GFDRR

DaLA

Damage, Loss and Needs Assessment

Guidance Notes

2

Volume 2

Conducting Damage and Loss Assessments after Disasters

1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: *www.worldbank.org*

Cover design: Hernan Gigena

Table of Contents

Preface ..... **v**

Acknowledgements ..... **ix**

Acronyms ..... **xi**

I. Introduction **1**
1. General Considerations 1
2. Conceptual Framework 2
3. Uses of the Damage and Loss Assessment 3
4. From Damage and Losses to Needs Assessment 4

II. Sector-by-Sector Assessment **7**
1. General 7
2. Generic Procedure for Assessment 7

III. Sectors to be Assessed **11**
1. Infrastructure Sectors 11
   1.1 Water and Sanitation 11
   1.2 Electricity 15
   1.3 Transport and Communications 19
2. Social Sectors 26
   2.1 Housing 26
   2.2 Education 29
   2.3 Health 34

3. Productive Sectors 38
3.1 Agriculture 38
3.2 Industry 68
3.3 Commerce 74
3.4 Tourism 78

Figures

Figure 1.1 From Damage and Loss Assessment to Post-Disaster Needs: Aceh Earthquake and Tsunami, 2004 4

Tables

Table 3.1 Ranges in the Cost of Rehabilitation and Reconstruction of Two-way Roads 23
Table 3.2 Marginal Operating Costs of Different Types of Vehicles in Different Types of Road Conditions 25
Table 3.3 Disaster Effects in Crop Sub-sector 39
Table 3.4 Summary Table for Agriculture 59
Table 3.5 Poverty Distribution by Regions and Type of Settlements, Bangladesh, 2000 63

Preface

Over the past years, both frequency and impact of disasters have been increasing worldwide. In the first decade of the new millennium a string of severe disasters hit countries on all continents. Most notable were the 2004 Indian Ocean earthquake and tsunami which claimed over 250,000 lives, the Haiti Earthquake which killed over 220,000 people and caused an economic impact equivalent to 120% of GDP, floods in Pakistan affecting 20 million people, but also additional earthquakes in Indonesia, floods and droughts throughout Africa, heat waves and fires in Europe, hurricanes in Central America, the Caribbean and the United States, and landslides triggered by typhoons in South East Asia.

The social impact of disasters is highest in developing countries, where poor populations are most vulnerable and least resilient. Economic impact of disasters amounted to 63 billion USD in 2009. By the turn of the century, damages from weather-related hazards can triple to $185 billion annually, without taking climate change effects into account. Factoring in climate change could then add another $28–$68 billion from tropical cyclones alone, according to *Natural Hazards, Unnatural Disasters: The Economics of Effective Prevention*, a joint World Bank-United Nations publication, released in November 2010.

In order to reduce vulnerabilities of the natural and built environment, the understanding of the social, economic and financial implications of disasters is becoming a priority for governments. The Damage, Loss and Needs Assessment (DaLA) methodology, developed by the Economic Commission for Latin America and the Caribbean (ECLAC) in the 1970s, has evolved as a globally recognized and applied tool to quantify the impacts of disasters, and to determine the necessary financial resources to achieve full reconstruction and recovery. Consistenly using this methodology identifies the socio-economic impact of any given disaster, as well as the exposure of sector assets. It also reinforces resilience by promoting the "Build Back Better" principles in reconstruction and recovery efforts.

The DaLA guidance notes presented here build on ECLAC's methodology. They aim at operationalizing the concepts for practitioners at government agencies, the World Bank and other national and international organizations, responsible for assessing the impact of disasters, and for developing recovery and reconstruction plans. Furthermore, the DaLA guidance notes expand the original ECLAC methodology by describing how to estimate recovery and reconstruction needs.

The guidance notes comprise three volumes i) Guideline for Task Team Leaders (TTL) in the Design and Execution of a Damage, Loss and Needs Assessment, ii) Conducting Damage and Loss Assessments after Disasters, and iii) Estimation of Post-Disaster Needs for Recovery and Reconstruction. Volume I, the guideline for Task Team Leaders, aims to facilitate the work of TTLs by providing the framework for conducting the assessment. It offers templates for sectoral TORs, survey questionnaires and other useful tools, and it describes in details how to plan, organize and carry out an assessment. Volume II guides the sectoral assessment team through the steps of conducting a Damage and Loss Assessment, and includes sample templates for determining damage and losses in each sector. It describes simplified procedures for estimating the value of destroyed physical assets and of changes or losses in the flows of the affected economy. Volume III illustrates how to derive the financial needs for recovery and reconstruction. This is done following a sector by sector damage and loss assessment, which itemizes distribution and priority setting based on geopolitical divisions, sectors of the economy, and different population groupings in the affected area. It also explains how to formulate a calendar of investments and to identify distribution channels for funding.

The guidance notes were commissioned by the Global Facility for Disaster Reduction and Recovery (GFDRR) of the World Bank. Building national capacities in disaster risk management and in post disaster impact assessment is a high priority for GFDRR, reflected in the cooperation agreement of the UN, EU and World Bank for conducting post-disaster needs assessments. Since 2006, GFDRR (a partnership of 36 countries and six international organizations committed to helping developing countries reduce their vulnerability to natural hazards and adapt to climate change) has been instrumental in assisting countries to incorporate risk reduction in development strategies, and in providing ex post disaster response through three financing tracks: (a) Track I, which promotes partnerships for advocacy and awareness-building; (b) Track II, which mainstreams DRR into country strategies, and finances analytical work and project preparation for disaster prevention and risk financing; and (c) Track III, which provides post-disaster needs assessments at governments' request, in collaboration with the UN, the European Union, and other partners.

GFDRR has conducted over 20 post-disaster assessments in the last three years, in countries such as Bangladesh, Myanmar, Burkina Faso, Senegal, Central African Republic, El Salvador, Samoa, Indonesia, Philippines, Lao PDR, Bhutan, Yemen, Cambodia, Bolivia, Namibia, Moldova, Haiti and Pakistan, and others. In these assessments, GFDRR particularly promotes self-reliance through capacity building in high-risk countries, which includes DaLA methodology training and sensitization for governments and other functionaries. To further strengthen capacities and adapt the methodology to country-specific circumstances, the experiences of these assessments are reflected in the three volumes at hand and will continue to be incorporated into future versions of these guidance notes.

Acknowledgements

These guidelines were developed as part of GFDRR's effort to increase the capacity of professionals and sector specialists in conducting post disaster damage, loss and needs assessments while applying the DaLA methodology for evaluating the social and economic consequences of disasters. The intention of GFDRR is to operationalize the Damage, Loss and Needs Assessment Methodology by building on the original ECLAC *Handbook for Estimating the Socio-economic and Environmental Effects of Disasters*. The guidance notes intend to contribute to the broad and consistent application of the DaLA methodology. They were prepared by Roberto Jovel, DaLA specialist with substantive country assessment experience. Mohinder Mudahar contributed to the development of guidance for the agriculture sector.

We are grateful for the inputs and comments of external and internal experts and practitioners, whose contribution was instrumental in completing these guidance notes. Based on their experience in damage and loss assessment and recovery planning, the guidance notes have been refined to ensure their applicability.

Special thanks go to Alicia Barcena, Executive Secretary of ECLAC, Ricardo Zapata and numerous other ECLAC colleagues for their continued support and collaboration throughout the process. ECLAC's deep institutional and practical expertise has been invaluable for the review of the guidance notes. We are also grateful to our colleagues at the World Bank who provided helpful comments on various aspects of these documents. We would like to highlight the contribution of Sofia Bettencourt, Lead Operations Officer and Wolfgang Fengler, Lead Economist, who served as peer reviewers, along with colleagues from ECLAC.

The development of the guidance notes was supported by the Track III program of GFDRR. Katalin Demeter, Doekle Wielinga and Sophie Herrmann provided input, oversight and guidance during the preparation stages. We acknowledge the financial support of our partners at GFDRR. Max Jira and Alisa Lertvalaikul provided excellent logistical support throughout.

Susanne Quigley was the principal editor. The cover design of the guidance notes were prepared by Hernan Gigena. The WB Office of the Publisher provided design, composition, and printing services under the supervision of Adrian Feil.

Acronyms

BOP	Balance of Payments
CIF	Cost, Insurance and Freight
DaLA	Damage, Loss and Needs Assessment
DRR	Disaster Risk Reduction
ECLAC	Economic Commission for Latin America and the Caribbean
ERL	Emergency Recovery Loan
EC	European Commission
EU	European Union
FOB	Free-on-board
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
MDG	Millennium Development Goals
MIC	Middle Income Countries
NGO	Non-governmental Organization
PDNA	Post Disaster Needs Assessment
SIC	Sector Investment Credit
SIL	Sector Investment Loan
SME	Small and Medium Enterprises
ToR	Terms of Reference
TTL	Task Team Leader
UN	United Nations
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
WB	World Bank

I. Introduction

1. General Considerations

In recent years, member governments have requested the World Bank's assistance in defining and financing economic recovery and reconstruction programs after disasters. To define the extent of post-disaster programs, the Bank has utilized the methodology for disaster damage and loss assessment initially developed by the United Nations Economic Commission for Latin America and the Caribbean (UN-ECLAC).[1]

The ECLAC methodology has been applied successfully since 1972 in the Latin America and Caribbean region. The methodology has also been applied in other regions of the world—most notably in Asia and, recently, in Africa—to quantitatively determine the effects of major disasters.

The World Bank has cooperated in the continued development, updating and simplification of the ECLAC methodology, with the intention to disseminate it to its staff, to share it with other international and regional agencies, and to transfer it to government officials in high-risk countries for widespread use in disaster impact assessment and disaster risk management. The updated and simplified version of the damage and loss assessment methodology at the sectoral level is presented in this document.[2]

[1] *Handbook for Estimating the Socio-Economic and Environmental Effects of Disasters*, UN Economic Commission for Latin America and the Caribbean (ECLAC), Santiago, Chile, 2003.

[2] Similar guidelines are presented separately for conducting macro-economic impact assessment, for estimating personal or household level impact, and for quantitatively estimating post-disaster economic recovery and reconstruction financial requirements.

2. Conceptual Framework

Two main types of disaster effects on a society and economy are considered for valuation: destruction (total or partial) of physical assets, and subsequent changes or modifications to economic flows in the affected area.

The following definitions of *disaster effects* have been adopted after careful consideration of the experience over the past four decades:

> *Damage*: total or partial destruction of physical assets existing in the affected area.[3] Damage occurs during and immediately after the disaster and is measured in physical units (i.e. square meters of housing, kilometers of roads, etcetera). Its monetary value is expressed in terms of replacement costs according to prices prevailing just before the event.
>
> *Losses*: changes in economic flows arising from the disaster.[4] They occur until full economic recovery and reconstruction is achieved, in some cases lasting for several years. Typical losses include the decline in output in productive sectors (agriculture, livestock, fisheries, industry and commerce) and the lower revenues and higher operational costs in the provision of services (education, health, water and sanitation, electricity, transport and communications). Also considered losses are the unexpected expenditures to meet humanitarian needs during the post-disaster emergency phase. Losses are expressed in current values.

The value of damage is used as the basis for estimating reconstruction needs—as will be described in subsequent sections of these guidance notes—while the value and type of losses provide the means for estimating the overall *socio-economic impact* of the disaster and the needs for economic recovery.

The socio-economic impact analysis includes an estimation of the disaster's likely effects on economic performance and the temporary macro-economic imbalances that may arise, as well as the temporary decline in employment, income and well-being of affected individuals and households.

---

[3] Disasters usually destroy different types of durable, physical assets: buildings, infrastructure, equipment and machinery, furniture and household goods, means of transportation and storage, irrigation works, etc. A detailed list of possible asset destruction in different sectors will be provided in the appropriate sections of these guidance notes.
[4] Losses normally include decline in production and sales, increased operational costs and lower revenues from the provision of services, and unexpected expenditures to meet emergency needs. Lists of typical losses in each affected sector will be provided in the appropriate sections of these guidance notes.

To measure the impact on macro-economic variables, analyses are usually made of the post-disaster performance on gross domestic product (GDP), the balance of payments (BOP) and the fiscal sector. The impact on GDP refers to the temporary negative repercussions of disaster losses on the performance of the economy, and to the positive effects on the construction and other sectors due to the initiation of the reconstruction program. The impact of damage on gross investments may not necessarily occur in the same year as the disaster, but is measured in the following years as asset restoration or replacement gets underway (depending on construction sector capacity and available financial resources). The impact on the balance of payments involves estimating the increase in imports and the decline of exports arising from the disaster, as well as possible reinsurance payments from abroad and relief donations from the international community. The analysis of disaster impact on the public sector budget is estimated in terms of increased operational costs and lower revenues; whenever the public sector directly owns sectoral enterprises, its budget would sustain losses.

In regard to the impact on personal or household well-being—which is a different and separate viewpoint of disaster effects and impact—the analysis normally includes an estimation of employment and income decline due to the losses sustained in the productive and services sectors, as well as higher than normal family or personal expenditures.[5]

3. Uses of the Damage and Loss Assessment

A damage and loss assessment following disasters can be used advantageously to determine post-disaster needs, including economic recovery planning and reconstruction program design. It can also be used later for monitoring progress of economic recovery and reconstruction programs.[6]

There are two distinct potential uses of the results of a damage and loss assessment: in the short term, to define government interventions for the immediate aftermath of the disaster, which aim to lessen people's suffering and to initiate economic recovery. In the medium to long term, the assessment is used to define the required financial needs to achieve overall recovery and reconstruction.

---

[5] The value of sectoral production losses already includes the corresponding income losses of the formal labor force. However, to provide a more detailed look into disaster impact at the personal or household level, income losses are estimated separately and should not be added to the sectoral production losses to avoid double accounting.

[6] A good example of this post-disaster performance monitoring is the system recently put into operation by the World Bank Jakarta Office following the 2004 tsunami in the Provinces of Aceh and Nias, Indonesia.

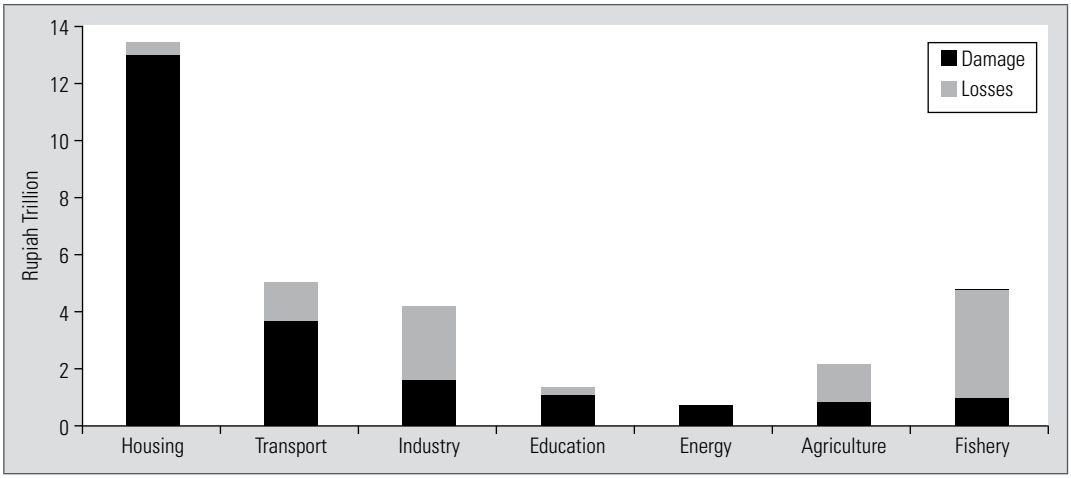
In addition to revealing the magnitude of effects caused by a disaster, the damage and loss assessment provides information to define effects and impacts on most geographical areas and sectors of the economy, as well as on overall economic performance.

4. From Damage and Losses to Needs Assessment

A subsequent use of the assessment results is to estimate the requirements or needs of financial resources necessary for recovery and reconstruction activities. The value and the spatial, time and by-sector distribution of losses are used to estimate the requirements of economic recovery, while the value and geographical and by-sector distribution of damage is used to estimate the requirements of reconstruction (see Figure 1.1).

Typical objectives of an overall economic recovery program include the restoration of personal and family income, and the resumption of essential services and production activities in the affected areas. The main objective of the reconstruction program is to replace or repair physical

Figure 1.1 From Damage and Loss Assessment to Post-Disaster Needs: Aceh Earthquake and Tsunami, 2004



Source: Bappenas and World Bank Report, 2005.

Note: Damage: indicates the efforts needed for reconstruction
Loss: indicates the efforts needed for recovery

assets that were totally or partially destroyed by the disaster, under a "building back better" concept.

The description of the procedure to estimate needs for economic recovery and reconstruction is included under Volume 3 of the Guidance Notes series prepared by the GFDRR.

II. Sector-by-Sector Assessment

1. General

The damage and loss assessment methodology is based on a sector-by-sector and a subsequent "bottom up" approach to estimate the overall effects of the disaster and the impact on society and economy.

A generic procedure for the damage and loss assessment in each sector is described here, and will be followed by detailed, step-by-step procedures for the specifics of each sector.

