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RECONSTRUCTION AFTER EARTHQUAKES: SUSTAINABILITY AND DEVELOPMENT

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ABSTRACT

This paper identifies key sustainability issues arising in earthquake-related projects financed by The World Bank and identifies the close connections between post-earthquake problems and development. First, background of the Bank's objectives in development and resource sustainability. Second, the connections between human activities and development decisions on the one hand and seismic risk and vulnerability on the other are discussed. The multiple nature of earthquake-related losses are identified, including economic (direct and indirect), time-related and institutional losses. Third, resource mobilization efforts following disasters are discussed, including issues related to local and international aid as well as aspects related to insurance and legislation. Fourth, the inclusion of measures geared to preventing losses in Bank-financed reconstruction efforts are explored within the overall context of preserving sustainability and reducing vulnerability. In the paper the specific activities of the Bank in post-earthquake reconstruction in Peru, El Salvador, Mexico, Nepal, Yugoslavia and Romania illustrate the different issues raised concerning vulnerability and development. In the Annexes, the paper contains information on Bank-financed reconstruction projects and illustrations of reconstruction efforts after the earthquakes in Nepal and Mexico.

The paper offers the conclusion that the losses from vulnerable development amount to a significant burden to member countries governments, institutions, and populations. From the discussion and the examples in the paper it is evident that policies and activities geared to strengthening local capabilities to reduce earthquake induced losses can only contribute to the achievements of sound development objectives and sustainable growth.

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INTRODUCTION

The goal of this paper is to identify key sustainability issues arising in earthquake-related projects financed by the World Bank. The close connections between post-earthquake issues and development will be highlighted since earthquakes, as well as many other natural disasters, impact development. Experiences in earthquake reconstruction in World Bank projects as well as Bank's policies and efforts to reduce seismic vulnerability and to strengthen the capacity of governments in disaster prone areas to cope with major catastrophic events will be discussed.

A BACKGROUND: RECONSTRUCTION ACTIVITIES

The World Bank as a development institution has as main objectives, inter alia, to encourage the development of productive facilities and resources in less developed countries and to assist member countries in raising the standard of living and conditions of labor. Earthquakes may significantly impact development in the affected countries, thus in a number of instances, the Bank has been actively involved in providing post-earthquake recovery and rehabilitation assistance. As the poorer countries become more and more vulnerable to natural disasters, and as the Bank is confronted with the need to respond to a growing number of reconstruction projects, more efforts are being addressed at increasing the focus on preventive measures.

Since the Bank was created in 1947, there were about 100 operations targeted for reconstruction after various disasters such as earthquakes, floods, hurricanes, volcanic eruptions and war. The very first four Bank operations targeted for reconstruction included the assistance to France, the Netherlands, Luxembourg and Denmark after Second World War.

The work of the Bank in disaster reconstruction is guided by the principle that its activities should focus on the recovery or rehabilitation of destroyed assets rather than on immediate relief activities. This is based on the fact that there are a number of national

and international aid organizations that are better equipped for relief, and that, while the Bank recognizes the priority of certain activities, its organization is better suited to assist countries in the restoration of their social and economic infrastructure.

In 1984 the Bank adopted a set of Guidelines for participation in reconstruction projects after disasters which defined reconstruction projects as a set of activities and investments to help rebuild economic, social, and physical systems after disasters through projects that could be prepared and implemented within a relatively short period or about two to three years. The Guidelines encouraged the inclusion of disaster prevention and mitigation measures in post-disaster activities.[1] A main concern expressed in the Guidelines was the promotion of assistance to disaster-prone countries in reducing their vulnerability to calamities, both through regular development activities and through reconstruction. In 1988, the Bank adopted a policy on emergency lending, which covers not only earthquakes but other emergencies as well.[2] Among the criteria the Bank will apply in considering future proposals, the policy identifies (i) urgency and effectiveness of short or medium-term action, and (ii) prospects for mitigating the impact of future emergencies. Currently, an Operational Directive on Emergency Recovery Activities is under preparation. The Directive integrates (i) lessons learned in recovery since the Guidelines were prepared, and (ii) the recommendations set forth in the 1988 policy on emergency lending.[3]

EARTHQUAKES AND DEVELOPMENT

Even though natural hazards are given features of the environment, the extent of damage that results from them is to a large extent a function of development decisions. Thus, costly but avoidable losses remain commonplace. In the specific case of earthquakes, significant losses are in many instances the result of inadequate design, weak building techniques, lack of quality control during construction, and changes in building occupancy. In the case of the 1985 earthquake in Mexico, V. Bertero[4] describes the substantial damage due to (i) the fact that buildings were designed and constructed based on codes which were formulated on dynamic characteristics of ground motions that were significantly exceeded during the September 19 earthquake, (ii) the poor

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1/ The World Bank, "Guidelines for Bank Participation in Reconstruction Projects After Disasters" (internal document), OPN 10.07, June 1984.

2/ The World Bank, "Lending by the Bank for Emergencies" (internal document), October 18, 1988.

3/ The World Bank, "Emergency Recovery Assistance" (internal document), OD 8.50, under preparation.

