Handbook

for Estimating the Socio-economic and Environmental Effects of **Disasters**

Economic Commission for Latin America and the Caribbean
ECLAC

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C O N T E N T S

Introduction

I. BACKGROUND

Disasters have a major impact on the living conditions, economic performance and environmental assets and services of affected countries or regions. Consequences may be long term and may even irreversibly affect economic and social structures and the environment. In industrialized countries, disasters cause massive damage to the large stock of accumulated capital while losses of human life are limited thanks, among other factors, to the availability of effective early warning and evacuation systems, as well as better urban planning and the application of strict building codes and standards. In developing countries, on the other hand, fatalities are usually higher owing to the lack or inadequacy of forecast and evacuation programmes. Although capital losses might be smaller in absolute terms when compared to those in developed countries, their relative weight and overall impact tend to be very significant, even affecting sustainability.[1]

Whether disasters are essentially natural or man-made in origin, their consequences derive from a combination of human action and interaction with nature's cycles or systems. Disasters occur frequently around the world, and their incidence and intensity seem to be increasing in recent years. They can lead to widespread loss of life, directly and indirectly (primarily or secondarily) affect large segments of the population and cause significant environmental damage and large-scale economic and social harm.

In fact, recent ECLAC estimates show that in the last three decades more than 150 million people have been affected by disasters in Latin America and the Caribbean, including more than 12 million direct victims and 108,000 deaths. Moreover, total damage –and this was not an exhaustive estimate for the whole region– amounted to more than 50,000 million 1998 dollars, concentrated in the smallest and relatively less developed countries, especially in Central America, the Caribbean and the Andean sub-regions.[2] (See Figure 1 below).

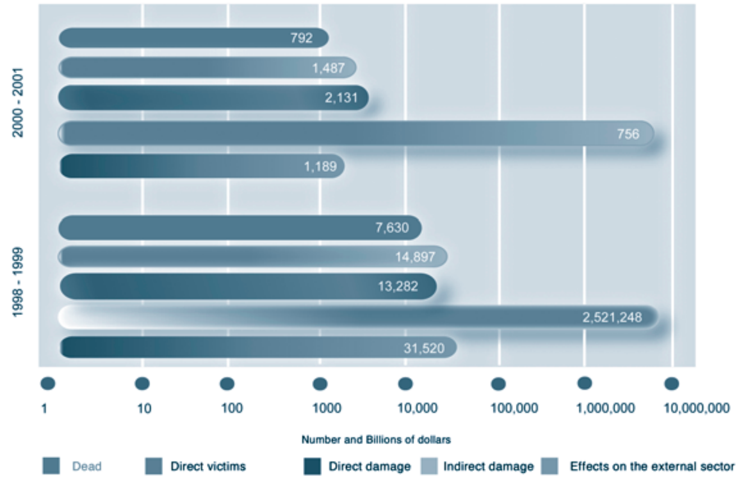
Globally, statistics show that disasters cause more socially significant and irreversible damage in developing countries, where the poorest and most vulnerable population groups feel the most severe impact. In the developed world, on the other hand, an increasing and significant degree of protection against disasters has been achieved over the years thanks to the availability of resources and technology for the introduction of effective prevention, mitigation and planning measures, together with vulnerability reduction schemes. Even in these countries however, damages have risen significantly as a result of the greater concentration and value of societal activities.

1 Jovel, Roberto, "Natural Disasters and Their Economic and Social Impact", *ECLAC Review*, No. 38, Santiago, Chile, August 1989.

2 See ECLAC and IDB, *Un tema de desarrollo: La reducción de la vulnerabilidad frente a los desastres*, Mexico City and Washington, 2000.

Some progress has been achieved in the field of planning, prevention and mitigation in Latin America and the Caribbean, but large segments of the population still live in highly precarious and vulnerable conditions. Most of the countries in the region are in areas that are prone to hydro-meteorological and geological phenomena that have produced well-known instances of widespread loss of human life and significant damage to physical and social infrastructure, while undermining economic performance and the environment.

Figure 1
LATIN AMERICA AND THE CARIBBEAN; EFFECTS OF DISASTERS (1998-2001)



Undesirable disaster effects may include damage to economic and social infrastructure, environmental modifications, fiscal and foreign sector imbalances, price increases, modifications to demographic structures and changes in development priorities as the task of replacing lost or damaged assets results in the deferment of projects intended to overcome long-standing needs. The most devastating impact is undoubtedly the deterioration in the social well-being of the population, especially among the poorest and most vulnerable population groups. Furthermore, the ramifications of disasters increasingly extend beyond the affected community or country through unexpected population migration, disease transmission, trade reductions or widespread environmental modifications.

To reduce the long-term effects of disasters, affected countries must take actions along parallel tracks. First, as an integral part of their economic and social development strategy, they should assign financial resources for the prevention and mitigation of the foreseeable impact of a disaster. Such a commitment should be understood as a high-yield investment –in economic, social and political terms– for achieving long-term growth. Second, once a disaster has occurred, they must ensure that reconstruction investments contemplate vulnerability-reduction features to favor an adequate level of sustainable growth.

When a disaster occurs, national-emergency bodies are generally in charge of assessing humanitarian needs during the emergency stage, with support from the United Nations System and other public and private international organizations. It is now standard practice for the affected community or country to take the most essential steps to meet humanitarian requirements arising from the emergency. In addition, friendly countries and international organizations either directly or through non-governmental organizations. Promptly provide additional assistance as needed, both public and private agents take part in this effort, along with many local, regional and international non-governmental or social assistance organizations.

Reconstruction of damaged or destroyed assets, however, normally requires resources well beyond those available during the emergency or humanitarian assistance stage or otherwise within reach of the affected country. As a result, reconstruction is often undertaken without vulnerability reduction. To put it bluntly, vulnerability is reconstructed instead of being reduced.

To avoid this, immediately after the emergency stage, an assessment must be made of the direct and indirect effects of the event and their consequences on the social well-being and economic performance of the affected country or area. This assessment need not entail the utmost quantitative precision, but it must be comprehensive in that it covers the complete range of effects and their cross-implications for economic and social sectors, physical infrastructure and environmental assets. With such estimates in hand, it is possible to determine the extent of reconstruction requirements, which is an, urgent task since those affected cannot wait long under the conditions prevailing after a disaster occurs. Such an exercise is indispensable for identifying and undertaking reconstruction programme and projects, many of which will require the international community's financial and technical cooperation.

To ensure vulnerability reduction, reconstruction programme and projects must be designed within a mitigation and prevention strategy that is part of the development process. Therefore, a set of diagnostic tools is needed to measure the type and amount of damage and losses caused by each type of disaster. Such working tools are not very abundant in the economic literature, especially since they must be able to gauge social, economic and environmental effects.

Based on special disaster-assessment endeavors in the region since the early 1970s, the Economic Commission for Latin America and the Caribbean (ECLAC) developed an assessment methodology that further broadened and developed the concepts outlined by UNDRO a decade earlier.[3]

3 ECLAC, *Handbook for the Estimation of the Socio-economic Effects of Natural Disasters*, Santiago, Chile, 1991; UNDRO, *Disaster Prevention and Mitigation: Compendium of Current Knowledge*, Volume 7, "Economic Aspects," United Nations, New York, 1979.

The methodology published by ECLAC at that time made it possible to estimate the effects of natural disasters; it was also applicable to man-made ones, as in the case of certain armed conflicts in Central America. In the original ECLAC Handbook, disaster effects are measured at the sectoral and global levels, thus allowing for an assessment of the reconstruction capacity of the affected country or region and the scope of the necessary international cooperation. The ECLAC methodology pays due consideration to the prevailing insufficiency of reliable quantitative information for the region, the availability of which is even more limited after a disaster. The ECLAC Handbook did not include methods for estimating damage and losses in certain social and economic sectors, to the environment or to specific population groups.

ECLAC now presents a revised and extended version of the Handbook that incorporates the practical experience acquired through the assessment of numerous disasters in the past decade, as well as the development of new and complementary concepts. This new version has also greatly benefited from the cooperation and contributions of distinguished experts and consultants from Latin America, the Caribbean and other parts of the world, and it is the result of the conceptual analyses of many disasters that have occurred in the region over the past three decades.[4]

This revised Handbook incorporates new and significant developments while refining and improving the methodology for damage assessment contained in several sections included in the first version published in 1991. In that respect, special reference should be made to the inclusion of cross-sectoral subject areas such as the environment, employment and income, and the differential effects on women, whose action is essential both during reconstruction and in mitigating the future impact of disasters. Furthermore, we put forward new tools for this type of analysis, which are now available thanks to the databases that can be accessed over the Internet, the use of remote sensors and the systematization of geo-referenced information. The Handbook points to some analytical difficulties associated with lags in the compilation of sufficiently detailed or itemized information –for example by sex, by income group or by geographic or political areas within a country– or the lack of baselines defining "normal" or pre-disaster situations such as environmental situation diagnoses and human development and social fabric indicators.

4 See the comprehensive listing of documents describing assessments undertaken by ECLAC since the early 1970s, included in the last section of the present Handbook.

II.CONTENTS

This new version of the ECLAC Handbook describes the methods required to assess the social, economic and environmental effects of disasters, breaking them down into direct damages and indirect losses and into overall and macroeconomic effects. The Handbook is not aimed at identifying the origins of disasters or defining the actions to be undertaken during the emergency or humanitarian assistance stage, since these tasks fall within the jurisdiction of other institutions and bodies. Although this second version of the Handbook contains significant improvements, it is not a finished product. Rather, we view it as a work in progress to be enriched continuously by the experience and contributions of its users as they apply it to the unique challenges of each new disaster.

The Handbook focuses on the conceptual and methodological aspects of measuring or estimating the damage caused by disasters to capital stocks and losses in the production flows of goods and services, as well as any temporary effects on the main macroeconomic variables. This new edition also contemplates both damage to and effects on living conditions, economic performance and the environment.

The Handbook describes a tool that enables one to identify and quantify disaster damages by means of a uniform and consistent methodology that has been tested and proven over three decades. It also provides the means to identify the most affected social, economic and environmental sectors and geographic regions, and therefore those that require priority attention in reconstruction. The degree of detail of damage and loss assessment that can be achieved by applying the Handbook will, however, depend on the availability of quantitative information in the country or region affected. The methodology presented here allows for the quantification of the damage caused by any kind of disaster, whether man-made or natural, whether slowly evolving or sudden. The application of the methodology also enables one to estimate whether there is sufficient domestic capacity for dealing with reconstruction tasks, or if international cooperation is required.

Although this Handbook provides methods for evaluating different types of situations, it is not intended to be all encompassing. However, the concepts and examples provided will afford the analyst the basic tools needed to examine cases not explicitly covered in this text.

The Handbook is divided into five sections. The first describes the general conceptual and methodological framework. The second section outlines the methods for estimating damage and losses to social sectors, with separate chapters on housing and human settlements, education and culture, and health. The third section concentrates on services and physical infrastructure, including chapters on transport and communications; energy; and water and sanitation.

The fourth section covers damages and losses to productive sectors, with separate chapters on agriculture and fisheries, industry, trade and tourism. The fifth section deals with overall, cross-sectoral and macroeconomic effects, with separate chapters on environmental damages, the differential effect of the disaster on women, the impact on employment and income, a damage overview that provides a procedure for calculating total direct and indirect losses, and the effects of the disaster on the main macroeconomic aggregates.

The damage overview is specially relevant since expressing total damage in comparison to the size of the economy or other general variables allows one to determine the magnitude of the disaster and its overall impact. The analysis of the effects of the disaster on the possible performance of the main macroeconomic variables or indicators should be undertaken for a time-frame ranging from one to two years after the event, although this may be extended for up to five years depending on the magnitude of the damage.

In addition to the conceptual framework described in each chapter, practical examples of actual cases analyzed by the ECLAC Secretariat are included as appendices for each sector. To the fullest possible extent, these examples have been chosen in order to reflect a wide range of possibilities: different natural phenomena (climatic or geological in origin, sudden or slow evolving events), as well as the composition and relative weight of losses. We have cited geographically diverse countries, and special conditions of vulnerability such as those found in Small Island Developing States (SIDS). In addition, we have included recurrent or seasonal events and phenomena with varying occurrence cycles.

The Handbook is presented in such a form that specialists involved in evaluating specific sectors can quickly refer to relevant conceptual material and chapters that are focused on their specific field of interest. An electronic version of the Handbook is also available on CD-ROM or at the ECLAC website; it also includes examples of recent case assessments using the revised methodology. We hope that this second version of the Handbook will not only be more complete but also more "user-friendly" than the original.

We further hope that readers and users of the Handbook will contribute their experiences in order to enrich and improve future editions. It will be used as a tool to train technical personnel in the countries at risk and also as a means to increase a greater culture of prevention within the region.

III. THE BEST TIME TO UNDERTAKE THE ASSESSMENT

It is impossible to decide a priori the most opportune time to undertake an assessment, as it will depend on the type of phenomenon causing the disaster, its magnitude and its geographic scope. In general, experience shows that the assessment should not begin until the humanitarian assistance stage is completed or well underway, so as not to interfere with search and rescue activities and to ensure the availability of sufficient quantitative information on direct, indirect and macroeconomic damage and losses. Given that in each case the assessment team will require the assistance of numerous national and regional counterparts from the affected areas, assessment work must be scheduled to begin when such personnel are no longer involved in humanitarian assistance efforts or, as is often the case, they or their families are no longer considered part of the affected population.

On the other hand, the assessment should not be unnecessarily delayed as there is an urgent need to elicit support from the international community, whose attention may quickly by diverted by disasters in other parts of the world.

The timing or sequence of dealing with the subjects in each assessment cannot be defined beforehand because it will depend on the type and magnitude of the event. However, in general terms, the analysis should usually begin with an evaluation of the population affected by the disaster with an eye toward defining the different degrees of impact; one should also keep in mind the differential impact on men and women and their differing roles during the emergency, rehabilitation and reconstruction stages. As a second step, one can identify and analyze damage to the social sectors (housing and human settlements, education and culture, and health), highlighting the situation of the most vulnerable groups. Third, the economic sectors (agriculture and fishing, trade and industry, and services) and infrastructure may be approached. The analysis of the effects of the disaster on environmental assets and services can be undertaken concurently.

The breakdown and depth with which the analysis is performed –as can be seen from the recent documents prepared by the ECLAC Secretariat– depend on the type of phenomenon involved and the availability of information for estimating damages and losses. In some cases it is possible to estimate damage and losses in minute detail, down to the level of vulnerable groups, municipalities or local communities.

IV. ACKNOWLEDGEMENTS

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ECLAC is deeply grateful for these contributions and also acknowledges the great importance to this exercise of interaction with many officials, academics and others who, in the course of assessment missions in the region, contributed ideas that enriched this manual.

V. AUTHORS

ECLAC entrusted the preparation of this version of this Handbook to Ricardo Zapata Martí, the Mexico City subregional headquarters official who acts as focal point for the subject of disasters at the Commission. Roberto Jovel, who directed the preparation of the first version of the Handbook, was hired as an external consultant to guide and supervise this version, as well as to write some sections. The following people, including members of the permanent staff, participants and in an interdivisional cooperation effort, and external consultans, were responsable for writing specific chapters:

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Health: Marcel Clodion, consultant from the Pan-American Health Organization (PAHO/WHO) and Claudio Osorio (PAHO/WHO).

Housing and human settlements: Daniela Simioni, ECLAC Division of the Environment and Human Settlements (DEHS); with support from Mauricio Faciolince, Ricardo Bascuñan and Silvio Griguolo (consultants).

Energy: Roberto Jovel, on the basis of previous work by Ricardo Arosemena (consultant).

Water and sanitation: Claudio Osorio (PAHO/WHO).

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Impact on women: Roberto Jovel, on the basis of a report by Angeles Arenas (consultant); with contributions by Asha Kambon and Roberta Clarke of the ECLAC subregional headquarters for the Caribbean, as well as from Sarah Bradshaw and Fredericka Deare (consultants).

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The following ECLAC officials read the original manuscript and provided valuable suggestions that enabled the improvement of the final version of the Handbook:

Nieves Rico, Women and Development Unit at ECLAC headquarters; Pilar Vidal, Women and Development Unit at ECLAC/Mexico; Esteban Pérez, ECLAC subregional office for the Caribbean.

Section One

Methodological and conceptual aspects

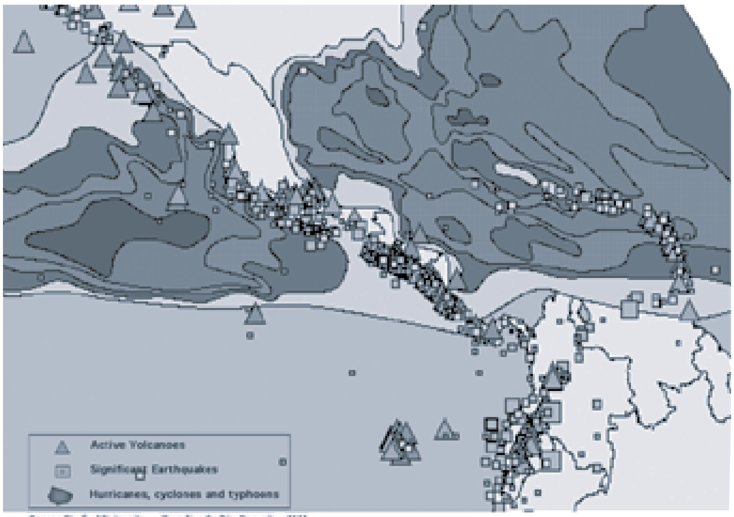
I. TYPES OF DISASTER AND POST-DISASTER STAGES

Disasters can be classified in many different ways. They are usually sudden and unexpected events –often accompanied by a loss of human life– that inflict on all or part of society suffering and harm, a temporary breakdown of existing vital systems, material losses and considerable obstacles to social and economic activities. Slowly evolving disasters, which tend to manifest themselves with fairly frequently, also affect societies and economies and, depending on their intensity and duration, can even cause food shortages or the inadequate provisioning of essential services.

Depending on their origin, disasters can be classified in two major groups: those deriving from natural hazards and those brought about by human activity. In addition, the effects of natural disasters are often magnified or exacerbated by prior human intervention. The most common natural disasters in Latin America and the Caribbean are those caused by tropical storms and hurricanes, floods, droughts, frosts and hailstorms, earthquakes, volcanic eruptions, tsunamis and mudslides. The most frequent man-made disasters are fires, explosions and oil spills. Some human actions increasingly cause or aggravate natural phenomena by failing to properly use natural resources or comply with codes and standards for the design and construction of development works. In other words, human intervention may increase the vulnerability of human settlements, production activities, infrastructure and services.

Natural hazards that cause disasters in Latin America and the Caribbean can be hydro-meteorological or geological in origin. Every year tropical storms and hurricanes move through both the Caribbean and in the tropical belt of the Pacific Ocean. The atmospheric and oceanographic modifications in the Pacific known as the El Niño phenomenon or the El Niño Southern Oscillation induce changes in seawater and cause floods and droughts. In addition, the presence of the "ring of fire" along the continent's Pacific coast, as well as various lines or areas of contact between tectonic plates, lead to earthquakes and volcanic eruptions.[1] The following graph indicates the areas most at risk of seismic, hydro-meteorological and volcanic activity including parts of the Pacific Rim and the Caribbean.

1 Jovel, Roberto, "Natural Disasters and their Socioeconomic Effects", *ECLAC Review*, No. 38, ECLAC, Santiago, Chile, 1989.



2

A SYSTEMIC SYNTHESIS OF THE RELATIONS BETWEEN VULNERABILITY, HAZARD, EXPOSURE AND IMPACT, AIMED AT POLICY IDENTIFICATION

By Gilberto C. Gallopin

A review of the existing literature reveals that there is no consensus on the concept of vulnerability. A systemic approach is proposed here that includes the central elements of the debate (see for example, Clark et al., 2000; IHDP Update, 2001; Rodríguez, 2000), while giving them a systemic framework that raises new questions and lines of attack.

The vulnerability of a system is defined here, in the most general terms, as its propensity to undergo significant transformations as a result of its interaction with external or internal processes. Significant transformation is understood here to mean structural or, at least, relatively permanent and profound change.

The concept of vulnerability is not exclusive to social systems. In fact, it can be applied to any system that interacts with its environment, in particular human systems (e.g., a village, a social group), natural systems (e.g., a forest ecosystem) and socio-ecological systems including human and biophysical components (Gallopin et al., 1989).

Both societal and ecological systems survive thanks to the constant exchange of matter, energy and information with their external environment. Those processes can give rise to modifications in the functioning or structure of the system triggered by changes in the system's environment (e.g., the effects of an earthquake on a population), by internal alterations (e.g., the impact of civil war on a country) or the interaction among external and internal processes (e.g., the effects of a prolonged drought in a country with internal conflicts).

Whether the event/change/hazard is described as external or internal depends on the scale of definition of the system. Earthquakes and hurricanes are clearly internal phenomena for the planetary ecosystem, but they are obviously external events if the system in question is a Central American village.

In human systems, vulnerability is often related to (but is not the same as) poverty or an integrated measure of well-being. Not all poor people are vulnerable and not all non-poor people are invulnerable.

Vulnerability as propensity (Popper, 1990) is not an absolute property, but one relative to a system in a given context, including specific changes or hazards. In other words, a system can be vulnerable to certain disturbances and strong in the face of others. However, some systems might be so fragile that they exhibit "generic vulnerability" to many types of disturbances.

According to this general conception, vulnerability is not always a negative property. It is possible to speak of positive vulnerability in cases where change leads to a beneficial transformation such as the emergence of a given social group from chronic poverty or the collapse of an oppressive regime. Of course, characterizing transformation as positive or negative is inherently a value judgment. In this sense, the "significant transformations" that are part of the definition of vulnerability can be differentiated as positive or negative as in Table 1, which also differentiates how gradual or sudden they are.

Table 1

A classification of systemic transformations or impacts

Effects	Dead	Wounded	Buildings totally destroyed	Buildings partially destroyed	Roads closed	Public services interrupte
	********	********	********	********	********	*******

Effects on the Environment

Effects	Air pollution	Water pollution	Land pollution
		******************	

However, for the purposes of this manual, hereinafter we will limit the discussion of vulnerability to its negative aspects, and limit the phrase "significant transformations" to the particular case of "damage" or "adverse effects".

Central to the consideration of vulnerability are the concepts of the system in question’s sensitivity and response capacity (target system, unit exposed or system of reference), the probability of occurrence, the type and magnitude/intensity/speed of the triggering event, exposure of the system to the event (external or internal) and the transformations or impacts the system undergoes.

Sensitivity is the degree to which the system is modified or affected by an internal or external disturbance or set or disturbances. Conceptually, it could be measured as the degree of transformation of the system per unit of change in the disturbance (Tomovic, 1963), but sometimes it only specifies whether the system is sensitive to a given factor.

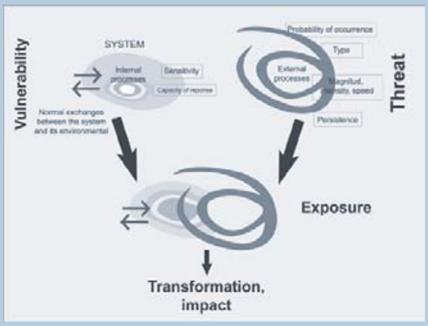
The response capacity is the system's ability to adjust to or resist the disturbance, moderate potential damage and take advantage of opportunities. Various factors play a part in determining response capacity, including resilience, the availability of reserves and information, internal regulation mechanisms and the existence of cooperative links with other systems.

The system's exposure to the disturbance, external or internal change, or hazard is the degree, duration and/or extension of the system in question's contact with the disturbance.

Vulnerability, as understood here, is a system attribute existing prior to the disturbance/change/hazard, although it is often related to the history of disturbances to which the system was exposed in the past (hence the importance of the system's history).

The system's exposure to the disturbance is, however, an attribute of the relationship between the system and the disturbance. As such, it is not an attribute of the system, but note that some authors include exposure as part of the definition of vulnerability (Cutter, 2001).

The impact on the system depends, apart from its vulnerability and exposure, on the event or set of events/changes/hazards, on the type of event (e.g., hurricane, earthquake, economic crash, internal conflict), its probability of occurrence, magnitude, intensity, speed (or gradualness) and persistence.



The difference between sensitivity, response capacity and exposure can be illustrated with a simple example such as a flood's effects on a population. The most precarious homes are harder hit by a flood than more solid ones (sensitivity). Oftentimes, the poorest homes are located in the places most susceptible to flooding (exposure). The families with the greatest resources have a greater availability of means to repair water damage (response capacity). The magnitude of the final impact will also depend on the intensity, magnitude and permanence of the flood (attributes of the event).

The figure above, illustrates the relations between the concepts discussed for the case of an event/change/hazard whose origin is external to the system. A similar diagram could be made for the case of the system's internal disturbances.

When developed, the conceptual system shows the importance of differentiating policies aimed at protecting human populations or natural ecosystems from natural disasters or other harmful events. Differentiated policies are required to reduce the system's vulnerability, the probability or intensity of a natural disaster (if that is possible) and the system's exposure to the hazard, as well as to mitigate the event's negative impact on the system in question.

The next figure illustrates the type of policies most commonly associated with the different aspects mentioned.

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Tomovic, R. (1963), *Sensitivity Analysis of Dynamic Systems*, McGraw-Hill, New York.

After a disaster occurs, activities are normally grouped together into three different stages: a) emergency, b) rehabilitation and recovery (also called transition), and c) reconstruction.

The emergency stage refers to the period for humanitarian assistance, when steps are taken to save lives and to provide essential supplies to those most affected. It includes such activities as search, rescue, evacuation, provision of shelters, first aid, emergency medical care and protection, temporary restoration of transportation and communication routes, preliminary repairs to essential public services, and initial actions to register victims and record damage to public and private property. This stage may vary in its duration, but it is generally relatively brief, depending on the magnitude of the disaster.

The rehabilitation or transition stage includes activities required to restore normality to the affected areas and communities. It includes temporary repairs to housing and buildings and to transport and public utility infrastructure. Problems related to the emotional and psychological recovery of the inhabitants of the affected regions are also addressed during this phase. The recovery measures most helpful to affected communities are those that allow victims to return to work, help create new jobs, make loans and other financial resources available and launch projects related to other disaster consequences.

Finally, the reconstruction stage includes activities designed to rearrange the affected physical space and environment and enable the allocation of resources in accordance with the new social priorities arising from the effects of the disaster.

Assessment activities described in this Handbook should be carried out when the emergency stage has been completed or is nearing conclusion, so as not to interfere with those actions and to ensure the availability of the necessary personnel and basic information. They are intended to facilitate the identification of needs and priorities for the reconstruction stage.

II. GENERAL METHODOLOGICAL CONSIDERATIONS

The ultimate goal of the assessment methodology presented herein is to measure in monetary terms the impact of disasters on the society, economy and environment of the affected country or region. National accounts are used as a means of valuation, supplemented with procedures for specific estimates such as environmental damages and the differential impact on women.

Application of this methodology provides affected countries or regions with the means to determine the value of lost assets and define reconstruction requirements. It enables the identification of the most affected geographical areas and sectors, together with corresponding reconstruction priorities. In addition, it provides a way to estimate effects on economic flows, the affected country’s capacity to undertake reconstruction on its own and the extent to which international financial and technical cooperation are needed. Moreover, it can be used to identify the changes to public policy and development programmes/plans needed to deal with needs arising from the disaster and to avoid undesirable effects in economic performance and public well-being.

It will often be necessary to conduct assessment work quickly in order to guide reconstruction activities and international support. The affected population's pressing needs must be met quickly, and it is essential to exhaust all opportunities to obtain reconstruction assistance before international attention is diverted to other areas of the world. Therefore, the timely presentation of the assessment takes precedence over exhaustive analytical precision, but this initial evaluation must clearly state the magnitude of damage and reconstruction requirements.

The following chapters offer a detailed description of the methodology and sources of information we recommend for the analysis of each sector, as well as those related to the assessment of overall impact. We also describe select criteria that are universally valid for addressing these questions.

The assessment should begin by gathering all existing quantitative background information needed for an appreciation of both conditions before the disaster and the magnitude of damage and losses and their macroeconomic effects. Assessors should consult government sources and industrial or professional associations (such as societies of engineers or architects), service providers, chambers of commerce and industry and farmer associations, as well as resident experts from national and international institutions or bilateral missions who may be in the affected country at the time of the disaster.