2. Generic Procedure for Assessment

The typical steps to follow during an assessment of damage and losses are:

1. Define a pre-disaster baseline;
2. Develop a post-disaster situation;
3. Estimate damage and losses on a sector-by-sector basis;
4. Estimate overall amount of disaster effects;
5. Estimate macro-economic impact; and
6. Estimate impact on personal/household employment and income.

2.1 Pre-Disaster Baseline for Assessment

This refers to the baseline of prevailing conditions prior to the disaster, and is the foundation for the estimation of damage and losses. Three sets of pre-disaster baseline data are required:

- A baseline on physical assets;

- A baseline on the provision of basic services; and
- A baseline on the performance of production and sales.

The baseline of physical assets refers to the existing facilities in the affected area before the disaster occurred, and should include the number and type of housing units, the number and type of educational and health facilities, the extent of irrigated agricultural areas, the number and capacity of electricity units, water supply and sanitation systems, the length and types of roads, etc. In some sectors, this baseline should also include the available facilities in nearby locations that may be used on a temporary basis to provide services in the affected area.

The second baseline should describe how basic services are provided under normal or non-disaster conditions, including for example, the access to education (percentage of school enrollment) and health care (coverage of free or paid medical attention).

The third set of baseline information refers to the performance of all economic activities in the affected area as projected prior to the disaster for the current and subsequent two years. This is measured as the volume and value of production and sales of goods and services, etc. Examples of required information are the calendar of agricultural production activities, and the value of production and sales in other sectors, the volume and value of essential services (electricity, water and sanitation, and transport and communications).

2.2 Develop a Post-Disaster Situation

The second step in the damage and loss assessment is to develop a post-disaster scenario, based both on the findings of a field survey where the assessment specialists obtain a comprehensive picture of disaster effects in each sector, and on interaction with local sector specialists (from the government and the private sectors) who provide initial inputs. The purpose is to clearly define how each sector will perform on a temporary basis after the disaster, until recovery and reconstruction are achieved.

The following information is necessary to define the temporary functioning of the affected society and economy after a disaster:

- Time frame required for the reconstruction of destroyed physical assets;
- The temporary scheme and costs for restoring access to social services; and
- The temporary scheme and costs to resume production of goods and services.

Two outputs are required in this step: a preliminary calendar or schedule for the reconstruction of physical assets, and a corresponding post-disaster, preliminary performance forecast of socio-economic activities in each affected sector.

To develop the preliminary calendar for reconstruction, the following information is collected in a field survey and from consultations with local specialists:

- A typology of physical assets (by size, capacity, construction materials, etc.);
- Unit repair and reconstruction prices for the above, not affected by scarcity or speculation; and
- A preliminary calendar of repair and replacement of physical assets, giving due consideration to the existing construction sector capacity (including availability of skilled labor, construction equipment and materials in the affected country or area) and to the expected availability of adequate financial resources.

To develop the preliminary forecast of social and economic activity performance after the disaster, it is essential to realistically estimate the time period required for the reconstruction and recovery in each sector, and to take into consideration all existing linkages between the sectors.[7] The forecast for recovery of socio-economic activities is developed on the basis of a calendar for the repair and replacement of assets, the possibility of adopting certain temporary solutions (for example tapping alternative water or energy sources from nearby areas, establishing provisional shelters for social services such as housing, education and health care, etc.), and the expected recovery of production.[8] The calendar for this recovery should include both services and production, as well as the costs involved.

2.3 Estimation of Damage and Losses

The estimation of damage and losses for each sector is made through a comparison of the pre-disaster and post-disaster conditions, described under the two previous steps. Damage figures

[7] Take into consideration that full recovery of demand for electricity, water and transport will not be achieved until full reconstruction of housing and industries is completed.

[8] Consider the combination of two possible scenarios for recovery in the analysis: the decline and the recovery in supply due to damage and reconstruction of physical assets, respectively, (as well as the decline and recovery of demand) in all affected sectors.

are presented in terms of the replacement value prevailing before the disaster, and losses should be estimated in current values.

To determine the overall amount of disaster effects, damage and losses for all affected sectors must be included, avoiding possible gaps or double accounting in the assessment.[9] It's important to consider all linkages between sectors in the estimation of losses.[10]

The overall amount of disaster effects will later be compared to main macro-economic variables in order to define the relevance of each effect and its impacts on economy and society. This process also serves to define economic recovery and reconstruction needs.

[9] Some examples to consider: losses in primary production must be estimated at producer prices, and not at wholesale or retail prices; farm roads should be included in the agriculture sector and not in transport; the tourism sector should not include damage to roads and service facilities (unless these are explicitly owned and operated by hotels).
[10] A typical case is the food producing chain that links the primary production of agriculture, livestock and fishery to industry and commerce. Also, losses in industrial production would produce subsequent losses in the trade or commerce sectors.

III. Sectors to be Assessed

The sectors included in the assessment of damage and losses are those of the economic activities listed in the system of national accounts of the affected country (see *Guidance Notes, Part I, How to Conduct a Damage and Loss Assessment*). Avoid focusing only on the most affected sectors; it may result in the involuntary dismissal of sectors where impact occurs later.[11] In such cases, sectoral needs may be left unattended and full post-disaster recovery is not achieved.

The following sections describe the procedures to assess the value of damage and losses for typical sectors of economic activity. The names and scope of the sectors may differ from country to country, and the assessment team must make the necessary adaptations based on the actual prevailing conditions.

1. Infrastructure Sectors

1.1 Water and Sanitation

1.1.1 General

The water and sanitation sector includes three separate sub-systems required for the provision and treatment of drinking water, as well as the collection, treatment and disposal of wastewater and solid waste. Any of these systems may sustain damage and losses from disasters. Damage refers to the total or partial destruction of physical assets; losses refer to the changes in economic flows in the sector that may arise as a result of the disruption of normal operations.

[11] One typical example is when no assessment is made of disaster effects in the industry sector because industries have not sustained damage or destruction. Nevertheless, agro-industries may sustain significant losses in the future as a result of production losses in agriculture, livestock and fisheries.

Damage is initially measured in physical terms and then converted to monetary value using pre-disaster replacement costs for the affected asset. Losses refer to the changes in operational performance of the sector enterprise(s), and usually include both a decline in revenues (for providing services), and increased operational costs. The losses are expressed in current monetary values.

Civil or sanitary engineers usually carry out the assessment of damage; the estimation of losses is usually done with the expertise of economists or accountants working in the water and sanitation field.

1.1.2 Baseline Information

When undertaking a damage and loss assessment, it's necessary to collect the following baseline information:

- The characteristics of water and sanitation systems located in the affected area itself (geographical or spatial location; installed production, treatment, pumping, conveyance, storage, distribution and disposal capacities).
- Existing similar capacities in nearby unaffected locations that may be used as alternative, temporary solutions after disasters.
- Statistical data on water supply, wastewater and solid waste demands by main consumers, including their seasonal variations over the year.
- Projections of the above for the current and subsequent calendar years.
- Financial information on the enterprises that provide services in the sector, including monthly operational data on revenues and production costs, as well as differential rates charged to consumers.[12]

1.1.3 Post-Disaster Situation and Performance

The second stage of the assessment requires a field visit (or visits, depending on the extent of the affected area and the complexity of the issues) to ascertain the disaster effects on the sector.

After the field survey and in-depth discussions with experienced personnel from the enterprises, the assessment specialist should be able to determine the remaining production capacity of each sub-system and its temporary performance until the systems can be repaired or rebuilt and brought back to their pre-disaster levels.

[12] In the case of privately owned enterprises, the information is normally available in the annual reports published for stockholders.

1.1.4 Estimation of Damage and Losses

Damage is estimated for each of the drinking water supply, wastewater and solid waste sub-systems. A further breakdown is required for the main individual components of these sub-systems (including dams, wells, water treatment plants, pumping stations, pipelines, storage tanks, distribution grids, sewerage facilities, latrines and septic tanks in the rural areas, and solid waste collection, treatment and disposal facilities, etc.).

The replacement value of destroyed assets must be ascertained using pre-disaster construction or replacement costs which can be obtained from private contractors presently involved in similar work in the affected country or area. Prices could possibly also be obtained from the utility's planning department that may have similar projects on-going. Note that the replacement values to use are those not yet affected by scarcity or inflation, as adjustments for these factors will be included when discussing overall reconstruction needs after the disaster.

In order to ascertain *losses*, it is essential that the assessment specialists develop an objective calendar of repair and replacement of the affected assets. They should be, taking into consideration the availability and delivery schedule of the adequate financing, replacement materials, equipment and machinery that will enable re-establishment of pre-disaster service levels.

Based on the above, the assessment specialists develop a preliminary calendar or schedule for recovery of capacity and access to water and sanitation service. When the demand for services has been considerably affected (for instance when destruction of housing and industries is widespread in an urban area), projections of the recovery for demand of water supply and sanitation services must be made as well, and superimposed on the calendar of supply recovery.

Losses are then estimated by comparing the pre-disaster to the post-disaster performance of each sub-system. Each of the following issues must be analyzed:

- Higher operational costs (due to use of alternative sources or means of supply and disposal, the temporary operation of damaged system components, or the temporary, more-intensive operation of undamaged system components).[13]

[13] Items to consider under this heading are: higher costs of chemicals to temporarily ensure quality of drinking water; higher water distribution costs when using tanker trucks to reach users; the more intensive operation of systems to compensate for higher water losses in damaged system components (such as distribution or conveyance components of the water supply system); cleaning of sewerage systems and treatment plants after flooding; higher transport costs to collect and dispose of solid waste, etc.

- Lower operational revenues for sector enterprises until services are brought back to normal levels (as a result of the temporary total suspension of operations, partial supply of services while assets are under repair, and temporary decrease of demand from consumers).[14]

Please note that in practice it is quite possible that the water and sanitation systems are repaired and reconstructed before the demand for their services recovers to pre-disaster levels. In the case of major disasters where entire cities are destroyed, the demand for water and sanitation services will not recover to pre-disaster levels until housing and industry have been fully reconstructed. As a result, revenues for the service enterprises will not recover until that time. The water and sanitation sector assessment specialist must therefore consult with the housing and industry sector specialists to ensure that estimated losses in the sector cover the entire period of reconstruction for the housing and industry sectors.

Losses should be estimated on a calendar year basis, including losses in the year of the disaster and in the subsequent years of recovery and reconstruction.

The ownership of damage and losses is separated into public and private sector.

During the assessment, it's important to emphasize that production losses arising in water-consuming sectors (such as agriculture, industry, and trade and tourism) need to be estimated and accounted for under each of those sectors. This is done either as production losses and/or as higher production costs when alternative, higher-cost sources of water are necessary as interim solutions.

1.1.5 Inputs for Macro-Economic and Personal Impact Analyses

As part of the assessment, the impact of damage and losses on the macro-economic performance need to be estimated. Estimations are also made of the well-being of persons and households in the absence of post-disaster interventions. In regard to the macro-economic impact, the analysis concerns first, the possible impact on GDP and, second, impact on the balance of trade and

[14] The operation of the services may cease fully during an initial period immediately following the disaster (a few hours to a few days), to be partially resumed during repairs and in the time until full system reconstruction is achieved. In addition, service demand may drop due to extensive destruction in cities and the subsequent overall lower economic activity. These temporary interruptions or partial operations for each sub-system would result in corresponding revenue losses for the enterprises running them.

payments and on the fiscal budget, especially when the sector enterprises are government-owned, or receive government subsidies.

The damage assessment should include estimates of the value of assets that will require import from abroad when no domestic production is available. Imports may include equipment, machinery, parts, and materials.

The impact of losses on the government budget is estimated in terms of increased operational costs and lower revenues. If the government directly owns the sector enterprises, losses will be sustained in the fiscal budget. When the operation of a private sector enterprise is government subsidized, the assessment specialist should ascertain whether the subsidies should continue uninterrupted and at the same level during the rehabilitation and reconstruction stage.

A second round of macro-economic impact analysis is made to ascertain the positive effects of recovery and reconstruction activities, once the respective needs have been estimated. This analysis includes estimations for alternative funding scenarios to meet the projected needs.

The sectoral teams need to supply the above information to the specialist making the overall, macro-economic impact analysis.

To determine the impact on the well-being of the affected population, the decline in personal or household income and the possibly higher expenditures are estimated once the production losses are assessed. This information should be provided to the assessment team in charge of such impact analysis.

1.2 Electricity

1.2.1 General

The electrical sector may also sustain damage and losses as a result of disasters. Damage refers to total or partial destruction of physical assets, while losses refer to changes in the economic flows that arise from the interruption of electrical supply and of the temporary decline in consumer demand.

In this sector, again, damage is initially measured in physical quantities or units, which later are converted into monetary values using the pre-disaster replacement cost of the affected assets. Losses include the possible decline in revenues that arise from the temporary interruption

of electricity supply, and the possible increase in operational costs until normal operations are achieved. These losses are expressed in current values.

Civil or electrical engineers usually estimate the value of damage; the estimation of losses requires the analysis of economists or accountants working in the electrical sector field.

1.2.2 Baseline Information

The following information is required to establish the baseline for the assessment of damage and losses:

- The characteristics—in terms of geographical or spatial location, installed capacities and operational costs—of all components of the electrical systems located in the area affected by the disaster.
- Existing stand-by capacities in both the affected and nearby systems or areas that may be interconnected to the affected system, or that have the capacity for rapid interconnection as an alternative, temporary solution after the disaster.
- Statistical information on electricity generation and consumption by the main consumer sectors, including seasonal variations over the year.
- Projections of above for the current and subsequent calendar years.
- Financial information on the enterprises in the sector, including monthly operational data on revenues, production costs per type of power plant, and rates charged to different consumers.[15]

1.2.3 Post-Disaster Situation and Performance

This stage of the assessment involves a field survey to ascertain the effects of the disaster on the production, transmission and distribution capacities of the affected electrical systems. When a disaster causes major destruction of housing and other sectors that consume electricity, the field survey must also ascertain the characteristics and extent of the decline in electricity demand from such consumers.

When completing the field visits and extensive discussions with experienced personnel in the sector, assessors must estimate the remaining capacity in terms of production, transmission and

[15] Such information is normally available in the annual reports issued by each electrical enterprise, both publicly and privately owned.

distribution. Likewise projections should be made of the expected temporary performance until the system is repaired and brought back to its full or pre-disaster capacity.

1.2.4 Estimation of Damage and Losses

The value of *damage* must be estimated for each of the electrical system components, including power generation plants, transmission sub-systems, and electricity distribution grids.

Damage is expressed in terms of the pre-disaster replacement costs for each system component. These values can be obtained from electrical enterprise planning departments, which usually keep them for on-going development plans. As a supplement, the assessment specialist should contact private building contractors who would have replacement costs information. The replacement or repair unit costs adopted should not be affected by scarcity or inflation arising after the disaster, as appropriate adjustments will be made in the final stage of overall reconstruction planning.

To estimate the value of *losses*, the assessment specialists should produce an objective calendar of repair and reconstruction for electrical sector assets, in close coordination with the local counterparts, that will take into account the availability and schedule of adequate financing, the replacement machinery, equipment and skilled labor to return the electrical service supply to pre-disaster conditions.

Along with this calendar for recovery, the assessment specialist and local counterpart officials must prepare a preliminary calendar or schedule of electricity supply recovery, together with a similar estimation of post-disaster electrical demand performance. These two schedules should be combined in order to define the overall post-disaster performance until full sector recovery of both supply and demand is achieved.

In this process (similar as in the case of the water supply and sanitation sector), make sure to include the recovery of demand from all consumer sectors, especially the residential, agricultural, commercial and industrial sectors. Note that if widespread destruction has been caused by the disaster, the demand for electricity will not recover to pre-disaster levels until full reconstruction in the consumer sectors has been achieved, even if electricity supply is restored earlier. It is therefore essential that the electrical sector specialists coordinate their actions and projections with those of other economic and social sectors that consume electricity in their daily functioning.

Losses are then estimated by comparing the pre-disaster with the post-disaster performance, ensuring that the following issues are analyzed in depth:

- Until pre-disaster levels of demand have recovered, operational revenues from sales to electricity-consuming sectors will be lower due to the temporary, total interruption of service; the partial supply of electricity while assets are being repaired or replaced; and the temporary decline in electrical demand from user sectors.[16]
- Higher operational costs incurred by the electrical enterprises due to use of stand-by power plants that have higher unit cost of operation, and/or higher costs for acquiring electricity from nearby, unaffected electrical systems.[17]

Losses are estimated on a calendar-year basis, for the year in which the disaster occurred and at least two subsequent years.

Ownership of the damage and losses is defined and broken down by public and private sectors, as the impact must be dealt with differently in the overall analysis of disaster impact.

1.2.5 Inputs for Macro-Economic and Personal Impact Analyses

The overall assessment of disaster impact requires a definition of impact of the damage and losses on the macro-economic performance of the affected country or area. The disaster impact on the country's gross domestic product, balance of payments and trade, and the fiscal budget is estimated by a separate assessment team. This is especially important when the government owns enterprises, or when the corporations receive government subsidies.