4/ Bertero, Vitelmo, "What Has the Structural Behavior of Buildings Told Us About Our Building Codes?" Paper presented at the Conference of the Earthquake Engineering Research Institute, "Mexico City and Chile Research," San Francisco, February 1989.

behavior of reinforced concrete structures with a dramatic pancaking of floor slabs, and (iii) changes in building occupancy which lead to the vertical overloading of structures and an increase in the reactive mass to lateral accelerations. Poor design and weak building techniques were also among the critical issues in the recent earthquake in Armenia.[5] In Spitak, tall buildings of about nine stories built with prefabricated concrete had a high rate of collapse. Also in Leninakan, relatively modern buildings suffered substantial damage.

The lessons learned both in Mexico and Armenia are that we are currently building an increased vulnerability. This is because of inappropriate knowledge of seismic risk as well as inappropriate building techniques and utilization of structures. An improved understanding of natural disaster vulnerability and of appropriate mechanisms to reduce it are critical issues to improve the sustainability of development. The insurance sector has in many instances helped to reduce the vulnerability of buildings, thus reduce catastrophic losses. For example, after the damaging 1960 earthquake in Agadir, Morocco, the only high rise buildings that resisted the impact were 29 high rise structures that had been insured (out of a total of 32 insured buildings), and built following strict structural and quality control requirements.

Earthquakes have an impact on development by requiring the diversion of funds from national, state and municipal budgets as well as from long-term development projects to relief and restoration of facilities and infrastructure. About 18 percent of all the Bank-financed reconstruction efforts after disasters, including catastrophic events such as earthquakes, hurricanes, floods, and volcanic eruptions since 1947, were addressed to reconstruction after earthquakes. In dollars, this amounted to about US$800 million of Bank-financing. The recipient countries were Nepal, Ecuador, El Salvador, Mexico, Chile, Colombia, Nicaragua, Peru, Yugoslavia, Romania and Guatemala.

The damage assessment and plans for the recovery efforts in all the cases in which the Bank participated had to integrate different types of losses and requirements, including direct and indirect losses, and institutional demands. The direct economic implications of earthquake impact were clearly visible. In addition to human life, direct losses included (i) losses to infrastructure, utilities, water, and other public sector facilities, (ii) damages to homes, business, industry and other private sector facilities, and (iii) decline in government revenues from taxes. Indirect economic damage included (i) loss of income due to damages to industrial and commercial facilities, (ii) loss of employment, (iii) time-related losses, and (iv) emergency and relief needs, demolition and debris clearance. Thus, the earthquakes mentioned above had significant impacts on public finances, by reducing public sector revenues on the one hand and by increasing public sector expenditures on the other. For example in Nicaragua, before the December 1972 earthquake that destroyed Managua, the public sector had required little domestic borrowing. In the absence of the problems resulting from the earthquake it would have been expected for

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5/ Kerr, Richard. "How the Armenian Quake Became a Killer," in Science, Vol. 243, January 1989, pp. 478-479.

the public sector to be a net lender rather than a net borrower during the period 1973-74. As a result of the earthquake there was an addition to the demand for domestic credit, which coincided with increased credit requirements for the private sector.

Time-related losses may be less obvious than other losses but nonetheless very important. They are costs imposed by the period required for a return of productive activities to normalcy. In Yugoslavia, for example, the earthquake of April 15, 1979, devastated the Adriatic coastline of Montenegro. The earthquake seriously hit the basic infrastructure of the area, including transport systems, schools, hospitals, hotels, houses, industrial plants, cultural-historic monuments, water supply systems, and telegraph-telephone grids. The losses were impairing to the tourism sector since roads, transportation and infrastructure in general were necessary for the operation of the sector. Overall, the economic consequences to earthquake were critical to Montenegro, which was one of the least developed regions in Yugoslavia. Essential economic activities were interrupted and slowed. The tourism industry came to a standstill and could only recover gradually as repairs were made in all the related sectors (roads, transport, water, energy). The minimization of time-related losses was dependent on the prompt remedial action, including both cleaning and demolition and replacement of facilities across sectors.

Time-related losses were also critical after the earthquakes and landslides of March 5 and 6, 1987, that hit the remote oil-producing north-eastern region of Ecuador. The major economic costs to the country were brought about by the interruption of oil production and exports, which resulted from damage to major sections of the Trans-Ecuadorian crude oil pipelines. The impact was severe to the economy, given that the petroleum sector accounted for 15 percent of GDP, and for about half of all exports in 1986. The cost of restoring oil exports, through rebuilding the damaged pipeline and related works was estimated at US$ 117 million. Road and bridge infrastructure damage was estimated at US$ 20 million. Damage to agriculture, housing, health and urban services, while substantial, would have been worse had it not been for the low population densities and limited productivity of the affected areas. By contrast, foregone oil revenues, until the end of July 1987, were estimated at approximately US$ 600 million, and the multiplier effect of reduced exports, decreased public expenditure and restricted domestic oil consumption was substantial. The overall damage was conservatively estimated at US$ 1.0 billion, equivalent to about 8 percent of GDP. When combined with loss of export revenues associated with the 1986 oil price decline, these adverse exogenous developments created an extremely difficult situation for the country.

In addition to economic losses, in the post-earthquake experiences mentioned above, there were significant demands on institutions, which in some cases were translated into destabilizing forces in the public sector. Events of such large magnitudes were unusual and national and sectoral agencies in many cases faced difficulties in accommodating requirements that were overwhelming. Rapid and efficient response was needed, particularly for the restoration in areas of major social and economic need such as housing, health, roads, water, education and production. Rapid decisions were needed, not only for relief activities, but also to cope with other important issues that arose after the earthquakes which had the

potential for compounding the negative impact of the events. Those issues included scarcity and inflation in prices of building materials, shortages of manpower, and increases in the costs of land, primary products and housing.