The reliability of the information obtained should be verified in the field. Sampling should often be used to determine both the number of units affected and the magnitude or extent of damage, applying appropriate assessment criteria in each case. The latter is especially true when determining the differential effects of disasters on women.

The assessments for which this manual is designed are a basic tool in the decision-making process of defining and assigning priorities for reconstruction plans and programmes. As suggested earlier, proper consideration must be given to the balance between estimate precision and the urgency of completing an assessment in order to launch programmes. Assessment results must, at a very minimum, provide an accurate estimate of the disaster`s impact, including its geographic and sectoral scope. More precise calculations can be provided later as specific investment projects are formulated.

SHADOW PRICES AND DISASTER DAMAGE ASSESSMENT

In terms of economic impact, a disaster may be considered the opposite of an investment project. Projects, whose results often take a physical form, involve decisions regarding the use of resources with a view to increasing, maintaining or improving the production of goods or the provision of services. The three basic parameters of an investment project are the amount of the initial investment, the lifetime of the project and the flow of costs and benefits generated by the project over its lifetime. From an economic standpoint, project viability is assessed by comparing costs to benefits.

In contrast, disasters cause damage to assets (they could be regarded as "disinvestments") and affect the production of goods and services, in terms of both their availability and the efficiency of production. If the method of project assessment is applied to specific economic sectors, three parameters are needed to assess the economic damage: (I) the amount of asset losses (or disinvestments); (II) the impact, in terms of prices and quantities, on the flow of goods and services in the relevant sector; and (III) the period in which markets are disrupted.

Like the methods for project assessment, the process of identifying the damage caused by a disaster involves comparing the "non-disaster situation" and the "disaster situation", rather than the "pre-" and "post-" disaster situations.[2] Otherwise, the damage caused by a disaster may be overestimated (in the case of production that was already tending to decline) or underestimated (if production was increasing), or damage may be attributed solely to the disaster when it may be due to other factors, as well.

There are two types of project assessment: private and social. In private assessment, annual returns derive from the sale of products or services, and costs derive from the purchase of inputs and factor payments. In social assessment, annual social benefits are obtained from the increase in national income generated by a project, while the costs refer to the income sacrificed by implementing that particular project rather than another one. Private investments may have social profit levels that are very different from the profits obtained by private investors themselves.

Social and private assessment use similar criteria to study project feasibility, but differ in their valuation of the variables determining the associated costs and benefits. Private assessment works with market prices, whereas social assessment uses "shadow", or social, prices. The latter take into account the indirect effects and externalities that affect the well being of society.[3]

2 With regard to assets, the "pre-disaster" and the "non-disaster" situation are the same when the disaster takes the form of an event of short duration (hurricanes, floods, earthquakes); there may be differences in the case of slowly evolving disasters (such as droughts). Economic assessment of changes in the flow of goods and services, however, requires the projection of a "non-disaster situation" in order to compare it to a "disaster situation" so that the damage will be correctly attributed to the disasters (the case of tourism in Belize is a good example).

3 Some types of projects have private prices that are very different from their social prices: (I) those which generate public goods, where the private price is equivalent to zero; (II) those implemented where there are market imperfections (monopoly, monopsony); (III) those implemented where there are taxes, subsidies or quotas that make the prices of products and inputs different from what they would have been in a situation of perfect competition; and (IV) those implemented where there are externalities.

Social assessment uses the three basic shadow prices: foreign currency, manpower and the social discount rate. The social prices of the goods and services generated by the project also have to be calculated, as well as those of the inputs used in production. The three basic shadow prices are generally calculated at the national level. The shadow prices of the goods or services produced and of production inputs are calculated with information on current and future supply and demand; this requires specific studies that may be rather complex.

In theory, the methodology for the social assessment of projects may be adapted to the assessment of economic damage caused by disasters, and shadow prices may be used to obtain a close approximation of the value of damage to society. For example, the damage caused by reduced production of an export item that generates foreign currency for the country may vary greatly depending on whether it is assessed using private prices or shadow prices. Although this approximation might be preferable in theory, the use of private prices is more practical given the amount of information that social assessments require, the number of sectors involved and the short time usually available for damage assessment.

III. CLASSIFICATION AND DEFINITION OF DAMAGE AND EFFECTS

Natural phenomena such as earthquakes, storms and floods not only produce immediately apparent effects, but they also unleash aftereffects that evolve slowly or emerge a relatively long time after the disaster has occurred, such as crop destruction due to the emergence of pests related to the event, or the shortage of essential products several months after the actual disaster.

This Handbook describes a proposed classification of a disaster's damages and effects that requires the application of two criteria: the methodology applied must provide an assessment of the full socio-economic and environmental effects at the time the disaster occurs as well as during its aftermath, and it must be able to do so at different geographical levels and sectors.

Granting that all definitions are by their nature conventional and that some cases may straddle the border between two concepts, the definitions applied here derive from the consensus achieved during the three decades in which such assessment activities have been undertaken in the region.

Expressed in the simplest terms, a disaster affects assets (direct damages); the flow for the production of goods and services (indirect losses); and the performance of the main macroeconomic aggregates of the affected country (macroeconomic effects). For convenience, use is made of the term damage or loss; however, disasters may also have a positive result. The assessment is therefore aimed at determining the net effect, giving due consideration to both negative and positive results.

Direct damages occur at the moment of the disaster or within the first few hours. Depending on the magnitude of the disaster, the latter two types of losses can extend over a period of up to five years. During slowly evolving or long-duration events –such as droughts or the effects of El Niño– direct damages may occur over an extended period and recur several times if the affected infrastructure was initially repaired and subsequently damaged anew, as in the case of bridges destroyed by repeated flooding. However, most losses will be indirect owing to the impact on economic flows.

During a quick assessment, identification and evaluation of direct damage is a relatively straightforward matter. The same cannot be said of a disaster's indirect effects. These indirect losses will become apparent at different times after the disaster and are, therefore, more difficult to identify during a rapid assessment.[4]

In fact, most of these indirect effects are not evident when the assessment is carried out, and although they can be identified when the damage is estimated, it is not always possible to measure them in monetary terms. In this respect, indirect effects in cases of slowly evolving disasters (such as droughts or extended flooding) will occur for as long as the causing phenomenon lasts.

The first two types of effects (direct damages and indirect losses) can be added together to obtain an order of magnitude of the total amount of damage, provided that it is duly indicated that the summation includes both assets and economic flows. The macroeconomic effects represent a different view of the assessment, however, since they describe the effects of the disaster on the functioning of the economy and the resulting macroeconomic imbalances arising from the event. Therefore, macroeconomic effects cannot be added to the other two categories of damages because that would involve double accounting.

Physical units (number of damaged or destroyed units, square meters of construction, hectares, tons, and so forth) are the starting point for any damage estimate. Using them will permit the adoption of the most suitable valuation criteria in each special case. Let us now turn to a detailed description of the damage to be estimated under each category of effects.

1. Direct damages

Direct damages (complete or partial destruction) may be inflicted on immovable assets and on stock (including final goods, goods in process, raw materials, materials and spare parts).[5] In essence, this category consists of damage to assets that occurred rigth at the time of the actual disaster.

4 The time period to be considered in estimating indirect losses is equal to that required to achieve "normalcy" or a situation equal to the one prevailing before the disaster.

5 Entrepreneurs or owners of companies normally also count as losses those to realizable assets, such as destroyed accounts receivable which, will not be collected. However, from a macroeconomic viewpoint, such losses should not be included as direct damage because if said collections did take place they would represent an inter-sectoral transfer of revenue and including them would involve double accounting.

The main items in this category include the total or partial destruction of physical infrastructure, buildings, installations, machinery, equipment, means of transportation and storage, furniture, damage to farmland, irrigation works, reservoirs and the like. In the special case of agriculture, the destruction of crops ready for harvest must also be valued and included as direct damage.

As will be seen in the sectoral chapters, a distinction should be made between public and private sector damage in order to determine where the weight of the reconstruction effort might fall.

The same is true in the case of repairs,[6] totally destroyed structures, equipment and stock. During the quantification of direct damage, the imported component necessary to replace the damaged or destroyed asset must be estimated as well, since this will have an effect on the balance of payments and trade.

THE VALUE OF A LOST LIFE

Disasters often result in the loss of human life. Setting aside the suffering sustained by families and society in general, fatalities are a direct loss to the society in any country affected by a disaster. They are a loss of human assets. There are indirect ways to estimate a monetary value of such losses.

A possible approach to estimating these losses would involve calculating the future income –expressed in net present value– that the deceased would otherwise have generated assuming that each had fulfilled her or his normal life expectancy. By comparing the average age of those killed by a disaster against their life expectancy –giving due consideration to sex differentials– it is possible to estimate the time loss for the deceased. A rough estimate of human asset losses may be reached by combining the resulting number of person-years with the expected average income over the appropriate time span.

Such a procedure has its shortcomings, however. As is well known, per capita income varies from one country to another. Using it as a yardstick to ascertain human asset losses would suggest that a human life lost in a developing country would be worth less than a life in a more developed nation, even within the Latin America and Caribbean region. This is morally unacceptable.

An alternative way of assigning a value to the loss of life would be the adoption of the amount paid by insurance companies in cases of airline-related accidents, as set forth by the Warsaw convention of the International Civil Aviation Organization (ICAO). However, here again shortcomings arise since the relevant values may vary by region.

6 In practice, the sectoral specialist will often value repairs as a percentage of the replacement value of a partially destroyed asset. Although this approach is expeditious, it should be enhanced by including estimation techniques more in keeping with the current value of those repairs.

A further alternative would be to adopt the average compensation paid by insurance firms in the region for accidental deaths related to hazardous activities. This method, however, cannot be used because the amounts paid depend on the actual payment capacity of insured persons, which most certainly do not match that of the average victim in a given disaster; it is also skewed by the same bias in regard to per capita income.

Other ways to arrive at the value of human life are based on the amount that a person is willing to pay to avoid premature death. For this purpose, one can use valuation methods based on a worker's annual contribution –determined through actual surveys– in cases of hazardous activities. This type of approximation has the advantage of reflecting costs not exclusively related to losses in production, but it yields higher figures than the previously discussed alternative procedures. Furthermore, it does not eliminate the problem related to differences in per capita income.

In brief, while there exist methods that might be adopted for the purpose, the above limitations render impractical any attempt to estimate the value of human loss of life.

2. Indirect losses

This effect refers essentially to the flows of goods and services –expressed in current values– that will not be produced or rendered over a time span that begins after the disaster and may extend throughout the rehabilitation and reconstruction periods. Convention calls for a maximum five-year time-frame although most losses occur during the first two. In any case, the estimate of these effects must be extended throughout the period required to achieve the partial or total recovery of the affected production capacity.

These indirect losses result from the direct damage to production capacity and social and economic infrastructure. Indirect losses also include disaster-induced increases in current outlays or costs in the provision of essential services, as well as diminished expected income in cases where these services cannot be provided under normal conditions or at all (which in turn will be reflected in macroeconomic effects). Examples of indirect effects are losses of future harvests due to flooding or prolonged droughts;[7] losses in industrial production due to damage to factories or a resulting shortfall in access to raw materials; and greater transportation costs as the need for alternative routes or means of communication imply longer, more expensive, poorer-quality options. These are indirect losses for the sector in question and will also be considered as macroeconomic effects when the main economic aggregates are examined.

7 However, if the disaster destroys crops that are about to be harvested, this loss should be considered direct damage, as mentioned earlier and as will be explained in the chapter on agriculture in Section Two of this Handbook.

The assessment specialist must be aware that some indirect effects of a disaster might generate benefits to society, instead of damage, costs, harm or losses. Indeed, indirect effects sometimes produce major benefits that can be estimated and must be deducted from the total damage estimate.[8]

Disasters also produce some major indirect effects that may be difficult to identify and impossible to quantify. These effects lead to "intangible" damage (or benefits) such as human suffering, insecurity, a sense of pride or antipathy at the way in which authorities have faced the disaster's consequences, solidarity, altruistic participation, the impact on national security and many other similar factors that have an effect on well-being and the quality of life. The assessment specialist will not always have enough time to attempt to place a monetary value on these important effects of disasters. However, he or she must be aware that a comprehensive evaluation of the effects of a disaster must include an assessment or at least a global discussion of such intangible damage or benefits, since they considerably affect living conditions and standards.

Finally, some indirect effects of disasters can be given a monetary value but are very difficult to calculate owing to the limited time available for the assessment. This category of effects includes the estimate of lost opportunities due to the impact of the disaster on the structure and functioning of economic activities, distributive and redistributive effects, losses in human capital represented by victims and so forth.

In brief, disasters often include one or more of the following types of indirect losses, which can be measured in monetary terms:

i) Higher operational costs due to the destruction of physical infrastructure and inventories or losses to production and income. For example, losses in sales of perishable goods or those that could not be stored in time and thus went unsold; unexpected costs incurred in the replacement of lost records in the health care system (clinical files in health centers).

ii) Diminished production or service provision due to the total or partial paralysis of activities. For example, damages due to the loss of a full school term; the costs of not being able to comply with export contracts.

iii) Additional costs incurred due to the need to resort to alternative means of production or provision of essential services. For example, the greater costs arising out of the use of longer or low standard roads (detours) and the construction of emergency roads.

iv) Greater costs due to budgetary reorientation or reassignment.

8 For example, once waters receded from widespread floods caused by the El Niño phenomenon in a South American country, a relatively large amount of coastal land that had previously been unsuitable for farming was temporarily made fertile. The owners cultivated this land, and the resulting harvest was deducted from the loss estimates as an indirect benefit.

v) Income reduction due to the non-provision or partial provision of services by public utilities (power and drinking water); reduction in personal income owing to loss of employment or being forced to work part-time.

vi) Costs incurred by all parties involved in attending to the affected population during the emergency stage.

vii) Additional costs for dealing with new situations arising from a disaster, such as the cost of health campaigns to prevent epidemics.

viii) Lost production or income due to linkage effects, similar to those that occur during a recession, which can be "forward" or "backward". For example, the destruction of a factory, reduces the economic activities of suppliers who have no alternative markets or of clients who have no other suppliers.

ix) The costs or benefits of external factors; namely any disaster repercussion or side effect whose costs (or benefits) are absorbed by third parties who are not direct victims (or beneficiaries) of the disaster. This concept is quite broad since it includes effects such as the benefit of training for emergency workers or brigades, some environmental pollution costs, greater traffic congestion and other similar repercussions of a disaster. The assessment specialist should only consider relevant external factors that significantly modify the estimate of the amount of damage.

Not all types of effects are mutually exclusive, and the assessment specialist should ensure that no double accounting takes places. For example, if effects are calculated on the production side, they must not be included again on the income side; if the effects of budgetary reassignment to deal with the rehabilitation stage are identified, the spending it financed must not be taken into account later as an indirect cost.

In light of the above difficulties, estimates of indirect losses should best be undertaken in close consultation with the respective authorities or experts. This co-operation is essential in cases such as estimating the time needed to reestablish services, lost production volumes, greater costs incurred in the provision of services and the corresponding reductions in income. An analysis must also be made of the operating results of public utilities so as to estimate their possible losses while rehabilitation is ongoing, as well as of the prices and yields of lost agricultural and industrial products. This Handbook provides step-by-step procedures for undertaking these estimates for each of the affected sectors.

The concepts outlined above are quite broad. We recommend that assessment specialists narrow their focus so as not to waste too much time in quantifications that do not yield applicable results, such as the intangible effects of the disaster on human production capacity, or the indirect effects resulting from how the emergency process was handled, or even certain drastic economic measures that might have been taken. The idea therefore, is, to measure only the most important indirect effects, which could also be called primary or first-round effects.

Adding the direct and indirect effects indicated so far will provide an estimate of the total losses caused by the disaster.

3. Macroeconomic effects

Macroeconomic effects reflect the manner in which the disaster modifies the performance of the main economic variables of the affected country, provided the proper national authorities make no adjustments. Since they reflect the repercussions of direct damages and indirect losses, they must not be added to those lists. Rather, macroeconomic effect estimates are a complementary way to assess direct damages and indirect losses from a different perspective. Quantification of macroeconomic effects is usually done for the national economy as a whole. Sectoral specialists must provide the macroeconomist with the information needed to achieve a comprehensive view of the impact on the main economic variables. While a country serves as the basic unit for this analysis, similar exercises can be conducted for disasters affecting smaller areas or regions –a province, state, department or municipality– provided that the necessary information is available.

A valid estimate of the macroeconomic effects of a disaster requires a reliable forecast of how each of the variables would have performed had the disaster not occurred. Such a projection serves as the baseline for ascertaining the degree to which the disaster disrupted results that would have been achieved otherwise and the extent to which the deterioration in the main variables has affected the country's ability to meet rehabilitation and reconstruction requirements and to define international cooperation requirements, especially of a financial nature.

The most important macroeconomic effects of a disaster are those that have a bearing on growth in gross domestic product and in sectoral production; the current account balance (due to changes in the trade balance, tourism and services, as well as outflows to pay for imports and foreign services, etc.); indebtedness and monetary reserves; and public finances and gross investment. Depending on the disaster's characteristics, an estimate of the effects on price increases, employment and family income is often relevant, as are changes to sovereign debt ratings, liquidity and domestic interest rates.

Gross domestic product can be undermined by reductions in the output of affected sectors, and it can be increased by reconstruction. When production is impaired, exports may narrow and goods may have to be imported to satisfy domestic demand, thus eroding both the trade balance and the balance of payments. Public sector spending generally increases as a result of disbursements made during the emergency and rehabilitation stages or to subsidies granted to significantly affected population groups. Fiscal revenues might drop due to decreased tax collection resulting from diminished production and exports, or even from a decision to temporarily lift some taxes to relieve pressure on significantly affected sectors. The combination of the above situations could provoke or expand fiscal deficits.

At the same time, prices may rise in response to shortages brought about by special demands stemming from reconstruction or by speculation, thus fanning inflation. The level of international reserves or the country's ability to meet its foreign debt servicing commitments might also be compromised depending on how the country's economy was performing before the event or the magnitude and effects of the disaster.

Macroeconomic effects to be gauged also include any deterioration in the affected population's living conditions as a result of obstacles to supply sources, reductions in the availability of essential services and, especially, the loss of employment and the corresponding fall in income. Although an erosion of the quality of life cannot be expressed in monetary terms, the effect of a disaster on a population or the drop in income caused by the partial, temporary or total paralysis of activities can be quantified.

To assess and globally consolidate macroeconomic effects, sectoral specialists must calculate foreseeable losses in the production of goods or services for the period they estimate is needed to recoup farmland, production equipment or physical and social infrastructure. They must also obtain background information that will enable an assessment of the impacts on other macroeconomic variables that have been mentioned (employment, income, exports, imports, gross investment, tax collection, etc.). Each specialist must prepare background information on how the sector was expected to evolve before the disaster based on recent performance or in accordance with goals established in each sectoral plan that officials adopted before the disaster.

The magnitude of the disaster is important for defining the time-frame for which macroeconomic effects are to be estimated. Experience shows that a "reasonable" time is normally the remainder of the year in which the disaster occurs (short term) plus another one, two or, under exceptional circumstances, five years (medium term).

It is important to keep in mind that the estimate of macroeconomic effects only shows what would happen should the authorities of the affected country or region not modify current public policies and programmes. Performance projection this provides these officials with a tool for reorienting policies and plans in light of post-disaster reconstruction needs.

Although this subject is addressed more broadly in the corresponding section of the Handbook, some general methodological aspects that are frequently used for estimating some of the most important macroeconomic aggregates are described below.

a) Gross domestic product. The macroeconomic specialist must estimate at constant prices disaster-induced losses in the production of goods and services for the recovery period, including the time needed to recoup lost capacity. Such projections require information from sectoral specialists, who must also define how the sector was expected to perform in the year the disaster occurred based on pre-disaster forecasts. This estimate is the basis for projecting losses to obtain the pre- and post-disaster results. The macroeconomic specialist should also take into account the possible positive effect on GDP of increased construction activity owing to reconstruction.

b) Gross investment. Losses in stock, computed as direct damage, will not be reflected in gross investment for the year because this involves the destruction of pre-existing assets. Depending on the availability of resources and the country's engineering and construction capacity, gross investment should increase the following year as asset restoration gets underway.

In the year of the disaster, this variable will reflect two types of effects: the suspension or deferral of development projects underway prior to the disaster, and losses of stock. The sectoral specialist should supply the macroeconomist with this data, together with a five-year estimate of the investment each sector will need for repairs.[9]

c) Balance of payments. The macroeconomic specialist must estimate the current account of the balance of payments for the year of the disaster on the basis of sectoral reports on the following: i) any decline in exports of goods and services as a result of losses that curtailed tourist activity, or impaired either the merchant fleet or the capacity of companies that export services, such as engineering firms.; ii) increased imports required for the two- to five-year recovery and reconstruction stage such as fuels, food (lost harvests), and building materials or equipment; iii) relief donations in cash or kind; iv) reinsurance payments from abroad; and v) any reductions in foreign debt servicing resulting from post-disaster agreements with creditors.

The balance -of- payments capital account must be estimated largely on the basis of the medium- and long-term external financing requirements of priority investment projects that will form part of the reconstruction process over, say, the five years following the event,[10] and the foreign financial complement required in view of a possible deterioration of the current account balance.

d) Public finances. This is another of the macroeconomic aggregates that must be quantified because the budget approved for the year the disaster occurs (as well as those in succeeding years) will most probably undergo major changes. In this regard, it is necessary to analyze the following possible macroeconomic effects: i) any shortfall in government revenues owing to reduced income from public sector companies, or declining tax receipts due to decreased production of goods and services and an erosion of income and consumer spending; ii) increased current spending related to the emergency, especially humanitarian relief and the urgent repair or rehabilitation of damaged public services; and iii) the investment demands of the reconstruction stage. The macroeconomist will have to try to make sense of the potentially contradictory data obtained from diverse sources. Then he or she will prepare public finance deficit estimates for the reconstruction years in order to better anticipate public sector financial requirements.

e) Prices and inflation. Although it is not always feasible or justifiable to measure general inflation levels before and after the disaster, a "sectorally" informed overview is needed of how supply limitations –arising out of the destruction of crops, manufactured goods, sales channels, transportation routes, etc.– might affect the price of certain goods and services that would have to be supplied by alternative means.[11] The influence of these variables on general and relative prices must be estimated and included among macroeconomic effects.

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9 Or whatever period the sectoral specialist and the macroeconomist deem most suitable for reconstruction.

10 See the previous note.

11 Prices may decrease if the substitute good that is imported or otherwise obtained from a non-habitual source is obtained at a lower price.

f) Employment. Sectoral estimates must be made of the overall effects on employment deriving from the destruction of the production capacity of social infrastructure and new demands for personnel arising during the emergency and rehabilitation process.

Finally, the experience gained from assessments by national and international institutions over the last 30 years makes it possible to draw certain relationships between the type of disaster and the nature of its damage. The most important of these are as follows:[12]

- Disasters of hydro-meteorological origin –such as floods, hurricanes and droughts– generally affect a wider geographical area than disasters of geological origin;
- In areas with similar population density, the number of victims in geological natural disasters –such as earthquakes– will very probably be higher than in the case of hydro-meteorological events;
- The destruction of capital stock in physical and social infrastructure resulting from earthquakes is generally much greater than that caused by floods;
- Production and other indirect losses, on the other hand, will probably be much greater in the case of floods and droughts; and
- A phenomenon of geological origin that causes floods or mudslides normally causes much greater production and other indirect losses than do other kinds of geological disasters.

The following general effects are common to all types of natural disasters:

- A variable number of victims;
- A significant reduction in the availability of housing, health and education facilities that expands pre-disaster deficits in developing countries;
- A temporary decrease in the income of the most disadvantaged social strata, and a corresponding increase in the already high rates of underemployment and joblessness;
- Temporary interruptions in water and sanitation, electricity, communications and transport services;
- Temporary shortages of food and raw materials for agricultural and industrial production;
- A tendency for small businesses and providers of personal services to be among the first to recover regardless of the amount of damage sustained;

12 Jovel, Roberto, op. cit., 1989.

- In countries with predominantly dual structures, a greater severity and duration of the loss of employment in the modern sector than in traditional sectors and in the industrial sector as opposed to agriculture, commerce and services;

- A modification of the employment structure during the rehabilitation and reconstruction stages as construction of housing and public works increases;

- A reduction in the volume of exports and an increase in imports; and

- A trend toward public deficits because increased social spending and greater investment is normally accompanied by lower tax collections and fiscal revenues in general.

4. Damage valuation criteria

Objective and accurate criteria are needed to assess the impact of disaster damage and losses. A true assessment will provide the basis for defining rehabilitation and reconstruction programmes.

Assessment experience in the past 30 years reveals the importance of adopting more than one alternative for the monetary estimate or valuation of disaster damage and losses and the impact to the economy of the affected country or region. This is true because damage valuation criteria depends on how the results of the evaluation are to be used. Moreover, the diversity of the goods affected by a disaster (housing, roads and highways, transportation, pipelines, sewers, drinking water and electricity networks, crops and agricultural land, manufacturing enterprises, commercial and recreational centers, etc.) requires the use of many sources and information that are not always comparable.

Consequently, criteria for the valuation of disaster damage and losses may vary over a range or variety of situations within the extreme situations that are described here in.

The depreciated value of lost assets (or "book value") might be used to evaluate disaster damages. This involves estimating the value of the lost or damaged asset in its pre-disaster condition, taking its age into account in order to arrive at the value of its remaining useful life. This valuation method would be suitable for fixed production assets and others that, while not necessarily used in production processes, are subject to depreciation and obsolescence.

In countries that still have high inflation rates, the book value is not representative of an asset or good's actual market value. In such cases, an attempt could be made to estimate its original value and adjust it for inflation from the year in which the good was acquired and the year in which it was destroyed. However, this process is complicated by the long-term changing trends in the physical characteristics of price index components. In this case, there would be no alternative but to use the replacement cost (with or without depreciation).

At the other end of the scale, damage valuation can involve an estimate of the lost asset's replacement cost that includes future disaster mitigation elements. In other words, the replacement cost of a lost asset would include not only certain technological advances (because of its age, it is unlikely that an identical product would still be on the market), but also features making it more resistant to the impact of future natural or man-made phenomena.

Other, intermediate valuation options exist. As stated above, their application depends on the needs of the analysis, the characteristics of the asset being valued, the availability of information at the time the valuation is made and, most importantly, the time the sectoral specialist has available to carry it out.

Thus, an intermediate position would involve valuing asset damage on the basis of its replacement cost with the same characteristics as its original design and without deducting the asset's depreciation over its useful life. This valuation would be useful in determining the financing needs of the state or the private sector to replace their destroyed or damaged assets.

Replacement costs should be determined with or without mitigation because they will provide the basis for the definition of the country's financial requirements and possible foreign credit needs for rehabilitation and reconstruction of production units or services affected during the disaster.

Regardless of the valuation option that is adopted, damage to assets should initially be quantified in physical units (number of pieces of machinery and production equipment as appropriate, square meters of construction destroyed, bridges, kilometers of highways by class, hectares of crops affected, tons of agricultural products lost, etc.). This will facilitate defining the most appropriate valuation criteria.

Concurrently, illustrative price lists must be available for different goods and services, such as the cost of a square meter of construction for housing of different characteristics, industrial facilities, steel bar and other construction materials, current prices of the main agricultural products, and so on. These can be derived from information generally available on the components of consumer, wholesale or producer price indices. It is often advisable to employ the prices of capital goods or construction materials used in investment projects the government might have in its portfolio or might have executed recently, since they carry updated prices and characteristics.

The assessment specialist will often have to adopt intermediate criteria, such as between the value of a square meter of construction for a destroyed marginal village and the type of permanent housing solution the government intends to provide for the victims (which will undoubtedly imply a qualitative upgrading of housing), or between the value of a destroyed textile machinery that was close to obsolescence and the cost of replacing the unit with a technically more advanced one. In all cases, the value used should be that of the equipment functionally closest to the equipment destroyed, and its cost or characteristics should fall within what can actually be found in the market and financed.

Indirect damage stemming from the interuption of the production or service flows over a given period must be valued at producer or market prices, as appropriate. In the case of production sectors, losses must be assessed at producer prices because they represent the value of what was not produced as a result of the disaster. In the case of interrupted service production (days or months of classes, the number of medical consultations, transportation costs increased due to detours, etc.) the most suitable approach (and perhaps the only feasible one) is to value services not generated as a result of the destruction of infrastructure, based on the prices or fares paid by the final consumer or end user.

