch, Jamnagar, Patan, Rajkot, and Surendranagar. The lives of educational administrators, teachers and students were disrupted both physically and emotionally. The total amount of asset losses in the sector is approximately Rs. 670 crore (\$144 million). More extensive damage has occurred to elementary and secondary schools than to higher and technical education institutions. Over 11,600 schools have been either damaged or destroyed. According to the GOG, 910 elementary, 37 secondary, 3 higher and 21 technical education students died as a result of the earthquake, and 1,051 elementary education students were injured. Among teachers, 31 lost their lives, and 95 were injured. Since the day of the earthquake was a public holiday, most children were not in school. Considering the number of schools leveled, many more children might have been killed if January 26 had been a normal school day.

2.63 While difficult to quantify, impacts of the earthquake include psychological trauma and social impact on many students, teachers, and educational administrators. An estimate for setting up a counseling program for students and teachers is about Rs. 14 crore (\$3 million). In addition, there is the impact of lost time spent in the classroom learning. This has a particularly serious impact on secondary education students in years 10 and 12. Both years are certifying years, the former for secondary and the latter for higher secondary. In many of the talukas visited, students have yet to resume classes, thereby shortening the time spent for revising academic subjects in preparation for the examinations to be held in April.

Dam Safety and Irrigation (*Annex 5*)

2.64 The earthquake caused widespread and severe damage to the water storage and irrigation infrastructure in Gujarat's Kutch district and, to a lesser extent, the Saurashtra region. In Kutch, 21 earthen dams have to date been found severely affected. These require complete reconstruction, while 164 earthen dams require major or moderate repairs and strengthening. In Saurashtra, 61 schemes have suffered moderate to minor damages, and will require repair and rehabilitation. Some structures and linings in the canal networks, both in Kutch and Saurashtra regions, have also suffered damages, and will also require repairs. The damages are limited to earthen dams on medium and minor schemes, generally to those constructed before the 1970s with either no or lower seismic engineering design standards. More recently constructed dams, and dams for major schemes have not been affected. Based on the assessment carried out to date by the GOG and the Central Water Commission, GOI, and the review by the assessment team, the total amount of damage to assets is estimated to be about Rs. 186 crore (\$40 million), and

the cost of reconstruction to upgraded modern seismic engineering standards is about Rs. 419 crore (\$90 million).

2.65 The urgency of the reconstruction or repairs varies. The 21 dams that have to date been identified as critically unsafe for impounding water, and any other unsafe dams that may be identified, will need to be dealt with urgently before the coming monsoon (June/July 2001). Repairs on other dams are also needed before the monsoon. Beyond the public safety concerns, where immediate action on all at risk structures are clearly critical, there is strategic need to restore all the earthen dams as quickly as possible. These storages are the source of drinking and domestic water for many villages and towns, for local industries, and for irrigation. Their safe and full functioning provides a basic need in the welfare and livelihoods of the local communities concerned.

Rural Water Supply (*Annex 6*)

2.66 Drinking water systems have been affected in 1,340 villages in five districts (Banaskatha, Jamnagar, Kutch, Rajkot, and Surendranagar), of which some 1,100 village systems have suffered severe damages. Systems in Banaskatha and Surendranagar have suffered minor damages, while the damage in the other districts is much more severe. Water supply in Kutch is largely groundwater based with only the Tappar and Shivilakha dams providing surface water sources. Affected areas in Rajkot and Jamnagar receive water supply mainly from surface water (the Machhu II dam) and from a few ground water schemes. Both the surface water schemes (dams, pumping stations, pipelines, water treatment plants) and all the ground water based schemes (121 regional schemes covering 693 villages, and 191 individual schemes) have been affected in varying degrees. The most severely damaged facilities include: two dams; two water treatment plants; over 350 tubewells with pumping equipment and pump houses; and, pipelines of over 1,500 km length of asbestos cement (AC)/PVC and reinforced cement concrete (RCC) material. The RCC underground tanks and overhead tanks, which were designed for seismic zone V, have largely withstood the earthquake impact whereas the masonry structures (pump houses, staff quarters, village-level small tanks) have nearly all collapsed. Other damage includes ruptures and dislocation of transmission pipelines resulting in excessive leakages. In the case of tubewells, the damages are in the form of caving in, casing pipe ruptures and disruption in gravel packing. The total amount of damage is estimated at Rs. 233 crore (\$50 million). The estimated cost of reconstructing and rehabilitating the affected systems with upgrades for hazard protection is estimated to be up to Rs. 451 crore (\$97 million).

2.67 The water supply service to the village communities, and bulk supplies to town residents as well as a sizable number of industries (Kandla Port Trust, Indian Oil, Fertilizer Corporation) have substantially deteriorated in terms of quantity, quality, and reliability. This has a number of effects. For example, the loss of in-house water-receiving and storage facilities requires that people wait for long periods of time for the delivery and collection of water by tanker to their homes or relief camps. Since the responsibility for water collection typically falls on women, this affects them mainly by reducing the amount of time they can spend on productive activities. In addition, environmental sanitation has deteriorated and health and hygiene may have suffered.

Municipal and Environmental Infrastructure (*Annex 7*)

2.68 Gujarat has six municipal corporations and 143 municipal towns. Of these, five municipal corporations and 57 municipal towns have been affected by the earthquake. For the purpose of this assessment, the urban and environmental infrastructure components include the following: water supply, sewerage, sanitation, solid waste management, municipal roads, municipal dispensaries, street lighting, municipal administrative buildings and other municipally owned buildings (does not include the state government owned buildings) such as libraries, town halls, municipal markets etc. The damage to the urban and environmental infrastructure varied extensively among the cities and towns located in the affected area. Based on detailed information provided by the Department of Urban Development and the agencies under it, municipal infrastructure in 15 urban areas were damaged to significant degrees. Severe damages were caused in 14 towns in Kutch, Rajkot, and Surendranagar districts and some damages to several cities/towns in other districts. The worst affected urban towns are Anjar, Bhachau, Bhuj, Gandhidham, and Rapar in Kutch district, and Morvi in Rajkot district. Municipal infrastructure in Ahmedabad city also suffered damage. The other municipal towns, which suffered relatively less damage are: Mandvi (Kutch district); Wankaner (Rajkot district); Dhrangdhara, Halwad, Limbdi, Surendranagar, Thangadh, and Wadhwan (Surendranagar district).

2.69 The damage to the water systems has been extensive, followed by damage caused to the sewerage systems, municipal roads and buildings, street lighting, and sanitation. The assessment team computed the damage estimate based on detailed information provided by the GOG for 14 towns and Ahmedabad city. In all, the assessment report covers 62 cities/towns. The damage estimate is presented in terms of cost of asset replacement as well as replacement cost with an upgrade for multihazard resistance. The assessed damage cost is Rs. 140 crore (\$30 million) and replacement cost with upgrading is Rs. 209 crore (\$45 million). The cost of the immediate improvements to restore basic services is Rs. 60 crore (\$13 million) and the short-term replacement cost is Rs. 79 crore (\$17 million) respectively.