RECOVERY, INSURANCE AND RESOURCE MOBILIZATION

The works financed by the World Bank in post-earthquake recovery ranged from single sector reconstruction and rehabilitation work, such as road infrastructure rebuilding after the 1970 earthquake in Peru, to the financing of a slice of an overall reconstruction program identified for the damaged region after the 1983 earthquake in Popayan, Colombia. The latter included reconstruction and rehabilitation of urban and rural infrastructure, housing, education, industry, power and transport. A key issue in timely recovery was the capacity to mobilize and coordinate internal and external resources required to meet the needs of immediate emergency relief and subsequent rehabilitation. In addition to the replacement of damaged facilities, resources were needed for (i) emergency aid; (ii) demolition and debris clearing; (iii) foreign exchange to finance the import of heavy equipment, and in some cases importation of building materials; (iv) balance of payment support to sustain normal activities in cases in which export earnings were lost; (v) budget support; and (vi) rehabilitation credit for business, farmers, and individuals to restore disrupted capital investments and activities.

In all the post-earthquake reconstruction cases, there was an intensive resource mobilization effort immediately following the disaster. On the domestic front, efforts included the enactment of regulatory measures, legislation, and mechanisms such as mobilization of manpower, to assist the impacted areas in alleviating the losses. On the international front governments sought diverse sources such as international relief aid, and financial assistance from other government as well as from multilateral organizations.

Insurance through special funds or through insurance firms was limited. The projects financed by the Bank are guaranteed by the governments of the borrowing countries. The Bank's general conditions applicable to loan and guarantee agreements require that insurance be provided for goods to be financed out of proceeds of loans.[6] Indemnities payable under the insurance have to be in a freely convertible currency to enable prompt replacement of lost or damaged goods. If the insurance is not provided through an insurance company, evidence should be provided that resources are readily available for prompt payment of the indemnities required to replace loss or damaged goods.

In many post-earthquake situations, insurance through insurance companies covered only a relatively small portion of the losses, with the number of insured facilities, infrastructure and lifelines amounting to only a small percentage of the total. Thus, the majority of the significant losses that were brought about by the exposure of settlements and capital investments to seismic events, as well as reconstruction costs

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6/ The World Bank. "General Conditions Applicable to Loan and Guarantee Agreements," Washington, DC, January 1, 1985.

were borne by the impacted countries. In other words, the burden of disasters was redistributed nationally. In the example of the earthquake in Ecuador mentioned above, the Trans-Ecuadorian pipeline became the property of a State Oil Consortium on March 1, 1986. Only part of the assets damaged were covered by insurance. For the portion of the pipeline and related installations that had no coverage, the Bank's financed project project required that the Consortium carry out an assessment of future insurance needs.

The financial arrangements to mobilize resources for recovery works in the different post-earthquake country experiences included funds from extraordinary taxes, temporary increases in tariffs, bond issues, contingency funds from the national budget, or reallocation in priorities in the national budget. In addition, there was funding from local and international donations, international development organizations and NGOs. For example, in the 1983 earthquake in Popayan, Colombia, the initial financing plan for the reconstruction program included resources from (i) a temporary increase in custom tariffs, (ii) bond issues, (iii) a rediscount line from the Central Bank and other financial institutions, (iv) a special loan from the Social Security Institute, and (iv) an advance from the national budget to the state. In addition there were programs of recovery and technical assistance implemented by international organizations (e.g. UNDP, UNICEF), NGOs and financial institutions.

To mobilize resources, in the case of the earthquake in Montenegro, legislation was enacted providing funds for reconstruction from contributions by each of the Republics and Autonomous Provinces into a Reconstruction Fund. The total contributions were determined on the basis of final damage assessments. The provisions specified that the contributions had to be increased yearly by amounts equal to the increase in consumer prices.

Post-earthquake needs also required the extraordinary mobilization of manpower and materials. In Romania, after the March 1977 earthquake, in addition to a domestic and international mobilization of financial resources the Government implemented measures to meet the urgent manpower needs by (i) requiring the extension of work into all Sundays on the month of the earthquake and subsequently one Sunday per month for the remainder of the year; (ii) mobilizing the working population not directly involved in the production process (e.g. white collar workers), as well as youth organizations; and (iii) the reallocating construction workers from non-affected parts of the country. In order to cope with urgent material needs, the Government established (i) the diversion of all equipment not directly used in production to construction enterprises, (ii) the reduction of exports of construction materials (cement, timber, pipes, and fuels); and (iii) the postponement of selected construction activity.

EARTHQUAKE IMPACT, VULNERABILITY AND SUSTAINABILITY

An important component of Bank-financed earthquake reconstruction projects implemented in the last few years has been the inclusion in project agreements with the governments of the concerned countries of measures geared to preventing losses and reducing vulnerability to earthquakes. Those measures included for example implementation of

mechanisms (i) to strengthen the capability of institutions in the disaster-prone areas to deal with risk reduction, mitigation and rehabilitation, (ii) to effectively raise funds and coordinate, (iii) to develop and implement instruments to avert future losses such as seismic-resistant codes, (iv) to develop preparedness studies, (v) to evaluate insurance needs in reference to specific civil works, (vi) to develop studies in microzonation, structural systems, quality of building materials, and (vii) to implement training on improved building techniques and construction management.