Costs and prices must be considered in "real" terms (the use of production resources, goods and services). In other words, financing costs would not be brought into the damage assessment. Such costs refer to commissions, interests, discounts, insurance and reinsurance, subsidies, and all free forms of post-disaster financing, paid or free of cost, domestic or foreign. (Note that costs or prices in the real economy are considered paid in cash). Transfers within the economy are also excluded from the disaster's costs (or benefits) because they are transactions that do not use resources or produce goods and services.

When calculating indirect effects –that is, the interruption or reduction in the production flows of goods and services– it is advisable to try to estimate them both with and without the disaster; in other words, to make a comparison between what outputs would have been obtained if there had been no disaster and what was actually produced with the effects of the disaster. However, it may not be feasible to apply this approach to most sectors when the goal is a rapid assessment of damage.

Finally, calculations of direct and indirect damage and losses should be carried out in local currency. However, it is often useful to convert these figures to United States dollars for the purpose of comparison and better understanding by the international community. Prices should be expressed directly in foreign currency in the case of export products or goods that have to be imported from abroad.

5. Sources of information

Disasters commonly obstruct normal channels of information, especially if the capital city or other political and administrative centers of a country have been significantly hit. Many public agencies and services will be impaired as they struggle to work out of provisional or temporary locations after being forced to evacuate their regular offices. Officials and experts might be engaged in fieldwork or drafted onto special commissions coordinating rescue efforts, thereby blocking access to several normal sources of information.

Assessment specialists must quickly evaluate their possibly far-flung sources of information. For example, if the offices of the national statistics institute are temporarily closed, an analyst may have to turn to other specialized centers or institutes for demographic and population data. Background information on victims is best obtained from the ministries of health or the interior, while information on damage to schools can be found at the education ministry or an agency in charge of the construction of educational facilities. National women's organizations must be approached for relevant information, and so forth for each specific piece of information needed. Moreover, background information can often be found only at the disaster site rather than in the capital city.

In most cases, assessment specialists must conduct an independent estimate of damage or a technical review of the assessments already made by authorities or rescue agencies. Their time will be limited and they must act in the adverse conditions of a territory that is just emerging from an emergency. We now describe some of the information gathering techniques derived from ECLAC's experience to date.

a) Strategic sources

Regardless of whether the emergency and rehabilitation organization is centralized or decentralized, the assessment specialist must locate a network of national organizations, national and international agencies, research centers and key people capable of providing the necessary data and authority to request and obtain additional documents and reports on the disaster. Despite the urgency of the situation, assessment specialists must only use documented facts, their own observations or those that can be derived from credible oral reports or summaries of the situation. In almost every case, without the support of such strategic sources, the assessment specialist will have no way of judging the validity and reliability of information or of harmonizing different opinions or contradictions.

b) The press

From day one, the press publishes news of the disaster that the assessment specialist may find useful. Newspaper clippings should be classified into easily manageable categories. The file must be kept up-to-date since it is of capital importance in four aspects of the assessment process: i) to locate names of potential strategic sources and useful documents; ii) to provide an independent opinion confirming the consistency and coherence of available official and unofficial information; iii) to draw attention to geographical areas and types of damage that may not have been covered by previous analyses; and iv) to provide data and figures that might complement the background information obtained from other sources.[13]

13 The assessment specialist must take due care to identify –and assign relative weight to– "sensationalist" information sometimes provided by the press.

c) Maps

Maps are an essential aid to the assessment specialist and must be obtained from the outset of the assessment mission. If they exist, post-disaster maps detailing the catastrophe's effects are particularly useful, but they are usually difficult to obtain as they are constantly being updated. It may be difficult to track down even basic maps from central institutions.

d) Reconnaissance missions

Such missions may be carried out by land, air or water. If, as is commonly the case, the assessment specialist can only conduct one reconnaissance mission, it should be undertaken after an initial desk assessment of information sources has been completed. This will help ensure that additional information not available from previously consulted sources can be collected during the field mission. In isolated or difficult to reach areas, the reconnaissance mission will often be the only possible way to gather information. This mission will provide the assessment specialist with the elements necessary to judge the quality of the information sources to be handled throughout the damage assessment process, and it also will make it easier to apply one's criteria in prioritizing disaster effects. Finally, such a mission is a unique opportunity to directly observe major damage that might not be included in any documented source.[14]

e) Surveys

Undertaking the detailed surveys needed for the rehabilitation and reconstruction stages, is only possible toward the end of the emergency phase, long after initial damage assessments are made. Three types of surveys can be very useful: i) studies carried out by offices and agencies that perform "rapid appraisal" surveys such as onsite inspection of the number and extent to which houses were damaged or destroyed, or local assessments of the number of victims and the morbidity structure; ii) broader studies that offer comparisons against pre-disaster conditions such as employment and unemployment surveys in the main cities (these tools are very useful in several sages of the damage assessment process and are analyzed below as an integral part of the secondary analysis of data); and iii) the rapid appraisal surveys the assessment specialist(s) can conduct, especially during reconnaissance missions (these should be viewed as a last resort whenever no better sources of information are available).

Surveys required to ascertain the differential effects on women pose a special challenge since there is no indirect way to obtain data on the increased workloads on productive work and on the assets and income losses in the backyard economy that women sustain in the wake of a disaster. A field survey of women temporarily living in shelters should be undertaken, whenever possible, to obtain such information.

14 This is often true in assessing damage to social sectors and the affected population, but it applies to all sectors. For example, while an initial assessment of an earthquake suggested that most of the damage was confined to the destruction of several kilometres of an oil pipeline, an air reconnaissance mission revealed major damage to agriculture due to landslides, something not initially taken into consideration.

f) Secondary data analysis

Publications, documents and reports containing background information prepared by secondary sources (institutions or persons other than the assessment specialists) can be fundamental sources of information. Regardless of the damage assessment methodology adopted, it will require a comparison of the post-disaster situation with a pre-disaster one. Secondary sources are the assessment specialist's best alternative when it comes to ascertaining pertinent values and the situation prior to the disaster. Moreover, pre-disaster background information will provide the starting point for an assessment of the disaster's effects. Without it, an objective damage assessment is impossible.

Reliable and valid data on the physical characteristics of the affected territory and its population (size, distribution, sex, age, density, economic, cultural and ethnic characteristics, etc.) must be obtained. When the assessment falls within the responsibility of government institutions or international organizations, the assessment specialist must use official sources or documents based on official sources to the fullest possible extent.

Population and housing censuses are particularly useful, as are sectoral censuses (agriculture, manufacturing, mining, etc.), statistical year books, statistics and census office reviews, any publications by research centers in the country affected and surveys carried out by official agencies, university centers or other authoritative bodies. In the immediate post-disaster stage, documents will be scarce and of the nature described above: partial surveys carried out by public offices and international agencies, together with internal reports by the institutions most closely involved in the emergency and rehabilitation stages.

g) Interpersonal communications

Assessment specialists often have friends or colleagues who are living within or near disaster areas. Contact with these reliable sources –by telephone, the Internet, radio or telegraph– is very useful for obtaining background information. Given that one of the first activities is to re-establish communications, it is highly likely that one of these systems will be working. Once contact is made, assessment specialists should make sure they clearly request specific information, which must then be verified by carefully comparing it against any independent sources that might be available.

h) Remote sensing data

Images obtained by means of remote sensors, especially those taken by satellites, can be extremely useful in damage assessment. However, their application faces certain important limitations.

First, there are obvious advantages to using satellite images for assessing the impact of phenomena such as floods, hurricanes, mudslides, earthquakes and volcanic eruptions, forest fires and oil spills. However, these images usually lack the resolution needed to identify physical damage to infrastructure. For example, from the air, a building may seem to be intact and yet have been earmarked for demolition because of internal structural damage. These sources cannot identify the injured or wounded, damage to sewers and underground pipelines, or internal damage to factories and commercial establishments.

These limitations may be overcome once a detailed geographic referencing system becomes available, but in the meantime, satellite images can be used to identify areas at risk in hazard mitigation and prevention work.

Second, acquiring images to be used in disaster assessment may be too expensive for most developing countries. Therefore, their use will likely be restricted to relatively more developed countries or to those cases where a developed country may decide to donate images to an affected country.

As we have previously noted, satellite-imaging techniques are a powerful tool in pre-disaster stages, especially in planning, early warning and vulnerability analysis. They can also be of obvious use during the reconstruction stage, when large amounts of satellite data can be rigorously classified and analyzed.

When available, aerial photography can be a powerful aid, but its importance can be overestimated. Experience shows that non-professional photography that is not systematically conducted will contain little information of use to the assessment specialist. However, the opposite is true when aerial photography is part of an aero-photogrammetric system, thus providing the assessment specialist with all the elements needed for a correct interpretation of the nature and magnitude of damage. When possible, therefore assessment specialists should make their estimates and calculations in close cooperation with personnel specialized in aero-photogrammetric analysis.

Section Two
Social Sectors

Section Two of the Handbook refers to social sectors. It includes chapters describing methods for estimating the affected population, and damage to housing and human settlements, education and culture, and health. We begin by describing the evaluation methodology, offering practical examples to help the reader better understand and use the Handbook.

In Section Five of the Handbook, we discuss how to estimate effects on employment and income and the differential impact on women as part of comprehensive disaster analysis. Each chapter on individual sectors –whether social or economic– cites specific sources the specialist can use to obtain basic information needed for a complete, comprehensive analysis.

I. AFFECTED POPULATION

The quantitative expression of the size and characteristics of the population affected by a disaster is a central part of the assessment process. One of the first tasks of the specialist in social themes is to work closely with the other sectoral specialists in the assessment group to define the geographical area that has been affected. Then one must estimate the affected population, including the number of victims, the situation of the displaced population and the site of possible reconstruction activities.

Estimating the affected population –the one item where all intangible factors come together– is essential for attaining an overview of the disaster and assessing the damage and losses in each sector such as agriculture, health and housing. This population evaluation provides an independent measure against which the consistency of the rest of the estimates can be gauged, and it constitutes the starting point from which to direct all national and international relief efforts and to set priorities for rehabilitation and reconstruction plans.

1. Definition of affected geographical area and population

Disaster assessment must begin with a definition of the affected area. The dimensions and characteristics of the affected population should be determined immediately thereafter. If possible, an assessment should be made of the post-disaster situation in order to obtain an overall idea of the intangible deterioration (or improvement) of conditions governing the standard of living. The population specialists will have to use their own analytical criteria in choosing among the wide array of conflicting means for defining and measuring the affected population. It is generally useful to begin with a broad view of the affected area and population and then narrow it down.

The data most often used for such estimates are available in the most recent population and housing censuses, as well as in population estimates and projections derived from these and other sources, which can be found in official or academic publications. These data can be complemented by information from household surveys or by vital or administrative records.

A single procedure should be used to define the extent of the affected area, an exercise that should be completed before the assessment process for each sector is begun. Affected population estimates provide a common and essential reference point for later achieving a more precise damage assessment for each sector.

The strategy of choice for determining the affected population will depend on the kind of phenomenon that caused the disaster. (Examples of selection strategies are described in Appendix I.). Other factors influencing strategy choice include the availability of detailed and up-to-date census data or population projections; unforeseen demographic changes that might render such projections invalid ; and the time elapsed since the most recent census. The greater the time elapsed since the last census, the greater the number of necessary estimate assumptions and uncertainties regarding the validity of the projections. The more the census data is disaggregated, the more likely the estimates will be correct. Because of the need for a rapid assessment, one can take at face value any very recent census data, especially if no important pre-disaster demographic events have occurred in the area since the census, such as significant migratory flows and the emergence of new settlement areas.

The following are possible approaches based on two alternative scenarios:

(1) Annual population projections at a detailed (e.g., municipal) level are available, the disaster has occurred no more than five years after the most recent census, and there have been no important demographic changes in the affected area since the most recent census. In this case, once the geographical area has been defined (identification of the affected municipalities), the projected population for the year can be taken directly, or it can be estimated for the date of the disaster using the following exponential growth formula:

$$Pd = Po^{*}\, er^{t} \qquad (1)$$

where:

Pd = the population on the day of the disaster;
Po = the most recent official estimate of the population;
r = the annual exponential growth rate for the year or period in which the disaster occurs; and
t = the length of time in years between the initial projection date used to calculate r and the time of the disaster.

Example: An assessment is made that a disaster that occurred on November 10, 2000, has affected 15 municipalities with a projected population of 3 590 000 on June 30, 2000 and 3 695 000 on June 30, 2001.

$$P_{10/11/2000} = P_{30/06/2000} * e^{rt}$$

The growth rate r can be calculated by applying formula (1):

$$r = [\ln (Pd/Po)]/t$$

$$r_{2000\text{-}2001} = [\ln(P_{30/06/2001} / P_{30/06/2000})] / 1$$

$$r_{2000\text{-}200}1 = [\ln (3\ 695\ 000/3\ 590\ 000)] / 1$$

$$r_{2000\text{-}200}1 = 0.02883$$

If

t = date of the disaster minus initial date of the population estimate
t = (November 11, 2000 – June 30, 2000)/365
t = (134)/365= 0.36712

then,

$$P_{10/11/2000} = P_{30/06/2000} * e^{rt}$$

$$P_{10/11/2000} = 3\ 590\ 000 * e^{0.02883*0.36712}$$

$$P_{10/11/2000} = 3\ 628\ 199$$

When significant changes have occurred in any of the affected areas (significant emigration or immigration flows before the disaster and after the census, for example), appropriate adjustments to the projected population figures and new projected totals must be made before undertaking the estimate shown above. Adjustments can be made by following the procedures shown in case (2). Once the new adjusted totals for the population of the affected area have been calculated, the procedure shown in (1) should be followed.

(2) The disaster has occurred five or more years after the most recent census, and, therefore, the projections at a disaggregated level may not be updated or do not exist. In this case, once the geographical area has been defined, either a projection of the population should be done or the available estimates should be analyzed to determine whether there is any evidence of municipalities whose population has increased or declined to a greater degree than that observed in the preceding inter-census period.

If there is no disaggregate population projection or if the existing one is out of date, it will be necessary to make a projection of the population in the affected area.

It is possible that projected information is available for a larger geographical area. In this case, the population of the affected area should be projected by applying the growth rate for the population of the department, province or state in which the area is located for the year or period that includes the date of the disaster.

Example: An estimate is required for the population of the area affected by a disaster that included 20 districts of Province X on January 15, 2001. According to the census taken on June 30, 2000, the corrected population figure for the area is 1 536 000. According to the department's own projections, the population of Province X will grow at a rate of 1.89 percent in the 2000–2005 period.

In this case, the estimated population of the affected area on the day of the disaster is calculated as shown below:

According to formula (1)

$$P_{15/01/2001} = P_{30/06/2000} * e^{0.0189*0.54110}$$

$$P_{15/01/2001} = 1\ 536\ 000 * e^{0.0189*0.54110}$$

$$P_{15/01/2001} = 1\ 551\ 789$$

In the previous example, it is assumed that no sudden demographic flows have occurred in the corresponding districts or municipalities, or that they were confined to displacement directly within the impact area. If this is not the case, it will be necessary to make separate projections for those municipalities or districts whose population growth or decline was greater than expected before continuing with the rest of the procedure. Additional sources of information (e.g., school rolls, new building permits and other administrative records) are necessary for such estimates, which involve specific methodologies.

The following two case studies demonstrate how to determine the affected geographical areas and population for two different disasters that occurred recently.

First case: In the case of an earthquake that occurred recently in a Central American country, there were conflicting versions as to the affected area and population. The population specialist made his or her own estimate by adopting the following procedure:

- To arrive at a broad initial estimate, the specialist marked on a map showing political and administrative divisions the geographical area where the population felt the earthquake, which registered V on the modified Mercalli intensity scale.

- The specialist then narrowed the area to include only those sections that reported victims or damage by reconciling official and unofficial partial data, figures obtained from an exhaustive study of press reports following the disaster and estimates gathered by visiting some of the affected areas.

- Some of the areas thus defined were virtually inaccessible, their population scattered or the latest census figures unreliable. The specialist then excluded those sections where only slight damage had been reported, and made "guesstimates" of damage in the remaining area (this was unavoidable given the limited time available to complete the assessment of damage).

- Census information was used as the basis for choosing the political-administrative unit with the most detailed population data. The area was thus defined, and the adjustments and projections needed to prepare a definitive estimate of the affected population were made.

Second case: In a similar case, where an earthquake affected a relatively inaccessible area of the Andes Mountains, it was necessary to determine the size and whereabouts of the population most affected by the disaster. The task was made more difficult because this was a rural area with a scattered population, and maps with current information about the population had not been located.

The following procedure was adopted:

- Information needed to identify the small, scattered population nuclei with sufficient accuracy was obtained from the cartographic bureau.

- By using this and other information related to material losses and the number of people affected, the population specialist was able to estimate the damage and the affected population in the hamlets, villages, and towns that were accessible by land. Information provided by teams sent to inspect nearby places (mainly to check the reliability and validity of the figures) made it possible to determine what percentage of the population had been severely affected in those localities. Although it was not feasible to visit large areas nearer to the epicenter, observations made in settlements with a concentrated population provided rough but clear evidence that as one got further away from the epicenter, the damage tended to diminish.

- With the resulting population data in hand, the specialist drew two concentric circles around the epicenter. The radius of the inner circle was the distance between the epicenter and the severely affected population centers furthest from it. The radius of the outer circle extended to the furthest population center in which the earthquake had been felt. Since the construction features of rural housing were also known, it was possible to estimate the size and location of the most severely affected population in the inner circle. Estimates of the total affected population (both urban and rural) were made on the basis of the population located within the circumference of the outer circle.

2. Software for accessing pre-disaster population data

a. General comments

As noted in the preceding paragraphs, the specialist must first define the affected area before estimating the varying degrees of population affectation. It is relatively easy to estimate the primary affected population by using available information about the number of people that are dead, wounded and housed in temporary shelters. To estimate the size of the remainder of the affected population (secondary and tertiary levels), baseline data on the total population living in the affected area at the time of the disaster is needed.

Once the disaster area has been defined, the sectoral teams work separately to gather and analyze information. Reports of deaths, injuries and shelter occupancy are the first field data on the primary affected population to become available. The analyst must then make estimates to compensate for holes in existing data on the pre-disaster population; here baseline information is essential. Population censuses (even when they were made well before the disaster) and household surveys (even if presented at less disaggregated geographical levels) may be used for this purpose. Detailed population data is generally more readily available when the affected area is very large (such as an entire region or province), but less accessible for smaller areas. In these cases, researchers should make use of computer software that is able to process population data from censuses and household surveys. A number of such software alternatives exist.

CELADE has developed and offers free of charge a programme called Redatam that can process population information from censuses and/or household surveys. Its ease of use and availability at no cost are advantages that cannot be overlooked. Furthermore, it has been tried and proven by ECLAC during several special assessment field missions.

Redatam G4 and its interface applications, such as R+G4xPlan, are designed to help generate population indicators from a variety of data sources. This facilitates decision-making at different geographical levels, from a country down to a municipality. The programme's features make it ideal for estimating the population and its characteristics in user-defined disaggregated areas, such as a set of districts added to another group of city blocks or rural sectors. Such a user-defined selection in combination with basic census or survey information can serve as a starting point for estimating the characteristics of the population and housing in these areas. These findings can be used to project population size. Alternatively, the increase in population up to the date of the disaster can be estimated using the methods mentioned earlier. This process is shown in Appendix III.

b. R+G4xPlan (pre-designed interfaces)

CELADE also makes available another Redatam-related tool. This is a Redatam interface known as RxPlan that makes it possible to use the database without needing to know how to use Redatam directly. This interface, which is very simple to create, can be generated before undertaking an assessment activity. It makes it possible to build modular applications tailored to the needs and specifications of the country and the disaster and to create predefined indicators (e.g., the number of households headed by women and the number headed by men; the number of unoccupied dwellings in comparison to occupied ones; the distribution of the affected population sorted by basic characteristics such as age, sex, marital status, education and employment) and to produce thematic maps.

Its interface consists of question forms or windows that produce output tables once a geographical area has been selected. It requires a census database in Redatam format and a map, if one is available.

This tool can assist in gathering information in a study of victims according to the optimum disaggregation level by considering the following items of information that should be obtained from data collected before and after the event:

- Total affected population (dead, wounded and those who have suffered material and economic loss);
- Disaggregation by age, sex and other basic characteristics; and
- Identification of high-risk categories (children under five, nursing mothers and pregnant women, the disabled or wounded and the aged).

3. Estimating the affected population

Since the population may be affected in different ways and to various degrees depending on the source of the disaster and the resulting damage and losses, we can break it down into primary, secondary and tertiary categories.

We thus establish a link between the affected population and the type of direct or indirect damage sustained, which may consist of lost capital or production or an increase in the cost of providing services. This link allows for a classification of the affected population in accordance with the three main components of total damage mentioned above.

a. Primary affected population

This category includes people affected by the direct effects of the disaster and consists of the dead, the injured and the disabled (primary trauma victims), as well as those who suffer material losses as a direct and immediate consequence of the disaster. This segment is made up of people who were in the affected area at the time the disaster occurred.

b. Secondary and tertiary affected population

These two types of affected population are defined as those segments of the population that suffer a disaster's indirect effects. The difference between the two groups is that the secondary affected population is located within or near the boundaries of the affected area, while the tertiary affected population usually resides outside or far away from the affected area.

Estimates of damages and losses sustained by secondary and tertiary affected population will be given by the sectoral assessments. Examples of the secondary affected population are the merchants in the affected area and people traditionally involved in marketing the lost crops, both of whom lose income as a result of the recessionary post-disaster environment. Examples of the tertiary affected population include people who have to assume the higher transport costs generated in the affected area, although they themselves live and work outside of it, and those who lose some benefits because public expenditure is reallocated to priority emergency activities.

In slowly evolving disasters, such as droughts or floods, secondarily affected people often take refuge in institutional or informal shelters. It is useful to keep a separate record of such people since their presence may provide an early warning of significant internal migration flows.

c. Assessing the direct and indirect effects on the population

Each sectoral assessment measures, in monetary terms, all direct damages and indirect losses sustained by the affected population. Damage to personal property is usually recorded in the housing sectors, while losses in production are included in the assessments of the productive sectors. Estimates of employment and income losses are made separately, as shown later in the Handbook.

The monetary loss due to deaths caused by a disaster may be high. From a methodological standpoint, it is possible to allocate a monetary value to such losses based on the victims' expected remaining period of useful life and the corresponding income that they would have earned, or based on life-insurance benefits. However, we do not engage in these estimates for two reasons. First, the purpose of this Handbook is to determine an amount of damage that can reflect the socio-economic impact of a disaster on the economic performance of an affected country or region. Second, using per capita earnings would result in the adoption of "second- or third-class" citizenship standards when comparing the victims with those in relatively more developed countries. In conclusion, loss of life is considered by ECLAC to be a permanent loss to society that cannot be substituted or recovered.

The most widely recognized effect on disaster victims is the deterioration in living standards. The physical environment is degraded, as are networks of social interaction whether they be on-the-job contact, communications systems, culture, and recreational activities; people begin to feel insecure and lose confidence in their way of life; access to education, health, and food is made more difficult; and the loss of homes and belongings reduces normal living standards.

Effects differ depending on the sex of the affected population: men generally sustain higher capital stock losses, while women usually end up facing increased reproductive workloads.

Other effects on the population –psychological harm and societal change, the solidarity or generosity shown in confronting the disaster, the despair of those who do not receive aid and many similar intangible costs or benefits– can only be estimated using indirect methods.

Disasters also produce psychological after-effects. Episodes of depression, anxiety, fatigue, nervousness, irritability, loss of appetite, modified sleep patterns and psychosomatic symptoms, such as diarrhea and headaches, have been observed and measured both during and after the emergency stage. Psychiatric interpretations of disaster effects suggest that damage of this nature may have significant short- and long-term effects. On the other hand, sociological research shows that while disasters produce significant stress, victims do not seem to behave in a dysfunctional way: profound pathologies are not common, psychological damage eventually disappears, and recovery is speedy.

The affected population's response mechanisms do not coincide with the alarmist version of events that dominates the media. Experience shows that victims tend to respond positively rather than panicking. Although cases of looting, plunder and social disruption have been observed in some cases, expressions of solidarity and support are the rule rather than the exception. Therefore, the population specialist should not try to estimate a probable cost for social disruption as a specific aspect of damage to victims.

Few events reveal societal inequalities better than the destruction caused by a disaster, especially in developing countries. The devastation suffered by the poorest people is so disproportionate that it becomes obvious where the cause lies: one is vulnerable because one is poor. These population strata are disproportionately affected by environmental degradation and the depletion of natural resources that are the basis of their urban and rural livelihood. In addition, inequalities among men and women become more acute. It is not unusual, therefore, for disasters to be followed by sweeping societal changes. To an even greater degree than intangible effects and psychological damage, the effects that cause societal change defy precise identification and measurement when making a quick damage assessment.

4. Estimating demographic effects after a disaster

Direct and indirect demographic effects of disasters are apparent in the components of population growth (mortality, fertility and migration), increased morbidity rates and/or the aggregate effect on population growth itself.

Direct effects on mortality rates refer to deaths that were an immediate consequence of the disaster and are included in the fatalities report. However, there are indirect effects on mortality rates that lead to loss of life in the short or medium term. In the short term, deaths, both in temporary shelters and elsewhere, may occur as a consequence of the increase in morbidity (such as acute respiratory ailments and infectious or parasitic diseases) caused by the disaster.

The deterioration in living conditions stemming from the disaster may still be felt in the medium term as a result of increased vulnerability and the deterioration of health, housing and basic-service infrastructure in general. The effects of a disaster on mortality and morbidity rates are determined in the health chapter of this Handbook. It is worth mentioning that the assistance provided after a disaster may have an indirect positive effect on the mortality rate if it brings about changes in health policy that improve the coverage and quality of services.

To estimate the specific demographic impact on the mortality rate by age and on the average life of the population, it is necessary to determine the age and sex structure of direct fatalities (and indirect ones, if feasible). Estimated life expectancy is calculated with the aid of a life table. The same table is then used to obtain a different average life expectancy figure by adding the additional fatalities caused by the disaster to each age and sex group. The difference between both is the number of years lost as a result of the disaster.

It is not as easy to calculate the indirect effects on fertility. The postponement or cancellation of marriages and a temporary drop in the frequency of sexual relations after a large-scale disaster or one with a long-lasting impact might lead to a short-term decline in the fertility rate. But there might be an effect whereby it recovers in the long term, as has been observed in the case of wars or other great crises. Sudden disasters, such as earthquakes or hurricanes, have substantial effects on the fertility rate only if the primary affected population is significant, thereby reducing the number of women of fertile age.

The link between cause and effect is very clear in the case of a disaster's impact on migration, but population specialists are likely to encounter difficulties in assessing the effects. Loss of property (land, homes, etc.) as a result of a disaster may lead to temporary population displacement. Other medium-term effects may be more significant. A change in production structure and in levels of employment may have a significant destabilizing effect. For many, this may create an opportunity to look for a new job or to emigrate, as was the case in the 1985 Mexico City earthquake. Since it is impossible to assess these impacts immediately after a disaster occurs, this analysis will have to be done later.

The full impact on demographic growth may be assessed only after the effects on the three previous components are known. Given the difficulties mentioned earlier in relation to fertility and migration, it will at least be possible to calculate a disaster's impact on demographic growth by taking loss of life into account. For example, if a disaster causes 200 deaths in an area whose population, in the year of the disaster, would normally have grown from 35 000 to 37 000 (that is an absolute growth of 2 000 people), it may be estimated that 10 percent (200/2 000) of the area's total growth failed to materialize as a result of the additional loss of life arising from the disaster.

Finally the effects on the elderly and the young must not be overlooked. These are especially vulnerable population groups that can be affected more intensively depending on the type or origin of any given disaster. A large impact on these groups may modify the prevailing demographic structure of the affected country, region or locality.