Public Buildings (*Annex 8*)

2.70 Damage to state public buildings and historic monuments are estimated at Rs. 339 crore (\$73 million). The spatial distribution of damage to administrative buildings and residential quarters that belong to various line departments followed closely the damages in housing. The buildings that collapsed were usually old, one- or two-story high structures with masonry walls (see also Annex 2b). Damaged buildings were more geographically spread, but were also, for the most part, load bearing structures. Damage to historic structures, and by extension the impact on Gujarat's cultural heritage, was significant. While some monuments such as the 1,000 year-old Rani Ki Vav (the Queen's stepwell) in Patan survived unscathed, other invaluable structures collapsed. The Roads and Buildings (R&B) Department has prepared a short-term program (the next 18 months) and a medium-term program (next three years) for reconstruction of public buildings. The former would include provision of temporary office space, minor and

major repairs and strengthening to damaged buildings, and preparation of designs for buildings to be reconstructed in the next two to three years. Under the medium-term program the R&B Department would undertake reconstruction of collapsed buildings to upgraded standards. In addition to these programs, it will be necessary to repair historic monuments and buildings protected by the central and state governments, and to rebuild a good number of police stations and outposts, particularly in Kutch district. Total reconstruction costs for public buildings have been estimated at Rs. 442 crore (\$95 million).

Power (*Annex 9*)

2.71 The power system in the Kutch region comprises the Kutch Lignite Thermal Power Station and the transmission system at 220kV, 132kV, and 66kV, with the associated distribution system. Most of the consumers in the region are from the agricultural sector. The earthquake has caused extensive damage to the power system facilities in Kutch and nearby districts of Banaskantha, Jamnagar, Rajkot, and Surendranagar. The diesel generator and building in Bhuj were also damaged. Total asset losses for the sector are estimated at Rs. 186 crore (\$40 million). Temporary restoration of power supply has been done in most of the areas. However, replacement of the old equipment will not be feasible. There is a need to strengthen the power system of the region. Moreover, for compatibility reasons, it will not be feasible to integrate new equipment with the obsolete portion of the existing system. Therefore, the government may wish to strengthen the power system of the region by installing suitable equipment and thus enhancing the reliability and efficiency of the power system. The immediate needs will have to be focussed on repairs and reconstruction of substations and accommodation for operating staff. The medium-term needs will focus on major replacement of equipment, transmission lines, and transformers. The cost to rebuild the damaged equipment and buildings and to rehabilitate the transmission and distribution systems will be about Rs. 456 crore (\$98 million).

Transport (*Annex 10*)

2.72 In comparison to the other infrastructure sectors, the transport sector suffered relatively little earthquake related damage. Most of the transport infrastructure remained functional after the earthquake. However, if the existing Surajbari Bridge had failed, road traffic into the Kutch district would have been disrupted. The preliminary cost of asset damages caused by the earthquake to the transport infrastructure of Gujarat has been assessed at about \$90 million: (a) roads, Rs. 233 crore (\$50 million); (b) railways, Rs. 79 crore (\$17 million); (c) ports, Rs. 98 crore (\$21 million); and (d) airports, Rs. 9 crore (\$2 million).

Telecommunications (*Annex 11*)

2.73 The earthquake has inflicted extensive damage to the telecommunication system. About 80,000 lines were down due to the collapse of the telephone exchange buildings. In Bhuj, Jamnagar, Rajkot, and Surendranagar, a total of 179 exchange buildings, and 146 staff quarters were destroyed. The collapse of telecommunications capacities

seriously affected the relief measures as no information was available about the intensity of the earthquake, precise locations affected, and the extent of damage. The amount of damage to telecommunication facilities is estimated to be Rs 51 crore (\$11 million), based on cost of purchase of equipment and construction of buildings. Temporary restoration has been started and about 54,000 lines have been charged. In addition, the cost of building 700 staff quarters for all working in the affected areas, 179 telephone exchange buildings, and the administration office at Bhuj will be Rs. 70 crore (\$15 million), bringing total reconstruction costs to Rs. 121 crore (\$26 million).

Agriculture and Livestock (*Annex 12*)

2.74 Agriculture contributes only 20 percent to the overall state economy and of this only a small share is estimated to be produced in the areas most affected by the earthquake (CMIE, 2001). As the state has become more industrialized, the share of agriculture and livestock husbandry has declined, in particular over the past 20 years. However, the sector still provides employment to nearly 50 percent of Gujarat's population. Agriculture has been severely hit by two consecutive years of severe drought, which have led to a contraction in output of nearly 13 percent in 1997/98 and 2 percent in 1998/99. The areas most severely affected by the earthquake were also those worst affected by the drought.

2.75 According to GOG estimates, total asset losses are estimated at Rs. 544 crore (\$117 million). Preliminary losses of assets to the private sector in agriculture and livestock are estimated at Rs. 512 crore (\$110 million), nearly 80 percent of which is in the Kutch district. While not very large in value, the loss of these agricultural assets and inputs is likely to have drawn down the assets of already poor groups of the population. Major asset losses are concentrated in irrigation assets, such as bore wells, pump houses, submersible pumps and water storage tanks, as well as storage bins, farm implements, livestock, plant protection equipment, and stored outputs and inputs. In addition, damages to the public sector, estimated at Rs. 37 crore (\$8 million), include buildings of the Agriculture Department, including Gujarat Agriculture University and Animal Husbandry units. Output losses due to the earthquake are estimated to be about Rs. 228 (\$49 million). These losses are expected to result from delay in picking the standing crops of cotton and castor, lack of irrigation at a critical stage, and lack of farm storage facilities. These estimates, obtained through rapid survey methods in the affected districts, are expected to be the upper bound for overall agriculture and livestock losses.

Industry (*Annex 13*)

2.76 Gujarat is one of the most industrialized states in India. Industry contributes around 39 percent of Gujarat's GSDP. However, industrial damages from the earthquake were concentrated almost entirely in Bhavnagar, Jamnagar, Kutch, Rajkot, and Surendranagar districts which together comprise less than a quarter of Gujarat's industrial capacity. Furthermore, well over half the damages took place in Kutch, a district which accounts for only around 2 percent of industrial GSDP.

2.77 The damages to industrial buildings, machinery, and inventory caused by the earthquake amount to around Rs. 340 crore (\$73 million). Even ignoring the growth impacts of reconstruction, the impact of the earthquake on industrial production is unlikely to amount to more than Rs. 1070 crore (\$230 million), which is 0.8 percent of Gujarat's total GSDP, and a negligible amount of India's GDP. However, the impact on earnings in Kutch may still be considerable, particularly for workers in the salt and handicrafts sectors, which were badly damaged.

Services (*Annex 14*)

2.78 The service sector contributes nearly 41 percent of the state's income and accounts for 50 percent of total employment. In the five most earthquake affected districts, nearly half a million people worked in the service sector and together they contributed about Rs. 6,766 crore (\$1,455 million) towards the state's annual income. This figure includes only the damage to the commercial establishments (shops, restaurants, hotels, and financial institutions), and the goods, inventories, and other working capital stored in these establishments. The assessment team estimated that the asset losses and output losses in the service sector are Rs. 1,163 crore (\$250 million) and Rs. 1,748 crore (\$376 million), respectively.

D. Social Dimensions (*Annex 1*)

2.79 The social fabric of the earthquake-hit areas has been devastated by the large number of human deaths and injuries. In addition to the immediate suffering caused, it is likely that an equally large number of families have been torn by the death or serious disability of a member (though family-level data are not yet available). This will have long-term consequences on the well-being of other members, particularly widows (especially young women), single parent children, orphans, and the elderly. There have been more adult female than male deaths, and a large number of children were also killed. Similar differences are likely among the injured.