In Nepal for example, where an earthquake measuring 6.7 on the Richter scale struck parts of Central and Eastern regions in August, 1988, extensive damage occurred to housing, schools, hospitals, public buildings, roads and bridges. The total damage was estimated at US$ 170 million. The agreement reached with the authorities as part of the Bank's effort to provide assistance includes the provision of technical assistance to mitigate the adverse effects of natural disasters in the country.

Along similar lines, the reconstruction program in Mexico included a number of provisions geared to reducing vulnerability. The earthquake brought about heavy damage to Mexico City and neighboring municipalities in the states of Jalisco, Colima, Michoacan and Guerrero. Virtually all sectors of the economy were affected, including housing, health, public administration, production, telecommunications and tourism. The damage in Mexico City was particularly devastating because of the heavy concentration of population, economic activity and buildings. The costs of earthquake reconstruction and rehabilitation work were estimated at about US$ 4 billion. The loss per capita in the Federal District can be estimated at about US$ 236. The overall loss insured was approximately US$ 275 million.[7] The reconstruction program financed by the Bank in Mexico was a slice of the overall needs for which there was no other financing available, including inputs in housing, health, and education. The program included a number of activities geared to reducing vulnerability such as (i) studies for retrofitting of school buildings, (ii) studies of soils and sub-soils for the development of microzoning regulations, (iii) a program of training for engineers and architects, as well as for construction supervisors and workers, (iv) studies of seismic risk, behavior of structures and foundations, and construction materials. The project agreement also called for the preparation and implementation of a revised building code, prepared according to the findings and studies conducted after the earthquake. A "temporary" code was approved and enforced two months after the earthquake, the revised code was approved and enforced one year later. Revised building codes for the states under seismic risk are currently being prepared.

In Popayan, Colombia, the earthquake of March 1983 affected all aspects of the city's urban systems: shelter, production, utility networks, public services, and public administration. The cost of reconstruction to pre-earthquake conditions, including some necessary remodeling, improvement of construction methods using seismic-resistant standards, relocation of settlements and supporting institutions was estimated at about US$ 765 million dollars. The agreements in the Bank-financed reconstruction

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7/ Munich Re - Terremoto de Mexico '85, Munich, 1986, Muchener Ruckversicherungs-Gesellschaft

project included (i) the preparation and implementation of a seismic-resistant code, (ii) the requirement that all physical works financed within the project would be constructed in accordance with the code, and (iii) provisions for seismic insurance provisions public and private buildings and other insurable assets financed under the project. Although the creation of a National Catastrophe Fund was contemplated under this project, the Fund was never implemented. The Catastrophe Fund was a victim of budgetary limitations as well as decreasing risk concerns motivated by the passage of time after the earthquake. The catastrophic eruption of the Volcano Nevado del Ruiz in 1985 and the almost total loss of the town of Armero shows that a disaster management system (including an insurance component) would have been a cost-effective initiative. The human losses could have been prevented at a relatively modest cost. In Armero, where 23,000 persons were killed and about 10,000 survived the eruption, about 40,000 migrants congregated in the area attracted by the distribution of relief aid, an issue to consider in development plans for the area, particularly if potential future volcanic risks are considered.

All of the above-mentioned projects were addressed to rebuilding damaged facilities, sectors or human settlements. They included concerns for reducing the potential for future losses as a mechanism to improve the sustainability of development. Now, for the first time in the Bank's history, a project is being prepared for Mexico to address preventive measures to reduce vulnerability in the education and health sectors. The project contemplates the retrofitting to school buildings and hospitals in order to reduce their vulnerability and to increase their seismic resistance.

In spite of their importance, the inclusion of disaster prevention and mitigation concerns both in reconstruction and in development projects in not an easy task. In many cases governments either resist discussion of the the prospect of natural disasters, or allocate minimal resources to prevention and mitigation. Those issues tend to be perceived as add-ons to development rather than as integral components of a process of growth.

CONCLUSION

The losses from vulnerable development amount to a significant burden to governments, institutions, and population in less developed countries. The World Bank's work on post-earthquake reconstruction has been enriched with the experience and lessons learned through its participation in efforts to help rebuild economic, social and physical systems after disasters. The Bank's assistance, particularly in the past five years, has been geared not only to helping rebuild lost assets and facilities but also helping reduce vulnerability of human settlements and capital investment to seismic events. From the discussion, and the examples in the paper, it is obvious that policies and activities geared to strengthening local capabilities to reduce earthquake induced losses can only contribute to the achievement of sound development objectives and sustainable growth.

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SUMMARY OF BANK-FUNDED EARTHQUAKE RECONSTRUCTION PROJECTS
1971 - 1989