The sectoral damage assessment should include estimates on the value of repair and reconstruction items that must be imported from abroad in the absence of domestic production. This includes equipment, machinery, construction materials and skilled labor. Also include the impact of losses on the balance of payment when exports of electricity to other countries must be interrupted. In addition, the impact of losses on the government budget must be ascertained in terms of increased operational costs and lower revenues when the government directly owns the electrical

[16] Recall that the provision of electricity may be stopped immediately following the disaster (from a few hours to a few days) and that electricity supply will resume on a partial basis during the period of repairs until the system has been fully reconstructed. Also, electrical demand may drop due to extensive damage and destruction of housing, agriculture, mining, industries and commercial establishments, and the subsequent overall decline in economic activity in the affected area.

[17] This is typically the case when damaged hydropower plant production is substituted temporarily with stand-by thermal power units that have a higher unit cost of operation, or when having to purchase electricity from nearby unaffected systems at unit prices higher than the affected enterprise's own production price levels.

enterprises. Whenever private sector enterprises receive subsidies from the government to provide electricity, the assessment should determine whether the subsidies remained despite service interruption, or whether their level was modified during the rehabilitation or reconstruction stages.

The above information should be given to the specialist in charge of the overall macro-economic impact analysis.

1.3 Transport and Communications

1.3.1 General

The transport and communications sector[18] and its many sub-sectors usually sustain extensive damage and significant losses from disasters. Damage refers to the total or partial destruction of physical assets, and losses refer to changes in the sector's economic flows of the sector that arise as a result of the interruption or temporary modifications to transport and communications flows.

As in other sectors of the economy, damage is measured in physical quantities or units, later to be converted into monetary value using the pre-disaster rehabilitation or reconstruction cost of the affected assets. Losses include the value of traffic interruption and the value of higher operational costs incurred by the users when temporarily adopting different means or modes of transport.

The most common kind of losses in this sector occurs when vehicular traffic must use alternative, longer physical routes that result in higher costs of operation. Other common losses happen when users must employ alternative ports or airports that have higher operational costs than those used under normal conditions. In addition, losses take place when products cannot reach the intended markets timely due to damaged normal routes of transportation. This is typical for perishable agricultural and fishery products; however, these losses refer to the value of production, rather than to higher transport costs, and should be accounted for under the primary production sector and not under infrastructure.

Make sure to separate the damage and losses caused within the transport and communications sector, and those caused in other sectors which make use of its infrastructure and services. The assessment of damage in this sector must be made by civil, structural or transport engineers, and the estimation of losses by transport economists.

[18] Depending on the specifics of the national systems of accounts in the affected country, communications may be dealt with separately.

The following sub-sectors are addressed separately when undertaking an assessment of damage and losses:

- Road transport;
- Water transport (including maritime, river and lake navigation) and ports;
- Air transport and airports;
- Railroad transport;
- Multimode transport; and
- Communications.

In view of the similarities among these sub-sectors, only the procedure for assessment of road transport will be described in full.

1.3.2 Baseline Information

The following information is essential for the damage and loss assessment:

- Location and capacities of each of the transport sub-systems as listed above, and their main individual components;
- Number and capacities of the vehicular stock available in each of the sub-systems;
- Most recent origin and destination surveys in the affected and nearby areas;
- Marginal operating costs in each of the transport modes for different types of vehicles; and
- Annual reports of performance of (private or public) communications enterprises.

This type of information is normally available from the ministries of public works or transport, in the respective departments of roads, ports and airports; from private enterprises that operate roads, railways, ports and airports under concession arrangements; and from building contractors and associations, civil defense institutions and insurance companies.

1.3.3 Post-Disaster Situation and Performance

It's essential to conduct a field visit to directly observe the disaster effects on the entire transport and communications sector. In many cases, an initial aerial survey can provide the necessary overview for subsequent, detailed field visits to key points of the transport and communications system by road, boat or foot. During the field visits, the specialist must draw conclusions on the post-disaster status of the entire system, the requirements for rehabilitation and reconstruction,

and the manner in which the system may function temporarily under abnormal, post-disaster conditions.

Needless to say, the specialist entrusted with the assessment must have previous experience in analyzing post-disaster situations and scenarios in the transport and communications sector.

1.3.4 Estimation of Damage and Losses

Detailed procedures for the estimation of damage and losses are described only for the road transport sector (the effects on other sub-sectors of transport can be estimated with similar procedures).[19]

When undertaking the assessment, note that the transport and communications sector is usually one of the most affected in terms of damage and losses. It frequently surpasses the values of housing and agriculture, depending on the type and extent of the natural phenomena that caused the disaster. One should bear in mind that not only road surfaces and structures sustain damage, but also associated bridges, culverts and other drainage works. In cases of earthquakes, damage is caused not only by the initial earth tremor, but also by aftershocks. Floods may cause both the collapse of structures and the erosion of road surfaces and earth fills.

Not all damage is necessarily evident immediately after the disaster; additional damage may become obvious only after some time has transpired. For example, when water subsides after long-term flooding, the road surfaces may seem to be undamaged. Generally water seeps through porosities in the pavement surface and erodes the base and sub-base of the road. Damage is aggravated by the continued traffic, which leads to subsidence that may cause serious accidents. Also, structures may seem to keep their verticality after earthquakes, but in actuality their building materials may have lost elasticity and structural capacity. In both of these cases, the affected structures must be demolished and substituted promptly.

Landslides and mudslides are other types of natural hazards that may cause damage to road transport and may as well destroy the road carpeting, interrupt traffic, and result in higher costs of transport.

Damage in this sector can be estimated as the value of investment required to replace the physical assets, assuming the same physical characteristics as prior to the disaster.

[19] In due time, detailed notes for the other sub-sectors may be developed and added to these guidance notes.

During the field surveys, the transport specialist must ascertain the extent and cost of rehabilitation or reconstruction based on the type and severity of damage to road transport works. The physical and traffic absorption characteristics of each affected component (or road section) must be combined with the unit cost of required rehabilitation or reconstruction.

Unit costs for rehabilitation may be obtained from the study and design and maintenance departments, or the transport or public works ministry/agency. Likewise, when private contractors in the sector are assigned the rehabilitation, they can be a source of information on unit costs.

Unit costs for reconstruction can only be obtained after completing the detailed design of the new infrastructure. However, recently developed and similar construction projects can be a starting point for preliminary estimations (information on such project costs can be obtained through the planning and design departments of the public works ministry/ agency).

As an aid to the specialist involved in the assessment of disaster damage, Table 3.1 shows the range of costs for rehabilitation and reconstruction of different types of roads.[20] Exercise special care when applying these figures, and give due consideration to local conditions, and also, adjust for inflation.

Damage to vehicle stock—including automobiles, buses, trucks and other smaller vehicles—must be estimated in the transport sector assessment. Construction and maintenance equipment should also be included, while tractors and other equipment used in agriculture must be accounted for under that sector.

For the estimation of damage to vehicles, the following simple classification may be adopted to facilitate calculations:

- Light vehicle
- Medium-sized bus
- Large bus
- Rigid, two-three axle trucks
- Flexible (four or more axle) trucks

The number of destroyed vehicles is usually estimated during the emergency phase, or may be estimated through consultations with transport enterprise associations and insurance

[20] This table has been developed by the Economic Commission for Latin America and the Caribbean for use within the LAC region. Similar values may be used in other developing countries located in different regions.

Table 3.1 Ranges in the Cost of Rehabilitation and Reconstruction of Two-way Roads ***(US Dollars per kilometer, in 2003)***

Type of work	Range in cost
Rehabilitation	
Dirt road, flat terrain	4,000–5,000
Dirt road, undulating terrain	5,000–6,000
Dirt road, mountainous terrain	6,000–8,000+
Gravel road, flat terrain	12,000–14,000
Gravel road, undulating terrain	15,000–18,000
Gravel road, mountainous terrain	18,000–21,000+
Paved road, flat terrain	22,000–25,000
Paved road, undulating terrain	25,000–28,000
Paved road, mountainous terrain	28,000–32,000+
Reconstruction	
Dirt road, flat terrain	8,000–10,000
Dirt road, undulating terrain	10,000–18,000
Dirt road, mountainous terrain	18,000–25,000+
Gravel road, flat terrain	45,000–50,000
Gravel road, undulating terrain	50,000–65,000
Gravel road, mountainous terrain	65,000–80,000+
Paved road, flat terrain	100,000–150,000
Paved road, undulating terrain	150,000–180,000
Paved road, mountainous terrain	180,000–250,000+

Source: ECLAC

company representatives. The monetary value can be estimated on the basis of information given in the Highway Design Model (HDM) used by the World Bank. To facilitate estimation when vehicles have only been partially destroyed, make simple assumptions on repair value as compared to the full value. Consultations with local repair shops can help ascertain typical unit costs.

Losses are sustained in the sector and, over time required for rehabilitation and reconstruction of transport works. The value of losses may exceed that of damage and in some cases even lead to overall inflation; hence, the importance of their estimation. Losses in this sector include: the value of interrupted transport flows, and the temporarily higher transport costs arising from use of alternate routes and/or alternate modes of transportation.

Three key elements are necessary to estimate the losses: the volume flows of traffic, the resulting higher unit operating costs involved after the disaster, and the time required for the rehabilitation or reconstruction.

The time frame for rehabilitation and reconstruction usually ranges from a minimum of three months for full rehabilitation, to about six months for the construction of alternate short road sections; and one to five years for full reconstruction of entire road sections (which may involve mitigation works through redesign and reinforcement).

To estimate the flows of traffic involved in the assessment of losses, the traffic patterns and volumes under pre-disaster conditions must be known. It follows that rapid, post-disaster manual counts need to be made of the temporary changes in traffic flow brought about by the disaster. The pre-disaster traffic flows can be obtained directly from the local authorities through the appropriate division of the transport or public works ministry/agency, using the most recent survey of origin and destination, duly updated when necessary. The post-disaster traffic flows must be measured by the transport specialist in close cooperation with the local counterparts, bearing in mind the time required for rehabilitation and reconstruction of the affected roads.

The marginal operating cost of vehicles varies depending on the type of vehicle, type of terrain and quality of road surface. It includes different components such as fuel, repairs, tires, depreciation, crew salaries, additional time of passengers, etc. These operating costs must be available for direct application in the estimation of losses. In fact, planning departments of the transport or public works ministries/agencies usually have this information. Should it not be available, the data shown in Table 3.2 provides the ranges of typical values of marginal operating costs for different road conditions and for the main types of vehicles in the developing countries of the Latin America and Caribbean region.[21] (The information needs to be adjusted for local conditions.) The range indicated goes from good to bad state of the road surface conservation, using roughness as the main parameter.

[21] These ranges have been developed by the United Nations Economic Commission for Latin America and the Caribbean for use in developing countries of this region.

Table 3.2 Marginal Operating Costs of Different Types of Vehicles in Different Types of Road Conditions
(US Cents per vehicle-kilometer, in 2003)

Type of road	Type of terrain	Type of vehicle				
		Cars and other light vehicles	Medium size buses	Large buses	Flat bed and other trucks	Rigs and trailer trucks
Paved roads	Flat	29–32	63–69	80–91	107–126	139–154
	Undulating	30–33	65–75	112–120	125–156	155–181
	Mountainous	31–34	69–80	144–157	156–182	156–225
Gravel roads	Flat	44–56	106–126	135–163	179–220	203–243
	Undulating	49–63	111–136	157–189	180–225	204–267
	Mountainous	46–67	114–144	197–234	184–249	207–246
Dirt roads	Flat	44–56	90–111	125–147	179–223	203–243
	Undulating	45–63	92–113	127–162	180–226	206–246
	Mountainous	46–57	96–113	134–176	184–249	207–267

Source: ECLAC

1.3.5 Inputs for Macro-Economic and Personal Impact Analyses

The overall assessment of disaster effects requires a definition of the impact of damage and losses on the macro-economic performance. The disaster impact on the country's gross domestic product, balance of payments and trade, and the fiscal budget is estimated. These estimations are made regardless of whether the transport facilities and services are government owned or under concession to private enterprises. The macro analysis is carried out by a different assessment team.

The transport sector damage assessment should include the necessary breakdowns so that, in the absence of domestic production, estimations can be made of the value of imported rehabilitation and reconstruction items (including equipment, machinery, construction materials and skilled labor). These items make up the imported component of damage.

The impact of transport sector losses on the country's balance of payments and trade must also be estimated through the assessment of significantly increased imports (or decreased exports) of fuels. In cases where the government directly owns the transport enterprises and services, the

impact of losses on the government budget should be determined in terms of increased operational costs and lower revenues. The above information and the estimation of disaster impact at the personal or household levels are delivered by the transport sector assessment team to the specialist in charge of the overall macro-economic impact analysis.

2. Social Sectors

2.1 Housing

2.1.1 General

The housing sector includes housing units in both urban and rural areas, as individual household units or multi-family apartment buildings. These housing units, and the household goods they contain, may sustain total or partial destruction (damage) from disasters. In addition to the damage to assets in the sector, disasters also cause changes or losses in the flows of the economy.

Damage is measured in physical terms and is later converted into monetary units using prevailing pre-disaster repair or replacement cost (cost to bring about the same standards of construction as prior to the disaster[22]). Losses in this sector normally refer to the costs of providing temporary shelter after the disaster, other unexpected expenditures and lower rental revenues of housing units.

Architects or civil engineers usually assess damages in this sector, while economists estimate the losses.

2.1.2 Baseline Information

The following information must be obtained to provide the baseline required for the housing sector assessment:

- Data on the number and characteristics of the existing housing unit stock in the area affected by the disaster, as well as of its typical household goods contents, broken down by urban and rural areas.

[22] When estimating post-disaster needs, however, the cost of reconstruction will be estimated on the basis of rebuilding the destroyed or damaged housing units with improved quality and disaster-resilient standards. This would be part of the "building back better" concept, if that is the chosen reconstruction strategy.

- Prevailing unit costs for repair and construction of housing units and replacement value of typical household goods, prior to the time of the disaster.
- Average values of monthly rental of housing units in the affected area.

This information is normally available in the most recent population or housing census, as well as in the most recent household survey, both of which are conducted by the statistical institute. Since the census and household surveys are not necessarily conducted in the same year as the disaster, projections may have to be made to the relevant year using population growth rates. Data on unit repair and construction costs for housing, and replacement costs for household goods can be obtained from local contractors and markets, respectively, during the assessment.

Based on the collected information, the assessors develop a representative typology of housing units. Criteria used are size and construction materials used, and whether units are occupied by their owners, or rented out to third parties. Normally, defining three to five housing types will suffice, depending on the diversity of housing in the country. The typology should include multi-family and individual family homes, as well as urban and rural homes.

2.1.3 Post Disaster Situation and Performance

The assessment team makes a field trip to ascertain the effects of the disaster on the sector and to enable the quantification of damage and losses.[23]

On the basis of existing reports from the emergency phase and data obtained during the field survey, it should be possible to estimate the number of housing units of each pre-defined type that have been fully or partially destroyed. Verification of the household goods content for each type of housing unit should also be done during the field survey. Consultations are held with private contractors and with government officials involved in the construction of housing units to obtain unit costs for repair and construction of the different types of units. Local markets are visited to ascertain current replacement costs for typical household goods.

Another important issue is the estimation of the extent, time frame and costs involved for setting up and running temporary post-disaster shelters to accommodate affected people not residing with relatives and friends.

[23] In recent years the manual counting of fully or partially destroyed housing units has been complemented by use of aerial photography and satellite imagery techniques. This method may not always be fully accurate.

2.1.4 Estimation of Damage and Losses

The value of *damage* should be estimated as the cost to repair and rebuild the number of housing units that have been partially or totally destroyed, plus the cost of replacing the destroyed household goods. To do this, the number of units in each type of housing must be multiplied with the estimated pre-disaster repair and reconstruction unit costs that will enable building back the units to the same (pre-disaster) level of quality and extent. The costs of replacing the destroyed household goods are similarly calculated and added into this estimation of damage.

The unit costs for repair, reconstruction and replacement of destroyed and damaged assets are those prevailing prior to the time of the disaster, still unaffected by scarcity or speculation. Adjustments for eventual multi-year inflation will be introduced later on when reconstruction needs are estimated.

In order to estimate the value of *losses*, a realistic calendar of repair and reconstruction is made first. This is based on an examination of the construction sector's capacity in the affected country or area, which take into account local availability of construction materials, equipment and labor, and considerations about other possible constraints for reconstruction (such as timely availability of financing). This should provide the time frame for the duration and phased discontinuation of any temporary shelter scheme, and the normalization of sector conditions.

The following losses are typical of the housing sector:

- The cost of the temporary shelter scheme, including investment and operation expense over the defined time frame, including:
  - cost of land acquisition when no public land is available to set up the shelter camps;
  - cost of temporary set up of water and sanitation, and electricity services for the shelter camp;
  - in certain cases, transport to and from the shelter camp to the city, if they are provided free to sheltered people;
  - cost of food, when it is provided free to sheltered people.
- The cost of demolition of destroyed or damaged housing units, and the collection and environmentally safe disposal of rubble.[24]

[24] Estimation of the cost of demolition and removal of rubble assumes removal up to the adjacent street only. The subsequent cost of transport and disposal to other areas is normally included in the assessment of the environmental sector. The assessment teams of the housing and environment sectors must coordinate to ensure there is no duplication of estimates and also that the total cost is duly considered in the assessment.

- In some cases of flooding, the cost of mud removal and of minor repair and cleaning costs of housing units.
- The loss of rental proceeds for rented housing units, over the entire time period when they are being repaired or rebuilt.