APPENDIX I

METHODOLOGIES FOR DETERMINING THE AFFECTED AREA ACCORDING TO THE TYPE OF NATURAL PHENOMENON

A. Seismic phenomena

Events

- Fault-line movements
- Tremors and earthquakes
- Liquefaction
- Tsunamis

Effects

Partial and total destruction of homes; large number of dead and wounded, especially those suffering fractures, as well as people left disabled or orphaned; an extended

Effects	Dead	Wounded	Buildings totally destroyed	Buildings partially destroyed	Roads closed	Public services interrupted
	********	********	********	********	********	********

Effects on the Environment

Effects	Air pollution	Water pollution	Land pollution
		Caused by overflows	Caused by overflows

reconstruction process requiring significant economic investment.

Basic Information to be collected

Location:

- Epicenter
- Geological information about the area

Intensity and magnitude of the phenomenon:

- The Mercalli scale measures the intensity of an earthquake according to the effects it has on people and property.

- The Richter scale measures magnitude, that is, the amount of energy released from an earthquake's epicenter as recorded on a seismograph.

History:

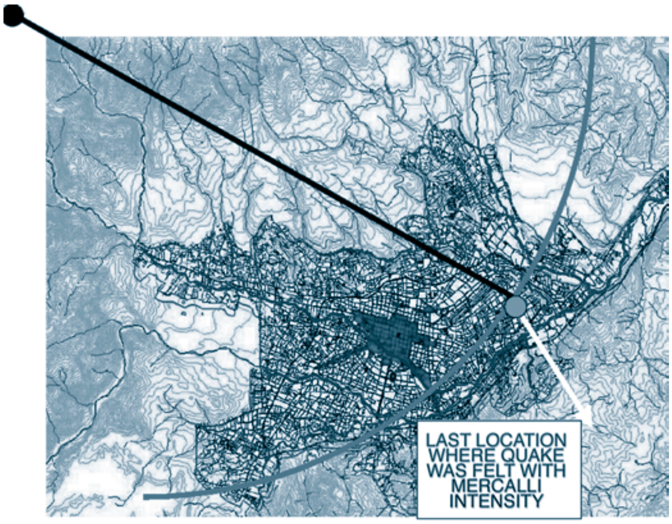
- Historical intervals between seismic phenomena

Determination of affected geographical area

One should use the epicenter as a reference point in defining the area affected by an earthquake. The study should be supported with as much relevant planimetric information as possible.

A circle is drawn with its center at the epicenter and its radius ending at the farthest point where the earthquake is known to have been felt at intensity V or greater on the Mercalli scale. This approximate representation of the affected area should be adjusted as more accurate information is obtained. The Mercalli scale may be used and more circles drawn to show affected areas that are more precisely tailored to the type of study to be carried out. For example, a smaller circle would be drawn for a study of physical damage to urban installations than for a study of the areas affected by interruptions in the supply of services. This means that areas where installations have been destroyed can be defined by a new circle whose radius is determined by the farthest place where physical structures are known to have been totally or partially destroyed (see figure 1).

Figure 1



Planimetrics - scales

- Country level: 1:1,000,000 - 1:250,000. This basically shows in what part of the country the phenomenon took place.
- Regional level: 1:500,000 - 1:50,000. This level shows the location of the event and the entire affected area (both rural and urban) in greater detail.
- Urban area level: 1:50,000- 1:2,500. These scales are used to prepare detailed plans of affected areas. They are more commonly used in urban areas.

B. Atmospheric phenomena

Phenomenon

- Tropical storms and hurricanes
- Heavy rains
- Droughts

Consequences

The heavy rains and high winds produced by tropical storms, hurricanes and other atmospheric phenomena, such as the rainstorms that occur in Central America and the Caribbean, may cause considerable damage.

Effects	Dead	Wounded	Buildings totally destroyed	Buildings partially destroyed	Roads closed	Public services interrupted
	********	********	********	********	********	********

Effects on the Environment

Effects	Soil erosion and silting of river beds	Water pollution	Land pollution
	***************		

Abnormal periods, in which rainfall is reduced or the dry season gets longer, often occur in the region. They have a negative impact on agricultural production, power generation at hydroelectric plants and, at times, the supply of water for human and industrial use.

Basic information to be collected

Location:
- Geographical areas affected

Intensity:
- Rainfall
- Wind speed

History:
- Historical intervals between atmospheric phenomena

Determination of the affected geographical area

The best tools for identifying an area affected by a hurricane or similar meteorological phenomena, such as rainstorms, are satellite photographs, which can be obtained via the Internet. Photographs of this sort clearly define which areas have been affected day by day and make it possible to locate the key points in order to mark out the affected area.

Planimetrics - scales

- Country level: 1:1,000,000 - 1:250,000. It basically shows in what part of the country the phenomenon took place. In the case of atmospheric phenomena, the scale often must cover several countries and indicate the phenomenon's path.
- Regional level: 1:500.000 - 1:50,000. This level shows the entire affected area (both rural and urban) in greater detail.
- Urban area level: 1:50,000- 1:2,500. These scales are used to prepare detailed plans of affected areas. They are more commonly used in urban areas.

C. Hydrological phenomena

Phenomenon

- River flooding
- Heavy seas
- Desertification
- Erosion

Consequences

This type of phenomenon will have different effects, depending on whether flooding takes place slowly or quickly.

- Slow evolution: minimal fatalities and injuries, damage to crops and both immediate and long-term effects on nutrition.
- Flash floods: many fatalities, few wounded, homes destroyed, immediate and long-term consequences for food.

Effects	Dead	Wounded	Buildings totally destroyed	Buildings partially destroyed	Roads closed	Public services interrupted
	********	********	********	********	********	********

Effects on the Environment

Effects	Air pollution	Water pollution	Land pollution
		******************	

Basic information to be collected

Location:

- Areas affected

Intensity:

- Rainfall
- Peak river flows
- Water volume
- Speed of movement

History:
- Historical intervals between hydrological phenomena

Determination of the affected area

There are two forms of measurement, depending on the type of flood:

- Floods caused by rain or storms can be measured by making a plan and establishing key points according to the information obtained (the triangulation method) or by examining the contours of the land, on the assumption that the lowest areas will be the most prone to flooding. These areas are also defined by geomorphic formations such as canyons.

- In the case of flooding caused by swollen rivers or tsunamis, the river's normal course or the beach line are taken as the base line. From there, parallel lines may be drawn, as reports arrive of affected areas (see figure 2). This information should be complemented with information about the sector's geographical conditions, such as contour lines, slopes, hills and so forth.

Figure 2
DEFINITION OF THE AREA AFFECTED BY FLOODING

Lines showing borders of flooded areas.

Planimetrics - scales

- Country level: 1:1,000,000 - 1:250,000. This basically shows the location of the event so that it can be seen in the context of the country where it occurred.
- Regional level: 1:500.000 - 1:50,000. This level shows the total affected area in greater detail and takes into account tributaries that might cause further floods later.
- Urban area level: 1:50,000- 1:2,500. These scales are used to prepare detailed plans of affected areas. They are generally used more in urban areas.

D. Volcanic phenomena

Phenomenon

- Rock ejections
- Pyroclastic eruptions
- Mudflows
- Lava flows
- Poison gas emissions
- Acid rain
- Pollution from toxic gases

Effects

Volcanic eruptions cause two kinds of direct damage, which may be found separately or together in a single event. However, the area affected by them can vary widely, depending on conditions such as wind and geographical agents.

- Damage caused by pyroclastic eruptions (the emission of ash and toxic gases into the air).
- Damage caused by lava flows.

Effects on urban infrastructure

- Fires
- Roofs collapsing under the weight of the ash
- Destruction caused by mudflows

Effects on health

- Injuries, broken bones, burns
- Worsening of respiratory ailments
- Bronchial irritation
- Asphyxia caused by inhalation of carbon dioxide
- Intoxication caused by hydrosulphuric acid and carbon monoxide

Effects	Dead	Wounded	Buildings totally destroyed	Buildings partially destroyed	Roads closed	Public services interrupted
	********	********	********	********	********	********

Effects on the Environment

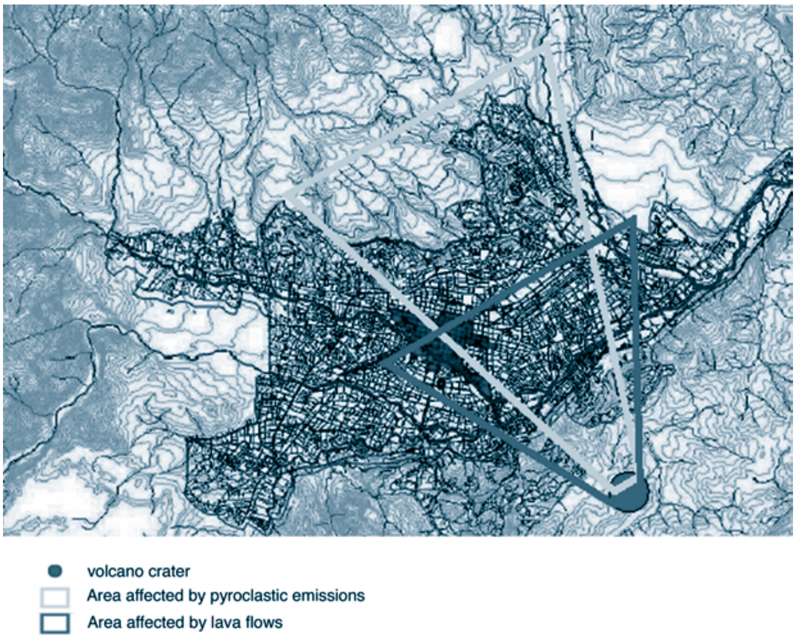
Effects	Air pollution	Water pollution	Soil pollution
	***************	******************	******************

Basic Information to be collected

- Location:
Location of the volcano and its relationship with its nearby surroundings

- Intensity:
Volume of ash emissions

- History:
Historical intervals between volcanic eruptions



Planimetrics - scales

- Country level: 1:1,000,000 - 1:250,000. This basically shows the location of the event so that it can be seen in the context of the country where it occurred.
- Regional level: 1:500.000 - 1:50,000. This level shows the entire affected area (both rural and urban) in greater detail.
- Urban area level: 1:50,000- 1:2,500. These scales are used to prepare detailed plans of affected areas. They are more commonly used in urban areas.

APPENDIX II

PROBLEMS RELATED TO AVAILABILITY AND USE OF INFORMATIONIN ASSESSING THE EFFECT OF DISASTERS

Specialists normally find it difficult to determine which information is the most reliable when they first embark on assessing a disaster. Not only is there often a lack of up-to-date information, but access may be limited, and information from different sources can be contradictory and of uneven quality depending on the variable and the geographical unit in question.

Some of these problems are described below and possible solutions to them proposed. We wish to emphasize that these are strategies for approaching the problems rather than specific solutions for all occasions.

Among the problems that are commonly found are the following:

- Difficulties in assessing the quality of basic information on fatalities and the number of other victims.

Information on the number of victims is often gathered by different organizations, and there is a risk of duplication. Also, there is a risk of overestimating the number of missing persons -which is often added to the number of fatalities- due to the challenge of adjusting figures when a person assumed to be missing is found. Another serious problem arises when estimating the number of people who have sustained losses. This figure can vary widely depending on when those living in shelters were counted.

A related problem that hinders future in-depth studies is the lack of information broken down by sex, age or other socio-economic variables.

In view of the above, we suggest reviewing and evaluating the estimated numbers of victims, including the dead, and obtaining as much information as possible regarding the demographic and socio-economic characteristics of the affected persons.

- Lack of consistency in data-gathering activities.

After a disaster, the institutions responsible for providing emergency assistance normally conduct surveys of the affected population. These are usually taken at shelters. Unfortunately, different methodologies are often used and the data are gathered on different dates, which means that the figures are not strictly comparable.

To avoid these complications, a single data-gathering activity should be coordinated as soon after the event as possible. Since this can be a time-consuming exercise, we recommend that it be conducted at shelters and that only a minimum of information be gathered. Questionnaires used in this type of survey often seek information that, although theoretically useful, is never analyzed. A basic set of questions should be designed to collect the following information:

- First name and surname(s)
- Sex
- Age
- Educational level
- Family members present in the shelter (e.g., father, mother, etc.)
- Sex and age of any family member who died
- Present state of health (e.g.,symptoms of acute respiratory problems, diarrhea or other contagious disease)
-Losses sustained by the family (e.g., house, domestic goods, farm animals, etc.)

- Availability of cartographic data.

The countries in the region are increasingly using digital cartography at an aggregate level and at the city and town levels, as well. When analyzing the effects of a disaster, use should be made of the most up-to-date maps available. In many cases, this information comes from the national statistics office or from cartographic organizations. Also, as a result of decentralization, many local authorities have developed their own geographical information systems, so they, too, may have up-to-date maps of the areas under their jurisdiction. Part of the disaster assessment process should be to determine which material is available and how up-to-date it is.

- Need for a data-gathering strategy to assess medium-term effects of disasters.

A detailed assessment of the indirect effects of disasters in the medium-term can only be made if there is a post-disaster strategy that makes it possible both to assess the progress of the reconstruction process and to determine, say, the patterns of post-disaster migration or the effects of the disaster and subsequent aid on living conditions.

APPENDIX III
ESTIMATING THE POPULATION OF AFFECTED AREAS WITH REDATAM

There are many software packages that professionals can use to quickly and easily process data taken from censuses and other sources, organizing it into hierarchical databases for any user-defined geographical area (such as a group of city blocks). One of these programmes, which was developed in-house by CELADE, is called Redatam. Its validity and usefulness has been tested during recent ECLAC assessment missions. The main features of Redatam+G4 are described below.

What can Redatam+G4 do?

It makes it possible to process information in very large compressed databases (created in Redatam+G4 format), such as population and agricultural censuses, household surveys, etc., which contain data on millions of people, housing units and homes. Consequently, a Redatam+G4 database normally contains micro-data, that is data or variables linked to individuals, housing units, homes or other information elements from which different tables can be generated for any geographical area previously defined by the user. This data is hierarchically organized for rapid access and processed to find specific results for defined geographical areas of interest.

New variables can be derived and tables and other statistical results processed rapidly using graphic interfaces, without the assistance of a programmer.

Example of Redatam+G4 in use

Information is needed on the age and sex of the people in an area that has been affected by a disaster.

The procedure for obtaining the required results is as follows (see figure 1):

1. Open the database dictionary (with levels and variables).

2. Create a geographical selection with the area to be analyzed. Select File/New/Selection from the main menu. Expand the area tree to display the areas to be selected and double click. Name the selection and save it.

3. Open the Statistical Process window by choosing the cross-reference variables option from the Statistical Process menu.

4. Use the mouse to select the variable to be processed from the Dictionary window.

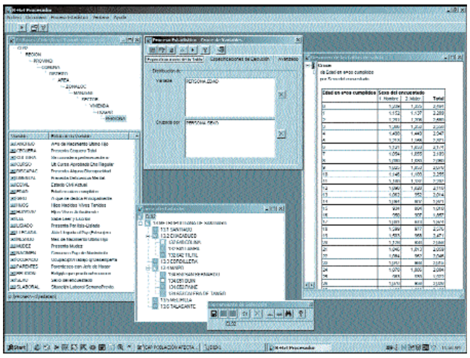
5. Select the name of the variable and drag it to the empty box in the process window.

6. Fill in the box(es) with the variable(s) to be processed, according to whether a frequency, cross-referencing of variables, or average is required.

7. Start the statistical process by clicking on the Start icon

Figure 1

REDATAM +G4 WINDOW WITH THE DICTIONARY, PROCESS, AND GEOGRPHICAL SELECTION DISPLAYED



R+G4xPlan (pre-designed interfaces)

The RxPlan tool provides controlled access to the information contained in a Redatam database. No understanding of its mechanism or internal operation is needed to use this tool, which provides an easy-to-use, user-friendly interface to access the information. Its operationality is commanded through the INL file.

An RxPlan can be loaded with information on the existing population before a mission to assess the impact of a disaster is started. This makes it possible to use the information in the field without having to be an expert in Redatam or other software.

Figure 2
Example of a plan with a population census (Panama)

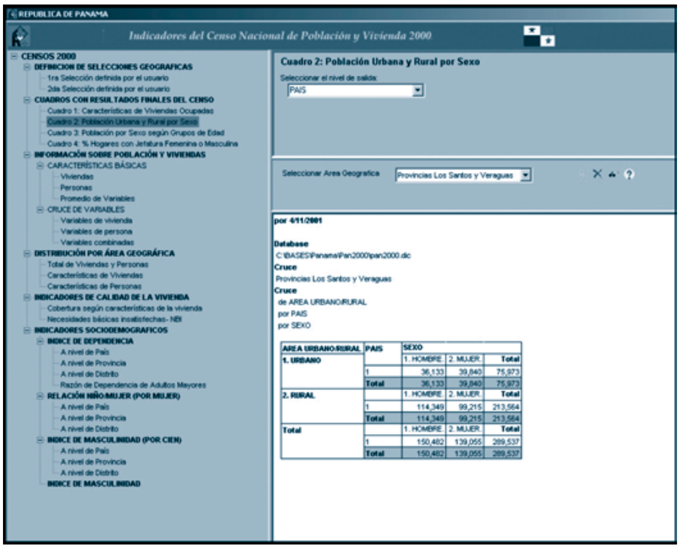
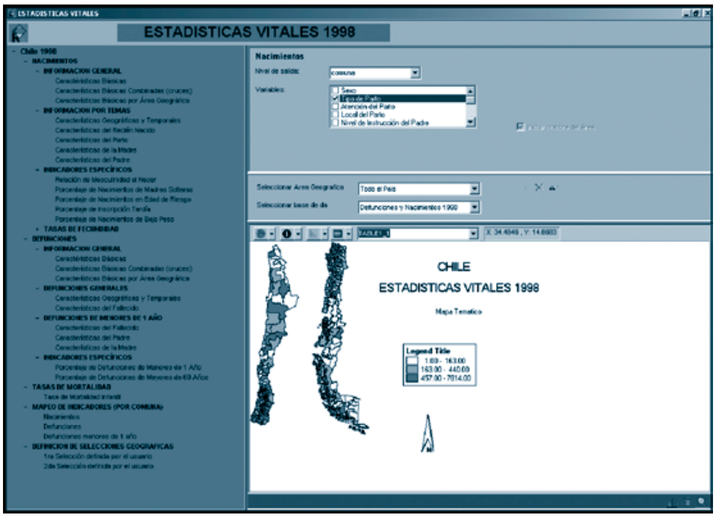


Figure 3
Example of a plan with vital statistics (Chile)



APPENDIX IV
THE USE OF GEOGRAPHICAL INFORMATION SYSTEM (GIS) TO ANALYZE INFORMATION GATHERED BY DIFFERENT SECTORS

A Geographical Information System (GIS) specifies a set of procedures in a non-graphic or descriptive database of real-world objects that can be represented graphically and whose dimensions can in some way be measured relative to the area of the world. Apart from a non-graphic specification, a GIS also has a graphic database of geo-referenced or spatial information, which is linked to the descriptive database. Information is considered geographical if it is measurable and has a location.

A GIS uses high-powered graphic and alphanumeric processing tools that are equipped with procedures and applications for inputting, storing, analyzing and visualizing geo-referenced information.

A GIS is useful mainly because of its capacity to build models or representations of the real world from information in databases. It achieves this by implementing a series of specific procedures that generate still more information for spatial analysis.

A valuable tool can be achieved by building simulation models that make it possible to establish the different influence factors by analyzing natural disasters or phenomena related to trends in time or space. GIS is therefore important for aiding hazard prevention and for simulating the damage that would be caused in the event of a natural disaster. GIS can also be used to interpret information by creating thematic maps that show the spatial distribution of the information. These maps show spatial patterns, trends or relationships, making it easier to analyze the information.

This is the case in the various successive stages of the process of assessing the damage caused by a disaster. The following possible uses of this tool are related to this point. A GIS makes it possible to modify the display of cartographic information by changing colors, symbols or values. This makes it possible to analyze the information from its spatial dimension in order to reveal patterns, relationships or trends.

A GIS is dynamic. Maps created with a GIS are not limited to just one moment in time. A map can be updated simply by updating the information linked to it. This operation is easy and quick and requires no special training.

Example:

THE JANUARY AND FEBRUARY 2001 EARTHQUAKES IN EL SALVADOR

Data gathered:

- According to the figures provided by El Salvador's National Emergency Committee, in the housing sector, 222 773 housing units (18 percent of the country's total stock of 1 259 697 urban and rural private housing units) were affected.

- Damage in the housing sector occurred throughout the country to differing degrees. The most affected provinces are Usulutan, (with 74% of housing damaged), San Vicente (with 69%) and La Paz (with 64%). In other affected provinces, such as Sonsonate, La Libertad, and Cuscatlan, figures of between 20 percent and 30 percent were recorded.

- Per capita damage varied from less than 100 US dollars to more than 1,000 US dollars.

Any of these data can be displayed on a map:

Map 1

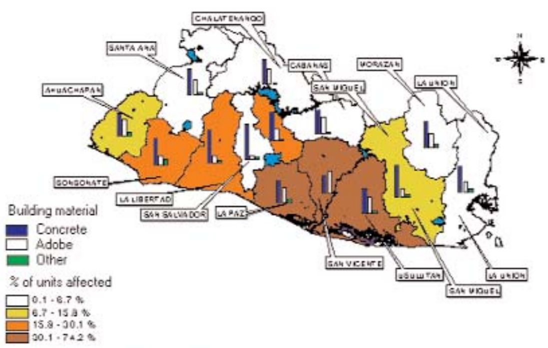
GEOGRAPHICAL DISTRIBUTION OF EARTHQUAKE DAMAGE JANUARY - FEBRUARY 2001

Source: ECLAC

With a GIS, different information can be fed into the same map. The mapping tools can then be used to modify the graphic representation to find spatial patterns and relationships, as shown in the following examples.

Map 2

IMPACT OF JANUARY 13, 2001 EARTHQUAKE
PERCENTAGE OF HOUSING UNITS DAMAGED BY DEPARTMENT
(Bar graph indicates breakdown by building material)

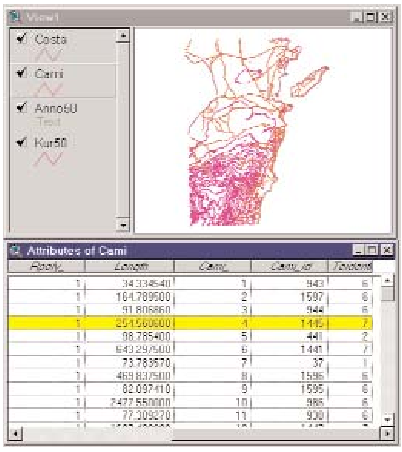


Source: COEN data at Feb. 2, 2001

Map 3
IMPACT OF EARTHQUAKES JANUARY - FEBRUARY 2001
SPATIAL DISTRIBUTION OF 2001 HUMAN DEVELOPMENT INDEX

A GEOGRAPHICAL DATABASE

A GIS maintains a database. The database concept is an essential part of a GIS and marks the main difference between it and simple drawing or computerized cartography software, which can only produce graphic information. Every modern GIS incorporates a database management system. This database may contain coverage, images, attribute tables, etc.



A GIS links the spatial data with descriptive information about some particular feature of a map. The information is stored as attributes or characteristics of the element that is represented graphically. For example, a road network may be represented by road centerlines, in which case a true visual representation would not provide much information about it. To obtain information about the road network, the user would consult the stored tabular data for roads, which might describe the class of roads, their width, type of surface, number of side roads, street names and ranking. The user can then create a display that represents all the roads according to the type of information required (see the following figure).

A GIS may also use stored attributes to calculate new information about a map's elements, such as the length of a given road or the total area of a particular kind of soil.

Users who want to go beyond mere drawing need to know three things about each element stored in the computer: what it is, where it is and how it is related to the other elements (for example, which roads are linked to form a road network).

Database systems deliver a means of storing a wide range of information and updating it without having to rewrite the programmes every time new data is input. In a GIS, the software handles the location of the elements, their descriptions and the way in which each characteristic is related to the rest.

A GIS allows the user to associate descriptive information with a map's elements, create new relationships that can be used to determine the layout of different sites for development, assess environmental impact, calculate crop volumes, identify the best location for new facilities, and so forth.

A GIS's capacity for data integration makes it possible to look at and analyze data in powerful new ways. Users can access information in a database table from a map or they can create maps based on the information in the table. For example, they can select a municipality on a map and display a list with all the relevant information about its population. Going the other way, users can also create a map of municipalities and display each of them according to the number of children, adults and seniors in their populations.

GIS COMPONENTS

A GIS has several components:

A GIS consists of hardware and software tools that use specific methods to perform operations on a database. The database is a simplification of the real world. The GIS user also becomes a vital part of the system when more sophisticated analyses are required. If queries about a place cannot be answered exclusively from the database screen, derived data may be required. Such derived databases are often the result of the effect of a model. A model is structured as a set of rules and procedures for deriving new information that can be analyzed by a tool such as a GIS and used to assist in problem - solving - and planning.

A GIS's analytical tools are used to build spatial models. The models may include a combination of logical expressions, mathematical procedures and criteria, which are used to simulate a process, predict an effect or imitate a phenomenon. Making the models calls for the tools found in a GIS, the ability to choose and use the right ones and great familiarity with the data being used. A GIS offers a great number of tools for analyzing the information in a spatial database.

When users wish to make a query or review a theme related to a spatial phenomenon, they can use a GIS to derive new information by creating a model that performs the analytical procedures. They can then examine the results from the model. This process, which is known as spatial analysis, is useful for evaluating suitability and capacity, estimating and predicting, and interpreting and understanding. There are many kinds of spatial analysis in a GIS, including contiguity analysis, proximity analysis, demarcation operations, surface analysis, network analysis and analysis based on the minimum element. These different forms of analysis include combined relational and spatial operations, as well as logical operations.

PROXIMITY ANALYSIS

How many houses are located less than 100 meters from a watercourse?
How many customers live within a 10 km radius of a given shop?
What percentage of alfalfa is within 500 meters of the silo?

To answer these questions, the GIS technology uses a process known as buffering, which determines the relationships of proximity between the elements (see the following figure).

LINKING ELEMENTS AND ATTRIBUTES

As mentioned above, the power of a GIS lies in the link between graphic (spatial) data and tabular (descriptive) data. Three are features noteworthy in this respect:

- A one-to-one relationship is conserved between the map elements and the records in the element attributes table.

- The link between element and record is conserved by a unique identifier assigned to each element.

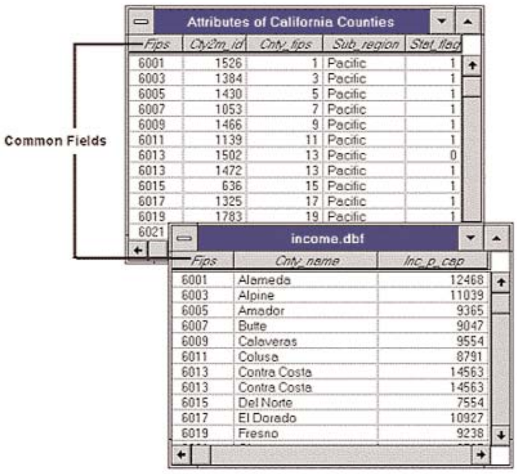
- The unique identifier is physically stored in two places: in the files containing the ordered pairs (x, y) and in the corresponding register in the element attributes table. A GIS automatically creates and conserves this connection.

Combined relational operations

In addition to keeping the elements and their attributes up to date, the previously described concept can be used for other functions. Either of the tables can be connected provided they share an attribute in common. A 'relationer' uses a common item to establish temporary connections between the corresponding registers in the two tables. In a relation, each record in one table is connected to a record in another table that shares the same value for an item in common. A relation has the effect of making a table of attributes 'larger' by temporarily adding attributes to it, which are not really stored there. An example of this can be seen in the following figure.

A relation temporarily connects two attributes tables by using the item they have in common.

In a GIS, a database that contains descriptive attributes can be joined to an element attributes table. If a relation is used, the file of related tabular data can be kept and updated separately. For example, the registers in tax files can be applied to a map showing plots of land, provided that each plot is identified with a unique number. Census data on land can be related with polygons using the number of plots of land contained in both.