FYear	Project Number		Country	Project Title	Loan Amount
FY1989	Cr 1988-NEP		Nepal	Municipal Development and Earthquake Emergency Housing Reconstruction Project	$ 41.5
	Cr 1463-NEP	(P,R)	Nepal	Primary Education Project	$ 6.0
FY1988	Ln 2135-EC	(R)	Ecuador	Low-Income Housing Project	$ 5.0
	Ln 2873-ES		El Salvador	Earthquake Reconstruction Project	$ 65.0
	Ln 1738-ES	(R)	El Salvador	Fourth Education Project	$ 4.1
FY1987	Ln 2803-EC		Ecuador	Emergency Petroleum Reconstruction Project	$ 80.0
FY1986	Ln 2651-CH		Chile	Santiago Water Supply and Sewerage II Project	$ 60.0
	Ln 2652-CH		Chile	Valparaiso Water Supply Reconstruction Project	$ 6.0
	Ln 2665-ME		Mexico	Earthquake Rehabilitation and Reconstruction	$400.0
	Ln 1945-ME	(R)	Mexico	Rainfed Agricultural Development Project	$ 14.0
	Ln 1990-ME	(R)	Mexico	Second Urban and Regional Development Project	$ 81.8
	Ln 2281-ME	(R)	Mexico	Medium Size Cities and Sinaloa Water Project	$ 17.5
	Ln 2331-ME	(R)	Mexico	Export Development Project	$ 41.1
	Ln 2450-ME	(R)	Mexico	Lazaro Cardenas Industrial Port Project	$ 19.0
FY1985		(R)	Chile		$ 22.8
FY1984	Ln 2379-CO		Colombia	Popayan Region Earthquake Reconstruction Project	$ 40.0
	Ln 1726-CO	(R)	Colombia	Third Water and Sewerage Loan	$ 1.5
	Ln 1558-CO	(R)	Colombia	Urban Development Loan	$ 6.4
	Not Processed		Yemen, AR	Earthquake Reconstruction	
FY1983	Ln 2208-PE		Peru	Higher Agricultural Education Project	$ 17.3
FY1981	Not Processed		Algeria	El Asnam Earthquake Reconstruction	
FY1980	Ln 1759-YU		Yugoslavia	Earthquake Rehabilitation - Highways	$ 21.0
	Ln 1768-YU		Yugoslavia	Earthquake Rehabilitation - Port of Bar	$ 50.0
	Ln 1769-YU		Yugoslavia	Earthquake Rehabilitation - Railways	$ 14.0
FY1978	Ln 1581-RO		Romania	Post Earthquake Construction Assistance	$ 60.0
FY1977	Ln 1314-GU		Guatemala	Earthquake Reconstruction - Education & Transport	$ 6.5
	Ln 1315-GU		Guatemala	Earthquake Reconstruction - Housing	$ 20.0
FY1973	Cr 0389-NI		Nicaragua	Earthquake Reconstruction Project	$ 20.0
	Ln 0808-NI		Nicaragua	Second Managua Water Supply Project	$ 6.9
FY1971	Ln 0706-PE		Peru	Road Reconstruction Project	$ 30.0

(P) Project is being processed for Board approval.
(R) Loan or credit was reallocated for rehabilitation/reconstruction purposes.

World Bank Lending Operations
Earthquake Reconstruction Projects

The Environment Department
May 11, 1989

NEPAL - Municipal Development and Earthquake Emergency Housing Reconstruction Project — FY1989[1]
Credit Amount: US$41.5 million
Credit #: Cr 1988-NEP
Tentative Reallocation:
US$6 million; Cr 1463-NEP - Primary Education Project
Disaster: Earthquake
Board Approval: 03/07/89
Closing Date: 06/30/96

Objective: (i) Assist in the reconstruction of houses damaged by the August 198[illegible] earthquake; and (ii) provide long-term technical assistance to (a) mitigate the effects of future disasters, including the construction of 42 demonstration houses which show earthquake resistant features; (b) improve construction techniques and building codes; (c) develop a housing strategy; (d) study alternatives to timber in buildings; and (e) carry out epicentral and seismic mapping.

ECUADOR - National Low-Income Housing Project — FY1988
Reallocation Amount: US$5 million
Loan #: Ln 2135-EC
Disaster: Earthquake
Board Approval: 05/04/82
Closing Date: 12/31/88

Objective: (i) Reconstruct and rehabilitate municipal buildings damaged by an earthquake and associated flooding in March 1987; (ii) reconstruct damaged residential houses by (a) extending grants or sub-loans; (b) furnishing building materials and technical assistance to beneficiaries; and (c) acquiring and utilizing vehicles and equipment.

EL SALVADOR - Earthquake Reconstruction Project — FY1988
Loan Amount: US$65 million
Loan #: Ln 2873-ES
Co-financing: Approximately equivalent to US$13.5 million from the Government of Japan
Loan Reallocation: US$4.1; Ln 1738-ES - Fourth Education Project
Disaster: Earthquake
Board Approval: 09/15/87
Closing Date: 12/31/93

Objective: (i) Rehabilitate and reconstruct the San Salvador metropolitan area through provisions for low-cost housing, public office and school buildings, and essential public services; (ii) support the expansion of the capital city towards areas less vulnerable to earthquakes; (iii) rehabilitate the micro-enterprise sector; and (iv) strengthen the government's capacity to manage the reconstruction effort and enhance its future preparedness to deal with national emergencies.

[1]Fiscal year indicates year of Board approval.

ECUADOR - Emergency Petroleum Reconstruction Project
Loan Amount: US$80 million
Loan #: Ln 2803-EC
FY1987
Disaster: Earthquake
Board Approval: 05/05/87
Closing Date: 06/30/89

Objective: (i) Urgently restore petroleum production and export flows following an earthquake by reconstructing of major sections of the Trans-Ecuadorian crude oil and LPG pipeline, and related road and bridge infrastructure; (ii) minimize the environmental impact of the disaster, caused mostly by oil spills; (iii) enhance institutional capacity to deal with the crisis and its aftermath; and (iv) enhance the Government's preparedness to deal with future national emergencies.