2.80 Other social impacts of the earthquake include deep insecurity among those who have lost assets, and increased risks among them to impoverishment. About 400,000 houses have been destroyed by the earthquake and a larger number were damaged. The livelihoods of many families have been disrupted, particularly among those residing in the worst affected towns and villages. About 19,000 handicraft artisans, the backbone of the Kutch district's economy, appear to be one of the most severely affected groups. In addition, several thousand salt farmers are faced with the collapse of their brine wells and destruction of salt fields containing the salt of up to two years labor. Many salt refineries are also damaged, which will hamper the export of salt from the region. Kutch alone accounts for 80 percent of India's salt production, and 80 percent of its facilities are reportedly dysfunctional. Another important source of livelihood in Kutch is cattle – about 20,000 cattle deaths have been reported. Economic recovery has been hampered by the outflow of people, including normally migrant workers, such as laborers on the salt farms in the affected areas.

2.81 Insecurity also stems from the repeated tremors in the region and the continuing drought. Though the people of Kutch are known for their strong independence and resilience, among those who were poor prior to the disaster, there may be a sense of helplessness and dependency (particularly on the Government). Rapid mobilization on the part of the Government has provided food grain and cash to affected families, initially at major population centers, but progressively reaching out to the more remote villages. NGOs, philanthropic groups, development agencies and private businesses have stepped in to supplement the Government's efforts to provide food, medical services, clothes, blankets, utensils, basic supplies, and tents. In spite of all their problems, however, the Kutch community has resisted putting orphaned children up for adoption. This demonstrates an expression of community solidarity and mutual support in a time of need, and is an indication of the will and ability of the communities to organize and rebuild their lives.

2.82 Another serious consequence of the disaster is an almost complete lack of services in the worst-hit villages and urban areas, including education, health, water supply, electricity, solid waste disposal, and agricultural extension. Most Gujarati villages are usually well served by these, but both public and private services are largely at a standstill, though drinking water is being provided in many places by tankers and electricity has now been largely restored. The Government is making a serious effort to restart schools—often in tents, but the large number of buildings destroyed and extensive household disruption mean that many children may still not be at school. Markets and banks have begun to function in the less affected areas, but are still limping back to normal in the worst situations.

E. Environmental Impacts (Annex 15)

2.83 Due to previous cyclones, ongoing drought, and previous flooding in the major urban centers of Ahmedabad and Surat, the earthquake has hit the region during a time of extreme environmental vulnerability. In addition to damage to dwellings, infrastructure and facilities, the earthquake has resulted in a number of environmental impacts. The earthquake will also have indirect environmental impacts associated with debris disposal, temporary shelter set-up and the reconstruction effort. Moreover, there are a few areas where the environmental impact is as yet unclear and which require ongoing environmental monitoring.

2.84 The major **direct environmental impacts** include: (a) debris and rubble removal and disposal, which has been estimated at 10 to 20 million metric tons (MT) in urban areas and 15 to 30 million MT in rural areas; (b) impacts and residual risks from damage to industrial facilities; (c) impact to water and water management resources; and (d) impacts to municipal and industrial environmental infrastructures such as sewage and wastewater treatment.

2.85 A number of **indirect environmental impacts** are also anticipated and, where appropriate, should be monitored and mitigated. The more significant indirect impacts include: (a) poorer sanitation and waste management practices; (b) increase in industrial pollution due to reconstruction activities requiring millions of tons of construction

materials, and (c) changes in land use due to need for rubble disposal sites and potential relocation of villages.

2.86 As all environmental impacts cannot yet be assessed, the development of a comprehensive environmental monitoring program becomes an important priority. Key sectors with yet **unknown environmental impacts** include: (a) potential impact of the earthquake on aquifers and groundwater movement, and (b) potential impact on ecosystems.

2.87 In all cases, appropriate monitoring and mitigation measures should be developed to minimize the environmental impact of the earthquake whenever and wherever possible, while considering the special extreme circumstances that now prevail.

SECTION 3. RECOVERY STRATEGY

A. Overall Approach: Empower Communities and Mitigate Social Impacts

3.01 While the aggregate impacts of the January 26 earthquake on Gujarat and India's output may be relatively small, the disaster was truly an event of catastrophic proportions at the community level. The overall situation can be considered a multiple disaster, since the earthquake is the third natural disaster to strike the state in four years. Gujarat still suffers from the effects of a cyclone in 1998, and drought which started in 1999, and which is expected to continue through 2001. The impact on the vulnerable population increases with each new disaster.

3.02 The social fabric of the earthquake-hit areas has been seriously affected by the large number of human deaths and injuries. And while there will be lasting scars, the people of Kutch are known for their strong sense of independence and resilience in the face of crises.

3.03 There are some obvious immediate priorities that need to be addressed in the reconstruction strategy. First and foremost, the **provision of temporary shelter** is urgent before the onset of the monsoon season in July. Simultaneously, the reconstruction of the devastated housing stock needs to be launched. An owner-driven, *in situ* housing reconstruction process is likely to lead to fast reconstruction and genuine acceptance by beneficiaries. Relocation of entire towns and villages may lead to considerable delays and may also dampen owner-driven reconstruction. Implementation should be decentralized, while the quality control of earthquake and cyclone resistant construction, financial management and procurement procedures would be coordinated by the newly created GSDMA.

3.04 Restoring lost records of property rights to housing, commercial property, and land should be launched as soon as possible, with special efforts made to assist the poor, scheduled castes, and squatters, who may have greater difficulty demonstrating legitimate property rights. Appropriate levels of indemnity will need to be identified for different income groups.

3.05 Second, there is an urgent need to **restore public services**, including health, education, water supply, power, communications, municipal and environmental infrastructure, and state administration. Careful prioritization of this reconstruction will be necessary. Even with substantial external financing, rebuilding everything at once is unlikely to be affordable or necessarily desirable. Appropriate standards for reconstruction need to be identified, which take account of the area's natural hazards but are not over-specified.

3.06 Third, efforts will need to be made to **secure the livelihoods** of vulnerable people in the earthquake-affected areas. Such support will need to be rapid if it is to be effective. It will need to be well targeted if it is to be affordable. It will need to be designed so as not to displace private enterprise and self-help if it is to be sustainable.

Cash grants or wages in return for rubble removal, production of building materials such as bricks or concrete blocks, or reconstruction work would be options to consider.

3.07 Subsection B discusses the needs and an initial strategy for reconstruction of sectors hit by the disaster. Experience from reconstruction efforts for previous disasters in India and other countries suggest that the following **core principles** are key to a successful reconstruction program, and should be integrated into each sector strategy.