2.1.5 Inputs for Macro-Economic and Personal Impact Analyses

The housing sector assessment team must make additional estimations that could have an impact at the macro and micro levels.

For purposes of the macro-economic analysis, the housing sector assessment team delivers the following values to the macro-economist:

- The imported component of housing reconstruction costs (comprising the items that are not produced locally, but must be imported from abroad), expressed in percentage terms (%) of the total reconstruction needs once they have been estimated. This information is to be used for the analysis of impact on the balance of payments.
- The estimated share of the central government in the costs of the temporary shelter scheme, and the same for the cost of demolition and removal of rubble. This information is to be used for analysis of impact on the fiscal budget.
- The estimated loss of rental revenues that the private sector owners will sustain while rented houses are being repaired or rebuilt. This information is to be used by the macro-economist for the estimation of GDP impact.

For the analysis of personal or household impact, make the following estimates and deliver them to the appropriate expert:

- The value of any increase on rental payments that families must meet when rented homes have been destroyed and cannot be used until reconstructed.
- Any higher cost of transportation incurred by family or household members during their temporary occupation of shelter camps or alternative housing arrangements.

2.2 Education

2.2.1 General

All levels of education—including pre-school, primary, secondary, technical, and university—are included in this sector, and must be addressed separately. Disasters may destroy physical assets and cause changes or losses in economic flows.

Existing physical facilities—including schools, other associated buildings and their contents—may be fully or partially destroyed from the disaster. The value of damage is estimated in terms of physical units that have been damaged, combined with the pre-disaster unit costs of repairs or reconstruction of buildings, and with the replacement cost of the goods that were contained in the buildings at the time of the disaster, assuming that the goods are to be restored to the same quality and standards they had prior to the disaster.[25]

Losses refer to possible higher temporary costs and lower revenues incurred during the recovery and reconstruction period in order to provide adequate access to education services.

The sector assessment team should include an architect or civil engineer to estimate the value of asset destruction, as well as a sociologist and an economist for the estimation of the losses.

2.2.2 Baseline Information

The following data must be obtained for the education sector assessment:

- Number and characteristics of existing schools, by type of building and level of education, as well as typical furniture, equipment and education material contents, broken down by urban and rural areas, and by public and private sector.
- Normal calendar of school year, including indication of any short holidays within the year.
- Enrollment rates in education, broken down by sex and age.
- Fees charged to students in private and public sector schools.
- Prevailing costs prior to the disaster of repair and construction (of education buildings), and replacement costs of furniture, equipment and education materials.
- Number of teachers available in private and public sector schools.

This type of information is normally available from the ministry of education in the affected country, and from both public and private institutions. It may also be available in the most recent population census. In regard to unit costs of repair and reconstruction of education buildings, information may be collected from both private contractors and from the government ministry

[25] In this case, as in that of the housing sector, if the post-disaster reconstruction strategy involves the "building back better" concept, reconstruction needs will be estimated using additional costs required to ensure improved quality standards and disaster-resilient construction norms.

in charge of building schools. Information on replacement costs of furniture, equipment and education materials can be obtained both from the ministry of education and from local markets.

As in the housing sector, a typology of schools is developed, using criteria such as level of education, number of students, type of construction materials used, location in urban or rural areas, etc. Usually, three to five types of schools are part of this typology, and the unit cost for each one is then determined.

2.2.3 Post-Disaster Situation and Performance

To estimate the value of damage and losses for this sector, use damage reports prepared during the emergency phase—no matter how partial they may be—in combination with additional information collected during special field survey visits to the affected areas.

This background information is used to estimate the number of units that have been partially or totally destroyed for each school type predefined. Verification of furniture, equipment and education materials for every school is made during the field visits. Consult with private contractors and government officials during the field survey visits to ascertain unit costs of repair and construction for the different types of schools and ancillary buildings. Local markets serve as information source to ascertain prevailing unit costs of furniture, equipment and education materials.

During the field visits, the assessors should also determine:

- The possible temporary utilization of schools as temporary shelter for the homeless and the likely duration of such measure.
- The likely duration of the suspension of classes in affected schools and in schools used as shelters.
- Possible schemes and associated costs to reduce education service interruption and to ensure full access to education for students.
- The possible, more intensive use of undamaged school buildings to continue school activities and avoid long periods of education interruption, including establishing more than one shift in each school. All related additional costs should be taken into account, as should the possibility of temporarily using tents, adapted transport containers, or rented premises as classrooms.
- The cost of providing students with food at schools (if at all) which may be financed by the government.

2.2.4 Estimation of Damage and Losses

The value of *damage* is estimated based on the number of different type schools that have been partially or totally destroyed by the disaster, combined with the unit values of repair and construction prevailing at the time prior to the event,[26] plus the costs involved in replacing the destroyed furniture, equipment and education materials.

To estimate the value of *losses,* the assessment team must prepare a realistic calendar of repair and reconstruction of physical facilities, as well as replacement of furniture, equipment and education supplies. During this process, keep in mind that the capacity of the construction sector (which is assessed by the housing sector team) is usually limited, and may not have sufficient resources to begin rebuilding across the board in all sectors simultaneously. Also, the availability of repair and reconstruction funding must be included in the calendar. It will provide the time frame for estimating losses in this sector, including the duration of temporary arrangements to provide education for students.

The following are typical losses in the education sector:

- The cost of demolition and removal and disposal of rubble or mud.
- Any additional costs involved in the post-disaster temporary education scheme, such as
  - interim rental of premises;
  - setting up of "tent classrooms", or other temporary facilities;
  - overtime salary payment to teachers and other education-related personnel whenever several shifts are incorporated into the education schedule; and
  - other costs associated with the reestablishment of adequate education to the affected population.
- The cost of repairing schools that have been subject to overuse while operating as temporary shelters.
- Possible revenue losses in public and privately owned schools while closed, (whenever students are charged fixed fees).
- Possible sector savings in the government budget for the temporary non-provision of food to students during periods of school closure (this may in fact result in a transfer of such costs to households' budget over the same time period, and will be analyzed as disaster impact at the personal or household level).

[26] But which prevailed just prior to the occurrence of the disaster. Any possible inflation due to scarcity and speculation is to be added when reconstruction needs are estimated, together with any possible higher unit costs due to building schools using improved or disaster-resilient standards, as set forth in the reconstruction strategy.

- Possible costs involved in the accelerated training of new teachers to replace those who have perished during the disaster.[27]

2.2.5 Inputs for Macro-Economic and Personal Impact Analyses

The education sector assessment team makes additional estimates of costs that could have an impact at both the macro-economic and the personal or household levels, and submits them to the assessment team that produces disaster impact estimates for the macro-economic level.

For the purpose of macro-economic impact analysis, the following items must be estimated by the education sector assessment team:

- The value of the imported component of education reconstruction and replacement costs (for items that are not locally available and must be imported from abroad), expressed in percentage terms (%) of the total reconstruction needs as soon as they have been estimated. This information is then used for the balance of payments analysis.
- The estimated share of the central government post-disaster higher expenditures (over and above the regular budget appropriations for the sector) for repairs of schools used as temporary shelters; demolition and removal of rubble; and payment of overtime to personnel of the sector. This information is used for the analysis of fiscal budget impact.
- The estimated possible savings in the government budget due to the non-provision of food to students over the period of stoppage or interruption of classes. This information is used for the analysis of fiscal budget impact and also for the analysis of personal or household impact.

For the purpose of impact analysis at the household or personal level, the amounts of savings in the government budget will result in higher than normal costs for affected families (for providing food to children during the period of interruption of classes) and need to be given to the respective assessment team.[28] In addition, estimates should be made of the value of the longer hours of reproductive work that women have to spend taking care of children when schools are temporarily shut down after disasters, as they represent opportunity costs to women's productive work.

---

[27] This situation may occur in those cases where the disaster death toll is very high, such as Indonesia tsunami (2004), Myanmar (2009) and Haiti (2010).

[28] In cases where the government provides free transportation to students to and from schools, this would also entail additional savings to the government budget over the time of school interruption; where parents must pay for this transportation costs for children to attend schools, they will gain corresponding savings. These additional estimates that are not mentioned in the text above, must be made and provided for the impact analysis at the macro and micro levels.

2.3 Health

2.3.1 General

After disasters, physical assets in the health sector may sustain significant destruction, and the sector may see losses in its economic flows arising from the increased workloads imposed by the disaster. Damage refers to the total or partial destruction of buildings and their contents; losses refer to changes in the flows of the sector due to the temporary absence of assets, and to increased demands for medical attention by the population.

As in all other sectors, damage is first measured in physical units and then converted into monetary terms using the asset replacement cost that prevailed prior to the disaster. Losses are measured as the change in operational costs for the provision of post-disaster medical care; they normally include higher expenditures, over and above the normal budgetary appropriations for the health sector, and lower revenues.

During an assessment for this sector, damage should be estimated for:

- Hospitals, health centers, other buildings
- Furniture
- Medical equipment
- Medical supplies[29]

Losses to be estimated include:

- Cost of treatment of injured persons (physical and psychological injuries), over and above the regular workload of the sector.
- Possible lower revenues in affected hospitals and other centers.
- Possible unexpected costs to monitor, prevent and control higher rates of disease and the corresponding vectors.

Architects or civil engineers usually undertake damage assessment based on an individual analysis of each major component of the sector assets. Losses are often estimated by a combination of public health specialists and economists, including medical doctors and epidemiologists.

[29] This refers to medical supplies that are directly destroyed during the disaster. They should not be confused with the use of more medical supplies and drugs required to treat patients during and after the disaster, which is accounted for separately under losses.

2.3.2 Baseline Information

Prior to undertaking a damage and loss assessment for the health sector, the following baseline information must be at hand:

- The characteristics of all existing hospitals and other health centers, including bed capacity and other indicators, in the affected area.
- Existing similar capacities in nearby locations that may be used as alternative, temporary solutions to providing health care.
- A description of the health management system, including its financing sources (whether free medical attention is given and paid for by the government, or whether individuals must pay themselves and/or with the help of medical insurance schemes), and annual government budget appropriations.
- Historical information on morbidity rates for different diseases for the affected and nearby unaffected areas.
- Unit costs for medical attention, either as outpatient or in hospital care, for the typical diseases prevailing in the affected area.
- The above information should be obtained for both public and private sector facilities and systems.

2.3.3 Post-Disaster Sector Situation and Performance

The assessment team conducts a field trip to determine the effects of the disaster on the sector's capacity to meet post-disaster demands for health care. The purpose of this field trip is also to collect primary information for estimating the value of damage and losses.

The findings of the field survey and existing reports prepared during the emergency phase define the number and capacity of hospitals and health centers, that are totally or partially destroyed. In addition, the field trip should verify the equipment, furniture and medical supplies that have been destroyed or rendered useless. Direct interviews with private contractors or government officials involved in construction and repair of hospitals and health centers should be conducted to ascertain unit costs for repair or reconstruction, as well as to determine the replacement costs of furniture, equipment and supplies.

During the field survey, hold consultations with health sector authorities to ascertain how temporary medical attention should be provided to the population (this includes possibly establishing temporary field hospitals or health care centers.) It's important to determine the likely duration of such measures, along with their associated costs.

Discussions should be held with proper health authorities to determine the likelihood of epidemics and increased morbidity rates from typical diseases in the affected areas. The costs involved in monitoring morbidity levels should be established, as should the costs for outreach campaigns to inform people about preventive measures, and programs to control possible outbreaks arising from the new environmental conditions after the disaster. These costs include any expenditures that are over and above the regular budget for the sector, arising directly or indirectly from the disaster.

A calendar is then developed to describe how the sector is to recover its capacity, including the time frame required to build back destroyed assets, and the time required for monitoring and controlling possible changes in morbidity levels. When estimating the time for rebuilding or repairing the sector's infrastructure and reestablishing services, consider the overall capacity of the construction sector in the country to rebuild physical assets, as well as the availability of construction equipment, materials and labor (as was discussed before in the case of the housing sector).[30]

2.3.4 Estimation of Damage and Losses

The value of *damage* in this sector is estimated based on the cost to rebuild or repair all hospitals and other health care facilities that were totally or partially destroyed, as well as the replacement value of the furniture, equipment and supplies that were destroyed, assuming that they are being replaced with the same capacity and quality as prior to the disaster.[31] The value of damage to health sector buildings is estimated on an individual basis, in view of the importance and specifics of each one.

In order to estimate the value of *losses*, use the overall reconstruction calendar for reestablishing normal medical and health care capacity, along with the estimated calendar for monitoring and controlling disease and increased morbidity rates (when sector experts consider such possible occurrence.)

The following types of losses should be estimated:

- Higher costs of medical and health care (over and above the regular budget of the sector) for

[30] Post disaster reconstruction normally requires simultaneous rebuilding of many physical assets from several sectors, and the capacity of the construction sector and the availability of financing may be limited or delayed.
[31] The higher costs involved in building back to improved, disaster-resilient standards and in retrofitting existing structures should be included as part of the subsequent estimation of needs.

    - overtime payment of health sector personnel, where appropriate;
    - provision of medical supplies and medicines, over and above the normal level of use, which must be used to replenish regular stocks;
    - treatment of physically and psychologically injured persons, over the time span necessary; and
    - transport costs of injured to alternative, unaffected nearby hospitals or health centers, when appropriate.
- Cost of demolition of buildings and environmentally adequate removal and disposal of debris, mud and bio-hazardous material.
- Cost of setting up and operating temporary hospitals, when required.
- Prevention and mitigation costs, including:
    - outreach campaigns to inform population;
    - monitoring possible increased morbidity from selected diseases (over and above regular budget appropriations);
    - possible vaccination campaigns, when necessary; and
    - vector control campaigns, when necessary.
- Direct costs associated with the control of outbreak or higher morbidity rates, broken down by each type of disease.
- Temporary decline in health sector revenues, that may occur due to:
    - destruction of buildings and temporary interruption of health care services; and
    - possible decrease in number of patients due to interruption of transport services and access.

These estimations of damage and losses should be made for both public and private sector facilities.

2.3.5 Inputs for Macro-Economic and for Personal Impact Analyses

The health sector assessment team must make additional estimations of costs that could have an impact both at the macro-economic and personal or household levels, and should deliver them to the appropriate assessment team members handling impact analysis.

The following values must be estimated and delivered to the macro-economist on the assessment team:

- The estimated imported portion of the health sector reconstruction costs (including all items that are not produced locally in the affected country and that will have to be imported from abroad), expressed in percentage (%) of reconstruction needs once

they have been estimated. This information will be used for the impact analysis on the balance of payments.
- The estimated imported portion of recovery (including the items of prevention and mitigation for the sector) that must be imported from other countries in the absence of local production, to be used for the analysis on balance of payments.
- The total value of higher government expenditures and lower revenues, over and above its regular budget appropriations, to be used for the analysis of fiscal sector impact.

For the analysis of personal or household impact, make estimates of the increased costs of obtaining medical or health care and deliver the information to the person(s) in charge of the subject.

3. Productive Sectors

3.1 Agriculture

The agricultural sector usually consists of four sub-sectors: crops, livestock, fisheries and forestry. This guidance note deals only with the crops, livestock and fisheries sub-sectors. It also deals with the agro-industrial sub-sector, which may or may not be part of the agricultural sector, depending on the country's system of national accounts.

3.1.1 Crops

General Considerations
In the crops sub-sector, the following effects may occur after a disaster:

- damage, as destruction of physical assets in the sector;
- losses, as either full or partial production losses, and/or higher cost of production.

The following chart shows the typical damage and losses for different types of agricultural activities, depending on whether they are annual or permanent crops.

Typical types of damage
Disaster damage in the crop sub-sector typically happen to physical assets such as the following:

- Agricultural land (e.g. soil erosion, sedimentation, salinization)
- Drainage system and infrastructure

Table 3.3 Disaster Effects in Crop Sub-sector

Type of effect	Nature of effect	Type of crop	
		Annual	Permanent
Damage	Tree destruction or uprooting		☐
Production loss	Production loss	☐	☐
	Production loss over time		☐
Yield decline	Productivity decline	☐	☐
	Productivity decline over time	☐	☐
Quality decline	Crop output quality decline	☐	☐

- Irrigation system and infrastructure
- Irrigation equipment (e.g. engines, electric motors, pumps
- Storage facilities
- Stored agricultural inputs
- Farm buildings and sheds
- Farm equipment and machinery
- Internal farm roads
- Perennial trees (e.g. plantations)[32]

This list of typical assets that could sustain destruction is indicative, but not fully inclusive. The list of actual damage would vary by the type, severity and location of the disaster.

Typical types of losses

The typical effects of a disaster that can be classified as losses in the agricultural sector include, but are not be limited to:

- Crop production losses
  - loss of standing full *annual* crop; and
  - loss of standing full *perennial* crop.

[32] In the case of seasonal or annual crops, the plants are not considered durable goods or assets since they last for less than one year and therefore no damage occurs according to the definitions in the methodology. Thus, only production losses may occur in the case of seasonal or annual crops. The fruit plants or trees, however, last many years and their destruction is measured as damage.

- Crop yield decline
  - decline in standing *annual* crop yields; and
  - decline in standing *perennial* crop yields.
- Crop output quality decline (main as well as by-product)
- Higher production costs
  - higher use of inputs required; and
  - higher use of irrigation required.