CHILE - Santiago Water Supply and Sewerage II Project
Loan Amount: US$60 million
Loan #: Ln 2651-CH
FY1986
Disaster: Earthquake
Board Approval: 02/11/86
Closing Date: 12/31/92

Objective: (i) Expand and modernize the sewerage system for metropolitan Santiago in order to redress sewage disposal problems and the high incidence of intestinal diseases; (ii) increase potable water quality and quantity; and (iii) strengthen management and cost control at Santiago's sanitation authority.

CHILE - Valparaiso Water Supply Reconstruction Project
Loan Amount: US$6 million
Loan #: Ln 2652-CH
FY1986
Disaster: Earthquake
Board Approval: 02/11/86
Closing Date: 12/31/90

Objective: (i) Reconstruct Greater Valparaiso's earthquake-damaged water supply system; (ii) prepare feasibility studies and final designs to support the improvement and extension of the water supply and sewerage systems; and (iii) improve operations of the local public works department.

MEXICO - Earthquake Rehabilitation and Reconstruction Project
Loan Amount: US$400 million
Loan #: Ln 2665-ME
Total Loan Reallocation: US$173 million
FY1986
Disaster: Earthquake
Board Approval: 03/25/86
Closing Date: 12/31/89

Loan Reallocation #1:
US$14 million; Ln 1945-ME - Rainfed Agricultural Development Project
Loan Reallocation #2:
US$81.8 million; Ln 1990-ME - Second Urban and Regional Development Project
Loan Reallocation #3:
US$17.5 million; Ln 2281-ME - Third Medium Size Cities and Sinaloa State Water Project
Loan Reallocation #4:
US$41.1 million; Ln 2331-ME - Export Development Project
Loan Reallocation #5:
US$19 million; Ln 2450-ME - Lazaro Cardenas Industrial Port Project

Objective: (i) Assist in the rehabilitation and reconstruction of devastated urban areas by removing heavily damaged structures and by reconstructing community facilities and housing; and (ii) protect urban infrastructure from future earthquakes by (a) reinforcing school buildings; and (b) identifying urban areas at risk and developing mitigation measures, regulations, construction standards, and land-use and zoning plans.

CHILE - Loan Reallocation FY1985
Reallocation Amount: US$22.8 million

COLOMBIA - Popayan Region Earthquake Reconstruction Project FY1984
Loan Amount: US$40 million
Loan #: Ln 2379-CO
Loan Reallocation #1:
US$0.5 million; Ln 1726-CO - Third Water and Sewerage Loan
Loan Reallocation #2:
US$5.4 million; Ln 1558-CO - Urban Development Loan
Disaster: Earthquake
Board Approval: 02/02/84
Closing Date: 06/30/88

Objective: (i) Contribute to the physical and economic rehabilitation of earthquake-damaged areas by (a) restoring essential facilities and services (shelter, water distribution and sewerage, electricity production, public buildings, and roads); and (b) reestablishing economic activity that minimizes medium- and long-term social and economic disruption; (ii) support an institutional arrangement appropriate for efficient reconstruction coordination; and (iii) develop measures to minimize potential damage from future natural disasters.

YEMEN ARAB REPUBLIC - Earthquake Reconstruction Project FY1984
Proposed Credit Amount: US$5 million
Never Processed
Disaster: Earthquake

Objective: (i) Provide technical advice on the condition of earthquake-damaged houses; (ii) disseminate information on the most appropriate repair/rebuilding techniques; and (iii) expedite the process of providing homeowner loans to finance repairs.

PERU - Higher Agricultural Education Project FY1983
Loan Amount: US$17.3 million
Loan #: Ln 2208-PE
Disaster: Earthquake
Board Approval: 11/09/82
Closing Date: 12/31/88

Objective: Increase the contribution of The National Agrarian University to the development of Peru's agricultural sector by (a) repairing and rehabilitating University facilities which were seriously damaged by a 1974 earthquake; and (b) construct and equip four research and instruction facilities.

ALGERIA - El Asnam Earthquake Reconstruction Project FY1981
Never Processed
Reconnaissance Mission Only
Disaster: Earthquake

YUGOSLAVIA - Montenegro Earthquake Rehabilitation Project - Highway FY1980
Loan Amount: US$21 million
Loan #: Ln 1759-YU
PCR #: 4935
Disaster: Earthquake
Board Approval: 09/18/79
Closing Date: 12/31/82

Objective: Support the restoration of the basic road network in southwestern Montenegro which was heavily damaged by the severe earthquakes of April - May 1979

YUGOSLAVIA - Montenegro Earthquake Rehabilitation Project - Port of Bar FY1980
Loan Amount: US$50 million
Loan #: Ln 1768-YU
PPAR #: 6339
Disaster: Earthquake
Board Approval: 11/27/79
Closing Date: 06/30/84

Objective: Rehabilitate and restore the Port of Bar's capacity to handle bulk and general cargo traffic generated by industrial development.

YUGOSLAVIA - Montenegro Earthquake Rehabilitation Project - Railway FY1980
Loan Amount: US$14 million
Loan #: Ln 1769-YU
PCR #: 6386
Disaster: Earthquake
Board Approval: 11/27/79
Closing Date: 06/30/84

Objective: Support the restoration of the railway line and facilities, including bridges and tunnels, which were damaged by a series of earthquakes in April - May 1979.