- ***Revival of the economy:*** There is an urgent need to **restart the economy** of the affected areas, which can be done in part by providing wage employment to local people for debris removal, construction, and the restoration of heritage sites. This type of program, if well designed, minimizes the potential for mistargeting. Transfers to households, for consumption or investment purposes, could also be envisaged.
- ***Empowering individuals and communities:*** While relief and charity are important in the immediate aftermath of a natural disaster, they should be replaced as soon as possible with efforts to foster **ownership and involvement of the people**. Relief assistance may already be creating an environment conducive to competition for handouts, community conflict, and dependency. Greater local participation and contributions to the reconstruction effort could reduce social tensions and lead to more sustainable development efforts. The majority of reconstruction efforts should be undertaken by affected people themselves.
- ***Affordability, private sector participation, and equity:*** Reconstruction of private and public property and efforts to revive the economy should take into account: **(a) potential impact on public finances; (b) use of available private sector participation and financing; and (c) relatively greater public assistance to those most in need**. The impact of the earthquake will further strain Gujarat's public finances. It is important, therefore, that reconstruction efforts seek to rationalize expenditures and carefully review standards at which reconstruction of both public and private housing and other infrastructure will take place. While it is the government's intention not to crowd out private sector and individual initiative, it is important that it continue to leave room for private initiatives on the part of the surviving victims themselves, as well as businesses wishing to share their burden. Public assistance and reconstruction efforts should prioritize those in greater need, and it is important to ensure that public policies and the incidence of public expenditures is pro-poor.
- ***Decentralization: Community-driven reconstruction must be at the heart of the state's recovery program***. Therefore, the development of effective networks that facilitate a necessarily decentralized system for recovery will be key to the success of the program. Decisions to relocate or rebuild *in situ* destroyed villages, for instance, should follow a clear, transparent and participatory approach to assess the wishes of the villagers and discuss the costs of different options. Locally elected bodies, where these exist, should be given a significant role.

- **Communication and transparency:** Communication and information dissemination are important to the successful and harmonious implementation of the earthquake recovery and reconstruction program. Policy initiatives, financial assistance, and technical know-how will not be effective without a system to convey their content swiftly and equitably to the public, to hear of and assess their suitability and sustainability within communities, and to **make appropriate adjustments based on community feedback**. There is thus a need for the Government to quickly devise a **communication strategy** to support the recovery program and ensure **effective dialogue between the government, the public and other partners**. An effective grievance redressal mechanism would be a necessary corollary of such a strategy (Annex 1).

B. Immediate Needs and Medium-term Strategy for Each Sector

3.08 The following recommendations on immediate needs and medium-term strategies for sectors draws on the provisional analysis conducted by the Government and the assessment mission. However, the analysis is necessarily highly provisional at this stage. Since financing will inevitably be limited, it is imperative that the GOG conducts rapid but rigorous further analysis of all spending proposals, taking full account of the opportunity costs and recurrent cost implications of different options. More than ever, following a disaster, it is essential to **prioritize and carefully phase investment**. This analysis should be conducted jointly by the Finance Department and the relevant line departments over the coming weeks.

Housing Recovery and Temporary Housing (*Annex 2*)

3.09 **Immediate needs.** The provision of temporary shelter before the monsoon in July is a top priority for the affected communities of Gujarat. Such shelter should have a life expectancy of at least two years while the reconstruction process unfolds. While rural dwellers would receive reusable building materials and technical assistance necessary for shelter construction in their own yards, urban residents would likely be served by cluster type arrangements of individual family shelters, which would be constructed by private contractors. Another immediate priority is to continue with debris removal from the totally destroyed urban sites through the use of heavy equipment, organized/subsidized by big industrial houses and the Government. In rural areas, debris removal is being done by the people, who salvage and recycle the reusable materials. In order to expedite the rubble removal process in rural areas and assist the people to have remunerative work, GSDMA will initiate rubble removal relief works, whereby each participating person will receive about Rs. 40 (\$1) a day. Besides the temporary shelter, immediate needs also include capacity building requirements, and measures to ensure transparency through formation of village-level committees and wide-scale information dissemination. These are discussed below.

3.10 **GOG reconstruction strategy.** The massive reconstruction efforts to respond to this large-scale destruction of private property are expected to be broadly guided by the rehabilitation and reconstruction policy announced by the GOG within three weeks from the day of the earthquake. It comprises four packages: (a) demand based grant assistance

for relocation of 256 villages where more than 70 percent of the housing stock has been destroyed, at an estimated cost of Rs. 30 million per village, including grants for land and housing as well as public facilities; (b) *in situ* reconstruction or repairs of housing in villages and towns located in areas declared as the worst affected in zones 4 and 5; (c) *in situ* construction for destroyed or damaged housing in the less affected zone 3, and (d) a package of grant based compensation in urban areas. A special fifth package is still to be developed for the four badly affected towns in Kutch district, Anjar, Bhachau, Bhuj, and Rapar. The policy helped define the government's approach to housing assistance. However, a number of concerns will need to be addressed in its design and operationalization.

3.11 The most important concern is an implicit emphasis on relocation of the heavily affected villages. While in principle, this decision will be locally decided, there are implicit incentives for relocation in the announced policy. International, and Indian experience from Maharashtra, suggests that *in situ* reconstruction is far more sustainable in the long run. Costs of relocation are far higher. Importantly, local opinion, as voiced by several NGOs, as well as several spontaneous civil society meetings shows a clear preference for *in situ* development. In many of the affected villages, households have already initiated work on their own plots. It would, therefore, be good to review the implicit preference in the policy for relocation, and support an informed and participatory decision process at the village level. Where villagers prefer to stay where they are, and unless there are public safety reasons for relocation, it would be appropriate to assist the villagers to rebuild *in situ*. Similarly, the considered views of urban dwellers should also be taken into account before decisions on relocation are taken. A participatory decision making process will be important to finding the best solutions for the communities concerned.

3.12 Other design concerns with the GOG strategy relate to the implicit inequities in the proposed packages and inadequate definition of house types and nature of damage. Rather than offering an equal grant to all affected households, and loan assistance for those with higher demand, the strategy, either directly or implicitly, offers higher grant assistance to those with larger houses, in larger urban centers and in zones 4 and 5. On the other hand, the poor and low income groups will receive a higher proportion of total cost of reconstruction as grants. Also, many of the other groups have lost housing and business related investments, comprising total life savings in most cases. Lack of clarity in definitions, however, may result in undue discretion and subjectivity at the ground level. Greater clarity is also necessary in deciding whether entitlements will accrue to owners or “occupants”, in issues of illegal land tenure, and in assessing legality of construction as linked to built up areas of construction. These concerns will need to be addressed in the damage assessment process.

3.13 GOG will need to undertake its ongoing more detailed damage assessment of the housing sector in an open, participatory, and transparent manner to ensure its local suitability and ownership. The GOG has already initiated the process of damage assessment for entitlements under different packages in rural areas. To ensure transparency, GOG has included three members in each assessment team, including a person from the revenue department, an engineer and an independent NGO or social

worker from the area. Adequate training is, however, necessary to ensure consistency across field workers. To ensure transparency at the local level, additional measures such as some evidence of entitlements for each household and appropriate public display of all entitlements will also be useful.

3.14 Approach to recovery strategy. Within the GOG's announced strategy, the recovery strategy will need to address the issue of standards in relation to an agreed level of disaster resistance and the nature of cost sharing envisaged. Within agreed general standards, the recovery strategy will encourage an owner driven approach with varied designs and materials. House designs (by households) will also help to incorporate concerns related to the "house as a workplace", which is common in rural Kutch. The use of local materials will be promoted as far as possible. Cost sharing is envisaged in three different ways: (a) in those villages where "partners" will be involved, it is expected that 50 percent of total costs will be shared by corporate houses, large NGOs, other agencies including state governments or any other donors; (b) the households may bring in their own savings or labor to share the costs of reconstruction; and (c) wherever possible, households may also seek to mobilize financing, though the government support for this is envisaged only in terms of facilitating information.