Fips	Cty2m_id	Cnty_fips	Sub_region	Stat_flag
6001	1526	1	Pacific	1
6003	1384	3	Pacific	1
6005	1430	5	Pacific	1
6007	1053	7	Pacific	1
6009	1466	9	Pacific	1
6011	1139	11	Pacific	1
6013	1502	13	Pacific	0
6013	1472	13	Pacific	1
6015	636	15	Pacific	1
6017	1325	17	Pacific	1
6019	1783	19	Pacific	1
6021				

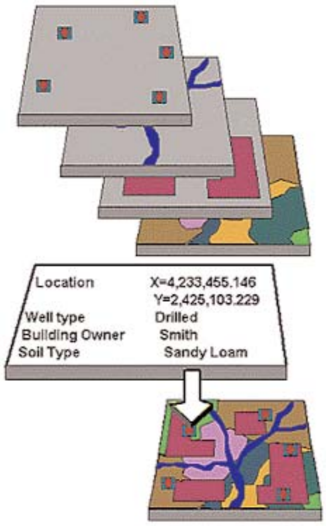
Fips	Cnty_name	Inc_p_cap
6001	Alameda	12468
6003	Alpine	11039
6005	Amador	9365
6007	Butte	9047
6009	Calaveras	9554
6011	Colusa	8791
6013	Contra Costa	14563
6013	Contra Costa	14563
6015	Del Norte	7554
6017	El Dorado	10927
6019	Fresno	9238

Combined spatial operations

Relations and unions are among the basic operations of a GIS. They are simple in concept and are often used. For example, when a spatial superimposition is created, each new output element has attributes from the two sets of input elements used to create it. The superimposition of polygons is essentially a spatial union. In this case, instead of using a common item from two tables, the records are paired on the basis of the location of their associated geographical elements.

In the figure below, a coverage layer of populated centers is combined with layers for the hydrographic system, zoning and relief. When these coverage layers are superimposed, the spatial information is combined, as are the attributes, and a combined coverage is produced.

The possibilities of a GIS are based on its ability to carry out the many kinds of spatial analysis needed to answer the wide range of questions that people might have. A GIS can carry out all these operations because it uses geography or space as the common key between the data sets. Information is related only if it refers to the same geographical area.



Like other information systems, a GIS confirms the saying that better information leads to better decisions. A GIS is not, however, an automated decision-making system. On the contrary, it is a tool for analyzing, querying and displaying geographical information that can be used to assist in decision - making. GIS technology is used to create scenarios that help us to make the best decision when solving a problem.

Finally, it is important to mention that the development of personal computers has now brought GIS technology within the reach of everybody. A GIS now makes it possible to perform complex, sophisticated spatial operations with a desktop computer.

QUESTIONS THAT A GIS CAN ANSWER

A simple GIS programme, such as ArcView©, MapInfo©, IDRISI© or GISMAP©, can be run on a PC to answer many of your location-related questions by making use of existing data.

The following are examples of typical questions that a GIS can help to answer.

Location: What exists in …?

The first of these questions attempts to discover what exists in a particular location. A location can be described in many ways, including place name, postal code or geographical references, such as latitude and longitude.

Condition: Where … ?

The second question is the opposite of the above and requires spatial analysis before it can be answered. Instead of identifying what exists at a given location, you may wish to find a place where certain conditions are met (for example, a non-forested piece of land with an area of at least 2,000 square meters, 100 meters from a road and with soil that is suitable for building).

Trends: What has changed since …?

The third question, which might include the first two, attempts to find differences within an area over a given period of time.

Patterns: What spatial patterns exist?

This question is a more complex . You might ask it to find out whether cancer is the leading cause of death among people living near a nuclear power station. Or you might want to know how many anomalies from a pattern there are and where they are located.

Creating models: What would happen if …?

This type of question is asked to find out things such as what would happen if a new road were added to a highway system or if a toxic substance were introduced into the underground water supply system. Specific geographical and other information is needed to answer this type of question.

The questions included when creating models call for the generation of additional data (using a complete GIS, such as ARC/INFO), based on existing geographical data. The following are some typical question-asking techniques.

Proximity: What are the characteristics of the area around the existing elements?

Provide a summary of the types of vegetation to be cleared within 100 meters of a fire cut-off for a high-voltage power line; inform the fire brigades about the nearest watercourse at the time of fighting a forest fire; notify the owners of wells within three miles of a toxic waste dumping site of possible pollution; warn all owners within 500 meters of a proposed change of site. All these problems can be solved with the proximity analysis tool: generation of intermediate memory areas or calculations of “intra-characteristic distance”.

Limiting operations: What exists within a specific region?

Examine a problem, test a hypothesis and define alternative courses of action for the prototype areas in order to apply a model to an entire area of interest. You will sometimes wish to create data for specific areas of study. The limit operation tools can separate specific areas or they can extract elements from within a particular area.

Logical operations: What is unique for a region or a set of elements?

Examine soils with a particular alkalinity; study roads built with a specific kind of surface; study wells that are deeper than their design depth. The answers to some questions about spatial elements can be found in their tabular attributes rather than their location. Elements can be extracted from databases or introduced into them by using logical operations.

Spatial union: Where is something?

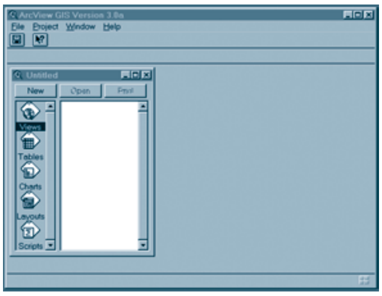
Establish area division discrepancies; establish wildlife habitat requirements; determine which parts of a right-of-way fall inside land whose ownership is in dispute. Many questions can be answered with spatial union operations, which are often referred to as the "superimposition of polygons". Spatial union operations provide new elements for the existing attributes.

NOTES ON USING ARCVIEW©

A spatial database may contain information about natural phenomena, artificial characteristics, limits, properties, etc. ArcView is a utility that creates an onscreen environment and queries the contents of a spatial database. ArcView allows users to explore the database, show all or part of its contents, query, display or save results and feed information to graphic and other applications.

THE ARCVIEW INTERFACE

The ArcView interface consists of windows, menus, a tool bar and a status bar. Like all programmes that run under Windows, ArcView is driven by menus that are activated by selecting options or clicking on icons. It is also extremely intuitive and user-friendly in its operating sequence.



ArcView's main window is the applications window. All ArcView operations are executed from there. This window can be resized, minimized and maximized with the mouse.

To load and display a coverage, an ArcView project must first be created, since every working session is saved in projects (file extension .apr). A project contains all the views, tables, graphics, cartographic compositions and macros that you need for a given application. This means that all your work is saved in the same place.

The projects window organizes and lists the contents of the active project and makes it easier to manage and control work. A new project will be named 'untitled' until given a new name. See left figure.

The tool bar is just below the menu bar. The icon buttons are used to activate given functions immediately without having to access them through a menu option. When the cursor passes over an icon on the tool bar, a description of its function appears in the bar at the bottom of the screen. At the start of an ArcView session, the main applications window contains only two buttons: one to save a project, the other to access the online help.

As you work with ArcView, the tool bars at the top of the screen change according to which window is active (a view, a table of attributes, graphics, etc.).

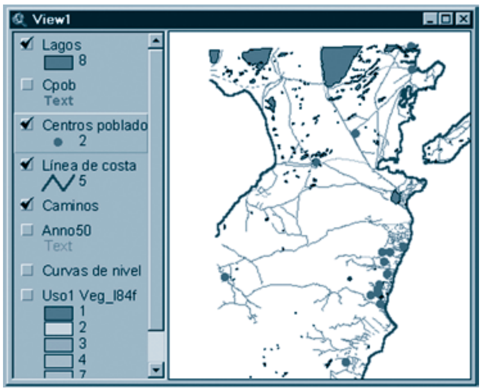
The following figure is a screenshot of several buttons grouped together. Each set of icons or buttons is used to activate different functions. For example, the tool bar in the second row beneath the main menu is used for operations that you might want to carry out on a map displayed in a view: request information about an element in the map, select an element, edit vertices, select a set of elements, zoom in and out, pan, measure, etc.

TYPES OF ARCVIEW DOCUMENTS

Boxes, tables, diagrams, schemes and macros handled in ArcView are known as documents. Each kind of document is briefly described below.

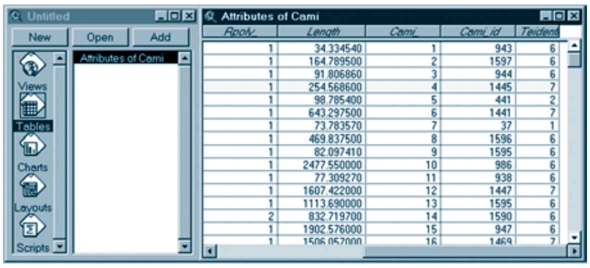
Views

A view is an interactive map that displays, explores, queries and analyzes geographical data. A view defines how the geographical data you are using will be displayed, but does not itself contain the geographical information.



A view can be thought of as a collection of themes. A theme is a collection of geographical phenomena defined by the user. The figure at right shows the view titled ‘View 1’, which shows the Punta Arenas sector in Region XII of Magallanes, Chile.

The view has a table of contents (or legend), which lists the themes being reviewed. The components of the view can be determined by looking at the table of contents. In the figure above, the window displays and lists the contents of the view.



Rpoly_	Length	Cami_	Cami_id	Teident
1	34.334540	1	943	6
1	164.789500	2	1597	6
1	91.806860	3	944	6
1	254.568600	4	1445	7
1	98.785400	5	441	2
1	643.297500	6	1441	7
1	73.783570	7	37	1
1	469.837500	8	1596	6
1	82.097410	9	1595	6
1	2477.550000	10	986	6
1	77.309270	11	938	6
1	1607.422000	12	1447	7
1	1113.690000	13	1595	6
2	832.719700	14	1590	6
1	1902.576000	15	947	6
1	1506.052000	16	1469	7

Table of Attributes

Tabular data are stored in a table. You can display, query and also analyze almost any kind of tabular data, such as geographical aspects, types of soil, road conditions and so forth.

Graphs

Graphs allow the user to show numerical information in a graphic form. A graph makes it possible to visually compare the behavior of one variable with that of another. ArcView provides several options for creating graphs that can accompany the display of attributes in a map

Cartographic compositions

Cartographic compositions allow users to locate every type of document in a single window and produce a final map. Instead of being copied directly, views, tables and maps can be referenced within a cartographic composition. In this way, changes to any of the elements are automatically reflected in the composition. You can add elements (titles, legends, bar scale, texts, arrow to indicate North, etc.) to the cartographic composition.

Macros

A macro is a set of commands written in the language known as Avenue that allows users to manage the database in ArcView transparently. You can use Avenue to design your own interface to access ArcView.

All documents are managed through the project control window. Each type of document is represented by an icon, which, when selected, will display a list of all the documents of this type contained in the project.

REPRESENTATION OF ELEMENTS ON THE MAP

Geographical phenomena are represented in the database by geometrical elements like polygons, lines, and points.

The geographical phenomena are known as classes of elements:

- Polygons might, for example, represent plots of land whose rateable value is within a certain range or parts of forests that contain particular species.

- Lines might represent paved roads, paths or drains of a specific diameter.

- Points might represent the location of warehouses, customers, wells or significant places.

AN ARC/INFO© COVERAGE

A coverage is a digital version of a map. It is the basic object that stores the geographical data (geographical elements and their attributes) in ARC/INFO©. A coverage may contain one or more classes of geographical elements. For example, a coverage whose elements are areas or polygons also contains labeled points that identify each polygon. In addition, a coverage containing polygons that represent plots of land may also contain linear elements (arcs) that contain information on the boundaries between the plots. When we add ARC/INFO© coverage to a view, the class of element to be used can be chosen.

ARCVIEW PROJECTS

A project is a space (with an .apr extension) that ArcView creates so that you can organize your work and documents in one place (or file). A project makes it easy to maintain and manage any combination of interrelated ArcView components. Views, tables, maps, cartographic compositions and macros can all be worked on and saved simultaneously in one file.

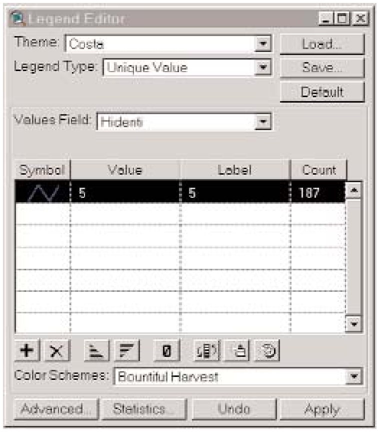
When you create an ArcView project, you create a file that contains the views, maps, plans and documents that make up the project.

THEMES IN A VIEW

ArcView uses geographical information from a variety of databases to display a given geographical characteristic or theme in a view. Examples are spatial databases, including ARC/INFO coverage, configured ArcView files and satellite image data. ArcView also supports tabular (alphanumeric) databases that contain geographical information, such as street addresses and x,y coordinates.

The definition of the theme might simply be a request to display the complete database referred to in the theme, or it might be a set of criteria applied to the database to identify which part of the data should be displayed. A database is an ARC/INFO coverage or an image file. The image may have been scanned, or it may come from a satellite.

Themes can be given any name. A theme might be named according to the database to which it refers, such as, USENOW (present use of land), P3716 or COV143. It might also be named according to the criterion that it meets, as in, “Appropriate areas for development,” “Soil code = 5,” or “Model 2 results.”



Each theme represents a set of geographical elements that have a given characteristic or attribute. This characteristic or attribute is reflected cartographically by means of a determined symbology that is shown in a legend. A legend controls the way in which the elements in a theme are drawn. It consists of symbols, such as patterns that fill an area, types of lines that trace a linear feature or marks that show the specific location of a point (see right figure).

The symbols can be drawn with a great variety of colors. A theme can be displayed by using the same symbol and a different color or vice versa. For example, all the roads can be drawn with a broad red line or shopping centers can be represented with a yellow flag. ArcView provides a color palette for this purpose (see following figure).

Since themes are derived from a geographical database, they generally contain geographical elements associated with a table of attributes. All the elements of a theme can be drawn on the basis of a particular attribute value. For example, each water main can be drawn in a different color or with a different thickness according to its diameter if diameter is an attribute of the linear elements that represent pipelines.

Elements can be classified and then symbolized in accordance with the classification scheme, or each unique value for an attribute can be drawn. For example, types of soil can be shaded according to their alkalinity; regions can be colored according their net migration figures; or plots of land can be shaded with a unique pattern or color according to existing holdings.

As you get used to ArcView, you will learn how to use the table of contents to control which themes are visible. It is possible to display all or just some of the themes on one screen. You can also control the order in which the themes are displayed. Each theme points to a coverage stored in a database somewhere in the system. The data can be stored on a local disk or on a disk in a network. Although many themes can be derived from the same coverage, an individual theme can only refer to one attribute of that coverage.

Although a theme can contain only one class of element (polygon, line, point or text), it can be derived from a coverage that has more than one type of element. For example, a coverage formed by censused city blocks (polygons) and the fronts of each block (lines) has a topology for the polygons and the linear elements, but the theme based on this characteristic can only display one of them. Another theme can be created to display the attributes of the other class of element.

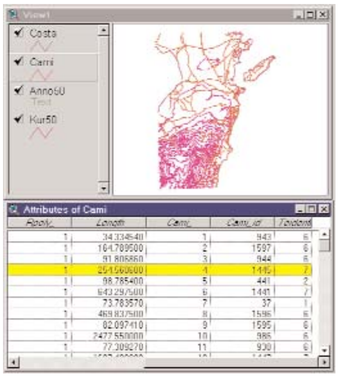


TABLE OF ATTRIBUTES

Spatial databases (e.g., ARC/INFO©) have a table of attributes associated with the geographical elements, which contains descriptive information. When a theme is displayed in a view, a table of attributes is immediately associated with the displayed elements (polygon, line, point or text).

If you have numerical information in an external file (in dBase, INFO, or comma- or tab- delimited ASCII format) that is related to the elements displayed in your view, it can be added to your ArcView project like any other table. These files generally contain additional information on the elements displayed in a view. It is also possible to create a table in ArcView to enter information interactively.

We have given basic information about ArcView operation and document handling. For a more detailed explanation of the programme's functions and operations, see the User's Manual for ArcView 3.0.

THE ROLE OF ARCVIEW IN SPATIAL ANALYSIS

As mentioned previously, ArcView© is a display and querying tool that can carry out many tasks included in the spatial analysis of ARC/INFO© geographical databases. ArcView can be used with more than one coverage or database. Since display and query are essential for interpreting the results of spatial analyses, ArcView complements the spatial analysis carried out in ARC/INFO©, by making it possible to investigate the results and new spatial relationships derived from analytical procedures and models previously made with ARC/INFO©.

II. HOUSING AND HUMAN SETTLEMENTS

A. INTRODUCTION

1. General comments

This chapter of the handbook refers to all buildings used as dwellings, urban infrastructure and equipment. It does not deal with sectors involved in the production and marketing of construction materials or directly engaged in construction, as these industries are discussed in the chapter on productive sectors.

The interrelations with other economic activities and social segments must be taken into account when analyzing this sector since the deterioration or destruction of housing has broader effects on the living conditions and economic performance of the affected country or region. When housing is hit by a major disaster, the micro, small and medium-sized businesses located in those homes are similarly affected, as are household incomes. Many of these enterprises are owned and operated by women. Spending on the construction (and reconstruction) of housing contributes to the gross formation of fixed capital in the economy. Any change in housing construction rates –such as would occur after a major disaster– has significant implications for employment and for industries related to the construction sector. Thus, any negative effect on housing has ramifications for other sectors that must be identified and taken into account both in assessing the overall impact of the disaster and especially in defining reconstruction strategies and plans.

Pre-disaster conditions should be considered in impact assessment and when drafting reconstruction plans, since a disaster often aggravates pre-existing housing deficits. Actions in the field of housing are a primary aspect of national social development policies through which governments try to satisfy the population's housing needs. Responsibility for designing and implementing such initiatives falls not only on central government authorities, but also increasingly on regional and local governments or agencies, and even on non-governmental organizations.

When assessing damage or drawing up reconstruction plans, one should provide some idea of the effect that both have on employment, as well as on the installed capacity of the industrial and commercial sectors that provide the necessary inputs.

2. Assessment procedure

The housing and human settlements sector specialist –like the other specialists on the assessment team– usually has from one to three weeks' notice prior to visiting the affected country or region and from one to two weeks for field work. Before embarking on the mission, the specialist must collect all relevant information on the housing sector in the affected area or country and prepare a list of the institutions and people to be contacted during the field visit.

The specialist must keep in mind that at the end of the mission, he/she will be expected to develop a summarized table of damage to the sector. It should specify the amount of direct damage and indirect losses, broken down by property type (private and public), and indicate how they are distributed between the geopolitical units previously agreed upon among members of the assessment team. Table 1 provides an example of the type of table that the housing and human settlements specialist is expected to produce.

Table 1

DAMAGES TO HOUSING AND HUMAN SETTLEMENTS
(Millions of dollars)

Item	Damage			Sector		Cost of reconstruction	Imported component
	Total	Direct	Indirect	Private	Public		
Total							
Public schools							
National University							
Private schools							
Sports centers							
Cultural heritage							
Houses of culture Town halls							
Houses in historic centers							

The housing and human settlements specialist will also have to ascertain the sector's effects on the main macroeconomic variables –the external sector, public finances, etc.– and provide it to the team's macroeconomic specialist. Likewise, he/she will have to work with the employment specialist to determine the impact on jobs for both the disaster and reconstruction phases. He/she must also work in close cooperation with the gender specialist in order to determine the differential impact on women, as well as the possible implications of these gender differentials for reconstruction plans and projects.

The following is a guide to the normal sequence of procedures the specialist should follow:

- Definition of the geographical area in which the sector was affected using the standard methodology described in the previous chapter;
- Assessment of the pre-disaster situation based on information provided from on-site sources;
- Identification of direct damage or effects;
- Quantification of direct damage or effects;
- Valuation of direct damage or effects;
- Identification of indirect losses;
- Quantification of indirect losses;
- Valuation of indirect losses;
- Development of a typology of affected housing according to size, prevailing construction materials and type of ownership;
- Determination of the geographic or spatial distribution of total damage and losses;
- Assessment of corresponding social effects;
- Assessment of macroeconomic effects;
- Assessment of the impact on employment;
- Assessment of the impact on women;
- Collection of available information on reconstruction strategies, plans and projects, as well as on their execution timetable and possible budgets;
- Identification of issues or areas within the sector that need priority support or attention during reconstruction; and
- Helping the relevant authorities formulate definitive reconstruction strategies, plans and projects.

3. Information requirements

Information on the situation prevailing in the housing and human settlements sector before the disaster in the affected area or country is essential for establishing the baseline for the assessment. Minimum information requirements include:

- Number of dwellings in the affected area, specifying for each whether they are rural or urban, single- or multi-family, owned by men or women, privately or publicy - owned;
- Quality of existing dwellings, broken down either by permanent versus temporary units, the type of construction materials used (reinforced concrete, brick, wood, adobe, cardboard, etc.), the degree of conservation (good, regular, poor, etc.) or the type of dwelling (house, mobile home, shack, etc.);
- Average dwelling size by type, taking into account the average number of inhabitants per unit and the average area in square meters.
- The main construction techniques and materials used in the affected area;
- Typical furniture and equipment in the affected area, by dwelling type; and
- Costs of construction, furnishings and equipment.

Costs must be specified at current market prices with the later application of depreciation coefficients to estimate the current value of lost or damaged assets, as described in the section on direct costs. Costs must be obtained in the local currency of the affected country, and later converted into dollars based on a single official exchange rate for the date of the disaster, wich the assessment team should determine in conjuntion with the country's financial authorities.

4. Sources of information

Basic information on the housing and human settlements sector can be obtained from both national and international sources.

The following national sources should be consulted:

- Periodic censuses and surveys, including population and housing censuses, statistics bulletins and yearbooks, land registries, periodic housing-sector surveys, construction permits and licenses and consumer price lists;
- National statistics institutes or agencies, housing and urban development ministries or institutes, planning ministries or institutes, construction industry chambers, pertinent trade associations (colleges, associations or federations of engineers and architects), banks or agencies that help finance social housing and academic or research institutions related to the sector;
- Women-focused institutes or bodies that can provide up-to-date statistics;
- Related companies such as construction firms and the producers and sellers of building materials;
- Trade and industry associations;
- Classified advertisements in local newspapers;
- Property and real estate brokers; and
- Insurance companies.

The following international sources can be consulted:

- United Nations statistical yearbooks or compendiums, such as the Statistical Yearbook for Latin America and the Caribbean (ECLAC), the Compendium of Human Settlements Statistics (New York), the Construction Statistics Yearbook (New York) and the United Nations Development Programme's Human Development Report (UNDP) and
- International organizations such as the Latin American and Caribbean Demographic Center (CELADE), the headquarters and subregional headquarters of the Economic Commission for Latin America and the Caribbean (ECLAC), the Women in Development Unit of ECLAC, the United Nations Programme for Human Settlements (Habitat/Kenya), the United Nations Statistics Division (New York) and the Organization of American States (OAS/Washington).

B. QUANTIFICATION OF DAMAGE AND LOSSES

1. Direct damage

a) General comments

As we noted in the previous chapter, direct damage refers to losses of assets and property. Essentially, it includes damage to, or the destruction of, housing, domestic furniture and equipment, and public buildings and urban infrastructure.

Damage depends on both the type of disaster and the type of construction. Earthquakes normally damage structural elements (beams, joists, panels, load-bearing walls, etc.) and non-structural elements (partition walls, non-structural roofs, furniture, installations, equipment, etc.) because of the additional strains or loads to which such elements are subjected. Permanent deformations of the land such as settling or landslides can also do damage.

The intense winds of tropical storms and hurricanes exert extraordinary pressure on buildings; they can damage structural and non-structural elements even when foundations and other elements located below ground are not affected. Other phenomena –such as volcanic eruptions, mudslides, and floods– also put added stress on buildings and can destroy or damage their components, deform the land on which they are built or render it useless. Water or wind can bury the area in mud, ash or waste.

The most severe damage is generally structural in nature and may be so extensive as to require demolition. Non-structural damage may be more visible but also more susceptible to repair, possibly only requiring the replacement of certain elements that do not affect the building as a whole. Land failure might require either abandonment of a building or soil stabilization efforts.

b) Classification of dwellings

In light of the relatively limited time available for assessment, the housing and human settlements specialist may not be able to obtain a detailed inventory of all affected or destroyed units. In lieu of a statistically representative sample, the specialist may have to settle for extrapolating from what inspections he/she is able to conduct.

The specialist should classify dwellings and public buildings into the three following categories:

Completely destroyed buildings or those beyond repair;

Partially destroyed buildings with a possibility of repair; and

Unaffected buildings or those with only minor damage.

A similar categorization can be made of the destruction or damage to household furniture and equipment.

By locating on a map all dwellings and buildings affected in accordance with the categories noted above, it is easy to visualize the areas hardest hit and thus requiring priority attention from authorities in producing more detailed studies and defining demolition and debris removal requirements.

In addition, the housing and human settlements specialist must use the following criteria to classify dwellings and buildings according to their pre-disaster state:

- Geographic location (urban or rural);
- Materials used in construction;
- Number of rooms per dwelling, and
- Ownership (individual or collective; leased or self-owned; public or private).

The information must be grouped by the following categories:

- Houses;
- Apartments;
- Precarious housing; and
- Other types of dwellings.

The housing and human settlements specialist will have to clearly describe each of these categories to facilitate reader comprehension of the assessment document.

Differences should be noted between permanent or durable and precarious construction materials. Such distinctions can be useful when teams in the field detect rural settlements built from local materials that are not employed in urban construction. Likewise, dwellings must be classed by number of rooms, thus allowing for a calculation of the average number of rooms for each type of housing unit.

Information on affected dwellings available after a disaster is normally broken down into simple categories such as destroyed or damaged and rural or urban, rather than the classifications used in the population and housing census In such cases a comparison cannot be made between the census and disaster-impact information. The pre-disaster information obtainable through REDATAM will only be useful for defining the universe of dwellings prior to the event. Comparisons will show that a disaster does not affect all construction equally; rather, "precarious" dwellings tend to be the hardest hit, while the resistance of specific types of construction materials varies depending on the type of disaster. Field surveys along with comparisons of pre- and post-disaster housing data are needed for the specialist to carry out realistic estimates of damage by type and location of dwellings.

Once the typology of the affected housing has been determined –albeit roughly– their pre-disaster values must be estimated based on a uniform measure, such as square meter of construction or per housing unit. Significant national variations make it impossible to define in advance standard housing price ranges for all of Latin America and the Caribbean. These estimates must be made for each case based on local information from construction industry chambers, housing funds, NGOs involved in the sector, housing cooperatives, classified advertisements, etc.

In Central America, the United Nations Programme for Human Settlements employs an evaluation formula comparing one square meter of construction of affordable housing to the prevailing minimum wage. The cost of land and basic services must be added to this calculation. This formula allows for rough estimates, but it is limited by potential variations in the relationship between labor and construction-material costs.

c) Damage - prone dwelling and building components

It is possible to identify ahead of time the basic components of dwellings and buildings that are subject to disaster damage, thus expediting the later assessment process. These components and the types of damage they are prone to suffer are described below.

i) Buildings. Possible damage to structural and non-structural elements:

- **Structural elements:** beams, joists, panels, load-bearing walls, foundations, etc.
  Potentially repairable damage:
  Types of damage: fissures, deformities, and partial destruction.
  Actions: repair the element and possibly reinforce it.
  Irreparable damage:
  Types of damage: fissures, deformities, total destruction.
  Actions: replace the element, reinforce it or condemn and replace the building.

- **Non-structural elements:** partition walls, internal installations, windows, non-structural roofing, floors, etc.
  Potentially repairable damage:
  Types of damage: fissures and cracks, deformities, partial destruction.

Actions: repair the element and possibly reinforce it.
Irreparable damage:
Type of damage: cracks, deformities, total destruction.
Actions: replace the element, reinforce it or condemn and replace the building.

ii) Furnishings. For the purposes of the assessment, furnishings are understood as furniture proper (beds, tables, chairs, etc.), kitchen utensils, all clothing, domestic appliances and equipment (stoves, washing machines, radios, etc.) and other items such as decorations, books and games. When possible, it is useful to define typical furnishings (and their value) for each type of urban and rural dwelling that can be identified during the assessment.

Furnishings do not include the machinery or equipment of home-based micro, small, and medium-sized enterprises. Since such ventures are often run by women and are a source of supplemental income, related damages should be estimated separately, in cooperation with gender and industry specialists.