ROMANIA - Post-Earthquake Construction Assistance Project FY1978
Loan Amount: US$60 million
Loan #: Ln 1581-RO
PCR #: 4791
Disaster: Earthquake
Board Approval: 05/30/78
Closing Date: 06/30/82

Objective: (i) Supply imports needed to reconstruct the transportation, telecommunications, construction, and engineering sectors; (ii) strengthen domestic construction capability to meet development requirements; and (iii) limit damage from future earthquakes.

GUATEMALA - Earthquake Reconstruction Project - Education and Transportation
Loan Amount: US$6.5 million
Loan #: Ln 1314-GU
PPAR #: 3273
FY1977
Disaster: Earthquake
Board Approval: 07/15/76
Closing Date: 06/30/83

Objective: (i) Reconstruct and re-equip earthquake-damaged public schools in the City of Guatemala and surrounding highland towns; and (ii) rehabilitate primary schools to accommodate refugees waiting for resettlement into new areas.

GUATEMALA - Earthquake Reconstruction Project - Housing Component FY1977
Loan Amount: US$20 million
Loan #: Ln 1315-GU
PPAR #: 3273
Disaster: Earthquake
Board Approval: 07/15/76
Closing Date: 12/31/82

Objective: (i) Provide housing for the refugees left homeless by the 1976 earthquake by developing housing sites and services, and by providing housing and micro-enterprise rehabilitation credits to individuals; and (ii) establish an institutional framework oriented toward rational urban development and the needs of the urban poor.

NICARAGUA - Earthquake Reconstruction Project FY1973
Credit Amount: US$20 million
Credit #: Cr 0389-NI
PPAR #: 2289
Disaster: Earthquake
Board Approval: 05/08/73
Closing Date: 09/30/79

Objective: (i) Restore the water supply in Managua; (ii) repair damaged water distribution lines and reservoirs; and (iii) finance 55% of the civil works performed under pre-earthquake Ln 808-NI.

NICARAGUA - Second Managua Water Supply Project FY1973
Loan Amount: US$6.9 million
Loan #: Ln 0808-NI
PPAR #: 2289
Disaster: Earthquake
Board Approval: 03/07/72
Closing Date: 09/30/77

Objective: (i) Provide safe, potable water to Managua; (ii) expand transmission and distribution facilities; and (iii) strengthen administrative and managerial capacity of the Managuan water authority.

PERU - Road Reconstruction Project FY1971
Loan Amount: US $30 million
Loan #: Ln 0706-PE
PPAR #: 3080
Disaster: Earthquake
Board Approval: 09/08/70
Closing Date: 12/31/78

Objective: Improve transportation to and within Peru's earthquake-damaged Northwest by reconstructing priority roads and providing technical assistance for future road maintenance.

The Mexican Reconstruction Experience in the Housing Sector: The Housing Reconstruction Program.

An earthquake measuring 8.1 on the Richter Scale rocked Mexico City in September of 1985, causing one of the most catastrophic disasters in the history of the Western Hemisphere. The earthquake was especially destructive for two reasons. First, it hit the most populous city in the Americas, and second, it ripped through inner city slums where poor families inhabited overcrowded tenements which had deteriorated through years of neglect.

Following the disaster, a World Bank loan supported a highly successful governmental program of unprecedented scale, familiarly known as RHP ("Renovacion Habitacional Popular"), or the Housing Reconstruction Program. RHP aimed to rehabilitate and reconstruct housing for the tenement dwellers, whose homes comprised 45% of the 8,336 residential buildings destroyed in the earthquake and whose plight was regarded as the hardest and most difficult to solve. Because tenement rents had been frozen over the past forty years, landlords had little incentive to rehabilitate demolished or unsafe structures. While the former renters could partially finance the tenement's reconstruction, they could not afford to rebuild entire two-, three- and four-story apartment buildings. RHP selected a team of highly qualified technical professionals to manage housing reconstruction in Mexico City. Their task was formidable. They had to resolve land tenure issues for some 4,320 parcels in 70 low-income neighborhoods, and they had to build 48,000 apartments for the homeless families sleeping in the streets and vacant lots of the city.

The success of RHP rested on several key decisions. Since a massive relocation of the homeless would have created new problems involving the separation of people from their work and neighborhoods, the RHP team decided to build the apartments directly on the devastated homesites. During the reconstruction process, temporary housing would be erected close to the sites. The team also decided to sell the renovated and reconstructed units to their former tenants, thus making the former tenement dwellers responsible as owners for the upkeep of their homes.

Finally, after considering the possibility of rebuilding different sized apartments according to the beneficiaries' needs and desires, RHP opted, instead, for a standardized design. Each condominium property would contain 40 square meters along with a common patio and circulation area. The design represented a significant improvement in the living standards for many families.

Proclaimed as "the largest reconstruction effort since World War II," the housing project was completed in a record 10-month time period at the low cost of approximately US $3,400 per unit. At the same time, the new apartments were well constructed and finished, and more spacious than the tenements they replaced. In 1987, RHP was recognized internationally for its work and its excellent design quality, and was awarded the Robert Matthews prize from the International Union of Architects.

As a small coordinating unit, the RHP team can attribute its success in large part to the human effort and enthusiasm it brought to bear upon the project. However, several additional factors also contributed to the program's success. Collaborating NGOs assisted in the censuses, needs assessments,

temporary housing, and some housing solutions. Construction was carried out by private contractors selected through competitive bids and guided by an incentive system which awarded additional contracts according to the quality and speed with which the previous projects were completed.