3.15 The key to the success of the strategy will be in appropriate implementation arrangements and ensuring local suitability and ownership and an owner driven construction process. Under the announced strategy, three models of implementation arrangements may be used: (a) the first model, implementation management responsibility will be with the "partner" (corporate/other agency) in association with local NGOs. The GOG has already received commitments for over 100 villages. In such arrangements, common maximum standards will need to be maintained, to avoid islands of high standards; and (b) the second model, in other villages, implementation will be facilitated by NGOs. NGOs in Gujarat have good capacity and outreach; they have participated extensively in the relief efforts in partnership with government. Many have indicated interest in rehabilitation efforts. However, effective capacity building support to the local NGOs will be essential as their experience is limited for reconstruction activities; (c) only in villages where NGO facilitation is not possible, the implementation process will be facilitated by professionally engaged social development consultants. At the village level, village *navrachna* (reconstruction) committees (VNS) will be formed with representation of all communities and adequate gender balance. Tripartite agreements outlining responsibilities of each partner--the VNS, local partner or NGO, and GSDMA--will guide the process and payment mechanisms. Payment of installments, following a first cash advance, will be against progress in work, monitored by NGOs with independent technical and financial audit.

3.16 For this massive effort to be successful, adequate support to these implementation arrangements will be required through: (a) development by the GOG of a panel of partners and NGOs, with associated capacity assessment; (b) a sustainable and effective capacity building strategy through building centers, production of education and training materials, capacity building of local NGOs and community based organizations, and development of demonstration buildings, including formation of VNSs; (c) effective supervision and monitoring arrangements with financial and technical audit, as well as a

grievance redressal system; (d) while the main focus will be on local materials, GOG will monitor prices of key construction materials to ensure easy and cost effective access and to take quick action in case of undue price hikes; and (e) an information dissemination and transparency strategy to ensure full local awareness, demystifying the disaster resistant construction technology, and informed and participatory decision making.

Health (*Annex 3*)

3.17 Relief measures have been provided efficiently with the collaboration of all sectors and partners; Government, NGOs, and the donor community. Temporary hospitals and a disease surveillance system have been established, immunization services are being reestablished, and a program for post-traumatic stress management has been initiated. It will be an immediate challenge to ensure access to curative and preventative health services to all people and areas, to maintain hygiene and sanitation at the temporary hospitals and relief camps, and to effectively manage post-traumatic stress.

3.18 The two top priorities in the health sector are to reconstruct the destroyed health facilities in order to restore proper delivery of health care, and to establish a central workshop for rehabilitation and prosthetic appliances at Bhuj. The existing private sector health providers in Bhuj have suffered major losses, but they do have the option to relocate outside Kutch. Therefore the public sector will continue to be the main provider of health services in the affected areas. As a first step in the rebuilding process, rationalization of service norms based on past utilization rates data is being done by the State Health Department, and a reconstruction strategy can be developed from this exercise. As the majority of injuries from the disaster are orthopedic/spinal injuries and amputations, the need for a rehabilitation center and prosthetic appliance workshop is key for the long-term management of these patients. It would be desirable to provide psychotherapy and counseling at the center as well, in order to build capacity for the long-term management of post-traumatic stress.

3.19 The extensive damage sustained by health facilities points to the urgent need to design and construct hazard resistant buildings (*Annex 2b*). This upgrade in technical norms will reflect in replacement costs being higher by about 20 percent over the base replacement cost. All building plans and designs should be reviewed by an architect/structural engineer to ensure appropriate hazard-resistant standards. District hospitals should be completed in about 18 months; taluka hospitals and PHCs in about 12 months; and subcenters and anganwadi centers in about eight months. The replacement cost with upgrade is estimated to be about Rs. 279 crore (\$60 million).

Education (*Annex 4*)

3.20 In order to restore some normalcy and routine, the GOG's immediate goal has been to start primary schools in centers comprising clusters of six to eight villages. About 300 such clusters are to be established in the affected districts. Since teachers in these districts were initially reluctant or unable to attend school, officers from nonaffected districts were deputed to these centers to resume instruction in primary school centers. Tents, water facilities, toilets, mats, teaching and learning material, and

family survival kits are to be provided by UNICEF for these centers. Trauma identification and treatment centers facilitated by NGOs and the Mumbai based Nirmala Niketan social work organization will also be located in these centers. The textbook board has provided 20 sets of textbooks for each cluster.

3.21 In secondary education, schools have become operational in tents. Students not in tenth and twelfth grade will be promoted to the next grade using local assessment, and not through examinations. Procedures are in place to enable students to transfer to another taluka or district without delay, if they so wish. Board examinations for grades 10 and 12 have been postponed by a month, and students who wish to take these examinations in nonaffected talukas are provided board, lodging and tuition through voluntary organizations. Examinations in higher education have also been postponed by two weeks. Temporary relocation of both higher and technical education students to institutions in nonaffected districts is in progress.

3.22 The immediate priorities for the education sector are to: (a) reconstruct collapsed classrooms and repair damaged classrooms in primary, secondary, teacher training and technical institutions; (b) rebuild kitchen sheds; and (c) set in place a counseling program that will address the needs of psychologically affected students and teachers. Strategies for addressing the damage in higher education institutions and grant-in-aid secondary schools are being explored.

3.23 GOG intends to rebuild and repair government primary schools within the year, and government secondary schools within the next two years. The structure and processes for the construction of buildings, in place in the ongoing District Primary Education Project II, supported by the Netherlands and the World Bank, will be used to reconstruct and repair primary education buildings in the affected districts. The designs used will be revisited to ensure affordable earthquake resistant models with the help of the Center for Building Research, Rourkee. The designing and implementation of reconstruction and repair of secondary education institutions, kitchen sheds, teacher training colleges, and technical education institutions would need to be finalized. GOG indicated that about 20 percent of the estimated cost for reconstruction and repair is for earthquake resistant designs and construction.

Dam Safety and Irrigation (*Annex 5*)

3.24 The critical safety and strategic nature of the reconstruction works will require urgent actions in both the immediate and medium-term. The 21 severely affected dams which would breach, causing serious risk to life and property, if not either reconstructed or cut open (so that the water is not stored) before the onset of the July 2001 monsoon are particularly urgent. It is possible that there may be other dams where damage is so extensive that they present high risks. A number of other earthen dams also present risks unless repaired and strengthened by July 2001. All of these dams are sources for rural and urban drinking water, industries and agriculture, and their full functioning by July 2001, or latest, by July 2002 is a strategic priority. Although cost estimates are provisional and subject to adjustment after the further inspections by the dam safety panels, it appears that the urgent short-term financing needs are about Rs. 70 crore (\$15

million) by end June 2001, and potentially up to a further Rs. 349 crore (\$75 million) in the medium-term until March 31, 2003. The aim is to start providing full irrigation and drinking water benefits by impounding the waters from the July 2002 monsoon, and to complete the reconstruction and related software activities if possible by March 31, 2003. The Water Resources Department of the GOG will be the responsible agency for the implementation of recovery efforts in this area.

3.25 As discussed in Annex 5, the program to thoroughly inspect all dams in the affected areas and to undertake remedial, rehabilitation or reconstruction works, some on an urgent basis, will require very tight management and parallel or rapidly sequenced actions. GOG's Water Resources Department will establish two dam safety panels of recognized technical experts and also deploying personnel, equipment and contractors on an urgent basis. Three severely damaged critically needed dams (for drinking water supplies) will be reconstructed on emergency force account basis before the 2001 monsoon. Repairs on other dams will also be undertaken. Those dams that are so severely damaged that they present immediate risks for the 2001 monsoon, yet which cannot be reconstructed before the monsoon, would be cut open to ensure public safety.