In cases of widespread destruction, time constraints may make it impossible for the housing and human settlements specialist to define with great precision the extent of damage to furnishings and the potential for repair at each site. Therefore, we suggest that the sectoral specialist use field inspections to define two or three basic ranges of damage (e.g., 100%, 50%, 25%) to furnishings in standard dwellings.

iii) Equipment. In addition to the usual in-house installations such as sanitary and electrical devices, some buildings have air-conditioning or heaters, small electricity generators, potable and waste water pumps, incinerators or other devices for solid waste disposal, elevators, security equipment, recreation (swimming pools and gymnasiums) and irrigation equipment.

Some of this equipment is very uncommon in the region and mostly confined to limited applications in specific climate zones (for example, air-conditioning in tropical areas or heaters in cooler areas). Therefore, the housing and human settlements specialist may wish to adopt one of the following criteria:

- Define and describe "typical equipment" for all affected dwellings;
- Define and describe "typical equipment" for specific types of affected dwellings (this is the most frequently chosen alternative);
- Define for each segment (stand-alone units or apartments, urban or rural, etc.) an average value for furnishings as a percentage of the total value of each housing unit.

Similarly, a detailed inventory of damaged or destroyed equipment may be out of the question. In that case, the housing and human settlements specialist should define two or three damage categories (e.g., equipment needing total replacement, major repairs or only minor repairs) to a dwelling’s typical equipment or to individual equipment units considered worth valuing.

iv) Public buildings. Government buildings and their furniture and equipment are affected by disasters in the same way as dwellings. While more limited in number than housing units, their complexity and cost is usually much greater; they therefore demand a more detailed application of the procedures described above.

Damage assessment for buildings of historical value should be dealt with separately. Detailed procedures for this purpose are given under the chapter on Education and Culture.

v) Other direct damages. It is necessary to record other damages demanding replacement or repair to their pre-disaster state. This includes household connections to public utilities such as water and sanitation services, electricity and –in some countries– gas lines.

The housing and human settlements specialist must also estimate damage to public areas including green zones and public parks or squares.

d) Quantification of damages

It is necessary to determine the replacement cost of restoring destroyed or damaged buildings to their pre-disaster state; in the case of precarious or informal dwellings, qualitative improvements must be introduced that expand unit replacement costs.

Definitive reconstruction costs, including any improvements for disaster prevention and mitigation, must be determined immediately thereafter.

i) Buildings, furniture and equipment. One should begin by estimating replacement costs for instances of total destruction before calculating partial damage costs. Many years of experience have shown that the fastest approach is to determine the number of dwellings affected in each typological category and apply average per square meter construction costs to this figure.

A replacement value should be adopted for informal dwellings that is equal to the cost of the most basic units in any government housing programmes currently under execution.

Damage to partially affected dwellings is estimated by adopting coefficients related to their total replacement cost.

Damage to, or the destruction of, furnishings and equipment in buildings should be estimated based on special surveys to ascertain their average value for each category of affected dwellings.

Where damaged housing and other buildings are determined to have been located in hazardous areas, it is necessary to estimate the cost of the land and ancillary services and deeds needed to rebuild safe places. However, this additional cost should be considered as indirect damages.

ii) Public buildings. Since this heading will normally cover a small number of units compared to dwellings, damage to public buildings should be estimated building by building. As in the case of dwellings, replacement cost should be estimated based on the surface area of construction and the corresponding cost of construction per square meter.

In coordination with officials, a specific case-by-case estimate must be made of furnishings and equipment, which undoubtedly will be much greater than in the case of dwellings.

Detailed estimates are needed even when only repairs are called for. One alternative would be to assign a fraction or percentage of the replacement cost.

iii) Cost of reconnecting public services. An estimate should be made of the cost of replacing or repairing basic service connections (domestic water, sewer, power, telephone, etc.). The calculation should be based on the number of units totally destroyed or partially damaged. Unit replacement or repair costs will have to be applied later as officials make them available.

iv) Public areas. Damage to green areas and public squares or parks should be estimated based on their size in square meters and their unit repair or replacement cost. Estimates for public parks or squares should include the number and repair or replacement cost of benches, lampposts and lamps.

Public areas may be classified according to the following categories:

- Parks with a regional or national relevance for the environment (including forest reserves);
- Large parks in an urban setting with relatively important infrastructure and support services and with relevance for the environment;
- Intermediate-sized parks within a local community (or communities), with only minor relevance for the natural environment; and
- Small parks located in small neighborhoods and with little or no relevance for the environment.

v) The differential impact on women. As we explain in greater detail in Volume Four, information must be obtained for ascertaining the differential impact on women in each sector.

With this in mind, the housing and human settlements specialist must uncover information on the percentage or number of homes where a woman is the head of household and/or owner of the dwelling or building. Those numbers are needed to determine the extent of women's losses in housing, equipment and furnishings. Losses to home production are taken into account as indirect damage, as described in Volume Four.

2. Indirect losses

a) General comments

In addition to direct asset losses, it is necessary to estimate indirect losses under the following headings:

- The cost of reconstruction-related demolition and debris removal (cleaning costs are dealt with as part of the humanitarian assistance or emergency stage);
- The cost of reducing the vulnerability of housing and human settlements including works to stabilize soil, protect dwellings or reinforce structures;
- The cost of purchasing land to relocate dwellings away from vulnerable places and to install basic services; and
- Temporary housing costs for the period in which new units are under construction or damaged ones are under repair.

Temporary income losses suffered during the reconstruction period by home-based micro and small businesses are addressed in Section Four on productive sectors and as part of the evaluation of the differential impact of the disaster on women since most of those enterprises are owned and operated by women.

b) Estimating indirect losses

i) Demolition and removal of debris. To repair or rebuild a dwelling or building, it must often be partially or totally demolished and the resulting debris removed. These indirect costs may represent significant portions of total damage, depending on the type of disaster damage.

These costs are different from the considerably lower emergency-related costs incurred during the emergency stage, when certain components of buildings must be demolished or some debris removed in order to locate, rescue and assist victims.

Demolition costs are highly variable, depending on the type of materials used in the construction of damaged dwellings and their location. To facilitate estimates, specialists often use overall unit cost estimates by type of dwelling, multiplied by the number of units affected. The costs of removing debris are often estimated based on the volume to be removed, the unit cost of removing and disposing of debris and the number of each type of affected dwelling units.

ii) Housing and human settlement vulnerability reduction. After a major disaster occurs, a decision may be taken to protect dwellings and other buildings against the possible occurrence of similar phenomena in the future. The cost of land stabilization, flood protection and structural reinforcement should be estimated under indirect damages. Given the wide range of possible endeavors, it is not possible to adopt a single estimate procedure. However, we recommend determining the main work required for each type of dwelling and estimating a unit cost per dwelling. Alternatively, one may estimate the costs for a group of housing units included within one single vulnerability reduction project.

iii) Relocation of dwellings. Estimates must be made of all costs for temporarily or definitively relocating human settlements to less vulnerable areas if such relocation is likely. This calculation should not include the cost of evacuation incurred during the emergency stage.

The costs that must be included under this heading include the following:

- The value of the land where new dwellings are to be located;
- The cost for the provision of water, sanitation, power, telecommunications and related basic services;
- The cost of title deeds; and
- The cost of transporting furniture and equipment to their new location.

All these costs can be obtained per square meter of construction or as an overall total per housing unit, and then multiplied by the number of dwellings to be relocated.

iv) Temporary housing. The cost of temporary dwellings that must be provided while definitive housing solutions are being prepared is an indirect cost that must also be estimated. The number of temporary solutions must coincide with the number of families who have lost their homes, and not necessarily with the number of dwellings destroyed (which may have housed more than one family per unit), as temporary solutions generally do not allow more than one family to be housed per unit.

These alternatives may consist of temporary shelters in buildings normally used for other purposes or ad hoc constructions. When existing facilities such as schools, churches or sports venues are pressed into use, one must estimate the cost of repairing any resulting damage once the facility has been returned to normal use, as well as the cost of not carrying out the activities for which the buildings are normally intended. This cost must be registered under the corresponding sector (such as schools under education) rather than under housing and human settlements.

When temporary camps or shelters are built, it will be necessary to estimate the cost of construction and related services, such as the provision of water, latrines and electric power. These costs are normally estimated on the basis of the number of square meters and the unit cost of construction of each temporary housing solution, combined with the number of dwellings or homes involved. Temporary solutions in this case do not refer to shelters used to provide humanitarian assistance during the emergency stage, but to ones of a longer duration such as when the decision is taken to postpone reconstruction until after the rainy season ends. In the case of ad hoc housing, the unit value will depend on its technical characteristics.

While officials in the disaster area may have to choose among a wide range of alternatives, we generally recommend using construction materials that can later be used to build or rebuild permanent housing.

3. Sources of information on direct and indirect damage and losses

The basic information required to estimate direct damages and indirect losses must be obtained from reports produced by national and local authorities and other non-governmental organizations that normally operate in the areas affected by the disaster and that participated in the emergency and humanitarian assistance stage. It must be complemented with information obtained by the housing and human settlements specialist during his/her field visit. Media reports can also be useful to the specialist, when duly weighed against field observations.

Information on unit prices can normally be obtained from various sources, such as bulletins issued by the construction sector, documentation of recent bidding on housing projects, material and equipment suppliers' price lists, indexes of changes in prices and wages in commercial, industrial and construction associations, and the printed media. Interviews with construction companies and associations of engineers and architects in the area may prove very useful.

4. Macroeconomic effects

Direct damage and indirect losses in the housing and human settlements sector have an impact on the living conditions of the population and on economic performance. These effects include the following:

- The loss of the contribution to the national economy of income generated directly or indirectly by housing leases (actually paid in or implied) with the corresponding effect on gross domestic product (GDP);
- An increase in construction sector activity;
- Effects on the external sector;
- Effects on the public sector;
- Effects on prices and inflation; and
- Effects on employment and income.

Each of the aforementioned macroeconomic effects is described in the following sections.

i) Loss of the contribution of housing leases to the economy. Gross domestic product takes into account rents and leases in a country's entire housing sector. This is estimated by multiplying the number of existing dwellings by the lease paid plus the implied lease on dwellings inhabited by their owners. When a disaster causes the destruction of, or significant damage to, the national housing stock, there is a corresponding effect on GDP.

The housing and human settlements sector specialist must cooperate with the macroeconomics specialist to carry out the corresponding estimates for this heading. The loss will be estimated by multiplying the number of dwellings totally destroyed by the average value of their actual or implied leases.

ii) Increase in construction activity. After a disaster occurs, activities in the construction sector are stepped up as rehabilitation and reconstruction programmes begin. In the case of major disasters, this may contribute to reactivating the economy or offsetting the fall in growth of other productive activities that might have been negatively affected by the same disaster.

The housing and human settlements specialist and the macroeconomist must jointly analyze the impact of housing sector rehabilitation on the construction sector. This must be based on a realistic analysis of reconstruction programmes and projects, available financing and the construction industry's execution capacity. The housing and human settlements specialist must obtain the rehabilitation and reconstruction plans for the sector from the relevant authorities, revise them and adjust them in accordance with an objective vision of actual domestic execution capacities; then he/she must prepare a realistic execution timetable. This schedule should be shared with the macroeconomics specialist for his/her GDP estimates.

iii) Effects on the external sector. Whenever a major disaster occurs, damage to the housing and human settlements sector can have negative repercussions or effects on the external sector of the affected country or region, as the need for additional materials, equipment and machinery will require that they be imported or diverted from the country's normal export flows.

If there is no local production of reconstruction materials, equipment and machinery, they will have to be imported from abroad, thus pressuring the country's balance of payments. The housing and human settlements specialist will have to determine, in close cooperation with local authorities, which components of buildings and equipment are not produced by the domestic industry so as to estimate the "imported component" of direct damages. This estimate will be used by the macroeconomics specialist for his/her external sector forecasts.

When the country is an exporter of these types of components, the execution of the reconstruction programme may greatly diminish or eliminate such shipments abroad, thus pressuring external accounts in the form of diminished export revenues.

Housing and other buildings are often insured against different risks, and local insurance companies have reinsurance with foreign companies. Should this be the case, when reinsurance payments are made, they generate a net foreign currency inflow that must be taken into consideration. The housing and human settlements specialist must determine the possible amount of such reinsurance flows and transmits the information to the macroeconomics specialist so that this information may be included in the foreign sector analysis

iv) Effects on the public sector. Public finances may be significantly pressured when central or local governments undertake demolition, debris removal and reconstruction work in the housing and human settlements sector.

The most significant expenses in rehabilitation and reconstruction tasks for the sector can be projected based on the estimated cost of the respective projects. An estimate can be made of the shortfall in tax receipts expected as the destruction of housing and other buildings pares tax collection. This can be estimated based on implied rent that will not be received.

The housing and human settlements specialist once again must cooperate closely with the macroeconomics specialist to carry out these estimates.

v) Effects on prices and inflation. During the visit to the affected country or region, the housing and human settlements specialist will not normally have enough time to estimate the effect of the disaster on prices of reconstruction inputs. However, speculation and a possible shortage of construction materials and equipment may result in price increases. The specialist must at least obtain qualitative information on the behavior of the supply and prices of these inputs by comparing current prices during his/her visit with those prevailing before the disaster, and on this basis provide a learned opinion as to their possible future evolution.

As in other cases, close cooperation between the housing and human settlements specialist and the macroeconomist will be essential.

vi) Effects on employment and income. A disaster may affect the employment and income of the people that work in the sector. Indeed, there can be temporary paralysis of normal construction work during the humanitarian assistance stage, including the indefinite suspension of development projects in the sector. Later, as reconstruction gets underway, construction sector employment is likely to expand and wages may rise in the event of a shortage of labor.

The paralysis that may accompany the emergency phase is generally very short lived, so the field visit may determine its effect to be insignificant. Experience suggests that it is very rare for development projects in this sector to be entirely abandoned in the face of reconstruction work; in fact, reconstruction and development projects are frequently combined. Therefore, the task of determining the impact on employment is normally limited to estimating the number of new jobs that will be required during reconstruction.

This increase in employment can be estimated based on the annual amount of investment in reconstruction, using factors that relate annual investment to the number of jobs. In this regard, the housing and human settlements specialist must cooperate with national or local authorities to determine these relationships for the special case under consideration, after a reconstruction timetable has been defined.

5. The reconstruction programme

The housing and human settlements sector specialist is often also involved in drafting or recommending changes to reconstruction strategies, plans and programmes, including prevention and mitigation measures.

She or he must identify and describe the characteristics and conditions of housing and its environs that might have determined the form and scale of the damage they sustained. This will make it possible to make general recommendations for reconstruction work.

This will require the description of the most common types of construction of the houses in the affected area and their disaster-related structural or non-structural failure. Equally essential are descriptions of the most commonly used construction materials in the affected area, their quality and behavior during the disaster and their suitability for the most common building typologies. In addition, the location of the houses and the physical characteristics of the environment -such as soil type, geology, topography, etc.- that might have had an influence on the degree of resistance of housing to the natural phenomenon will also have to be described. Such details will make it possible to prepare recommendations on the following relevant aspects of the reconstruction process:

- Technical characteristics of the repair and reconstruction of houses, processes to be applied and the types of locally available or imported materials to be used;
- The location or relocation of houses in accordance with the environment's characteristics, including reference to the need for upgrades when it is not possible to relocate houses away from vulnerable areas;
- Economic and supply issues for reconstruction inputs; and
- Administrative and institutional matters for the execution of reconstruction works such as community participation, available technical support, personnel training, inter-institutional coordination and the like.

It will also be necessary to identify and briefly describe those technical cooperation projects –international or national– that might be required to fully develop the items described above in order to support reconstruction.

Any available information on rehabilitation and reconstruction project lists must then be collected, clearly indicating the amounts of required investments and possible sources of financing (international or through internal resources, public or private).

The housing and human settlements specialist must develop a timetable of reconstruction works and their corresponding financial requirements to be able to prepare one or more hypotheses on the amounts and periods in which reconstruction can be carried out, estimating the possible effects on public finances and the institutional capacity to carry them out. To do this, the following aspects must be taken into account:

- The availability of financial resources for reconstruction and the time periods required for their negotiation, allocation and disbursement;
- The institutional and organizational capacity of institutions that will be responsible for leading and executing reconstruction, taking into account the role the public and private sectors and civil society will play therein;
- The capacity of the construction sector to face the challenge of reconstruction, taking into account the scale of disaster damage –to housing and other affected sectors– as well as the volume and value of the sector's output (during the five preceding years, for example), while bearing in mind that reconstruction will generally demand an additional effort on top of normal construction activities;
- The supply of inputs for reconstruction –in terms of human resources, materials and equipment– including any imports that might be required;

- The time periods required for the design, planning and organization activities for reconstruction; and
- Aspects related to climatic conditions and to the return to normalcy after the disaster. For example, the onset and duration of the rainy season or the time required for floodwaters to recede might prevent or hinder reconstruction work.

The housing and human settlements specialist will have to obtain all information possible on the above-mentioned items from public and private - sector organizations, and add his/her own observations derived from the field visits undertaken during the assessment mission. This will make it possible to prepare a timetable of the number of dwellings and the amount of investments that will be possible in each succeeding year; this schedule can be used for analyzing both reconstruction and its macroeconomic impact.

III. EDUCATION AND CULTURE

A. INTRODUCTION

1. General comments

This chapter describes how to assess disaster damage and losses to the education and culture sector's infrastructure, equipment and general functioning. The infrastructure considered here includes all premises used for school or adult education (classrooms, laboratories, workshops, etc.) and their auxiliary installations, such as sanitary services, general services and administration, storerooms, sports areas and installations and libraries. Culture includes all buildings considered to form part of cultural and historical heritage, including assets formally declared to be part of heritage, museums, archaeological sites, archives, libraries, churches, houses located within historic centers and houses of culture. We do not include under this heading buildings that form an integral part of other productive or social sectors, such as libraries and training classrooms located in hospitals or in manufacturing industry.

In Latin America and the Caribbean, both public and private sectors attend to these sectors, with the relative weight of one and the other varying from one country to another. In many rural or low-income urban areas, schools also discharge other functions by serving as centers for community and cultural activities. In other cases, the relationship is inverted, and churches, community centers and so forth are used for educational activities.

Schools are often used to temporarily house disaster victims, wich can cause both a temporary interruption of the school cycle and damage from the use of the installations in overcrowded conditions.

Undoubtedly, the reconstruction of the education and culture sectors after a disaster will not be so significant when compared to –for example– the housing or transportation sectors. Nevertheless, delays in restoring normal operations in the education and culture sector after a disaster can have very important repercussions and even psychological effects on affected families.

2. Assessment procedure

The procedure to be followed to assess damage to education and culture is very similar to the one just described for the housing and human settlements sector. Indeed, the specialist in education and culture must work closely with the housing and human settlements specialist to ensure there is no duplication of estimates, especially in regard to houses and buildings of historic value.

The education and culture specialist must produce a summarized table of the damage and losses sustained in his/her area. The table should indicate the amount of direct and indirect effects, break them down by type of property (private and public) and educational level (primary, secondary and university) and show their spatial distribution within the geopolitical unit previously agreed on with other members of the assessment team. The following table shows the type of result the sector specialist must produce at the end of the assessment.

Table 2
DAMAGES ON EDUCATION AND CULTURE
(Millions of dollars)

Item	Damage			Sector		Cost of reconstruction	Imported component
	Total	Direct	Indirect	Private	Public		
Total							
Public schools							
National University							
Private schools							
Sports centers							
Cultural heritage							
Houses of culture Town halls							
Houses in historic centers							

Likewise, the specialist in education and culture must estimate the effects of his/her area on the main macroeconomic variables -the external sector, public finances, etc.- to assist the macroeconomics specialist. He/she will also have to interact with the employment specialist to jointly determine the impact of the disaster on education and culture. Likewise, he/she will have to work in close cooperation with the gender specialist to estimate the differential impact of the disaster in the sector on women, including –among other factors– the increase in women's reproductive work when school activities are suspended.

A usual procedure to carry out the required work would include and follow the sequence of actions described below:

- Definition of the affected area for the sector, based on the standard procedure described in the first chapter in this section of the Handbook;
- Determination of the spatial distribution of total damage and losses;
- Assessment of the conditions prevailing before the disaster occurred;
- Identification of direct effects;
- Quantification of direct damage;

- Valuation of direct damage;
- Identification of indirect losses;
- Estimation of indirect losses;
- Valuation of indirect losses;
- Determination of the geographic or spatial distribution of total damage and losses;
- Assessment of macroeconomic effects;
- Assessment of the impact on employment;
- Assessment of the differential impact on women;
- Collection of information that the sector's authorities might already have available on reconstruction strategy, plans and projects as well as their execution timetable and possible budgets;
- Identification of items or areas within the sector that might need priority support or attention during reconstruction and their possible financial requirements; and
- Support in the formulation of the final reconstruction strategy, plans and projects, as an input for the affected government.

3. Information requirements

The specialist in education and culture must gather information that will enable him/her to develop a baseline for the sector in order to assess the impact of the disaster. The information listed below is the minimum that should be obtained.

Educational premises:

- Number of educational premises existing in the affected area, classified into urban and rural, publicly and privately owned and educational level (primary, secondary or middle, technical and vocational, university).
- Number of classrooms and students –total or, for example, per morning, afternoon and evening shift– for each educational premise;
- Quality of the building of the premises, based on –for example– the type of construction materials used (adobe, wood, brick, concrete, etc.), the average age of the construction and its degree of maintenance;
- Furnishings and equipment typical of educational centers in accordance with previously defined categories; and
- Unit building, furniture and equipment costs.

Cultural heritage buildings:

- Number and characteristics of public historic heritage assets –in other words, historic assets declared to be State property– broken down into the categories of world heritage, heritage buildings, museums, archaeological sites, movable goods, archives or documentary collections;
- Number and characteristics of private historical heritage assets –whether individually or institutionally owned– broken down into heritage churches, houses located in historic centers, libraries and collections located in foundations, libraries and churches;

- Non-heritage public cultural infrastructure –in other words, non-historical assets that are State owned and under official cultural programmes– broken down into cultural spaces, libraries, recreational parks, cultural centers in indigenous communities and artisans communities;
- Quality of construction of the above premises, based on –for example– the type of construction materials used (adobe, wood, brick, concrete, etc.), the age of the construction and its degree of maintenance;
- Furnishings and equipment typical of heritage centers in accordance with previously defined categories; and
- Unit costs of building, furniture and equipment.

As in the case of housing and human settlements, construction, furniture and equipment unit costs must be determined at current market prices with the later application of depreciation coefficients to estimate the current value of the lost or damaged assets, as described in the section on direct costs in Section One of this Handbook. Costs must be obtained in the local currency of the affected country, and later converted into dollars based on an official exchange rate defined in cooperation with the country's financial authorities, for the time of the disaster.

4. Sources of information

As in other cases, local, national and international information sources in the education and culture sector must be used.

The normal local and national sources include:

- Ministries of education and culture;
- Public - sector institutions entrusted with building and maintaining educational and cultural premises;
- Public institutions that are entrusted with coordination of university and adult education;
- Religious bodies and private foundations that manage and operate educational and cultural centers;
- Insurance companies, especially for the case of museums, libraries and archives; and
- Censuses of the educational and cultural sector.

The main international sources for the sector are the United Nations Education, Science and Culture Organization (UNESCO) and the Organization of American States (OAS). Both maintain records and issue periodic publications on the development of the education and cultural heritage of the Latin America and Caribbean countries. The Economic Commission for Latin America and the Caribbean (ECLAC) also publishes information on the sector, most notably in its Social Panorama.

B. QUANTIFICATION OF DAMAGE AND LOSSES

1. Direct damage

a) General comments

As mentioned in Section One of this Handbook, direct damage refers exclusively to losses of capital or assets. In the education and culture sector, direct damage refers to the destruction of, or damage to, buildings, furniture and equipment, and materials, works or volumes of a cultural nature stored in heritage buildings that may have been affected by a disaster.

Because of the similarity to the housing and human settlements sectors, there is no need to repeat the methodology for damage assessment. The specialist in education and culture should refer to the corresponding chapter to obtain detailed information.

b) Classification of buildings

Unlike in the housing sector, a classification or typology of education and culture sector buildings is not a simple task. An exception might be public school-based education centers, especially those built in recent years under development programmes for the sector. Other educational establishments, especially cultural establishments, always have non-standard construction designs and qualities. Educational establishments are often converted residences or buildings originally intended for other uses that have been adapted as teaching premises. Heritage buildings in turn, are not only highly diverse, but in many cases were built many years ago, even as far back as the Colonial era.

i) Teaching premises. Some typologies of school premises should be established in order to facilitate the education and culture specialist's work, on the basis of -for example- educational level, type of construction materials used, state of preservation or the age of the building. This implies that teaching premises of the same educational level have similar spaces as regards areas for teaching, other purposes and recreation. The type of materials used in the construction will enable an estimation of the buildings' unit costs of construction, whereas the degree of preservation and age of the building will assist in determining their depreciated value and in differentiating between damage caused by the disaster itself and damage sustained due to the lack of proper maintenance.

The space standards below are not always strictly enforced, depending on the educational level and location (urban or rural) of the educational establishment. As regards spaces and equipment used for adult and university education, the range is so broad that it is impossible to present average values that would have widespread application. Therefore, the education and culture specialist will have to carry out assessments on a case-by-case basis and define typologies on each occasion, based on his/her observations in the field. Notwithstanding, the standards presented here might provide a basis for the specialist's work in the field.

RANGE OF SPACE STANDARDS FOR SCHOOL PREMISES

Standards governing the construction and operation of school premises throughout the region of Latin America and the Caribbean vary widely. However, their ranges based on the type or use of educational premises can be given, as follows (figures indicate square meters per student):

Classrooms for primary and secondary education

Total surface area of construction	6.0 (Argentina) to 1.2 (Paraguay)
Surface area of individual classrooms	1.5 (Uruguay and Peru) to 0.9 (Guyana and Haiti)

Other school installations

Administrative buildings	0.85 (Argentina) to 0.05 (Bolivia)
Laboratories	3.80 (Ecuador) to 1.20 (Dominican Republic)
Technical and manual workshops	5.00 (Ecuador) to 1.20 (Uruguay)
Art workshops	6.00 (Paraguay) to 1.50 (Uruguay and Peru)
Industrial workshops	9.00 (Guyana) to 4.50 (Guatemala)
Libraries	4.32 (Brazil) to 0.15 (Bolivia)
Music rooms	2.70 (Paraguay) to 1.20 (Argentina).

ii) Cultural heritage buildings. In this case, infrastructure and equipment follow no standards because the buildings vary widely in origin and construction. However, these buildings could be classified along the following typologies:

Public historic heritage buildings, including historic assets declared as such that are the property of the state:

- World heritage, world cultural assets registered in UNESCO’s list of World Cultural and Natural Heritage;
- Heritage buildings or declared historic buildings, with their equipment and collections;
- Museums;
- Archaeological sites;
- Moveable goods, such as state-owned collections of historic value that might be located in buildings other than museums; and
- Archives and collections of documents.

Private historic heritage buildings, whether owned individually or by foundations:

- Churches registered as historical heritage through legislative decrees or executive orders;
- Dwellings located in historic centers, including buildings of historical value (used as dwellings or as dwellings and businesses) located within sections deemed historical heritage; and
- Libraries and collections, including private moveable goods located in foundations, libraries, churches, etc.

Non-heritage public cultural infrastructure, referring to State-owned non-historical goods operated under official cultural programmes:

- Cultural spaces, including houses of culture, public libraries and non-heritage theatres;
- Libraries and their equipment;
- Recreational parks, including zoos;
- Cultural centers in indigenous communities; and
- Artisan and crafts communities.

iii) Sports facilities. This is another instance in which there are no patterns, as each facility is unique in its characteristics, design and construction materials. Assets that may be damaged include gymnasiums, stadiums and other, smaller facilities.

c) Components of buildings that are prone to damage

Although the education and culture sector shares many similarities with the housing and human settlements sector, it has special characteristics that should be noted. In any case, the education and culture specialist should refer to the corresponding housing sector chapter in order to complement the assessment of damage to or destruction of his/her sector.
i) Buildings, furnishings and equipment. In the education and culture sector, "furnishings" is meant to include all instruments, utensils and equipment used in education and culture functions (for example laboratory and manual workshop equipment, sports gear, etc.), or that may be necessary to process or use works contained in the buildings (such as microfilm readers, computers, projectors, etc.) that are normally individually itemized in inventories.