The massive sale of homesites and registration of apartment titles required the active support of the national government. Soon after damage assessments identified the tenements in need of abandonment for the interest of safety, the Government carried out a single expropriation decree of unparalleled scale. Former owners were compensated for the expropriation with government bonds, which had a relatively low sales value, but paid more in dividends than the previous tenants had paid in rents. The National Association of Registrars of Deeds relaxed its titling requirements in order to expedite the processing of 48,000 new apartment units. In addition to the reconstruction program, existing building codes were studied and revamped to meet disaster-resistant standards.

Finally, the program's beneficiaries were organized into "Renovation Councils" for the purpose of communicating their concerns directly to the RHP team. Beneficiaries were included in decisions to limit housing solutions to the single basic design, and to institute a cost recovery plan which called for an up-front subsidy of 50% and payments indexed to the minimum wage.

RHP's policy of rehabilitating tenements and converting them to condominiums has continued even after the completion of the earthquake reconstruction program. The City's housing institute recognized that if the former rental system and its associated neglect was permitted to continue, then tenements which survived the earthquake relatively unscathed or experienced only slight damage will continue to deteriorate and be at greater risk in future disasters. As a result, two lines of credit were introduced to spur the application of seismic-resistant building techniques. First, the housing institute began to assist owners in financing home improvements. And second, the Casa Propia ("Your Own Home") Program, introduced under the same terms as RHP, started to help tenement renters finance both the purchase of apartments and the cost of their rehabilitation to seismic-resistant building codes.

The Nepal Earthquake Reconstruction Effort.

Nepal is among the world's poorest countries. Over 90% of the population lives in small towns or in the remote countryside three to four days from the nearest village. After an earthquake measuring 6.7 on the Richter Scale struck eastern Nepal on August 21, 1988, one of the most difficult problems experienced in the disaster response process involved assessing damages and assisting victims.

During the months following the earthquake, helicopter surveys identified approximately 66,000 damaged or destroyed homesites and estimated that 460,000 persons had been rendered without shelter. One thousand rupees (US $41), a certificate of need, and in some instances, a temporary shelter were supplied to the victims as part of disaster relief efforts.

With the assistance of a Bank credit, the Nepalese Government decided to offer reconstruction loans to all homeless families. The achievement of Government's goals would be arduous in light of the large numbers of victims and the distances they covered. In addition, the country's poverty meant that few of those affected by the earthquake had the resources or savings to rebuild independently, and that reconstruction assistance from the government would be minimal. The vast majority of loans, on the order of US $400, would cover only housing repairs. Only 5% of the housing reconstruction loans would be distributed for about US $2,000, the maximum amount, in order to finance a starter home in an urban area. Any family with a certificate of need could qualify for a loan. The Housing Ministry named a special team to manage the reconstruction program and designated three banks, chosen for the large number and widespread venue of their branch offices, to process the housing loans.

The housing reconstruction program has been operational for less than one year. Twenty-five percent of the funds were disbursed during the program's first five months, and the pace was accelerating. Although repayment rates appear to be high, recovery of program costs will not be complete because of the project's lending system of subsidized interest rates. The program loans the first 5,000 rupees (US $205) at an interest rate of 1% per annum, the second 5,000 rupees is loaned at 10%, and the remainder (up to 50,000 rupees or US $2050) is loaned at 15%. The current commercial lending rate is 19%.

A number of factors in Nepal, which were conspicuously absent in the Mexico City case study, have been extremely advantageous in the country's reconstruction efforts. Most important, because over 95% of all Nepalese homes are owner-occupied, land tenure was not problematic. Marshalling resources for a massive training program in support of the effort's self-help component was unnecessary because most affected families or their acquaintances were well-versed in housing construction. In fact, families began rebuilding their homes almost immediately after the earthquake in response to the country's cold climate. These factors have motivated the Government to move quickly in order to keep up with the rapid pace of reconstruction and to offer effective assistance.

The management and implementation of the recovery program has primarily relied on each member of a reconstruction team to direct the activities of two "panchayats" or counties. The reconstruction team is guided by ten "overseers", or technical officers, who come from the ranks of local contractors and

engineering students especially trained in earthquake-resistant construction techniques. Damage assessments on numerous homes identified faulty construction, particularly a lack of framing, as the principle cause of structural failure. To ensure that more resistant building methods are applied in the reconstruction process, overseers review designs and construction in situ.

Actual building inspections may not always be possible considering the inaccessibility of many damaged homes. But, since loans are given in tranches, families will be obliged to visit the banks periodically. For this reason, overseers are building forty-two demonstration houses in close proximity to these banks. With each credit withdrawal, loan recipients will be obliged to walk through the demonstration houses and study their construction. The models emphasize bonding at corners, using lintels and wall openings correctly, building proper foundations, and securing roofs to walls. In addition, the Housing Ministry is taking advantage of the reconstruction effort by promoting sanitary solutions and low-energy stoves. Both are included in the demonstration houses and financial incentives for their construction are integrated with the program's loan packages.

The added sanitary and energy components represent only two elements of what is becoming a long-term effort to preserve the environment and to prevent and mitigate future disasters. With support from UNDRO, the government is also enacting new building codes and developing its disaster management capabilities. The threat of deforestation is serious in Nepal - the country has suffered six devastating floods in the past eight years. Conservation measures which reduce consumption of wood also reduce disaster risk. The Nepalese government has begun to realize that a cross-sectoral approach must be employed to manage its vulnerability to the ever-present threat of earthquakes, floods, and landslides.