Rural Water Supply (*Annex 6*)

3.26 The temporary measures already undertaken by the Government to restore water supply (tankers, tractors, diesel generating sets, etc.) will need to continue over the next nine months, though on a declining scale.

3.27 GOG and the Gujarat Water Supply and Sewerage Board (GWSSB) have planned a range of medium-term measures to provide sustainable and reliable drinking water supply to affected areas which can stand multirisk situations covering cyclones and earthquake. These measures are aimed at ensuring bulk water supply to 14 towns, and bulk supply as well as internal distribution in all the affected 1,300 villages (beneficiary population about 0.4 million urban and 0.7 million rural). This involves repairing/replacing damaged properties to achieve functional equivalence of the destroyed capital assets (tubewells and pumps, pipeline repairs) and, in some cases, their possible upgrade to mitigate higher risks (e.g., all civil works, pipelines, dams, water treatment plants). In the case of water supply pipelines, where cost-effective, mild steel (MS) and ductile iron (DI) pipes might be used, which would have more flexibility and strength to encounter earthquake impacts. Where appropriate, greater use of expansion joints, and thrust and anchor blocks should be ensured to minimize disruptions in pipeline alignments.

3.28 Possible medium-term reconstruction measures, costing up to Rs. 451 crore (\$97 million) in total are:

- (a) for the Tappar and Shivilakha surface water systems, replacement of intake structure, pumps, large pipelines and water treatment plant;
- (b) repairs/drilling of about 400 deep tubewells and pumping installations;

- (c) reconstruction of local distribution systems and tanks in 1,300 villages;
- (d) subject to careful cost-benefit analysis, replacing transmission pipelines of possibly some 2000 km length by metallic pipes (MS, DI) which are less susceptible to earthquake effects; and
- (e) other works such as pump houses, and intermediate balancing tanks.

3.29 **Recovery Strategy.** GWSSB intends to adopt the following prioritization criteria for implementation of its rural water supply recovery program (this includes bulk supply arrangements to 18 towns):

- Works that can be done within a period of six to nine months to restore as far as possible pre-earthquake service levels (benefits) to the maximum population. These are: repairing/drilling of bore wells, installing pumping equipment, village-level works and priority transmission pipelines.
- Subject to cost-benefit analysis, start other identified works but which will take between one to two years for completion. The design and construction of water supply schemes to towns and villages which may decide to relocate, would be taken up only after final decision on their relocation has been taken. The current estimates assume their *in situ* rehabilitation and reconstruction.
- Encourage NGOs to assist village communities in planning and implementing village-level works.
- Limit the above measures to rehabilitating/replacing the damaged properties to deliver pre-earthquake functional equivalence and not include further expansion or augmentation of water supply.

Repairs and particularly replacements should be with materials and specifications designed for higher earthquake resistance and protection against other hazards.

Municipal and Environmental Infrastructure (Annexes 7 and 2b)

3.30 The ongoing relief efforts have somewhat restored basic levels of essential services such as power, water and transportation. However, there is a continuing problem with water supply and sanitation in the temporary shelter areas. In addition, thousands of people remain without normal basic services to their homes. The Urban Development Department (UDD) and the GSDMA have developed an initial strategy for restoration of basic services in larger urban areas, with a three phase approach: (a) **immediate needs** to restore essential services such as water supply, power, sanitation, and roads to a level that will sustain both the people still remaining in their homes and the large displaced population; (b) **medium-term**, for the next two to three years, to rehabilitate and reconstruct the urban infrastructure and civic facilities; and (c) **long-term** to develop improved capacity at the local level enabling them to properly operate and maintain their

local systems for which they have become responsible for under the 74th Constitutional Amendment.

3.31 **Immediate needs.** Efforts to address immediate needs will require careful planning to ensure that the most cost effective and efficient approach is followed, and that interim measures can be readily incorporated into the permanent works undertaken in parallel. This plan should be prepared with extensive community input to determine solutions to housing relocation issues related to loss of private property to enable widening of roads and providing for adequate sized building plots. The cost of rubble clearing will be in the order of one third that of constructing new sites and services.

3.32 In order to achieve this, the following steps are envisaged:

- establishment of a reconstruction committee in each town, with civic leaders and elected or appointed representatives from the major interest groups and cultural communities, participating in the decision making process of the administrative authorities, and the monitoring of the reconstruction works;
- public consultations and information campaigns to explain the strategy and procedures;
- detailed examination and testing of existing public structures and systems to determine what is structurally sound and suitable for rehabilitation and use as is, or if it should be demolished;
- temporary repairs to restore water and sewerage systems as much as possible through patching, jury rigging above ground lines, and setting up a regular tanker service for water to unserved areas and the numerous temporary camps around the major centers;
- rehabilitation of superficially damaged buildings on a permanent basis; and
- removal of rubble to enable private house and building owners and builders to access their sites, and to clear the roads of the current congestion and dangerous driving conditions.

3.33 **Medium-term reconstruction.** This phase will continue for the estimated two to three years required to complete rehabilitation and reconstruction of all facilities and systems, incorporating standards and specifications to strengthen the reconstructed facilities against damage from disasters. The urban planning initiated in the first phase would be expanded to incorporate future requirements into the reconstruction. During this period, all works would be completed to enable full restoration of services. This could include new building sites for swapping or sale to existing owners who elect to relocate their houses or businesses. This period will also require a rationalization of the local civil service and a massive training program so they can properly operate and maintain the new systems. The reconstruction does afford an opportunity to institute such changes since the involved staff could practice their newly acquired skills by taking

advantage of the expertise and specific capacity building programs provided under the reconstruction program.

3.34 Long-term. In the longer-term, strategies need to be developed and installed for coping with future disasters, to reduce the delays and problems incurred in the recent earthquake. The Kutch region unfortunately suffers from near-annual calamities related to cyclones and droughts. In the past, municipalities have been fully dependent on the state to provide emergency services, relief and rehabilitation from these calamities. Disaster management capability needs to be developed at the local municipal level (refer to section on disaster management). The municipalities have been very dependent on grants and subsidies from the state to manage, operate and maintain local services and public facilities. For example, in one town visited by the assessment team, the local cost recovery for water, sewerage and solid waste was less than 10 percent of the cost of operation. This has caused severe deterioration of all facilities, which undoubtedly contributed to the extensive damage caused by the earthquake, and deteriorating levels of service. Once recovery from the earthquake is well underway, rationalization of property taxes, water tariffs, and fees for sewerage, sanitation, and other services should be instituted through a plan to achieve cost recovery of the operation and maintenance costs. The total cost of reconstruction is estimated to be Rs. 209 crore (\$45 million).

Public Buildings (*Annex 8*)

3.35 Short-term (next 18 months) needs. The R&B Department is responsible for the repairing and rebuilding of administrative buildings and residential quarters, and it has already started to do some minor repairs. Temporary office and housing arrangements will be necessary while some buildings are repaired or reconstructed. Major repairs and strengthening of buildings, as well as design of new buildings with improved standards, can be carried out in the next 18 months.

3.36 Medium-term (two to three years) needs. Many administrative buildings, police stations and outposts, and residential quarters will have to be reconstructed in the next two to three years. In addition, it is essential to carry out a comprehensive survey of critical public buildings to develop and implement a state-wide retrofitting program. The Department of Sports, Youth and Culture has already taken the immediate steps to commence minor restoration works and prepare detailed conservation reports of badly damaged monuments. It is also exploring financing sources that could be approached to carry out restoration works, including specialized international agencies and corporate sponsors.