Again, this list only gives examples of typical disaster effects in the agricultural sector—actual losses vary by the type, severity and location of a disaster.

The crop loss or yield decline *over time* refers to fruit trees being destroyed. Since they need to be replanted, it will generally take several years before the new trees mature and begin producing fruit. Decline in the quality of crop output (main product or by-product) may not result in lower yield, but can result in lower revenues due to declined market prices for the lower quality of crop produce.

Seasonality in crop production

Unlike other productive sectors and sub-sectors of the economy (e.g. industry, commerce and services), crop production is highly seasonal. Generally, there is an optimal time for sowing seeds, transplanting seedlings and harvesting. If these activities are not performed at the optimal time, crop yields will be lower than possible. Consequently, the criteria used for estimating crop production losses will vary depending on the time when the disaster occurs. In tropical countries, crop calendar is little more flexible than in countries with temperate climates, however, even then seasonality remains important for determining crop production losses. In some countries, a particular crop may be grown more than once a year. For example, in Bangladesh, farmers can plant three rice crops in a year (*Aus, Aman* and *Boro*). Each of these rice crops is different in terms of seasonality, agronomic practices, crop varieties and likely yields. Unlike the annual or perennial crops, sugarcane is another unique crop since the cropping cycle lasts one year and the roots sprout for the next crop season. Sugarcane is replanted every three to four years.

Initial analysis of the crop sub-sector

In order to provide a broad socio-economic perspective and to accurately estimate damage and loss from a disaster, it's important to first undertake an initial analysis of the crop sub-sector. The importance of the crop sub-sector varies from one country to another and even from one region in a country to another. The initial analysis should deal with, but not be limited to, the following aspects:

- Socio-economic importance
  - contribution to GDP;
  - contribution to employment;
  - contribution to food security; and
  - contribution to exports.
- Type of crop production
- subsistence or commercial;
  - annual or perennial;
  - irrigated or rain fed;
  - labor intensive or mechanized;
  - single or multiple cropping;
  - specialized or diversified; and
  - cropping pattern.
- Calendar of crop production
  - annual crops (planting to harvesting); and
  - perennial crops (flowering to harvesting).

Keep in mind that while the crop sub-sector may be very important nationally, it may not be so in the region where the disaster has occurred, and vice versa. Similarly, the type of crop production in the disaster region determines the nature and magnitude of damage and production losses. Finally, by superimposing the time of disaster on the crop calendar, it's possible to define whether the crop has been fully lost or only partially lost from the decline in crop yield.

There is also a need to analyze (i) farm size, agricultural land distribution and the relative share of the landless and small and marginal farmers (in order to get a sense of equity); and (ii) the quantity and quality of physical assets (list is provided above) and their distribution by farm size groups and regions or provinces. This analysis is important for two reasons, i.e. to determine the impact of a disaster on crop productivity and production, and to determine the impact of a disaster on rural poverty.

Pre-disaster situation in the crop sub-sector

In order to properly estimate damage and loss in the crop sub-sector, it's important to first develop the baseline information for each of the crops (both annual and perennial crops) with respect to the following:

- Historical production by crops at the national level
  - area;
  - average yield; and
  - production.
- Historical production by crops and regions (or provinces or districts)
- area;
  - average yield; and
  - production.
- Projected production by crops at the national and regional levels
  - area;
  - average yield; and
  - production.

This statistical information is not only essential for estimating production losses caused by the disaster, but also important in order to validate information received from various sources. It's important to have a complete inventory of all the physical assets used in the crop sub-sector by regions or provinces. In the absence of appropriate baseline information, it may not be possible to accurately estimate the damage. This information should be available at the national ministry of agriculture, provincial departments of agriculture and the statistical agencies.

Post-disaster situation and performance in the crop sub-sector

Determining the post-disaster situation for both annual and perennial crops involves defining the affected area and yield. When determining the damage of physical assets, an inventory is taken of assets, including soil (land); agricultural infrastructure (buildings, internal farm roads, irrigation system; farm machinery and equipment, such as irrigation equipment, etc.); perennial crops; and agricultural stocks (such as seeds, other inputs and produce) stored at the farms. This information should be available at the national ministry of agriculture and the provincial departments of agriculture. The information, however, needs to be supplemented through surveys, field visits, satellite maps and interviews with farmers.

Estimating of Damage and Losses

The damage to physical assets in the crop sub-sector can be estimated by taking an inventory of the damaged assets and then determining the extent of the damage. As indicated above, these physical assets can be classified into six broad categories:

- Soil (agricultural land)
- Irrigation system
- Agricultural infrastructure
- Agricultural machinery and equipment
- Agricultural input stocks
- Perennial crops

With the exception of perennial crops (which will be discussed later), the damage can be estimated by multiplying the number of units of fully damaged physical assets by the replacement value (for soil, irrigation system and infrastructure), or by the prevailing market price (for agricultural machinery, equipment and stocks). Partially damaged, but repairable physical assets can be estimated by multiplying the number of units with the prevailing average cost of repair or rehabilitation. The estimated value of full and/or partial damage (across regions, provinces or districts) is then aggregated to obtain the estimated value of total disaster damage to physical assets in the crop sub-sector.

Estimating production loss in annual crops

Criteria for determining the magnitude of loss: If a disaster occurs at the end of the crop season and the annual crop is affected by the disaster, the crop production loss is equal to

- full loss if the crop is fully destroyed; or
- partial loss if crop yield only declines.

If the disaster occurs at the beginning of the crop season, and depending on whether the crop can be replanted without affecting the quality and quantity of the next crop, the value of production losses is equal to:

- full loss if the crop cannot be replanted; or
- partial loss that is equal to the value of investments made before the crop was destroyed by the disaster.

These criteria apply to each of the annual crops affected by the disaster.

Estimating full crop production loss

Procedure A: The following steps are involved in the estimation of production loss for individual annual crops:

- Determine baseline (historical) data for
  - crop area;
  - average crop yield;
  - crop production; and
  - farm gate price for crop produce.
- Obtain pre-disaster forecast for
  - crop area;
  - crop yield; and
  - crop production.
- Develop post-disaster forecast for
  - crop area;
  - crop yield;
  - crop production; and
  - current farm gate price of crop produce.

Crop production loss is the difference between the value of post-disaster crop production and the corresponding value of pre-disaster forecast for crop production.

This procedure cannot be made unless historical records on crop area, unit yield and production are available, or an annual production forecast for the affected area has not been prepared at the start of the calendar year. An alternative procedure must be followed in such absence of information.

Procedure B: This procedure involves the following steps for estimating the production loss for individual annual crops that have been fully destroyed by the disaster:

- Determine post-disaster affected
  - crop area;
  - average crop yield for a normal year; and
  - current farm gate price of crop produce.

Crop production loss is equal to the value (using current farm gate price) of lost production as determined by the affected crop area and the average crop yield for that crop in a normal year.

To validate the estimated crop production loss from the disaster, it's good practice to use both of these procedures, if the necessary data is readily available.

Procedure for estimating production loss due to decline in crop yields: For a particular individual crop that has produced only partially lower yield after the disaster, the production loss can be estimated by determining:

- Disaster affected crop area (say, A)
- Average crop yield in a normal year (say, Y)
- Crop production in a normal year (A*Y)
- Percentage decline in average crop yield (say, p)
- Likely crop production loss (p*A*Y)
- Current farm gate price (P)
- Value of likely crop production loss (P*p*A*Y)

In other words, the estimated production for a particular individual crop following the disaster is the estimated production in a normal year minus the likely production loss. The value of production loss for this crop can then be estimated by multiplying the production loss times the current farm gate price. The value of production losses for individual crops can be aggregated to obtain the total production loss from lower yields.

Estimating production loss in perennial crops

Perennial crops (plantations or trees) are likely to follow three post-disaster scenarios: full destruction of the perennial crops (and likely loss in production over a period of time until the new crop starts producing); full production loss of the standing crop; and partial production loss due to a decline in yield.

Full destruction of perennial crops

In this scenario:

- Damage is equal to the cost of replanting the destroyed perennial crop (the replacement trees or plants should be of equal or better quality); the same is true for a pasture which is essentially considered a perennial crop or an asset, but will be accounted for under the livestock sub-sector.

- Loss is equal to the sum of the value of the full standing crop production loss at the time of the disaster plus the value of future production losses over the period of time required for the trees or plants to fully mature and start producing fruit.

Full production loss: In this scenario, there is no destruction of trees or plants due to the natural disaster, but the loss is equal to the value of full production from the standing crop. The estimated value is obtained by multiplying the affected area under the perennial crop with average unit yield in a normal year, and with the average farm gate price.

Partial production loss due to a decline in yield: Under this scenario, the production loss is determined by following the same procedure as has been outlined above for a decline in yield of the annual crop. However, there is one difference. Depending on the nature and intensity of the disaster, the yield for perennial crops may remain below normal for several years. For example, if the perennial crop in the coastal areas is affected by the intrusion of brackish (saline) water—due to water surge caused by a cyclone, as in the case of Cyclone Sidr in Bangladesh—,yield may remain below normal levels for several years.

Public and private sector distribution of damage and losses

In general, the crop sub-sector is in the domain of the private sector since farmers are private entrepreneurs and own and/or lease land for cultivation from private landowners. In this context, any disaster induced damage to the physical assets or production loss to annual or perennial crops on farms, is in the domain of the private sector. Even in the centrally planned economies, land is generally cultivated by private farmers. However, in most low-income developing countries, selected agricultural infrastructures (particularly irrigation infrastructures, such as canals or flood control embankments) are built and maintained by the public sector. Any damage to this infrastructure will of course be in the public sector. The damage or losses could also be sustained at the public sector crop research stations or experiment stations. The main logic for dividing the damage and losses into the public and private sectors is to determine the relative shares of disaster impact for the public and private sectors, and to assign the primary responsibility for recovery and reconstruction accordingly. Even when most of the damage and losses are in the private sector, governments generally play an active role in financing recovery and reconstruction programs (from their own budget and/or grants, and credits or loans from bilateral and multilateral donors).

Geographical distribution of damage and losses

The geographical distribution of disaster effects and impact depends, on one hand, on the intensity and type of natural hazard that cause the disaster as well as, on the other hand, on the size of the economy. For example, frequent cyclones generally cover most of Haiti (a small island nation), but may cover only parts of Bangladesh or India. In order to develop an appropriate recovery and reconstruction strategy, it's important to determine the location-specific effects and impact of the disaster in terms of damage, loss, macro-economic impact and socio-economic impact. If several provinces and districts are affected, it may be important to assign responsibilities for recovery and reconstruction to the respective local, provincial and central governments. Furthermore, it is important to allocate recovery and reconstruction resources based on the actual damage and loss, rather than on political considerations. Estimating damage and loss by geographical areas provides an objective criterion for allocating scarce financial resources following a disaster, irrespective of their origin.

3.1.2 Livestock

The broad principles for damage and loss assessment in the livestock sub-sector are similar to that of the crop sub-sector described above. However, a brief description of salient features in the damage and loss assessment for the livestock sub-sector is provided here. Livestock is very important for low income developing countries since it concerns high value agriculture (e.g. poultry and dairy). It provides regular cash flow (from poultry and dairy), and is an important source of cash income for both the landless and women (as part of the backyard economy). It also makes an important contribution to human nutrition. Therefore, any damage and loss to the livestock sub-sector has serious consequences for post-disaster levels of rural household income and poverty.

Typical effects of a disaster: damage

The main categories of assets that are damaged by a disaster are livestock infrastructure, animals, pasture, equipment and machinery, and stocks. Specifically, the most common damages are to the following:

- Animal deaths or disappearance
- Pasturelands
- Livestock sheds
- Storage buildings
- Stored feed and fodder
- Livestock equipment and machinery

The damage is valued at the replacement value (for infrastructure), or the prevailing market price (for animals). The cost of repair and rehabilitation is used in cases of partial damage to infrastructure. As with perennial crops, the value of pasture is estimated as the cost of replanting the pasture.

Typical effects of a disaster: loss

The typical losses in the livestock sub-sector are similar to the losses for the perennial crops in the crop sub-sector. More specifically, the most common losses are the following:

- Production loss
  - loss of milk production;
  - loss of meat production;
  - loss of egg production;
  - loss of honey production;
  - loss of wool production; and
  - loss of draft power due to stress.
- Higher production costs
  - higher use of inputs (e.g. feed); and
  - veterinary cost (medicine and consultation fees) for ill animals.

Like for the perennial crops, following the death of animals during the disaster, production loss must be calculated for the number of years that will take the young livestock to grow, mature and start producing milk, meat, eggs, honey, wool or draft power. For animals used for draft purposes, losses will be estimated by using the value of annual services. However, in the case of animals or poultry used for meat production only, the value of dead animals and birds is estimated as their current average market price. This value is included as part of the damage.

Initial analysis of the livestock sub-sector

It is essential to undertake an initial analysis of the livestock sub-sector before estimating damage and loss from the disaster. The size, scope and the role of the livestock sub-sector may vary by country and by regions within a country. The initial analysis of the livestock sub-sector should highlight at least the following aspects:

- Socio-economic importance
  - contribution to GDP;
  - contribution to employment;

  - contribution to food security;
  - contribution to exports; and
  - contribution to nutrition.
- Type of livestock production
  - subsistence or commercial;
  - role of pastures, fodder and feed;
  - specialized or diversified; and
  - role of animals used as draft.

It is also important to relate the role of the livestock sub-sector to the overall agricultural economy in terms of its contribution to household income by farm size categories. This is supplemented by information on the type and quantities of physical assets in the livestock sub-sector by provinces.

Pre-disaster situation in the livestock sub-sector

The pre-disaster situation in the livestock sub-sector should focus on the baseline information related to the following:

- Historical production by type of livestock at the provincial and national levels
  - number of animals, birds or bees;
  - average yield; and
  - production.
- Projected production by type of livestock at the provincial and national levels
  - number of animal, birds or bees;
  - average yield; and
  - production.

It is also important to collect information on the type of animal breeds popular in the affected farming community, since market value and productivity may vary greatly depending on breeds. Pre-disaster information related to the livestock sub-sector is obtained from the ministry of livestock (or from the ministry of agriculture, if included in that department). It could also be obtained from livestock administrations at the provincial levels and the statistical agencies.

Post-disaster situation in the livestock sub-sector

It is important to take an inventory of the livestock sub-sector and the likely damage and loss in the affected areas, which will depend on the type, extent and severity of the disaster. Cyclone

surges in the coastal areas and flash floods are likely to kill animals through drowning, and long droughts are likely to kill animals through starvation. Furthermore, disaster-induced stress on animals may reduce their weight and productivity of milk, meat, etc. In addition to the production loss, it's necessary to take an inventory of the damage to physical assets, including livestock infrastructure, equipment and machinery, stored input, feed and fodder stocks on the farm, etc. Post-disaster information related to the livestock sub-sector can be obtained from the ministry of livestock (or agriculture) and livestock departments at the provincial levels. Additional information should be obtained through surveys, satellite maps, field visits and interviews with livestock farmers in the disaster-affected areas.

Estimating damage to physical assets

The physical assets in the livestock sub-sector can be classified into the following six broad categories:

- Animals
- Pasture
- Livestock sheds
- Storage buildings
- Stored feed and fodder
- Livestock equipment and machinery

The damage to these physical assets can be estimated by multiplying the number of fully destroyed units with the replacement cost (for sheds and buildings) or current market price (in the case of dead animals, poultry and honey bees, feed and fodder). On the other hand, the value of destroyed, or partly destroyed, physical assets can be estimated by multiplying the number of units by the average unit cost of repair or rehabilitation. The estimated value of damage to individual physical assets is then aggregated to obtain the value of total damage for each province and for the country as a whole.

Estimating production loss

To estimate production loss in the livestock sub-sector, two scenarios are likely: full production loss due to death of animals, birds or bees; and partial production loss due to a decline in yield that is caused by stress, lack of shelter, food shortage and health problems attributed to the disaster.

Full production loss due to death of animals, birds or bees: Death of male animals used for meat and broilers will be included only in the damage part of the livestock sub-sector. However, production loss is estimated for the male animals used for draft purposes, animals used for meat, cows and buffaloes used for milk, poultry for eggs and honey bees for honey. Loss is equal to the value of this production over time until the young replacements are mature and start producing. The lost value for milk production, for example, can be estimated by multiplying the number of dead cows with annual average milk yield and current market price for milk. This procedure can also be used for estimating the value of production loss for meat, eggs, honey and draft power. However, in order to accurately estimate the value of production loss, it is important that only that number of cows that was in actual production is part of the calculations. The same is true for poultry layers and draft animals.

Partial production loss due to a decline in yield: In this scenario, the production loss is determined by following the same procedure as outlined for estimating production loss from decline in yield for perennial crops. During disasters, the livestock may come under stress, may not have appropriate shelter, and may lose weight, or become sick. Depending on the nature and severity of the problem, the decline in yield may last a year, or it can continue for several years. Over time, yield will generally improve as the conditions for livestock return to normal. The lost value of milk (and/or lost value of other livestock products) can be estimated by multiplying the number of affected cows with reduced milk yield and the farm gate price for milk.