On the contrary, "equipment" refers to installations that are part of the building itself, such as elevators, security equipment, air conditioning, internal communication systems, and so forth.

ii) Stocks, works and collections. Buildings used for education normally have stocks of school materials (paper, books, chemicals, etc.) required for the undertaking of their respective activities. Their whose value can be sufficiently high to warrant individual assessment.

Inventories of works and collections deposited in a given institution must also be included under this heading. This must include books in libraries, religious and art works, samples or pieces in museum collections, the documentation in archives, and so forth.

Educational materials may be easily replaced; ascertaining their value is a straightforward matter. Works of a cultural, historic and religious nature found in libraries, museums, archives and churches must be identified almost individually. The latter can be difficult (or impossible) to repair or replace when they are unique or irreplaceable works. It is difficult to carry out valuations of objects whose value is subjective or that are not openly exchanged in the marketplace, as in the case of works of art or those that have a historical value.

d) Quantification of damage

Once again, reference must be made to the indications included in the housing and human settlements sector to quantify damage in the education and culture sector, because the valuation and quantification criteria contained therein are also applicable in this case. It is directly applicable to both educational - establishments and non-heritage cultural infrastructure. However, the cultural heritage subsector is a special case, and its particular headings are described below.

i) Heritage buildings. These will have to be treated individually because they are highly heterogeneous, and their direct repair or replacement cost will be estimated on an individual basis. When only repairs are needed, specialists in the field will have to be consulted to estimate restoration costs.

Valuating completely destroyed historical centers requires average bids made just prior to the disaster to purchase the dwellings and buildings, bearing in mind that there are land-use controls and that therefore no speculation would be involved. It is assumed that the bid price represents the cultural value and condition of the buildings within said historical centers.

Furnishings and equipment costs must be estimated following the same criteria as for the housing and human settlements sector, duly adapted for application to each cultural building.

ii) Movable goods, archives and other items. The recovery costs of works of art, collections and objects of a historical value must be estimated in consultation with a specialist in the field, taking into consideration the type of good (paintings, sculptures, decorative objects, religious images, etc.), its origin and antiquity, and the degree of damage sustained. In the case of archives, a recovery alternative would be to estimate the cost of microfilming to at least keep the information available for public use.

Experts will have to be consulted in order to estimate the value of totally destroyed goods. Insurance companies can often provide the required information, since these goods are often insured.

2. Indirect damage

a) General comments

Direct damage to assets of the education and culture sector cause indirect losses in the future, while the affected goods are being repaired or replaced. These losses include the following items:

- The costs of repair or rehabilitation of educational and sports premises that were used temporarily to house refugees;
- The costs of demolition and debris removal, after the emergency stage and before reconstruction;
- The costs of temporarily leasing premises to provide educational or cultural services that might be incurred during repair and reconstruction of infrastructure;

- The costs of reducing vulnerability in the sector's buildings;
- The costs of buying land and installing basic services to relocate buildings in less vulnerable or invulnerable areas;
- Income that will not be received as student fees while school premises are under repair or reconstruction;
- Income that will not be received from heritage establishments and from sports facilities during the repair or reconstruction period; and
- The increase in women's reproductive work because of the suspension of school activities. This figure should be included in the estimate of the differential impact of the disaster on women.

b) Estimation of indirect effects

i) Damage due to the temporary use of educational, sports and cultural premises as shelters. Schools, stadiums and churches are often used to temporarily house refugees during disasters. This leads to damage to their infrastructure, wich is not designed for continuous use by a large number of people. Therefore, the cost to repair these installations must be estimated as indirect damage. Repairs are often needed to sanitary services, walls must be repainted and furniture and other similar items must be repaired.

ii) Demolition and removal of debris. To repair or rebuild any kind of building, its damaged or destroyed parts must be demolished, and the debris removed and disposed of. Depending on the type of construction involved, these costs may amount to significant proportions of the total cost of the building.

These demolition and debris removal costs are different from costs incurred during the emergency stage to locate and rescue people trapped inside buildings. The latter are to be included under emergency stage expenditures.

In light of the variety of materials used and the diverse location of buildings in the education and culture sector, their demolition and debris removal costs are highly varied. Therefore, they are often estimated based on the volume of material to be removed and the unit cost of removal and transportation for each establishment in the sector. Another way of proceeding is to adopt a percentage of the total replacement cost of the affected good, which –as experience shows– may range from 10 to 25%.

iii) Temporary leases. Given the need to continue ensuring the provision of services –in educational, cultural, sporting and religious buildings that have been damaged or destroyed– it is usual to lease other premises while the original building is being repaired or rebuilt. Such costs must be estimated based on prevailing rents in the market at the time after the disaster and projected throughout the estimated repair or reconstruction period.

The cost of transporting all furniture and equipment required to provide the educational and cultural services to and from the leased premises must also be included under this heading.

iv) Vulnerability reduction. Costs to reinforce buildings in order to prevent further damage by similar future events must be taken into account under this heading. These may include reinforcement of structures, stabilization of soil that has been affected by mudslides or land settling and flood protection works. Likewise, protection systems might have to be established for moveable goods and objects of cultural value that may be located within the buildings, in addition to the establishment of early warning and evacuation systems in schools.

v) Relocation of buildings. Costs to relocate buildings exposed to the action of extreme natural phenomena into safer places must be estimated, provided there exists reasonable evidence that relocation will actually be undertaken.

The following costs should be included:

- The value of the land where the new building will be located;
- The cost of providing water, sanitation, power, telecommunications and other services when not available on the plot chosen; and
- The cost of transporting furnishings and cultural goods to the new location.

vi) Loss of income. Especially in the culture sector, but in education and sports as well, there will be losses of future income throughout the repair and reconstruction period resulting from damage to, or destruction of, infrastructure and goods. Likewise, commercial and tourism activities often cease due to damage to or the loss of heritage property, resulting in a reduction in or loss of income for the affected establishment or community.

The education and culture specialist must estimate the income that will not be received, based on what used to be received before the disaster and the estimated rehabilitation or reconstruction period. In addition, the education and culture specialist must cooperate with the productive sector specialists to estimate –and not duplicate– reductions in commercial and tourism income (local or regional fairs, etc.) that may occur in the future due to the damage to or lack of cultural buildings and property.

vii) The differential impact on women. When educational establishments are temporarily used as shelters for refugees, classes are normally suspended and women must face an increased amount of reproductive work to look after children of school age at home. Although this item is not considered in national accounts –as mentioned in the appropriate chapter on the differential impact of disasters on women– the education and culture specialist must cooperate with the gender-related specialist to estimate this increase in women's reproductive work, providing the estimated duration of the period for which the school year will be suspended.

In addition, the education and culture specialist must estimate, in cooperation with the gender and employment specialists, the temporary loss of employment and income for women in this sector, since it usually employs a relatively high proportion of women.

3. Macroeconomic effects

a) General comments

Damage to or the destruction of buildings in the education and culture sector caused by disasters will produce effects on macroeconomic performance and living conditions in the affected country or region. These effects will occur along a period of variable duration after the disaster.

A list of these macroeconomic effects is shown below:

- The loss of the sector's contribution to the development growth rate of the national or local economy;
- Effects on employment;
- Effects on the external sector;
- Effects on public finances; and
- Effects on prices and inflation.

b) Estimations of macroeconomic effects

The education and culture specialist must cooperate with the macroeconomics specialist to estimate the macroeconomic effects arising from the sector.

i) Loss of contribution to development growth rate. Institutions in the education and culture sector generate income that is calculated within the personal services sector in the national accounts system.

To estimate this loss, it is first necessary to estimate the "production" of such institutions while differentiating between private for-profit, private non-profit, and public - sector institutions. The production of for-profit entities can be estimated by using the same criteria applied to industrial sector companies, while that of non-profit entities can be carried out indirectly, by measuring loss as a function of inputs. The quantities or volumes of imports –both intermediary and primary– will have to be estimated and multiplied by their estimated average unit price and by the period of time the cessation of services is estimated to last.

The impact of private education loses on the GDP growth rate may be estimated by combining the non - received average fees and the time period over which classes were suspended, as indicated under the heading of indirect effects. The result must be adjusted by the ratio of value added over total value for the sector –which usually ranges from 50 to 75 per cent– in the national accounts for the affected country. As an alternative, use could be made of the ratio of value added to gross income, derived from school accounting.

The macroeconomic impact of losses in public education is usually non - existent or extremely low, as its contribution to GDP is measured through wages and salaries earned by teachers and other sector employees of the sector, who generally continue to work and be paid during disaster situations, even if at alternative locations.

In any case, care must be taken not to calculate temporary interruptions of service in normal working timetables when these are to be made up whether by extending the school year or implementing double shifts on the same premises – unless such measures imply greater disbursements for the year.

ii) Effects on employment. A disaster may lead to changes in the sector's employment rate by rendering personnel who work in the affected institutions unemployed for relatively long periods. However, in many public - sector cases, as previously indicated, personnel collect their wages continuously throughout the whole year, something the education and culture specialist must take into account when making his/her estimates. In any case, the number of employment positions lost temporarily is to be estimated, and the sector specialist must cooperate closely with the employment specialist.

iii) Effects on the external sector. The repair or reconstruction of education, sports and culture sector facilities can have an effect on the affected country's imports and exports. This could be due to the situations described below.

- When construction materials, machinery and equipment are not produced domestically, they will have to be imported from abroad, with the subsequent effect on the balance of payments. Estimation of this item must be carried out in the same fashion as described in the housing and human settlements sector; that is, estimating the proportion of imported elements and costs in reconstruction.
- The affected country might export materials, machinery and equipment whose production might be redirected to reconstruction, thereby resulting in a shortfall in exports and a subsequent effect on the balance of payments. To estimate this item, the education and culture specialist must cooperate with the housing and human settlements specialist and jointly analyze the installed capacity of the construction sector.
- As a result of insurance for damage to or destruction of buildings and goods in the sector, that portion of the insured amount that is reinsured by companies abroad must be taken into account as an increase in foreign currency income and introduced in the balance of payments. This is especially important in the case of works of a high historic and cultural value. To estimate this item, the specialist must consult with local insurance companies.
- Financing for reconstruction programmes and projects normally involves foreign-currency income throughout the reconstruction period. The duration of said period and a tentative scheduling of reconstruction and its external financing must be defined with local authorities, and the effects on the balance of payments, estimated on that basis. The education and culture specialist must cooperate closely with the macroeconomics specialist in these estimates.

iv) Effects on the public sector. The destruction of, or damage to, the sector's facilities and their repair or reconstruction can significantly affect public finances, especially under the following two items.

- Lower revenue due to the reduction in tax collection or transfers in the sector's damaged or destroyed buildings, which can be estimated based on the reduction in the income of each private institution affected and its income-tax rate;
- Greater public sector spending and investment needed for rehabilitation and reconstruction, which are estimated based on project execution and financing schedules, as indicated in the heading on effects, above.

v) Effects on prices and inflation. If there is significant damage and destruction in the sector and shortages arise in materials, machinery and equipment for reconstruction, the prices of such inputs might rise. This is true for all sectors of the national economy.

The specialist in education and culture must cooperate closely with the housing and settlements and macroeconomics specialists to deal with this issue, and must at least provide inputs –even if only quantitative– so that the latter can carry out a complete analysis of the situation.

APPENDIX V
EXAMPLE OF CALCULATING DAMAGE TO THE EDUCATION AND CULTURE SECTOR

The information available on the earthquakes that affected El Salvador in January and February 2001 is used to illustrate how to calculate the damage and effects caused by a disaster in the case of the education and culture sector.

1. Direct damage

Direct damage to the education and culture sector was estimated based on the field observations of mission specialists and prior surveys by the sector's local authorities.

a) Education

It was determined that the first earthquake damaged or destroyed a total of 1 367 educational centers, including various National University buildings, in addition to 34 private - sector premises. With the second earthquake, 219 buildings that had already been affected by the previous event were further damaged or destroyed, and an additional 150 public sector and 27 private - sector educational premises were affected, raising the total figure for educational premises affected to 1 516.

The average unit price for the repair or construction of each kind of building was determined, differentiating between buildings in the urban and rural sectors, and between educational level; that is, primary, secondary, technical and vocational, and university. These figures, taken together with the average surface areas of construction for each type of building, allowed total direct damage to education to be estimated at 63.9 million dollars.

In the case of sports facilities, it was determined that there was minor damage to the infrastructure of three public - sector stadiums administered by the National Sports Institute, as well as to some privately - owned stadiums. An estimate was made of the cost of repairing these structures, with the total amounting to 1.2 million dollars.

b) Culture

The earthquakes negatively affected the country's cultural heritage. There was damage to numerous public historic heritage installations: cultural goods, 22 heritage buildings, two museums, an archaeological site, furnishings and archives. Damage was also recorded in the case of private historic heritage (more than 100 churches, 5,120 dwellings located in historic centers, libraries and the collections of two foundations), in addition to cultural locations such as 145 urban culture centers, three libraries, various theatres, three recreational parks, 39 cultural centers in indigenous communities and 40 craft communities.

A detailed and individualized estimate of each heritage center had to be carried out in cooperation with government authorities to determine the cost of repair or reconstruction. For public historic heritage sites, an estimate was made of the costs of restoration and replacement of objects, collections, furnishings and equipment, as well as the repair and reinforcement of buildings. For private historic heritage, the costs of repairing and rebuilding churches had to be estimated, based on figures available in the country for certain rescue projects. The estimate of the costs of replacing dwellings located in historic centers was based on purchase bids available before the disaster in controlled-use sites, together with estimates of the value of the furnishings and equipment of the dwellings; when dwellings had been partially damaged, the costs of repair were estimated. As regards non-heritage cultural infrastructure, repair and reconstruction costs were estimated based on figures available for contemporary buildings of similar characteristics. In the case of craft communities, in addition to the cost of the repair or reconstruction of infrastructure, the value of stocks of goods stored by members, 75% of whom are women, had to be estimated. The cost of repairing damage to cultural centers located in indigenous communities was estimated based on the costs of recent construction in similar centers.

The total amount of direct damage to the culture subsector was estimated at 125.2 million dollars.

2. Indirect effects

a) Education

Few educational centers were used as temporary shelters for victims. Nevertheless, the start of the school year had to be postponed until premises were available, either after repairs were completed or when temporary or leased facilities could be made available. In addition, authorities decided to postpone the start of students' vacations to match the delay in the start of the school year, ensuring there would be no loss in the quality of education. The indirect damage estimated in this case was for the provision of temporary or provisional classrooms, amounting to 19.2 million dollars.

Because of the minor damage to certain public and private sports installations, certain events had to be suspended, causing a loss of income that also had to be estimated, worth 0.7 million dollars.

b) Culture

In the case of cultural heritage, income not received during the period needed to repair or reconstruct historic buildings, both public and private, was estimated, along with the temporary leasing of other premises to house some of their activities. In the case of dwellings located in affected historic centers, the estimated cost of leasing equivalent units was, calculated at 5% of direct cost. The total amount of indirect effects was estimated at 0.2 million dollars.

In addition, the reduction in the income of craft community centers during the period needed to rehabilitate and reconstruct infrastructure, as well as that of fairs that are carried out around historic or religious buildings that were damaged or destroyed, was estimated. However, these items were taken into account in the trade and services sectors to avoid duplication when determining the total amount of damage in the country.

3. Summary of damage

The total amount of damage caused by the earthquakes of January and February 2001 in El Salvador in the education and culture sector was estimated at 57.3 million dollars: 40.9 million dollars in direct damage to heritage and 16.4 million dollars in indirect effects stemming from reduced income and increased spending to provide services. The analysis indicates that 51% of total damage was to the public sector (29.4 million dollars), while the remaining 49% (27.9 million dollars) belonged to the private sector.

IV. THE HEALTH SECTOR

A. INTRODUCTION

1. General Comments

All disasters have an impact on the health sector, whether due to the need to protect the population's health during emergency situations and disasters, evacuate and rescue victims and modify health-care models or programmes in the medium and long term, or because of damages caused to the infrastructure of the health-care services network. This impact translates not only into immediate needs, but also into long-term effects.

Understanding and assessing these effects requires the availability of information that allows one to determine, in the time available for the assessment, the scope of damage to the sector's different components and functions. In the absence of such information, the assessment must proceed via spot studies or projections to measure the time and requirements for recovery. The collection and analysis of information and, more generally, the implementation of health information systems, is an essential component of disaster preparation. The availability and quality of the health information are very important, because they form the basis for understanding the fundamentals of health policy and thus provide the opportunity to undertake a review of the health-care services network, with an eye to rationalizing resources and modernizing the sector.

Disasters can be considered a problem for public health for several reasons:

- They can cause an unexpected number of deaths, injuries or illnesses in the affected community, thereby exceeding the therapeutic capacity of the local health-care services and forcing authorities to reorganize the sector or tosolicit outside help;
- They can destroy local health infrastructure such as hospitals, health-care centers, laboratories and the like, which will thus be unable to respond to the emergency. Disasters can also alter the provision of routine health-care services and preventative activities, with subsequent long-term consequences in terms of increased morbidity and mortality;
- Some disasters can have adverse effects on the environment and the population by increasing the potential risk of transmissible diseases and environmental dangers that increase morbidity and premature deaths andcould lower the quality of life in the future;
- They can affect the mental health and the psychological and social behavior of the affected communities. Generalized panic, paralyzing trauma and antisocial behavior rarely occur after big disasters, and the survivors quickly recover from the initial shock. However, anxiety, neurosis and depression can arise following both sudden and slowly forming emergencies;
- Some disasters can cause food shortages, with severe nutritional consequences such as a specific deficit of micronutrients (vitamin deficiencies); and

- They can cause broad movements of the population –whether spontaneous or organized– often to areas where the health-care services cannot meet the new situation, with a consequent increase in morbidity and mortality. The displacement of large population groups can also increase the risk of outbreaks of transmissible diseases in the displaced and host communities, where the large groups of displaced persons may be housed in and share unhealthy conditions or contaminated water.

After the disaster, the sector must take on three essential tasks: the rescue, treatment and subsequent care of primary trauma victims who have suffered the direct effects of the disaster; the prevention of the appearance or propagation of effects that are harmful from the perspective of public health; and the speedy recovery of the affected health-care facilities. Any expense that corresponds to the rescue, treatment and subsequent care of primary trauma victims that has not been taken into account in the emergency stage or in the corresponding section of the affected population must be accounted for within the assessment of the corresponding effects on the health sector, as discussed in the present chapter.

Given that the health sector's mission is to prevent the propagation of disaster-related effects that could endanger the public health, unfounded rumors and the speed with which massive international efforts in medical aid are mobilized to the most distant areas have contributed, in part, to the erroneous idea that disasters are almost inevitably accompanied by the outbreak of epidemics transmitted by contaminated water, vectors or direct contact. In fact, experience confirms that there is usually no immediate risk of epidemic outbreaks due to causes attributable to a disaster. After a period of time has passed, the implementation of normal surveillance methods for detecting epidemics or the application of a situation-specific protocol of surveillance makes it possible to identify and control the risk of transmissible diseases and prevent any potential epidemic outbreak. Experience gained with all kinds of disasters over the last ten years confirms that it is not necessary to undertake massive vaccination campaigns.

Recent experience thus shows that the swift mobilization of communities, national resources and international aid facilitates the treatment of the wounded –including the most serious cases– within a short time, thereby reducing the disaster's impact in terms of the length of the "crisis" in the health sector. Consequently, reconstruction issues will be addressed much more quickly and effectively.

2. Assessment procedure

Like the other specialists participating on the assessment mission, the one in charge of the health sector should be notified of his or her participation on the mission two or three weeks in advance. The field mission should last one to two weeks. It is therefore recommended that in the period leading up to the visit, the health specialist should collect all the available information on the sector, both at the national level and at the level of the affected region. Likewise, it is advisable for the specialist to prepare in advance a list of people and institutions with whom contact must be established in the field.

At the end of the assessment mission, the specialist will be expected to present a table summarizing the effects on the health sector. The information should be broken down not only by geographical area, in particular at the level of the country's administrative units (the same units used for all the sectors), but also by public and private sector and by the amount of direct and indirect damage (see Table 1, which presents a model of the kind of information to obtain).

The health specialist should also provide the macroeconomics specialist with any pieces of information that facilitate an estimation of the health sector's effects on the main macroeconomic variables, especially public finances. It is also important to work in close coordination with the specialists in the other sectors to assess the repercussions of the disaster, particularly on the employment sector. With regard to the issue of gender, the health specialist must take into account that the sector employs mostly women and that disasters have a greater impact on women's health.

Table 1

THE IMPACT OF A DISASTER ON THE HEALTH SECTOR
(Thousands of dollars)

Component	Damage			Sector		Effect on the balance of payments*
	Total	Direct	Indirect	Public	Private	
Infrastructure[1] Health ministry Social security Private						
Equipment and furniture[2] Health ministry Social security Private						
Medications Health ministry Social security Private						
Unforeseen expenses and income Emergency treatment Income not received Treatment not given Increased costs Increased expenditures in medications Epidemiological surveillance Vector control Community education Psycho-social rehabilitation						
TOTAL						

1 Specify the name of the affected infrastructure, if relevant, and the severity of the damage.

2 Identify any equipment and furniture that require specific quantification due to their value.

Table 2

THE IMPACT OF A DISASTER ON THE HEALTH SECTOR, BY AFFECTED REGION
(Thousands of dollars)

Component	Region			
	1	2	3	TOTAL
Health ministry[3] Infrastructure Equipment and furniture Medications				
Social security Infrastructure Equipment and furniture Medications				
Subtotal, public sector **Private** Infrastructure Equipment and furniture Medications				
Subtotal, private sector **Unforeseen expenses and income** Emergency treatment Income not received Treatment not given Increased costs Increased expenditures in medications Epidemiological surveillance Vector control Community education Psycho-social rehabilitation				
TOTAL				

The assessment process might develop through the following stages:

- Determination of the geographical area affected by the disaster, as well as the disaster's main immediate effects;
- Analysis of the sector's operation and policy before the disaster, based on existing documents;

3 Specify the name of the affected infrastructure, if relevant, and the severity of the damage, as well as any lost equipment and inputs, so as to facilitate a specific quantification.

- Analysis of the political and socio-economic implications of the disaster's effects on the sector;
- Field assessment of direct damage and effects to validate or modify the information provided by the sector's authorities;
- Quantification of the direct effects;
- Estimation and valuation of the indirect effects;
- Assessment of the macroeconomic effects;
- Estimation of the effects induced on other sectors, in particular on employment and women;
- Gathering of any available information concerning the strategy, plans and projects that may be under consideration, as well as the support and reconstruction resources that are, or may be, made available to the sector; and
- Cooperation in formulating the strategies, plans and projects for the reconstruction and revitalizing of the sector.

3. Information requirements

To assess the disaster's impact and effects on the sector, it is important to analyze the available administrative, economic, social and epidemiological information for the period before the disaster in the affected region and/or country.

This report should, at the very least, contain the following information:

- The socio-demographic situation and the status of the main epidemiological indicators, including the morbidity rate and incidence of different diseases that are relevant to the type of disaster in question;
- A description of the characteristics and location of existing health-care facilities;
- The existing human resources, equipment and medical supplies in the health sector and its facilities;
- The sector's management, the way in which it is financed and its financial resources;
- The health service coverage provided by each of the different institutions; and
- The cost of the services supplied, including the cost of a doctor's visit, daily hospital room charges and average wages, among others.

4. Sources of information

Sources of information vary widely in type and origin. No source should be ruled out when it comes to obtaining information that might help measure the impacts and assess the direct and indirect effects on the sector.

It is important to make use of existing information, including available publications, pertinent historical material and data on the situation prior to the emergency. It is also advantageous to talk with appropriate, well-informed individuals, including donors, personnel in humanitarian organizations and in national public administration, local specialists, community leaders of both sexes, the elderly, health-care workers, teachers, businesspeople and so forth. Group discussions with members of the affected population can provide useful information on practices and beliefs. Other sources of information include early warning systems and vulnerability assessments, as well as national and regional plans for preparing in case of disaster.

One of the main sources of information will necessarily be the government agencies in charge –in this case, the ministry of health and social security– as they can provide statistical and budgetary information on the sector's resources and activities. Especially useful are annual or periodic budget documents, the inventories of relevant institutions (which contain details on their personnel and materials), periodic statistical publications, reports on health structures and bulletins on the epidemiological situation.

The different services of the health and social security ministry can similarly provide information on current programmes, international aid and any reform plans and projects being developed. Apart from the health ministry, the ministry in charge of coordinating foreign aid and cooperation in the country can supply useful information on the aid resources being channeled into the sector.

The pharmaceuticals industry and the government agency in charge of its regulation generally make available useful information on the medicinal drugs market.

Information on the population and its main socio-demographic characteristics can be requested from the national institutes or agencies in charge of producing official statistics. More detailed or specific information can be obtained from decentralized agencies, municipalities and professional associations.

Private institutions are another important source of information, as they can supply a detailed inventory of the private sector's infrastructure and human and financial resources, information on the costs of different services rendered, frequency rates for medical visits to private hospitals, private sector development forecasts and so on. Similarly, training bodies and professional medical and paramedical associations are important sources for verifying medical demographic information.

Information published by international agencies that provide specific support to the sector should generally be taken into consideration. Examples include the (regular) statistical publications of the PAHO/WHO, the report on "Health Conditions in America", the UNICEF publications on children's health and publications by the United Nations Population Fund (UNFPA). The International Red Cross and international NGOs that are involved in emergency assistance are equally important sources to consider. Multilateral and/or bilateral assistance agencies that finance specific reform-support programmes usually generate information that can help clarify current policies.

B. QUANTIFICATION OF DAMAGE

1. Definitions

a) Direct damages

Direct damages are those caused to the health system infrastructure, as well as to the stock of medical equipment and inputs. The following components are usually the most affected:

- Hospitals, health centers, clinics, dispensaries and rural and urban health-care stations belonging to the national health or social security system;
- Health sector offices;
- Laboratories and blood banks;
- Rural and urban private sector hospitals and clinics;
- Medical and auxiliary equipment and medical and surgical instruments;
- Non-medical equipment and supplies used in the health sector;
- Furniture and basic material; and
- Stocks of medications and vaccines.

The magnitude of the damage to the health infrastructure and medical inputs/equipment will depend not only on the type of construction, but also on its location and the type and origin of the disaster.

b) Indirect losses

Indirect losses occur after the event that caused the disaster; they refer to the consequences for the economic flows of the sector. Indirect effects thus include the reduction in the level of normally available services, the additional cost of caring for victims, including the cost of relocating services and personnel into emergency services, the cost of maintaining idle human resources as a result of the impact on infrastructure, the reinforcement of epidemiological surveillance, the increased cost of medical treatment, lost income, activities associated with emergency care, delivery of medications and other inputs, vector control, vaccination, psychological care and so on.

The nature of indirect losses varies greatly. The following are some of the main types:

- The costs of monitoring and controlling the spread of infectious and contagious diseases and the harmful effects on health;
- The public and private cost of hospital and outpatient care;
- The cost of reinforcing primary care in rural areas and for vulnerable groups;
- The decline in the victim’s well-being and living standards due to the general erosion of the standards of public hygiene;

- The general decline in activity in the formal and informal productive sectors resulting from the psychological trauma suffered by the affected population (this is usually measured in the estimates for the corresponding productive sector);
- The additional cost of treatment and health care for the affected population; and
- The additional cost incurred to reduce the vulnerability of the sector's buildings

C. ASSESSMENT METHODOLOGY

1. Direct damages

Public and private health-sector authorities are the main sources of the information required for assessing direct damage. Information may also be requested from the decentralized government services that normally operate in the affected area.

Information on current prices in the construction sector can be obtained from authorized professional entities (engineers' or architects' associations, construction chambers).

Given that the disaster's consequences can also be analyzed as part of an operational review of the health-care services network and model of care –on the regional or country level, depending on the magnitude of damages– the health and social security ministry can provide indicators of activity that make it possible to judge the functionality of a given structure and decide whether it should be repaired or replaced. The disaster can thus provide an opportunity to lower the operating costs of structures that no longer ensure that the population will receive effective service.

a) Damages to infrastructure

To assess direct damage to health sector infrastructure, the same general procedure described in the chapter on housing and human settlements should be followed. That discussion defines three broad types of damage to infrastructure:

i) Structural damage: beams, joists, structural flooring, load-bearing walls, foundations and so forth;

ii) Non-structural damage: partition walls, interior installations, doors, windows, non-structural roofing, floors and so on; and

iii) Deformations to the land: settling, shifting and so forth.