3.37 Reconstruction Strategy. The R&B Department has prepared a short-term program to be implemented in the next 18 months, which would include: provision of temporary office space (temporary residential accommodations to be provided through regular provision of temporary housing); minor and major repairs and strengthening to damaged buildings, and preparation of designs for buildings to be reconstructed in the next two to three years. The total cost of reconstruction is estimated to be up to Rs. 442 crore (\$95 million).

Power (Annex 9)

3.38 **Needs.** The **immediate needs** include repairing the equipment of the Kutch Lignite Thermal Power plant; replacing the diesel generator at Bhuj; and, repair of the transmission and distribution network, transmission lines, and substations. The damaged equipment had been installed many years back and have become obsolete, and spare parts are not available. These will have to be replaced with new equipment. However, such *ad hoc* replacements will not be sustainable, as equipment of different reliability and fault levels will be operating in the same system. Such a mismatch would contribute to operation problems. Therefore, for the **medium-term**, GOG and Gujarat Electricity Board (GEB) have planned a range of measures to ensure reliable functioning of the power transmission and distribution systems, and to improve systems efficiency. These measures include converting rural feeders from low-tension to the high-tension system, installation of meters for rural connections, providing capacitors and computerization of billing.

3.39 **Recovery strategy.** Temporary restoration of power supply has been done in most of the affected areas. However, the asset losses are considerable, and replacement of the old equipment will not be sustainable. Therefore, modern equipment will need to be installed, where appropriate, to enhance the reliability and efficiency of the power system in the region. The immediate needs will have to focus on repair and reconstruction of substations and accommodation of operating staff. The medium-term needs will focus on replacement of equipment, transmission lines, transformers, and computerization. GEB will be the implementing agency for the restoration works. An expert in the design of multihazard protection measures, especially earthquake resistant structures, will be required to prepare the specifications, designs and construction methods. The expert will also ensure that the approved procedures are being followed at site. The total cost for restoration and upgrading of the affected power system could be up to Rs. 456 crore (\$98 million).

Transport (Annex 10)

3.40 **Rehabilitation and reconstruction needs.** The estimated cost of short-term (within 18 months) rehabilitation/reconstruction of transport infrastructure is about Rs. 479 crore (\$103 million): (a) roads, Rs. 256 crore or \$55 million; (b) railways, Rs. 93 crore or \$20 million; (c) ports, Rs. 121 crore or \$26 million; and (d) airports, Rs. 9 crore or \$2 million.

3.41 **Recovery strategy.** The recovery strategy will focus on restoring the full carrying capacity and efficiency of all of the subsectors of the transport sector to enable the movement of people, goods and services in the earthquake affected districts of Gujarat. What follows is the short-term recovery strategy broken down by transport subsectors:

- **Roads:** the immediate focus is on the rehabilitation and reconstruction of damaged structures (e.g., bridges and culverts) followed by the rehabilitation of road stretches that have been damaged or further damaged by the earthquake;

- **Rail:** the focus will be to restore the rail link to the Navlakhia Port and full capacity on the Virangam-Gandhidam broad gauge line. This should be completed within the next six months and Indian Railways will be responsible for its implementation;
- **Ports:** the emphasis will be to rehabilitate/reconstruct the Kandla and Navlakhia Ports. The rehabilitation of Kandla and Navlakhia should be completed within about one year and GOG and GOI will be responsible for implementation; and
- **Airports:** the focus will be to accelerate the construction of the replacement air terminal at Bhuj and to complete the reconstruction of the air terminal at Kandla. This program should be completed within one year and will be implemented by the Airports Authority of India.

3.42 With the exception of the minor private ports, the public sector (GOG and GOI) will be responsible for managing and funding the implementation of the recovery/reconstruction strategy in the transport infrastructure sector.

3.43 In addition, GOG has already started to identify a targeted state road rehabilitation and reconstruction program to be implemented within the next one to five years in the districts most affected or prone to natural calamities. The cost of this program is estimated at about Rs. 419, 465 crore (\$90 to \$100 million), and will focus on increased maintenance and rehabilitation of key state roads in the earthquake affected districts. Thus, the estimated combined total requirement for the state road sector during the next five years could be as much as Rs. 651 to Rs. 698 crore (\$140 to \$150 million), excluding the eventual cost of building new state roads to connect any relocated towns and villages.

Telecommunications (*Annex 11*)

3.44 **Needs.** The reconstruction priorities in the immediate and medium-term, in light of assessed damages, will be to repair all the remaining lines as soon as possible. This has been taken up. Temporary housing has to be arranged for the staff, in addition to providing alternate locations for the telephone exchanges. To restore the entire telecommunication system Bharat Sanchar Nigam Ltd (BSNL) has estimated an expenditure of Rs. 51 crore (\$11 million). Another Rs. 70 crore (\$15 million) will be required to construct the new exchange buildings, offices and 850 staff houses. The cost of the staff houses will be borne by BSNL, and are not included in the state government estimates.

3.45 **Reconstruction strategy.** Telephone exchange equipment has been brought in from various locations within the Gujarat Circle and also from other circles. Line testing work has started, with about 54,000 lines charged. The remaining would be charged within the next few weeks. Staff have been provided alternate temporary accommodation, till such time permanent arrangements are made. Action has been initiated for the procurement of equipment and construction of exchange buildings, offices and residential accommodation. All structures will be designed taking into

consideration the need for multi hazard risks. A time frame of about 12 months is envisaged, at this stage, to achieve full restoration including civil works.

C. Addressing Environmental Issues (Annex 15)

3.46 There are several issues related to the most pressing reconstruction activities, such as rubble removal and temporary housing, that have important environmental and health implications. First, the disposal of rubble in urban settings requires that guidelines be issued promptly to avoid haphazard disposal and additional costs through the repeated loading and dumping of waste materials. The guidelines should address siting issues and be based on basic principles which minimize environmental impacts. Removal and disposal of rubble from industrial facilities must consider the likely presence of hazardous substances. Recycling and reuse of rubble in noncritical applications should be considered whenever and wherever possible. Specific instructions should be issued with regard to rubble removal/movement from heritage sites.

3.47 In addition, community environmental management plans should be developed for the proper management of environmental issues, mainly sanitation and waste management, in camps set-up as temporary shelter for earthquake victims. Other immediate and short-term needs and actions include: (a) inspection of dams and water management schemes before the next monsoon season; (b) development of short-term environmental monitoring to effectively mitigate residual environmental risks that arise from the damage and/or weakening of industrial infrastructure; and (c) technical assistance for reconstruction efforts of environmental institutions.

3.48 In the medium-term, there are several environmental actions that are recommended to further support an environmental risk mitigation strategy and sustainable reconstruction effort. Key actions include: (a) undertaking a comprehensive environmental impact assessment; (b) assessing and monitoring industrial risks especially for industries producing, handling, storing or transporting hazardous materials (including the development of emergency response measures and capacity); (c) strengthening of the institutional capacity and environmental governance framework; (d) introducing cleaner technologies; and (e) as part of its reconstruction efforts, the Gujarat Institute for Desert Ecology (GIDE) should consider adopting stricter environmental guidelines for the industrial estates that it is rebuilding as a further measure for environmental governance and sustainability.