Public and private sector distribution of damage and losses

Like the crop sub-sector, almost all of the livestock sub-sector is privately held. Possible exceptions are centrally planned economies, or livestock in the public sector research or experimental stations. In other words, most of the damage and production loss in the livestock sub-sector occur in the private sector. Similarly, almost all the physical assets are in the private sector, and unless the government provides support, the private sector entrepreneurs are responsible for financing recovery and reconstruction activities. However, often the government makes credit lines available to assist livestock farmers in rebuilding their assets and restoring production. This is done either directly through the development banking system, or indirectly by persuading private banks to provide such financing.

Geographical distribution of damage and losses

In order to adequately and equitably plan for recovery and reconstruction activities that are financed by the government, private sector sources, donors or NGOs, it is important to estimate

the magnitude of damage and losses by various provinces, regions and districts. Since much of the livestock production activities are part of the backyard economy, a disaster is likely to affect the household income of poor households, particularly women. This has important implications for increased poverty among the households and regions specializing in livestock production. In order to meet the increasing demand for fresh milk and other livestock products in the urban areas, livestock may have been kept near the urban centers, and it's important to account for the damage and losses in these areas as well.

3.1.3 Fisheries

The broad principles for damage and loss assessment in the fisheries sub-sector are similar to the methodology outlined for the crop and livestock sub-sectors. However, some key points will be discussed in this section. Like the livestock sub-sector, the fisheries sub-sector is very important in low income developing countries since it deals with high value agriculture (e.g. fish and shrimp aquaculture). It is an important source of cash flow and household income for the landless fishers' communities (including women), and it makes up an important contribution to human nutrition and export earnings. Any damage or loss to the fisheries sub-sector has serious consequences for the rural household income and poverty. The fisheries sub-sector broadly consists of (a) aquaculture for fish or shrimp; (b) artisan fisheries (both inland capture and marine); and (c) commercial fisheries (mainly marine). The relative importance of each varies by country or provinces.

Typical effects of a disaster: damage

The broad categories that are likely to be totally or partially damaged by a disaster are fisheries infrastructure, stored fish, equipment and stocks. More specifically, the most commonly destroyed items are the following:

- Fish and/or shrimp ponds
- Hatcheries (fish and/or shrimp)
- Fish fry and fingerlings
- Freezers and storage buildings
- Fish and fish feed
- Engines and boats
- Fisheries equipment

The damage is valued at the replacement value (for infrastructure) or the prevailing market prices (for fish, feed, and equipment).

Typical effects of a disaster: loss

The typical losses, due to disaster in the fisheries sub-sector, are the following:

- Production loss
  - loss due to decline in fish yield for aquaculture; and
  - loss due to decline in fish catch.
- Higher production costs
  - higher input cost for aquaculture;
  - higher production cost due to equipment rental; and
  - higher cost of fuel to reach fish after their migration to other areas.

Unlike perennial crops or animals that take several years to mature and begin production after a disaster, all the production losses in the fisheries sub-sector are seasonal or annual. Most of the damaged physical assets for fisheries can be fixed or replaced in a relatively short period of time, and production can resume relatively quickly.

Initial analysis of the fisheries sub-sector

The relative importance and the type of fisheries vary by country and regions within a country. As a background for the damage and loss assessment, the initial analysis of the fisheries sub-sector is extremely important and concerns the following aspects:

- Socio-economic importance
  - contribution to GDP;
  - contribution to employment;
  - contribution to food security;
  - contribution to nutrition; and
  - contribution to exports.
- Type of fisheries
  - aquaculture
  - artisan fisheries; and
  - commercial fisheries.

The initial analysis should provide a broad perspective of the role of the fisheries sub-sector in the agricultural sector, as well as in the overall economy. It should also outline the major challenges, opportunities and the production potential of the sub-sector by type of fisheries. Finally,

the analysis should include details and a summary of the national physical assets by type of fisheries, and by provinces.

Pre-disaster situation in the fisheries sub-sector

The pre-disaster situation in the fisheries sub-sector should focus on baseline information related to the following:

- Historical production and possible exports by type of fisheries at the provincial and national levels
  - fish fries and fingerlings;
  - aquaculture;
  - inland capture fisheries; and
  - marine capture fisheries.
- Projected production and possible exports by type of fisheries at the provincial and national levels
  - fish fries and fingerlings;
  - aquaculture;
  - inland capture fisheries; and
  - marine capture fisheries.

Since prices vary greatly depending on type of fish, it is important that production information is broken down by fish species. Baseline information should also be collected for the key physical assets. It is very important that the pre-disaster information is accurate and complete—the main sources of information should be the ministry of fisheries (or agriculture), departments of fisheries at the provincial levels, seafood export associations, and the statistical agencies.

Post-disaster information in the fisheries sub-sector

In order to estimate the damage and loss of production, it is important that the post-disaster information on the physical assets and production in the fisheries sub-sector, particularly in the disaster-affected area, is accurate and complete. Unlike the other sub-sectors, fisheries face a unique situation with respect to fish fries and fingerlings. For example, during heavy floods, individual fish farmers and hatchery owners may lose stock and thereby experience substantial financial losses. However, most of the fish fries and fingerlings merely swim to other parts of the country (and some may go to the sea). As a result, the country may actually sustain only a

minimal financial loss of fries and fingerlings. Supposedly, as these fries and fingerlings mature, they will be available for catch by the fishers operating in the inland, coastal and marine waters.

Estimating damage to physical assets

First, it is important to estimate the number of different type of physical assets that have been fully or partially destroyed by the disaster (such as ponds, hatcheries, fries, fingerlings, stores, stocked fish or fish feed, and fishing equipment). The damage to these physical assets can be estimated by multiplying the number of fully destroyed units with their unit replacement value (for infrastructure) and current market price (for fish or fishing equipment). On the other hand, damage to partially destroyed physical assets can be estimated by multiplying the number of partially damaged units by their average unit cost of repair or rehabilitation. The value of the total damage from the disaster can then be estimated by aggregating the values of fully destroyed assets and those of partially destroyed assets.

Estimating production loss

For estimating production loss in the fisheries sub-sector, three scenarios are likely:, partial to full production loss in aquaculture ponds; full production losses in inland capture fisheries; and full production loss in marine capture fisheries.

Partial to full production loss in aquaculture ponds: Depending on the damage to the pond, contamination of pond water and loss of fries and fingerlings, fish yield per pond may decline up to 100 percent. The yield decline may vary from one pond to another, and it's important to estimate average yield decline separately for fish and shrimp. The value of the production loss can be estimated by multiplying the decline in yield times the area under aquaculture affected by the disaster, and the market prices for fish or shrimp that would have been paid to fish farmers and fishermen under non-disaster conditions.

Full production loss in inland capture fisheries: Depending on the loss in the number of fishing days caused by either disaster or damage to the fishing equipment, full production loss follows for a certain number of days (or partial loss in terms of annual loss). The effect could possibly be full production loss for the whole year. Similarly, the value of lost production can be determined by multiplying the production loss with the market prices that would have been paid under non-disaster conditions.

Full production loss in marine capture fisheries: The methodology is same as above with the exception that it is applied to production loss in marine capture fisheries production. It is important, however, to make a distinction between the production lost by the artisan fishermen using small fishing boats and the commercial fishermen using large fishing boats and trawlers.

Public and private sector distribution of damage and loss

Like the other two sub-sectors of agriculture, private fishers and entrepreneurs dominate the fisheries sub-sector. However, some infrastructure (including hatcheries) may be located on fisheries research or experiment stations, which are likely to be in the public sector. Therefore, it is important to estimate the relative shares of damage and losses in the public and private sectors, and to develop an appropriate recovery and reconstruction strategy. It is also important to keep in mind that most fishers (not hatchery owners or farmers dealing with fish or shrimp aquaculture) are generally landless and among the poorest segments of society. On the other hand, shrimp aquaculture is highly profitable and in some countries (for example in Latin America) it's mostly for export purposes. Shrimp is often exported in large quantities to the US, Japan and other countries.

Geographical distribution of damage and loss

Again, it is very important to determine the geographical distribution of damage and production loss caused by the disaster. This information is critical in designing objective recovery and reconstruction strategies and in allocating necessary budgetary resources, grants, credit or loans accordingly. As has been indicated above, fishers (not necessarily shrimp aquaculture farmers) may be amongst the poorest segments of society and every effort must be made to make sure they get all the necessary financial recovery assistance. Since water is the main requirement for the sub-sector, fisheries are generally located near lakes, rivers, in the coastal areas and in the marine waters. In deltaic countries like Bangladesh, the fisheries sub-sector is country-wide, but it is concentrated near lakes, rivers, coastal areas and marine waters.

3.1.4 Agro-Industry

Agro-industry is an important link between the agricultural and the industrial sectors of an economy. In terms of its organization within the government, agro-industry may be part of the ministry of agriculture, or the ministry of industry. Depending on the organization of the national accounting system, it can be part of different sectors in different countries. Its importance to the economy varies largely depending on whether the agricultural sector is subsistence, semi-commercial (or semi-subsistence), or commercial. Agro-industry is highly developed in a

country with commercial agriculture and the least developed in a country with subsistence agriculture. Most low-income developing countries in the world are somewhere between these two extremes. Consequently, before initiating a damage and loss assessment in a particular country, it is important to get a perspective on the status and importance of the agro-industrial sector and its relationships to the agricultural and industrial sectors.

Supply chain scenarios

Depending on the level of commercialization, part of the crop, livestock and fisheries production is kept by the farmer to meet household consumption needs. In a country with subsistence agriculture, farmers may on average keep over 90 percent to meet household needs. On the other hand, in a country with commercial agriculture, farmers may keep less than 10 percent. The remaining marketable surplus of the farm produce is sold directly or indirectly to the agro-industry for further processing, packaging and distribution. The agro-industry generally sells processed agricultural products to the wholesalers (commerce) at a price that is higher than the farm gate price. The difference in the prices accounts for the processing cost, marketing cost and the marketing margin for the agro-industry. The wholesalers in turn sell the processed agricultural products to the retailers (commerce) at a price that is higher than the wholesale price. The difference in these two prices accounts for the marketing cost and the marketing margin for the wholesalers. In some cases and for some commodities, agro-industry may sell directly to retailers, or to both wholesalers and retailers. Depending on whether the country is a net importer or exporter of a particular agricultural product, trade also enters at the levels of agro-industry and wholesalers. Trade can include either raw materials, processed commodities, or both.

Damage and loss in the agro-industry

Depending on the disaster, the physical assets of the agro-industry can be totally or partially destroyed. This includes processing plants, warehouses, transport facilities, access roads, buildings and stocked raw material, as well as processed products. Any production loss in the agricultural sector also affects the level of production in the agro-industrial sector, as well as the commerce in the supply chain. For example, a reduction in the production of paddy rice (or rough rice) due to floods or cyclones will reduce the supply of rice as raw material in the rice processing mills. As a result, the existing rice processing mills will not be able to operate at full capacity and some may not operate at all. A similar case occurs in the sugarcane and sugar mill industry where losses in sugarcane production (or reduction in the sugar content of sugarcane) caused by a disaster will result in lower production of sugar in the sugar mill industry. Same thing (i.e. low capacity utilization rate and reduced production) happens to other processing plants in the

agro-industry if there is a reduction in production (and hence sales to the agro-industry as raw material) and/or quality in the crop, livestock or fisheries sub-sectors. The magnitude of these losses, however, depends on whether agriculture is commercial or subsistence. Furthermore, the value of total losses may even be higher, depending on the nature and magnitude of forward and backward linkages in the supply chain.

Estimating damage and production loss

The value of total damage to physical assets can be estimated by taking the number of destroyed assets and multiplying them with the replacement value (for infrastructure) or current market price (for stored raw material or finished products). Similarly, the value of partial damage to physical assets can be estimated by multiplying the number of partially damaged units with the average unit cost of repair or rehabilitation. This can be done for each affected province or district and then aggregated to obtain the total value for damage and loss at the national level.

The value of production loss in the agro-industry can be estimated as follows:

- From the crop, livestock and fisheries sub-sectors, obtain the amount of production losses at the national level, by commodity, due to disaster;
- Determine the average shares of agricultural production for each crop, livestock and fisheries products that are kept at the farm for household consumption, and the average shares sold to agro-industry.
- Estimate the amount of production loss as raw material input for the agro-industry.
- Using the national input-output tables, determine the agro-industry/agriculture ratio and based on this ratio, estimate the loss in production of agro-industry.
- Estimate the value of agro-industrial production loss by multiplying the amount of production lost with the ex-factory wholesale price for that particular product.
- If the input-output ratios for products are not available, use the difference in the farm gate price and wholesale price for a particular commodity to determine the value added.
- Estimate the value of agro-industrial production loss for a particular commodity by multiplying the production loss as raw material with the price difference between the farm gate price and the wholesale price.

Distribution of damage and loss

As in the case of agricultural production losses, it is very important to determine the distribution of damage and loss in the agro-industry by public and private sectors, as well as by province or

regions and districts. Keep in mind that the agro-industry for a particular product may or may not be located in the same area where the disaster affected the agricultural raw material. Again, this has implications for designing the recovery and reconstruction strategies and for allocating financial resources following the disaster.

3.1.5 Summary of Damage and Loss in Agriculture

In order to get a perspective of the damage and loss caused by a disaster on agriculture, it is important to aggregate the damage and loss for each of the agricultural sub-sectors and prepare a summary table, as follows:

Table 3.4 Summary Table for Agriculture

Sub-sector	Total damage	Loss (Yr 1)	…	Loss (Yr N)	Total loss
Crops					
Livestock					
Fisheries					
Total					

Agriculture refers to the sum of the damage and loss in the crop, livestock and fisheries sub-sectors. The sum of this and the damage and loss in agro-industry provides the total damage and loss in agricultural production and agro-industry. Loss continues until the damaged physical assets are fully reconstructed. The length of time can vary depending on the time it takes for the replaced physical assets to resume production (anywhere from one to four years, or even longer in some cases). Before preparing the summary table, it is important to check whether agro-industry is included as part of the agricultural sector, or as part of the industrial sector in the national accounts of the particular country.

3.1.6 Inputs for Macro-Economic and Personal Impact Analyses

In addition to the damage and loss, a disaster may also have macro and socio-economic impacts which may last for several years. These impacts depend on the type and severity of the disaster, and include (a) macroeconomic impact; (b) impacts at the personal and household levels; (c) impact on food balance and food security; (d) impact on rural poverty; and (e) impact on the availability of agricultural inputs. In addition, disasters have a major psychological effect on

rural households and on human health, nutrition and productivity, which should be part of the discussion in the health sector.

Macroeconomic impacts

The analysis of macroeconomic impact usually covers four of the main aggregates: gross domestic product (GDP), balance of payments, fiscal budget and inflation. Based on the damage and loss estimates, it is important that the assessment team for the agricultural sector (crops, livestock, fisheries and agro-industry) makes estimates of the likely impacts on these four macroeconomic variables (i.e. disaster-induced changes in agricultural GDP, reduced exports, increased imports, higher than normal government expenditure and lower tax revenue). The possible impact on overall inflation would be estimated once the post-disaster impact data from all sectors becomes available.

Gross Domestic Product: Since GDP and loss due to a disaster are flow concepts, the estimated magnitude of loss in agriculture GDP and reduction in agriculture GDP growth rate due to a disaster (as well as for GDP in general) can be determined by comparing the respective values in the year of disaster with that of the previous year. However, in order to make this analysis, the losses in individual agricultural sub-sectors must be multiplied by the value added coefficients to reach the value added losses. These value added coefficients capture the effect of linkages between the sectors. In addition to the direct impact of losses on the level and growth of GDP, there are indirect disaster effects that will have an impact on GDP.

Balance of payments: As a result of a disaster, the affected country may have to either import more food or other agricultural commodities, and/or reduce exports of agricultural commodities. This will adversely affect the balance of trade (and hence the balance of payments). For a country with limited foreign exchange reserves, or which depends heavily on the exports of agricultural commodities to earn foreign exchange, the disaster could have serious macroeconomic consequences.

Fiscal budget: Following any disaster, the government may have to allocate additional budgetary resources (over and above the regular budget appropriations) to finance emergency relief, recovery and reconstruction work in the affected agricultural and rural areas of the country. Most low-income developing countries, however, have limited budgets. In order to finance activities following a disaster, these countries may either have to increase budget deficits and/or divert scarce financial resources from public investment to finance the emergency needs in the rural agricultural sector. In either case, a disaster will have serious consequences for the annual budget at all government levels. Even though the agricultural sector is not a very good source

of government tax revenue, any disaster that affects agriculture will have serious consequences for government revenue.

Inflation: Depending on the disaster and its impact on both the demand and supply of goods and services, it will have consequences for the prices of essential commodities and services, and hence inflation. An increase in prices for affected food commodities following a disaster is a good example. Similarly, prices for the critical construction material may also increase due to heavy demand during the reconstruction period. The actual impact on inflation, however, depends on the relative share of affected goods and services in the consumption basket that is used to determine the consumer price index. In other words, inflation depends not just on the prices of agricultural commodities, but also on the prices for goods and services from all the other sectors of the economy. Any inflationary impact of the disaster is, however, likely to be temporary.

Impact at the personal and household levels

The impact of a disaster on the personal and household levels may be measured through changes or declines in employment, livelihood opportunities, household income and gender in the agricultural sector. In order to estimate this impact, the relevant secondary information from the disaster areas needs to be supplemented with appropriate randomly selected sample surveys, focus group discussions, and detailed information exchange with the local, national and international NGOs actively operating in the affected area, and even satellite image analysis.