Starting with a list of health infrastructure in the area affected by the disaster, with the facilities organized by type of establishment, the specialist will proceed to diagnose the damage. As in the case of housing, it is advisable to classify the facilities into the following groups: buildings that were totally destroyed or that are beyond the possibility of repair; buildings that were partially destroyed or that can be repaired; and buildings that were not affected or that suffered minor damage.

In other words, after collecting reliable data on the number of damaged or destroyed hospitals, health-care centers and other infrastructure in the sector, the specialist should seek up-to-date information on the value per square meter of new construction or repair, as is relevant in each case.

Next, each facility must be specifically identified, with details on its location, category, the main materials used in its construction and the unit prices for its reconstruction, full replacement or repair, as required in each case. The cost estimate for repairs should be expressed as a percentage of the cost of full replacement, as estimated by the assessor responsible for determining whether the facility should be repaired or partially rebuilt (see Table 3).

To assess the effects on the service network, the specialist should also categorize the affected health sector facilities by i) geographical area, ii) level of care, iii) number of beds and iv) public versus private. The analysis should include a description of the post-disaster situation in each of these categories. As part of this analysis of the impact on the services network, the specialist should also asses the affected infrastructure as a percentage of the total (see Table 4).

b) Furniture and equipment

The assessment of the damage to furniture and equipment can be based on the same three categories used for infrastructure: i) no possibility of repair (necessary replacement); ii) possibility of repair; iii) and minor damage.

To estimate the cost of repairing or replacing medical equipment and furnishings, depending on the level of the facility, either a coefficient can be allocated to each hospital bed to represent the value of the equipment and furnishings associated with it or an estimate can be made on the basis of existing price lists or price lists prepared for this purpose.

In the case of specialized equipment, however, it will be necessary to determine the current cost of replacement and whether the item must be imported.

The assessment must also take into account possible damages to non-medical equipment. This encompasses all non-medical equipment necessary for maintaining the sector’s operations, from the air and water quality control system to personnel administration. Examples include air conditioning units, heaters, refrigerators for storing vaccines, office equipment, air purifiers, water filters and the like.

A table can be drawn up to summarize the estimated damage to infrastructure and equipment, with a breakdown by degree of damage and a detail of the associated costs, as follows

Table 3

DIRECT DAMAGE TO INFRASTRUCTURE AND EQUIPMENT

	Replacement		Repair		Minor damage	
	Units	Ave. cost (per sq. m)	Units	Ave. cost (per sq. m)	Units	Ave. cost (per sq. m)
Hospitals						
Clinics						
Health-care stations						
Pharmacies						
Laboratories						
Medical equipment						
Non-medical equipment						
Furniture						
Other						
Total						

Table 4

AFFECTED INFRASTRUCTURE AS A PERCENTAGE OF THE TOTAL

	Replacement		Repair		Minor damage	
	Units	% of the total	Units	% of the total	Units	% of the total
Hospitals						
Clinics						
Health-care stations						
Pharmacies						
Laboratories						
Total						

2. Indirect losses

a) Demolition and clean-up costs

The costs of demolition, removal of debris and land improvement are considered indirect losses. This assessment should be carried out in close cooperation with the government officials responsible for the sector. Demolition costs vary widely in relation to the type of building materials involved. The specialist should thus consult with an engineer or architect on this point. The costs of removing debris are usually estimated based on the volume to be removed and the unit cost of removal and transport to the waste disposal location.

b) Cost of disaster mitigation works

It is often necessary to adopt mitigation and prevention measures to avoid or reduce the impact of future disasters on the sector's infrastructure. The costs of such works or measures, as well as the costs of relocating facilities to less vulnerable sites, are considered an indirect effect of the disaster.

The mitigation of disaster-induced losses via the adoption of preventative measures is a highly profitable endeavor in areas that experience recurrent events. Each dollar spent on adequate mitigation before a disaster hits represents enormous savings in losses that could have been avoided. Different mitigation measures have different implementation modes and costs. The simplest and most economical are those associated with non-structural and organizational-administrative aspects, whereas structural measures are more complex and expensive.

Phasing in an integrated hospital damage mitigation plan will facilitate a slower, more feasible application of resources. The practical experience gained in hospital damage mitigation works over the last ten years, together with current information on the building code, can serve as the basis for estimating these costs.

c) Cost of treating victims

From a medical standpoint, the classification of the wounded and injured according to the severity of their wounds and their chances of rehabilitation is especially relevant. When a disaster causes a relatively large number of victims, it is not possible to attend to all of them at once. In such cases, medical or paramedical personnel should sort the victims by triage at the time of search and rescue operations. Triage is essential for optimizing existing curative resources, since it describes and sorts the victims while making it possible to estimate the cost of treating and rehabilitating both the seriously and slightly injured.

Health specialists may face two alternative situations. Under the first scenario, primary victims are few and relatively concentrated, and the normal relief and treatment services in isolated or remote regions are capable of dealing with all the cases without too great a delay. In this case, information will generally be centralized, and the health specialist should therefore have no difficulty in estimating the additional costs related to additional medical examinations, hospitalization costs, long-term treatments, the increased demand for medications and sedatives, overtime work by medical and paramedical personnel, transportation expenses for victims or for long-time patients who are deemed healthy enough to return home and so forth. The second scenario occurs when the number of primary victims exceeds the capacity of primary and hospital health-care services both inside and outside the devastated area. In view of the difficulty of estimating the cost of medical attention, the following standard is customarily accepted: no conjectural estimates are made to account for the wounded who are not registered in the national system or in the private health-care system, and the total cost incurred by the hospital system is estimated on the basis of the care given to the primary victims. In other words, the increase is determined as the total cost incurred by the system for search and rescue and the treatment and subsequent care of the trauma victims from isolated or remote areas. The accuracy of the estimate will depend essentially on the validity and reliability of the classification procedure and access to information.

If the number of existing entries in the registry is reliable, the health specialist should not have much difficulty estimating the costs. Otherwise, they may be able to estimate them based on the increased costs of the following interventions: i) the enlargement of the reception and treatment areas; ii) the length of stay of patients in the reception, treatment and hospitalization areas; iii) the treatment and recovery of hospitalized patients; iv) the treatment and recovery of outpatients, if justified by the availability of personnel; v) medical, paramedical and auxiliary personnel; vi) the evacuation of new and pre-existing patients; vii) transportation costs; viii) the treatment of patients sent home prematurely; ix) mobile units; and x) health inspections carried out in homes.

These cost components can be rearranged to suit the public or private hospital system unit responsible for receiving the primary victims of the disaster. If some facilities charge for medical services, the value of the benefits thus given are replaced by the procedure described above. Finally, monitoring and registration of the victims' records will probably be centralized by the health ministry or other governmental body.

d) Costs of public health and epidemiological interventions

This section analyzes public health interventions necessary for preventing or controlling the spread of harmful effects from the disaster on public health.

Health measures following a disaster are generally palliative in nature. Their primary objectives are to control water quality, prevent epidemic outbreaks and ensure that the disaster's impact does not trigger the spread of latent diseases. With regard to epidemic outbreaks, the health specialist must identify those that are caused exclusively by the disaster event before registering the costs.

The following kinds of interventions are rapid and are generally coordinated by the health ministry. It is important to request that the health ministry provide all the available information on these interventions (resources, operation, financing commitments, nature and amount of outside aid, etc.). The associated costs must be identified for each intervention, if it is implemented.

- Water. This category includes the cost of supplying the population with simple materials outlining instructions on i) the need to check water quality before using the water; ii) uses for sterilized water; iii) the danger of storing water in broken, dirty or uncovered containers; and iv) the importance of keeping wells, springs or other sources of raw or potable water free of contact with human and animal excrement, trash and industrial or domestic wast water.

Water quality must also be monitored (this is defined and estimated under the heading water and sanitation in the chapter on infrastructure). The process might include carrying out an analysis of water quality (residual chlorine or bacteriological quality), overseeing sterilization, monitoring the quality of water distributed via water tanks and so forth. Public health authorities will have the responsibility of ensuring that all shelters and affected population without access to water sources have appropriate, undamaged water storage containers, whose capacity is sufficient for the number of people in the shelter.

If the shelters do not have water storage containers, some type of storage facility will have to be provided (PVC, fiberglass or asbestos-cement tanks). Water sterilization tablets may also be distributed to the affected population or shelters.

Another cost to take into account is the removal of the corpses and remains of buried or partially buried animals.

- Sanitation control. This item includes public health educational activities concerned with food handling and domestic hygiene, as well as health inspection of living quarters and temporary shelters for the victims or the primary affected population. Measures that might be carried out include mass public awareness campaigns, talks with affected groups, visits to shelters and so on. The wide-scale or selective distribution of protective products might also be undertaken, as in the case of masks for filtering ash in an effort to prevent respiratory problems following a volcanic eruption.

- Fight against vectors. This includes the cost of destroying and monitoring new foci of vector reproduction, as well as the fight against the vectors themselves. It includes the localized application of rodent controls and insecticides, the protection of domestic water supplies, the destruction of unnatural water collection areas, the detection and treatment of cases and prophylaxis, if necessary. This item should also include health education and the distribution of repellents or barriers to reduce contact between people and the vector.

- Vaccination campaigns. It may be necessary to carry out mass vaccinations (typhoid fever, cholera) or selective campaigns (for example, children and measles); such costs should be considered an indirect effect of the disaster. At the same time, efforts should be made to avoid interrupting the regular national vaccination programmes, which may require the following actions: i) immediately reinstate the vaccinations routinely given in national immunization programmes; ii) propose the temporary use of cold boxes (RCW42) to ensure the preservation of vaccines in affected areas and consider the possibility of mobilizing immunobiologics, provided ice is available: iii) resort to the use of photovoltaic refrigerators for storing vaccines and producing ice, given the availability of sufficient batteries; and iv) initiate the recovery of the cold chain (purchase of refrigerators, thermoses, thermometers and so on).

- Epidemiological surveillance Epidemiological surveillance after a disaster involves four fundamental steps: i) investigate rumors and reports of cases in the field; ii) approach laboratories to obtain definitive diagnoses and support for epidemiological investigations; iii) present epidemiological information to decision makers; and iv) ensure surveillance during and after the rehabilitation phase. It is necessary to determine the cost of the following items: epidemiological surveillance in health-care facilities and in the community (including field research, data processing and laboratory analysis); the quarantine, isolation and treatment of the first cases; and finally, the epidemiological surveillance of people housed in shelters.

- Food safety. The health sector may contribute to the formulation of intersectoral post-disaster policies on food safety by providing information and orientation as needed. The health sector is also responsible for preserving the sanitary condition of food donated by humanitarian aid. It must also monitor the nutritional status of the affected population (for example, via surveys), given that the decreased availability of food could lead to malnutrition from a lack of protein or micronutrients, such as vitamin A, vitamin C or iron. All of these actions should be included in the cost assessment.

The main source of information will be the national emergency committee and the health ministry. In principle, all relevant epidemiological information should be included.

The health specialist will probably find that the relevant information has already been classified in some form. In any case, it is useful to verify the validity and reliability of the available information or to make one's own cost estimates.

Health specialists should give particular attention to the following items:

Cost of personnel. This item should include the cost of the additional personnel and regular staff overtime needed to tackle the post-disaster situation. Special attention should be given to the additional personnel recruited by the health system and assigned to disaster-related public health interventions, water quality control, epidemiological surveillance, vaccination campaigns, laboratories, environmental health and the fight against vectors. The cost of special brigades for health-related actions or epidemiological surveillance must also be accounted for. Other costs include the training or orientation of personnel for the implementation of disaster-related public health measures.

Cost of material and equipment. Here, the costs to be considered include the purchase, storage and distribution of equipment, medications, vaccines and pharmaceuticals used for preventative purposes (and curative, in the case of transmissible diseases) to counter the effects of the disaster. The logistical costs of vaccination campaigns are also included, as are the costs of equipment that had to be purchased for vector control and for sanitary control measures that form part of the disaster response. The cost of imported medications should be accounted for separately.

Cost of diffusing public information. The cost of diffusing public health information must be measured, whether it involves mass social awareness campaigns, educational programmes targeting the affected population or talks with vulnerable groups.

To avoid double accounting, it is important to distinguish between the cost of personnel, material and equipment involved in the treatment of victims and those channeled into the aforementioned public health measures. The former should be taken into account under the first heading of indirect effects (the cost of treating the victims), whereas the latter should be analyzed and incorporated here.

The health specialist's first task is the identification of the costs associated with sanitation and epidemiological surveillance operations. The second, and more difficult, task is to determine which disaster-related effects can be considered aftereffects. This distinction should be taken into account especially for epidemiological surveillance activities such as the collection and interpretation of data to determine the risk (or presence) of outbreaks or foci of transmissible diseases. It is generally said that a disaster does not "produce" transmissible diseases, but merely modifies environmental conditions, thereby unleashing latent diseases. When changes in the incidence of disease are detected, the only way of knowing with any degree of certainty whether an increase can be ascribed to the disaster is to refer to the epidemiological records and the health organizations' reports.

Additional sources include sectoral programmes run by international organizations, which often maintain their own information systems. Health specialists can also draw on the following sources of information:

- Project presentation documents;
- Press reports; and
- Interviews with health personnel.

e) Increased cost of preferential health care for vulnerable groups

While there are many, complex causes of vulnerability, experience shows that the chief cause is poverty, especially in the case of single mothers, children under the age of five and the aged. Likewise, after a disaster, pregnant women and the undernourished are the population groups that are most exposed to risk, especially infectious and contagious diseases. Other highly susceptible groups include adolescents, unaccompanied minors and people with disabilities. Consequently, the protection of these groups after a disaster requires specific health interventions. Special health operations are also often carried out for other groups that have been particularly affected by the disaster, such as rural families and farmers whose land has been severely damaged by flood or prolonged drought. The cost increase resulting from these special interventions on behalf of vulnerable groups should be estimated and recorded as an indirect cost.

f) Additional indirect health service operating costs

The destruction or crippling of the public and private hospital, primary care and other health infrastructure, together with disaster-related deaths and injuries to medical and paramedical personnel, force the national and private health system to incur additional operating expenses. These are described below.

Failure to meet income forecasts. If there is a lack of qualified personnel or if the infrastructure is put out of service, this might lead to a reduction in income from the charged services of the national public health system and of private clinics and hospitals. The health specialist should determine the value of such a reduction in future expected income for outpatient and hospital services by referring to the applicable rates prior to the disaster.

The calculations can be simplified by using earnings and cost indexes that have been previously established by the hospitals' planning departments. A more precise as asessment can be made when there is a hospital information system that keeps records on the volume and relative cost of the assumed illnesses.

Non-provided health-care services. It is also necessary to estimate the cost of the services, whether free or subsidized, not provided by the public health system. Two types of calculations can be used to make a quick assessment. The number of non-performed outpatient examinations, surgical procedures and hospital treatments can be estimated and evaluated on the basis of established prices. When this information is unavailable (or when there has been considerable destruction or impairment of the infrastructure), it is preferable to use the "foregone income" of the medical, paramedical and auxiliary personnel while activities are stopped. The average individual salary of each of these categories should be multiplied by the total number of shifts not worked and by the number of members absent in each of the health officials' categories.

The valuation of this item should consider the possible reduction in costs owing to the total or partial non-operation of certain health-care facilities, with a corresponding decrease in the purchase of inputs and payment of basic services used in the operation of these facilities.

Increased costs of providing services. This item covers all additional costs incurred by the public and private health-care services to ensure that services are available, except i) those services provided to direct victims of the disaster and ii) the public health-care services mentioned above. In general, it encompasses the increase in the cost of services stemming from the disaster, the expense of replacement personnel (estimated in the same way as in the preceding paragraph), the relocation of outpatient services, the strengthening of the infrastructure, transport, public information costs, importation of medications and instruments and so on. It is essential to take into account that the use of resources to prevent the consequences of a disaster has a cost inasmuch as these resources are no longer used for their originally intended purposes. The health specialist thus has the choice of estimating these resources from the point of view of the benefits that they will have ceased to supply because they are being used for disaster-related needs and estimating them in accordance with the replacement value of the service supplied.

When calculating increases in health-care operating expenses, health specialists must include all expected future services, even though they might not yet have been supplied, because they represent a net loss for the beneficiary population.

Interruption of aid programmes. In many countries, the national health-care services are in charge of implementing and distributing some social aid programmes (distribution of milk, family assistance programmes, advance payments of health-care expenses, etc.). Such programmes are often interrupted when a disaster occurs. Since a good number of these programmes are only briefly interrupted, often without important consequences for the beneficiaries, the health specialist should use his/her judgment in estimating the corresponding costs. If beneficiaries suffer net losses during the time that such programmes are suspended, the cost of these losses must be calculated for the time that the services are expected to be suspended. The same goes for the additional costs that will probably have to be incurred to speed up the normal supply of these benefits.

g) Increased public and private costs owing to higher sickness rates

The increase in morbidity owing to causes attributable to the disaster, as confirmed by the people in charge of epidemiological surveillance services and by the health specialist, entails increased costs for both the national and private systems, as well as for the victims themselves. Health specialists who make a quick assessment of the damage may find that information is scarce. In these circumstances, the easiest thing to do is to record the additional public and private costs that will have to be incurred, using an estimate of the number of cases to arrive at the costs. When there are many cases spread over a wide area, the first task will be to verify the two categories of cost attributable to the disaster:

- The treatment of primary cases (quarantine, isolation, etc.); and
- The increased costs to the sector for the provision of additional services.

If either or both of these items incur costs, the health specialist should separate the additional costs that are attributable tot the higher level of sickness from the additional costs that are attributable to other causes. This will ensure that the same costs are not counted twice and that only the increase stemming from the greater morbidity rate is measured.

Disaster-related morbidity forces individuals to incur expenses, lowers production and gives rise to medical or hospitalization costs. The health specialist should work in cooperation with the macroeconomic specialist to asses these related losses and add them to the costs incurred by organizations. There are two ways of calculating these sickness-related production losses. In the first, the average per capita production figure is calculated for a defined period using a process of prorating and extrapolation, and this is then subtracted from GDP. This method facilitates comparison, but it fails to show that the activities do not fall within a single segment of society and that sickness is not distributed evenly throughout the population. The second method is based as much as possible on the productive activity of the sick. It consists of defining the groups of different income levels that may be affected and then arriving at the amount of lost production by calculating the number of days not worked. Nevertheless, these costs do not include the "intangible effects" on the quality of life of the sick and their surroundings.

The difficulty here is to express the cost of the effects on morale and psychological suffering in monetary terms. In order to estimate the additional costs related to the increased morbidity, an average cost per sick person should be estimated. In the case of medical expenses and the cost of medications, this may be done either by referring to existing tables or by using all of the sickness-related costs of a sample of the sick. These figures (that is, lost production, medical expenses and medications) should be applied to the part of the population recognized as being sick from causes attributable to the disaster. If treatment costs differ appreciably according to the patients' age, this will have to be taken into account by separating particular age groups.

D. MACROECONOMIC EFFECTS

The health and macroeconomic specialists should work together to determine the macroeconomic effects originating in the health sector.

a) Diminished contribution to development growth rates

Losses should first be measured in terms of the health sector's contribution to gross domestic product (GDP). Health is a service sector that creates multiple jobs and has many ramifications, including knowledge investment (scientific research), human capital investment (training and education) and material investments (buildings and materials).

National accounts can be used to measure the reduction in the sector's output as a percentage of GDP. In the case of the private sector, this reduction may be assessed using the criteria of businesses in the industrial and commercial sector. For the public sector, one should first calculate average production and then apply the figure to the estimated period of suspended or reduced activity.

b) Effects on employment

The damage caused to infrastructure may lead to unemployment among sector personnel. In most cases, these employees will continue to receive their wages. The actual number of jobs lost in the relevant period will, however, have to be estimated.

c) Effects on the external sector

A disaster's effects can have an impact on imports and exports insofar as the raw materials and equipment needed for reconstruction are concerned.

- In some countries, the construction or repair of health infrastructure entails importing materials and equipment that are not produced locally. In this case, it is important for health specialists to work closely with the officials responsible for the sector on a national level to determine the quantities and costs of the products and materials to be bought overseas, and then to estimate the portion of imports that are destined for the reconstruction effort.

- If damaged or destroyed buildings and equipment are insured with a local insurance company that has reinsured that risk with a foreign company, an influx of foreign currency may result. The health specialist should obtain information about this by questioning the insurance companies.

d) Effects on public finances

The health specialist must determine the increase in public budgetary outlays needed to meet emergency, rehabilitation and reconstruction requirements. This estimate can be made by adding the amounts spent during the emergency stage to projections on rehabilitation and reconstruction projects.

In addition, the government may experience a drop in normal income, since any reduction in the services provided by private health-care establishments translates into a corresponding decrease in the amount of taxes paid. When estimating such losses, the normal tax rate for these cases should be taken into consideration.

e) Effects on prices and inflation

The magnitude of the damages might be so great that the reconstruction needs for all sectors –not just health– leads to a scarcity of construction materials and equipment and causes prices to rise. The health specialist should search all available sources to obtain information about prevailing prices before and immediately after the disaster so as to make allowances for any increase and to project price movements. To do this, the health specialist must collaborate closely with the specialist in housing and human settlements.

f) The differential impact on women

As in other sectors, the disaster affects women differently than men. In the health sector –as in education and culture– women account for a higher percentage of workers than men, such that any loss in employment and income will affect them directly as a group. Furthermore, whenever overtime is required of health sector workers, women's overall work load will be increased beyond the compensation of the additional income they may receive, as they must still discharge their reproductive activities after returning home late.

To determine these differential effects on women, the health specialists must work in close cooperation with both the employment and gender specialists of the assessment team to ensure that these losses are properly estimated and that no double accounting occurs.

As in previous chapters, an example of the application of the methodology described above is provided in the following appendix, using information obtained during a recent disaster.

APPENDIX VI
ESTIMATE OF DAMAGES IN THE HEALTH SECTOR CAUSED BY THE 1999 MUDSLIDES IN VENEZUELA[1]

Torrential rains occurred in December 1999 along Venezuela's northern coastline after a low-pressure trough stalled over the Caribbean for nearly 20 days. The resulting mudslides and flooding had catastrophic effects on the population, urban infrastructure, basic services and productive infrastructure, as well as incalculable effects on the environment. The states of Vargas, Miranda and Falcón were the most severely affected.

1. Health sector

The health sector was unable to respond fully to the extraordinary demand arising out of the catastrophe as a result of damage to physical infrastructure, access to facilities and the availability of personnel –areas that were already showing weaknesses and inequalities before the events of December.

The physical plant of hospitals and outpatient centers sustained varying degrees of damage in the hardest-hit regions –especially in the state of Vargas– with some rendered non-operational as the tragedy unfolded. Even the medical facilities that could continue working were completely cut off, as many roads were washed out. The loss of furniture, equipment, materials and medications –exacerbated in some cases by looting– was another difficulty that had to be faced, as was the effective loss of personnel, a third of whom were themselves victims (in Vargas) while others were unable to reach work owing to difficult conditions on key roads, including the Caracas-La Guaira highway.[2]

Medical reinforcements were deployed from abroad during the initial relief effort, including more than 400 Cuban doctors, paramedics and nurses who worked in the most devastated areas. International shipments of equipment and medications also helped alleviate much of the immediate shortage.

Once the emergency phase –rescue, emergency medical care, finding the dead[3] and moving victims to temporary shelters– had passed, environmental and epidemiological surveillance efforts were stepped up so as to minimize risk factors. In an effort to involve the public at large in Vargas, health brigades were formed and given training in the handling of toxic solid waste, food preparation and conservation, water treatment and vector control.

1 ECLAC, *Los efectos socioeconómicos de las inundaciones y deslizamientos en Venezuela en 1999*, Mexico City, February 2000.
2 Many health-care workers missed paydays because service had been suspended at the banks where their wages are normally deposited.
3 The Attorney General's Office was entrusted with locating the corpses of victims.

Other emergency-phase priorities included repairing damaged health-care facilities. At the beginning of 2000, Venezuela had 182 hospitals, as well as 707 urban and 3 541 rural outpatient clinics.[4] Most of the damage was concentrated in the states of Vargas, Miranda, Falcón, Yaracuy and the Federal District, in which a total of 31 hospitals and 687 outpatient clinics are located. Of these, 9 hospitals (29%) and 251 outpatient clinics suffered damages, ranging from minor to total loss. The extent of the damage may not seem significant as a national percentage, but it is clearly quite high in the disaster areas, affecting health-care services for 360 000 disaster victims (see Table 1).

Table 1

VENEZUELA: HEALTH-CARE FACILITIES DAMAGED IN THE MOST SEVERE DISASTERS AREAS

Federal Entity	Hospitals			Out-Patient Clinics		
	Total	Damaged	%	Total	Damaged	%
Total	31	9	29.0	687	251	36.5
Vargas	5	5	100.0	36	26	72.2
Federal District	6	1	16.7	76	-	-
Miranda	12	1	8.3	178	107	60.1
Falcon	3	1	33.3	308	97	31.5
Yaracuy	5	1	20.0	89	21	23.6

Source: Ministry of Health and Social Development and PAHO/WHO

Most of the health-care facilities in Vargas were affected, to varying degrees. Five outpatient clinics and two hospitals were severely damaged.[5] The Macuto maternity hospital (Hospital Materno Infantil de Macuto) was completely covered by mud, destroying its 120 beds and other equipment, but apparently leaving the building itself in tact.

The state psychiatric hospital was similarly affected. The Venezuelan Social Security Institute's Hospital Vargas, which was not open to the public at the time of the disaster, was quickly cleaned up and pressed into service to cover spillover from other besieged medical facilities. The Pariata and La Sabana hospitals functioned at 70% of their normal capacity, while the Naiguatá hospital operated at 40%. Outpatient clinics proved to be the most vulnerable. The type III clinic, "Dr. Alfredo Machado" at Catia la Mar, a key medical facility in a heavily populated parish, was completely covered by mud, and it struggled to provide some services at a church next door. In Vargas alone, six outpatient clinics were deemed a total loss.

4 See Censo de Establecimientos de Salud de las Direcciones Generales Regionales de Salud, 1998.

5 The state of Vargas had three specialized hospitals (Hospital de Niños Excepcionales, Hospital Dermatológico "Martín Vegas" and the Hospital Materno Infantil de Macuto), two type III hospitals, 19 urban outpatient clinics (5 type III, 1 type II and 13 type I) and 17 rural outpatient clinics (all type I).

The Federal District's oncology hospital suffered extensive damage to its very costly equipment, but with some well-known exceptions, most facilities were easily restored following clean-up and the restoration of the water and drainage systems and roads.

Direct damage to physical plant at health-care facilities was estimated at 18 million dollars, plus 11 million dollars in lost equipment and furniture. Total direct cost to the sector thus reached 29 million dollars. The cost of fully rebuilding damaged facilities, incorporating modern materials and equipment, was estimated at around 55 million dollars.

Table 2

VENEZUELA: DAMAGE TO THE HEALTH SECTOR a/
(Millions of dollars)

Item	Total	Direct	Indirect a/	Reconstruction Costs	Foreign component
Total	61 0	29.0	32.0	55.5	4.2
Total or partial destruction of healthcare infrastructure	18.0	18.0		32.4	2.3
Loss of equipment and furniture	11.0	11.0		23.1	2.0
Increased allotments for hospital and out-patient care b/	12.0		12.0		
Additional costs for sanitation, vaccinations and epidemiological control b/	8.0		8.0		
Retrieval and treatment of trauma victims	1.0		1.0		
Medical, psychological and food assistance at b/	8.0		8.0		
Cost attributed to the diminished capacity of healthcare services	3.0		3.0		

Source: ECLAC, based on data supplied by the Ministry of health and Social Development and PAHO
a/ Includes estimated costs affecting the public health system, as well as both for-profit and non-profit private health-care facilities.
b/ Includes cash and material aid from other nations.

Of even greater significance for the sector were the extraordinary outlays it made –with assistance from the international community, civil society and the local community itself– which were estimated at 32 million dollars. These emergency funds went primarily to special care for injured and displaced persons and to preventative health and vaccination campaigns. Total direct and indirect costs attributable to the health sector thus reached 61 million dollars.