D. Disaster Risk Management for the Short- and Long-term

Immediate Needs and Actions

3.49 As mentioned previously, the GOG established the GSDMA in response to the earthquake to manage and coordinate the implementation of the reconstruction program. Recognizing the high level of exposure of Gujarat to a number of natural and technological hazards, the mandate of the GSDMA was quickly broadened following its establishment to include the forward looking issues of long-term disaster risk reduction for all hazards facing the state. The agency's immediate focus, however, will be on the

earthquake recovery efforts. This points to the immediate need to develop the capacity of GSDMA to: (a) coordinate with all relevant line agencies and stakeholders involved in reconstruction; (b) provide financial management of the Gujarat Earthquake Rehabilitation and Reconstruction Fund, also newly established, and (c) monitor progress of the overall program.

3.50 It is critical for sustainable reconstruction efforts that appropriate and affordable antiseismic designs, using local materials and construction techniques, are quickly developed and disseminated to builders at the state, district and local levels, and that programs are established to train workers in the construction industry in their use. Furthermore, construction monitoring and code enforcement should be carried out throughout the building process, and inspections should be conducted of completed works. Critical structures that were not destroyed in the earthquake, such as schools, hospitals, essential infrastructure, congregation areas, administrative buildings, monuments and hazardous industries should be retrofitted to conform to hazard-resistant standards.

3.51 There is also an immediate need, capitalizing on the strong public awareness and expectations for improved disaster management following the earthquake, to develop a comprehensive and sustainable disaster risk management program. This is supported by the favorable environment at the national level through the work of the Government of India High Powered Committee set up in August 1999 to draw up national and state-level disaster management plans and earlier/ongoing work undertaken in other states, notably in Andhra Pradesh, Maharashtra, Orissa, Uttaranchal, and Uttar Pradesh.

Long-term Disaster Risk Reduction

3.52 For the reconstruction efforts of Gujarat to be truly sustainable, it is necessary to develop long-term disaster risk management capacity. This is not only necessary for the Government, but needs the active participation of the private sector, NGOs, and local communities.

3.53 There are three main components to a comprehensive disaster risk management strategy: (a) identifying the hazards one is exposed to and the vulnerability to those hazards; (b) reducing the risks by taking steps to prevent or prepare for potential impacts; and finally (c) transferring or sharing the portion of risk that cannot be reduced. Each component is discussed briefly here, with some specific areas suggested for further development in Gujarat.

3.54 **Risk identification: assessing hazards and vulnerability.** Any effective strategy to manage disaster risk must begin with identification of the hazards and vulnerable populations. In this way, informed decisions can be made on where to invest, and how to design sustainable projects that will withstand the impacts of potential disaster events. In addition, a more complete understanding of the full economic, financial, and social impacts of disasters on a country or state help to demonstrate the importance of including risk reduction measures in any development strategy.

3.55 Hazard distributions are well understood in Gujarat, as described in the *Vulnerability Atlas of India for Gujarat, 1997*. Further research can be done, however, on establishing the probabilities of future earthquakes and microzoning for land use planning purposes. As hydrometeorological hazards also pose significant threats, existing observing and forecasting systems should be evaluated and upgraded where necessary. Additional work may also be needed to document industrial/technological hazards throughout the state.

3.56 Finally, a comprehensive vulnerability assessment should be done for each hazard, including drought and technological hazards, that includes nonstructural factors that contribute to vulnerability. These include livelihood systems, gender and socioeconomic status. A complete understanding of vulnerability is necessary in order to design and target appropriate risk reduction and transfer measures.

3.57 **Risk reduction: avoiding hazards and reducing vulnerability.** Disasters result when an extreme natural or technological event coincides with a vulnerable human settlement or activity. The risk of disaster can be reduced by reducing either the hazards or the vulnerability (or both). Strategies to avoid hazards (e.g., earthquake zones and their effective monitoring and enforcement) include land use and development planning. Resistance strategies (e.g., building codes) ensure that safe structures are built that can withstand the effects of extreme events. In addition to addressing the need for scientific and technical knowledge, projects also consider how to overcome the socioeconomic, institutional and political barriers to the adoption of effective risk reduction strategies and measures. Since awareness and knowledge play an important role in risk reduction, also to be supported would be workshops and conferences aimed at heightening the awareness of stakeholders to the threat of natural disasters and what can be done about it, and educational and training activities that increase the understanding of policy makers, decision makers and practitioners about disaster management.

3.58 Given the high degree of the state's exposure to disasters, preparedness measures are an important strategy for reducing disaster risks. These include early warning and independent communications systems, contingency plans, evacuation plans, and shelter construction. As the GSDMA develops capacity in the area of risk reduction, a review of existing preparedness measures at the state, district, and community level could reveal weaknesses for subsequent strengthening.

3.59 **Risk sharing/transfer: protecting investments and sharing the costs.** In India, as in many developing countries, the public sector and the individual carry the majority of the costs resulting from disasters. As a result, *ad hoc* funds transfers to respond to disaster emergencies disrupt planned development activities, which tends to postpone progress toward long-term economic and social development.

3.60 The private insurance sector contributes important funding for natural disaster reconstruction in industrialized countries, but it has made fewer inroads in developing country markets. Moreover, insurance can provide important incentives for reducing disaster risk, through such mechanisms as reduced premiums for incorporation of hazard resistant measures or linking insurance to mortgage lending. India is currently viewed as

an attractive emerging insurance market at the global level, since investment of foreign insurance companies has been admitted to India's vast market.

3.61 The GOG has expressed its intent that every newly reconstructed house should be appropriately insured against natural disasters. It is recommended that an analysis by qualified experts be undertaken to assess the capacity of the domestic insurance industry, and to develop a strategy for increased insurance penetration in the region.

3.62 Internationally, there are a variety of new financial mechanisms for transferring and financing disaster risk being explored by public and private sector entities alike. These include catastrophe bonds, weather derivatives, and other hedging instruments.

3.63 It is important to remember, however, that the very poor typically lack access to traditional insurance mechanisms. In India, tools are being developed to assist the very poor to more effectively manage disaster risk. For example, SEWA is developing microinsurance mechanisms for its members. Their experience covers several areas, including natural disasters, and is worthy of study and further support.

E. Donor Coordination

3.64 As the relief efforts wind down and the rehabilitation and recovery phase begins, it will be essential to have coordination among different national and international agencies involved in the reconstruction effort. The GOG should lead consultations with the different agencies to assess capacities, identify complementarities, recognize gaps, avoid duplication, and coordinate efforts. By joining efforts on this assessment exercise, the World Bank, ADB, and the GOI and GOG have worked together closely and will continue to coordinate their efforts in the development of assistance programs. Consultations with other donors were also held in the field during the assessment, with such organizations as the UK's Department for International Development, USAID and the Netherlands, a number of UN agencies, private corporations, and with many NGOs. After assisting GOG in its coordination of the relief efforts, the United Nations Disaster Assessment and Coordination team has been succeeded by the UNDP, which is providing assistance to GOG in coordination of the recovery phase.

3.65 Communication between the Government, these and other aid agencies, commercial organizations, NGOs and community-based organizations which have come forward to assist in this massive recovery program is of paramount importance. Not only should their physical activities be coordinated but it is important that they follow common technical and finishing standards, harmonize policies, and do not undermine the drive and the initiative of local communities. Outside partners need to ensure that local leadership as well as poor, vulnerable and marginalized sections of society are the primary participants, and to be mindful of communities' dignity, traditions and practices. Only continuous and interactive dialogue between the communities, external partners, and the Government will ensure this.