Rural employment: The production losses caused by the disaster result in lower employment in the short and medium-term. This decline in employment in each of the agricultural sub-sectors (expressed in terms of person months) can be calculated by multiplying the value of production loss with the corresponding labor coefficient that relates the value of total production to the number of people employed. The decline in employment in the agricultural sector can be calculated by adding decline in employment in each of the sub-sectors. It is also possible to calculate decline in employment in agro-industry as a result of production loss in the agricultural sector. Decline in agricultural employment affects both family labor and hired labor. Landless laborers, whose household income depends entirely on their jobs, will be affected much more by the disaster than the landowners and regular service employees.

Rural livelihood opportunities: The livelihood opportunities in the rural areas depend primarily on the agricultural and rural non-farm activities (which in turn depend directly or indirectly on agriculture). The disaster-triggered damage to physical assets and production loss will have significant short and medium-term implications for the small farmers and the landless rural

households. The assessment of the impact on rural livelihood opportunities, however, requires both qualitative and quantitative analysis based on focus group discussions and surveys of randomly selected farming and landless households. In low-income developing countries with large backyard economies, rural livelihood opportunities led by women may be impacted seriously.

Rural household income: Depending on the type and severity of the disaster, the average household income for farmers, rural entrepreneurs and landless rural households will decline as a result of agricultural production loss, reduced employment and livelihood opportunities. Again, an accurate assessment of the household income decline requires focus group discussions and surveys based on randomly selected rural families.

Rural women: The likely impact of a disaster on rural women varies by country and depends on the nature and degree of involvement of women in agricultural and other rural activities—in Asia and Africa, for example, women are actively involved in these areas. In Bangladesh, women carry out a large number of agricultural and rural non-farm agricultural operations (such as household gardens, dairy, poultry, harvesting, post-harvest management and marketing). Women are also very active in cash earning backyard economic activities. The estimation is based on secondary data and does not always give an accurate picture of the role women play and must therefore be supplemented by focus group discussions and surveys.

Impact on food balance and food security

Disasters with major impact on agricultural production generally have serious consequences for food balance and food security at the national, provincial, district, village and household levels. Until the international food crisis of 2007, most developing food-deficit countries were gradually increasing their dependence on trade to meet their food security needs. However, after the crisis, most of them now would like to increase domestic food self-sufficiency and/or food stocks to improve food security. They would thereby minimize their own population's exposure to the uncertain international market in the need for principal food commodities, particularly rice and wheat. It's very important to analyze the impact of a disaster on the food balance and food security at all possible levels, including the national and household levels, particularly in the case of low-income food-deficit developing countries.

This analysis would require a careful examination of total food requirements (e.g. for human consumption, animal feed, seed, losses and stocks, as well as elements of food supply, including domestic food production, stocks (both public and private), and net imports (imports minus exports). Requirements for increased food imports have direct implications for foreign exchange

needs and balance of payments. It's also important to analyze the implications for access to food by the poor segments of the society affected by the disaster. In this context, food is an important component of the national social safety net. Food-for-work programs generally follow, or become even more important, after a major disaster. The likely sources of information related to food balances are the ministry of agriculture, ministry of food (some countries may have such a separate ministry), ministry of trade, commodity trade associations, national statistical agencies, and household income and expenditure surveys.

Impact on rural poverty

Poverty in most low-income developing countries is generally a rural phenomenon. For example, at the national level, approximately eighty percent of the poor in Bangladesh and Yemen live in the rural areas and mostly depend on agriculture for their livelihood. Any natural disaster that seriously affects agriculture and the rural population has serious consequences for increased rural poverty since the small and marginal farming and landless rural households generally are part of the poorest households. In many countries, urbanization is very rapid and rural poor are migrating to the urban areas in search of jobs. Consequently, urban metropolis areas may also have a large share of poor people affected by the disaster. The existence of poverty, however, varies a great deal from one region to another (urban or rural), and from one productive sector to another. For example, summarized below is the poverty profile (as percentage of population below the poverty line) by regions and sectors in Bangladesh in the year 2000:

Table 3.5 Poverty Distribution by Regions and Type of Settlements, Bangladesh, 2000

Region	Rural poverty (%)	Urban poverty (%)	National poverty (%)
Barisal			40
Chittagong			48
Dhaka			45
Khulna			51
Rajshahi			61
Bangladesh	53	37	50

The poverty rate as well as the actual number of poor people is much higher in the rural than in the urban areas. Consequently, the total number of poor living in the rural areas is very high,

almost 85 percent in Bangladesh. The poverty rate is almost 50% higher in the Rajshahi Division (the so called bread basket of Bangladesh, which has the highest poverty rate) than in the Barisal Division (with the lowest poverty rate). Even under normal conditions, poverty is very high in Bangladesh. With the increasing frequency and intensity of flood and cyclone disasters in this country, the likelihood of severe impact on rural poverty is very high.

Due to the damage and losses caused by a disaster, many of those affected experience significant income declines, which may increase the size of population below the poverty line (in the affected areas and in the country as a whole). In other words, the burden on all levels of government to implement programs to combat poverty will increase. Higher disaster-induced poverty will also affect the time line to achieve the millennium development goals (MDGs) at the provincial and national levels.

Impact on the availability of agricultural inputs

A disaster can affect the quality and quantity of agricultural inputs, including damage to agricultural land; death of draft animals; damage to irrigation systems and equipment; stored seeds, feed, fodder and fertilizer; agricultural equipment and machinery. Unless compensated from other parts of the country (which is not possible in case of damage to land or irrigation systems), the availability of most of the affected agricultural inputs will decline and market prices will go up. In the case of Bangladesh, for example, monsoon rains and floods generally affect the *Aman* season rice crop soon after it is planted. Since most of the rice crop is transplanted, this reduces the supply of good quality seedlings and the production of rice crop. It takes about three to four weeks for the seedlings to be ready for transplanting. Hence, depending on when the flood comes, either the whole crop is lost (if there is no time to replant) or agricultural inputs used for the crop are lost and have to be replaced (if crop is affected at the early stages). Under these circumstances, disaster can result in lower revenues from loss of crop production (loss of whole crop or decline in crop yield) and/or higher production costs. Again, be very careful to make sure that there is no double accounting. Also keep in mind that it may take several months before critical agricultural inputs are imported and available to farmers. This will certainly have negative consequences for crop, livestock or fisheries production during that season.

Relevant prices for making dala estimates

The DaLA methodology uses different prices to make appropriate damage and loss estimates depending on the category of assets, type of losses and level in the supply chain:

Farm gate prices: The farm gate prices refer to the prices received by the producers (farmers, livestock owners, and fishers) for the produce that they sell at the farm or nearby market. The average farm gate prices are used to estimate the value of production loss for the crop, livestock and fisheries sub-sectors following a disaster.

Wholesale prices: The wholesale prices refer to the prices at which the wholesalers, traders or agro-industry sell agricultural commodities (processed or unprocessed) to the retailers. The difference between the wholesale and the farm gate prices generally reflects the cost of transforming raw agricultural produce into processed products. In other words, it is a reasonably good estimate of the value added by the agro-industry.

Retail prices: The retail prices refer to the prices at which the retailers sell agricultural products to the consumers, or agricultural inputs to the producers. The difference between the wholesale and the retail prices generally reflects the cost of commercialization, including marketing cost and marketing margins. In some countries and for critical commodities, the government may fix the retail prices. However, depending on demand and supply, the actual prices paid by the consumers or producers may be higher than those fixed by the government.

Procurement prices: The procurement prices refer to the prices at which the government procures (assuming government has a procurement policy in effect) agricultural commodities after harvest. The procurement prices generally serve as the floor for the market prices. Under these circumstances, producers tend to suffer a loss, but they face lower market risk since the procurement price also serves as the guaranteed price and the market is assured by the government. The procurement prices are common in India and Bangladesh and other developing countries.

Import prices: As indicated above, following a disaster, the country may have to import certain commodities in order to meet the domestic requirements. This may include food, agricultural inputs, construction material, feed and veterinary medicine. The import prices for these items refer to prices that are paid by the importers for goods and are generally known as CIF (cost, insurance and freight) prices. Any internal transport and handling costs and any import taxes are on top of the CIF prices and hence must be added to the CIF price. The total import bill is therefore calculated by multiplying the quantity imported and the CIF price paid for the imports of a particular commodity.

Export prices: Most countries have a comparative advantage in exporting certain agricultural commodities. A disaster may adversely affect the production of these export commodities. Assuming

no change in domestic needs, the lower production will reduce the amount of commodities available for export and hence also the export earnings, which are determined by multiplying the quantity exported with the FOB (free-on-board) price received. However, any internal transport and handling cost up to the domestic port must be subtracted from the FOB price in order to calculate the export earnings for a particular export commodity.

Replacement value: None of the above prices are applicable to non-tradable items that do not enter the market. This includes items such as rural infrastructure, irrigation system, animal sheds and hatcheries. Replacement value is based on the cost of replacing these damaged assets. It can be calculated by adding the cost of all the necessary inputs and the labor cost. The cost of inputs can be estimated by multiplying the quantity needed with the market price for those inputs. Similarly, labor cost is determined by multiplying the required labor by the going wage rate. In addition, there may be other costs such as taxes and the cost of equipment. The replacement value may vary in different parts of the country.

3.1.7 Appropriate Information for the Assessment

Depending on the disaster, the damage and loss assessment should begin two to four weeks after the disaster. Sometimes floodwater may take even longer to recede. During this period, the government should focus on three activities. First, it should complete the work related to humanitarian assistance and relief. Second, it should make the necessary financial and logistics arrangements for fielding a DaLA mission. Third, the baseline information and relevant documents should be collected. In order to successfully complete the DaLA mission for the agricultural sector, it is extremely important to have all the necessary information and a team of participating mission members with the right expertise.

Information requirements

The information requirements for making an appropriate damage and loss assessment can be grouped into three categories: (i) detailed baseline information on all the physical assets and production activities for the relevant sub-sectors of the agriculture sector (possibly up to 10 years of historical data, including the most recent year prior to the disaster); (ii) damage and loss information for each of the agricultural sub-sectors and related activities following the disaster; and (iii) information related to the projections for agricultural production and physical assets for the future, including the affected year. All this information must be at the national level, and disaggregated to the lowest administrative unit possible. This information should deal with, but not be limited to, the following activities:

- *Crops:* Area, yield and production of various crops (annual and perennial), use of agricultural inputs, availability of physical assets and agricultural infrastructure, including irrigation system.
- *Livestock:* Number, yield and production of livestock, use of livestock inputs, availability of physical assets and livestock infrastructure.
- *Fisheries:* Area, yield and production of various types of fisheries, use of fisheries inputs, availability of physical assets and fisheries infrastructure.
- *Agro-industry:* Level of use of agricultural raw material in the agro-industry, type and location of agro-industry and input-output coefficients.
- *Macroeconomics:* Agricultural GDP, overall GDP, value added coefficients, balance of payments in agriculture, revenue and expenditure in agriculture and inflation.
- *Personal and household levels:* Population, labor supply, labor demand, wage rates, employment, unemployment, livelihood opportunities, level of rural household income and role of women in agriculture.
- *Food:* Production, imports, exports, stocks, social safety net, food-for-work program, nutrition, hunger, role of dairy, poultry and fisheries, and role of processed food.
- *Rural poverty:* National and regional poverty levels over time and by rural and urban sectors, as well as the criteria for determining poverty levels.
- *Agricultural inputs:* Production, consumption, distribution, imports and exports by type of inputs and location, levels of productivity of various inputs.
- *Agricultural prices:* Farm gate, procurement, guaranteed, wholesale, retail, export and import prices for all agricultural inputs and outputs, as well as marketing of inputs and outputs.
- *Agricultural trade:* Exports and imports of agricultural inputs, outputs and related products by country and mode of transport.

Every effort must be made to assure no double accounting, no gaps in critical information and that information is cross checked for quality.

Sources of information

The sources of information may vary by agricultural sub-sector, sector, region and country. However, the generic and critical list of the likely sources of information is provided below.

- National and regional statistical agencies
- Census data (e.g. agriculture, population, credit)
- Household or household income and expenditure surveys

- Specialized post-disaster field surveys
- Satellite photographs (before and after the disaster)
- Field visits to the affected areas
- Government reports on the disaster
- Reports by UN agencies on the disaster
- Reports by national or international NGOs
- Interviews with affected stakeholders
- Newspaper articles (local and national)

3.1.8 Assessment Team Composition

The composition of the damage and loss assessment team may vary by the type of disaster and the extent of the likely damage to the agricultural sub-sectors. However, the assessment team should include the following experts:

- Agricultural economist
- Civil and agricultural engineer
- Agricultural extension specialist
- Agronomist
- Livestock specialist
- Fisheries specialist
- Food technologist

Ideally, these experts should have some previous training in DaLA methodology, particularly in the context of agriculture. Otherwise, such a training program should be organized before the actual assessment begins. Someone representing the statistical agency should also be part of the team, and serve as the resource person to brief the agricultural team (as well as others) on all necessary information that may or may not be available through the statistical agency. Finally, it is very important to make sure that there are no gaps in the statistical information and that no contradictory information passes through the quality assurance program. Local experts can guide in this process.

3.2 Industry

3.2.1 General Considerations

The manufacturing or industrial sector is affected by disasters of every kind, and may sustain destruction to assets and, also, losses or changes in the flows of its economy. In addition, branches

of industry that rely on raw material obtained from other sectors of the economy for production (such as the food-producing industries) may sustain production losses even if no damage happened directly to the industrial facilities.

As in the case of other sectors, the value of damage in industry is initially measured in physical terms and subsequently converted into monetary terms by using the reconstruction or replacement cost of the destroyed assets. The guideline is to use prices that would bring the assets back to the same quality and quantity standards they had prior to the disaster.[33]

Losses in the manufacturing sector refer to the value of the industrial output decline, and increases in operational costs that may arise as a consequence of the disaster. Post-disaster reconstruction, on the other hand, may actually produce an increase in the demand and production of certain manufactured goods.

The assessment of damage and losses for this sector is more complex than in other sectors in view of the usually large number of different size and type industrial shops, across the various branches of industry. Therefore, a special sample survey of affected industrial establishments should be carried out in parallel to the field visits. Its results are combined with the existing baseline information in order to cover the entirety of the sector.

Civil or industrial engineers are part of the assessment team to estimate damage in this sector, while industrial engineers and economists are responsible for estimating the losses.

3.2.2 Baseline Information

Baseline information on the characteristics and capacity of the manufacturing sector and its different branches of activity is obtained to provide the quantitative basis required for the assessment. The information includes:

- Number and size of industrial establishments in the affected area, by branch of industry.
- Typical physical facilities in each of the above, including a description of the number and capacities of industrial equipment and machinery.

[33] The possibility of reconstruction or replacement using improved, disaster-resilient standards, as part of a strategy to "build back better", is introduced later when estimating needs for recovery and reconstruction. Multi-year inflation is also introduced in the estimation of needs whenever the recovery and reconstruction activities will last for more than one calendar year.

- Information on annual or monthly gross production for each industrial establishment.
- Quantitative information on the usual destination of manufactured goods, whether for domestic use, or for export to other countries.

This type of information is normally available in the most recent industrial survey or census, which may have been conducted either by the ministries of industry or by the statistical office. The national statistical office may be able to supply further information from the national accounts. Since some information may be out of date at the time of the assessment, projections to the current year must be made based on the recent growth rates for the sector.

Additional information can be obtained through direct contacts with private sector chambers or associations of industry, which may have the particulars about the associates' installed capacities and production. In fact, such private sector bodies may become useful partners in conducting the assessment, since they are likely keen on defining post-disaster needs for rehabilitation, recovery and reconstruction.

A typology of industries, by branch of industrial activity, size, and private or public ownership should be established for assessment purposes. The national accounting system determines which branches of industrial activities should be analyzed.

3.2.3 Post Disaster Situation and Performance

To assess the value of damage and to estimate losses, the effects of the disaster are examined during field visits by the sector assessment team, and combined with information from the sample survey of typical industrial establishments mentioned above.

Any existing reports—however partial in coverage—are used in conjunction with the field visit and the sample survey mentioned above to estimate the number of industrial establishments of each pre-defined type that have sustained total or partial destruction, and whose production may be affected directly or indirectly by the disaster.

The field visits by the assessment team, coupled with the sample survey questionnaire responses,[34] should enable to define the average type and value of damage for each industrial establishment

[34] A copy of the questionnaire developed for this type of sample survey of industrial and trade shops is enclosed as an Annex to these guidance notes. It requires only minor adaptation in order to capture information on the different types of industrial branches existing in the affected country (what branches to include is determined by the system of national accounts).

category, the time of production stoppage or decline for different reasons,[35] and the likely requirements for recovery and reconstruction. The repair and rebuilding unit costs of physical asset reconstruction and replacement are defined during that field visit, as are costs for replacement of equipment and machinery. The information is obtained through interviews with industry executives and representatives. Any difficulties and limitations foreseen by the owners of the industries should be noted—for instance, in terms of financial and credit requirements, availability of raw materials and inputs, availability of labor, time required for replacement of specialized equipment and machinery, etc.

Based on the collected information, and in combination with the baseline data on existing physical capacities and normal, non-disaster production, it will be possible to develop a scenario of how the sector is likely to function until full recovery and reconstruction is achieved. This includes developing separate calendars for the repair and reconstruction of buildings and other facilities, the replacement of equipment and machinery, and for resuming normal or non-disaster production levels over time.

3.2.4 Estimation of Damage and Losses

The value of *damage* in this sector should be estimated on the basis of the cost to rebuild or repair the buildings and other associated facilities that were totally or partially destroyed. It also includes the replacement value of destroyed furniture, equipment, machinery and supplies, assuming that they are being replaced with the same capacity and quality as prior to the disaster.[36]

In view of the usually very large number, size and type of industrial establishments in the affected area, the damage assessment must rely on information from the parallel sample survey to define average values of damage for each branch of industry, and accounts of the number of each industry type that was either totally or partially destroyed. Then, an extrapolation is made of the value of damage covering the entirety of industrial establishments in the affected area, based on an assumed ratio of destructed versus total number of industry shops. (The same ratio as the

[35] Production stoppage or decline may have several possible reasons, such as: destruction of premises, equipment and machinery; temporary unavailability of inputs like electricity and water; and the temporary lack of sufficient labor and inputs for processing.

[36] The higher costs involved in building back to improved, disaster-resilient standards and in retrofitting existing structures should be included as part of the subsequent estimation of needs in the assessment. If for some reason the destroyed equipment and machinery only can be substituted by more modern and capable machinery, the additional costs involved should be taken into consideration in the estimation of needs.

one derived from the housing sector could possibly be used in some cases). The accuracy of this extrapolation is of course of paramount importance, and the assessment team should devote sufficient time to discuss and agree on the ratio, so that the results are fully reliable.

The estimation of the *losses* is made based on several considerations, and the time frame is very important. Losses will normally occur over the time period required to achieve full reconstruction of premises, replacement of destroyed machinery, and full availability and flow of raw materials and inputs. Losses are likely to occur from:

- Damage to the industrial capacity, in terms of destroyed buildings, equipment and machinery.
- Temporary stoppage of production due to lack of electricity or water.
- Temporary disruption of raw material availability and inflow.
- Temporary unavailability or shortages of labor.
- Future unavailability of raw materials in agro-industrial plants due to future losses expected in agriculture, livestock and fishery production.[37]
- Insufficient or non-existent working capital at the enterprise.
- Possible changes (decline or increase) in demand of the manufactured goods, which may arise from possible generalized income decline of the population, and from the expected high demand for reconstruction materials, respectively.

It is essential for the industrial sector assessment team to obtain or derive a comprehensive calendar of how and when the limiting factors can be overcome, taking into account the limited availability of adequate financing.

The estimated losses should include both possible production decline and operational cost increases. Production decline losses are estimated on the basis of the expected time frame required to achieve normal or pre-disaster levels of production. Increased operational costs may arise for the following reasons:

- Payment of overtime to staff for attending to and solving the most urgent problems immediately after the disaster.
- Rental of alternative premises while the destroyed or damaged ones are being rebuilt or repaired.

[37] This is a typical case for the food processing industry, but also applicable for other agro-industry enterprises that may face future shortages of raw materials due to losses in primary agriculture, livestock and fishery production.

- Temporary acquisition of electricity and water for the production process from alternative sources, such as renting or acquiring portable power generators, or resorting to use bottled water rather than tap water.
- Temporary acquisition of raw materials from alternative sources that may be more costly and/or found in distant locations, including other countries.

The estimated values of damage and losses should be broken down according to ownership by public and private sector. Recall that some industrial enterprises might be public sector owned, some private sector owned, and some may be jointly owned.

3.2.5 Inputs for Macro-Economic and Personal Impact Analyses

The industrial or manufacturing sector assessment team must make additional estimations on impacts at both the macro-economic and personal or household levels, and deliver them to the appropriate assessment team members handling impact analysis.

For the macro-economic impact analysis, the following figures must be estimated and delivered to the macro-economist in the assessment team:

- The value and calendar of industrial production losses, expressed in current value, to be used for the analysis of disaster impact on gross domestic product and growth.
- The imported component of the industry sector reconstruction costs (including the items that are not produced in the affected country and that will have to be imported from abroad), expressed in percentage (%) terms of reconstruction needs once they have been assessed (to be used for the impact analysis on the balance of payments).
- Values of tax revenues that will not be accrued by the government due to the decline in industrial production (to be used for fiscal sector impact analysis).
- Values of decline in production and higher production costs in the case of government-owned industrial enterprises (to be used in the analysis of the fiscal sector).

For the analysis of personal or household impact, estimates of industrial production losses and of related employment impact should be delivered to the person(s) in charge of the subject.

3.3 Commerce

3.3.1 General Considerations

The commerce or trade sector is affected by every kind of disaster, through destruction of its physical assets and losses of sales, or other changes in the flows of its economy.

As is customary, damage in commerce establishments is initially measured in physical terms and subsequently converted into monetary terms by using the reconstruction or replacement cost of the destroyed physical assets, to the same quality and quantity standards they had prior to the disaster.[38]

Losses in the commerce or trade sector refer to decline in sales of goods and to increases in operational costs that may arise as a consequence of the disaster. During the post-disaster reconstruction stage, however, demand for sales of construction materials and equipment may increase and compensate—and sometimes exceed—the losses. However, these increases in demand are evaluated later, and the initial estimation of losses should not consider such positive indirect impact of the reconstruction.

The assessment of damage and losses for this sector is more complex than in other sectors in view of the usually large number of existing commercial shops, of different types and size, in the affected areas. Therefore, a special sample survey of commercial establishments is carried out[39] in parallel to the assessment, and used in combination with the existing baseline information to cover the entire sector.

Civil engineers are required on the assessment team to estimate damages, while economists estimate the losses.

3.3.2 Baseline Information

The following baseline information on the characteristics and capacity of the trade or commerce sector must be obtained to provide the quantitative basis required for the assessment:

- Number and size of commercial establishments in the area, by type of commerce.

[38] The possibility of reconstruction or replacement using improved, disaster resilient standards, as part of a possible strategy to "build back better", is considered at the time of estimating needs for recovery and reconstruction. Multi-year inflation should be added into the estimation of needs whenever the recovery and reconstruction activities will last for more than one calendar year.

[39] In fact, a joint sample survey is usually conducted for the industry and commerce sectors, since much of the required information is similar for both..

- Typical physical facilities in each of the above, including a description of the standard furniture, equipment and storage of goods.
- Information on the value of annual or monthly gross sales for each commercial establishment.
- Quantitative information on the usual destination of sales, whether they are for domestic consumption or for exports abroad.

This type of information is normally available in the most recent commerce survey or census, which may have been conducted either by the ministry of trade and/or by the statistical office. Further information may be obtained from the national accounts handled by the national statistical office. Since this information may be out of date at the time of the assessment, projections to the current year must be made based on the recent growth rates for the sector.

Additional information may be obtained through direct contacts with private sector chambers of commerce representatives, who normally have detailed information on the capacities and sales. In fact, such private sector bodies should become partners in conducting the assessment, since they are normally keen on defining post-disaster needs for recovery and reconstruction.

A typology of commercial shops, under private or public ownership, is included in the assessment.

3.3.3 Post Disaster Situation and Performance

The trade sector assessment team carries out a field visit to determine the disaster effects in trade or commerce shops. This, in combination with a sample survey of typical commercial establishments, leads to an assessment of the value damage and an estimation of losses.

Any existing reports from the emergency phase—however partial in coverage—should be used in conjunction with the field visit and the sample survey to estimate the number of commerce establishments of each pre-defined type that have sustained total or partial destruction, and whose sales will be affected directly or indirectly by the disaster.

The assessment team's field visits, coupled with information from the sample survey questionnaire responses,[40] should enable the definition of the average type and value of damage for each

[40] A copy of the questionnaire developed for this type of sample survey of industrial and trade shops is enclosed as an Annex to these guidance notes. It requires only minor adaptation in order to capture information on the different types of commerce types in the affected country, which can be obtained from the system of national accounts.

commerce establishment type, the time of sales stoppage or decline due to different reasons,[41] and the likely requirements for recovery and reconstruction. During the same field visits, information is also obtained through interviews with traders and building contractors on unit reconstruction and replacement costs for rebuilding physical assets and replacement of equipment and stock of goods. At this time, identify any difficulties or limitations foreseen by the owners (for instance, financial and credit requirements, availability of goods to sell, availability of labor, etc.).

Based on the collected information and also the baseline data on existing physical capacities and normal or non-disaster volume of sales, it will be possible to develop a likely scenario of how the sector will function until full recovery and reconstruction is achieved. This would include developing separate calendars for the repair and reconstruction of buildings and other facilities, replacement of equipment and goods to sell, and for the resumption of normal or non-disaster sales levels over time.

3.3.4 Estimation of Damage and Losses

The value of *damage* in this sector is estimated on the basis of the cost to rebuild or repair totally or partially destroyed buildings and other associated facilities, and on the basis of the replacement value of the destroyed furniture, equipment and stocks of goods to sell, assuming that they are being replaced with the same capacity and quality as prior to the disaster.[42]

It's likely to find a very large number of various size and type of commerce establishments in the affected area, and the damage assessment must rely on information obtained from the already-mentioned, parallel sample survey to define average values of damage for each type of commerce. The sample survey also provides the number of each commerce type that were either totally or partially destroyed. Then, an extrapolation is made of the value of damage, based on an assumed ratio of destructed versus total number of shops (using perhaps the same ratio that was derived from the housing sector, if deemed appropriate) covering the entirety of trade establishments. The accuracy of this extrapolation is of course of paramount importance—the assessment team should devote sufficient time to discuss and agree on the ratio, so that results are reliable.

---

[41] Sales stoppage or decline may be due to several possible reasons, such as destruction of premises, equipment and machinery, temporary unavailability of inputs like electricity and water, and temporary unavailability of sufficient labor and of goods to sell.

[42] The higher costs involved in building back to improved, disaster-resilient standards and in retrofitting existing structures must be included as part of the subsequent estimation of needs in the assessment. If for some reason, the destroyed equipment and machinery can only be substituted by more modern and capable machinery, the additional costs involved should be taken into consideration during the estimation of needs.

The estimation of the value of *losses* is based on several considerations, and the time frame for their occurrence is very important. Losses will normally occur over the time period required to achieve full reconstruction of premises, replacement of destroyed furniture and equipment, and full availability and flow of raw goods to sell. Losses are likely to occur due to:

- Damage to sector assets, in terms of destruction of buildings, furniture and stock of goods to sell.
- Temporary stoppage of sales due to lack of electricity or water.
- Temporary disruption of goods availability and inflow.
- Temporary unavailability or shortages of labor.
- Future unavailability of goods to sell that may be due to future losses expected in agriculture, livestock and fishery production.[43]
- Insufficient or non-existent working capital at the commercial enterprise.
- Possible changes (decline or increase) in demand of the goods that may arise from possible general income decline of the population, and from anticipated high demand for reconstruction materials, respectively.

Therefore, it is essential for the commerce sector assessment team to obtain or derive a comprehensive calendar of how and when the limiting factors could be overcome, giving due consideration to the limited availability to adequate financing.

The estimated losses should include both possible sales decline and operational cost increases. Sales decline losses are estimated on the basis of the expected time frame required to achieve normal or pre-disaster levels of sales, after overcoming the problems described above. Increased operational costs could arise from the following reasons:

- Payment of overtime to staff to attend and solve the most urgent problems immediately after the disaster.
- Rental of alternative premises while the destroyed or damaged ones are being rebuilt or repaired.
- Temporary acquisition of electricity and water from alternative sources, such as renting or acquiring portable power generators.

[43] This refers to the case of food products obtained from the food processing industry, but is also applicable for goods from other agro-industry enterprises that may face future shortages of raw materials due to losses in primary agriculture, livestock and fishery production.

- Temporary acquisition of goods to sell from alternative sources that may be more costly and/or located in far away locations including other countries.

The estimated figures of damage and losses should be broken down according to ownership by private and public sector. Note that trade enterprises can be public sector owned, private sector owned, and in some cases, jointly owned.

3.3.5 Inputs for Macro-Economic and Personal Impact Analyses

The trade or commerce sector assessment team must make additional estimations of factors that have an impact both at the macro-economic and personal or household levels, and should deliver these estimates to the appropriate assessment team members handling impact analysis.

For the macro-economic impact analysis, the following values must be estimated:

- The value and calendar of losses in sales, expressed in current value, to be used for the analysis of disaster impact on gross domestic product and growth.
- The imported component of the commerce sector reconstruction costs (items that are not produced in the affected country and which will have to be imported from abroad), expressed in percentage (%) terms of reconstruction needs once they have been assessed. The information is used for the impact analysis on the balance of payments.
- Estimated values of tax revenues (sales taxes or value added taxes, depending on the country´s tax structure) that will not be accrued by the government due to the decline in commerce sales. The information is to be used for fiscal sector impact analysis.
- Values of decline in sales and higher production costs arising from the disaster in the case of government-owned commerce enterprises (to be used in the analysis of the fiscal sector).

For the analysis of personal or household impact, estimates of commerce sales losses and of related employment impact are delivered to the person(s) in charge of the subject.

3.4 Tourism

3.4.1 General Considerations

The tourism sector is highly vulnerable to the effects and impacts of various disasters. This is for three main reasons: first, the frequent location of its assets in vulnerable coastal areas; second,

the volatility of tourism demands due to fear or misinformation about the possible consequences of disasters; and, third, in view of the seasonality of high-demand tourism, the income from an entire tourism season is often lost after a disaster.

Hotel bed capacity is a measure of asset availability in the sector (the ability to run services and admit both foreign and domestic tourists.) After disasters, bed capacity decreases due to the full or partial destruction of hotels and other facilities. The continued arrival of tourists, especially foreign, is contingent on the perception of what has happened in the affected area after the disaster[44] and misinformation can play a negative role in the recovery of demand for tourism services. Therefore, the time required for the tourism demand to fully recover after the disaster may be longer than the time required to rebuild the affected bed capacity.

The negative impact of disasters on tourism is reflected on decreased amount of foreign exchange earnings, possible decline in domestic employment, and possible decline in government revenue earnings, since many countries have special taxes on tourism income. Countries whose tourism sector represents a significant fraction of the gross domestic product would logically be more vulnerable than those where tourism is limited.

Damage in this sector is initially estimated in physical terms. It is subsequently converted into the monetary value of bringing assets back to the same quality and quantity standards as prior to the disaster, by using the unit repair, reconstruction or replacement costs of the sector assets.[45]

Losses in this sector refer to, on the one hand, decline in revenues due to temporary non-availability of destroyed assets and decline in tourists; on the other hand, to higher costs of operation for the tourism facilities (such as provision of water and electricity from alternative sources) and the unexpected costs of tourism promotions to convince visitors to return. These losses have double impact in that they may not only decrease GDP, but also negatively affect the balance of payments, since significant foreign exchange flow may be interrupted. This will be discussed later on.

---

[44] This situation occurred in Mexico after the onset of the swine flu pandemic. Foreign tourists, who have a significant impact on the country's economy, stopped traveling to Mexico's tourism sites without regard to the fact that the flu was relatively mild and that some tourist areas (such as Cancun) had no deaths from the flu. In total, losses from foreign tourism income in 2009 alone amounted to US$ 2,300 million.

[45] As for any other sector, the possible repair, reconstruction or replacement of tourism assets using improved, disaster-resilient standards as part of a "building back better" reconstruction strategy, should be considered later on when estimating the needs for recovery and reconstruction. At that time, multi-year inflation is added whenever the reconstruction program takes longer than one calendar year.

In this sector again, a detailed assessment of all tourism facilities must be made on a one-by-one basis, since the assets are usually distinct from each other, and the approach of developing typical types of assets used in the housing sector is not suitable. This will then involve visits to all affected tourism resorts and facilities. Assistance may be obtained from the existing hotel associations in the country.

The assessment team requires that architects and civil engineers estimate the value of damage, and that an economist estimates the losses.

Note that the tourism sector may not be itemized as an individual sector in some countries' system of national accounts, but instead may be part of the trade sector. When that is the case, the values of damage and losses for tourism should be added to the trade sector. Tourism has been included as a separate sector in these guidelines because in some small countries, especially those of the small island development country type, tourism activities often make up a significant part of GDP, and therefore receive separate handling in the national accounts.

3.4.2 Baseline Information

The following is a minimum of the quantitative baseline information required for the assessment of damage and losses for the tourism sector:

- The number, size and location of all tourism assets that exist in the affected areas.
- Description and quantities of the typical furniture, equipment and other goods normally present.
- Statistical data on the arrival and seasonal variation of tourists, both domestic and foreign, since they are likely to be different.
- Information on the average length of stay of tourists in the country or area, and on their average expenditures (both for domestic and foreign tourists).
- Data on any fees or special taxes charged to foreign nationals, including visa fees, special tourism taxes, etc.

The place to search and obtain most of the baseline information is the country's statistical office, since this is normally where data is kept on the number and origin of tourist arrivals, as well as seasonal variation. It also has data on the average length of stay by tourists and their average expenditures. Many countries, whose tourism is important, conduct annual surveys of the sector. The private sector association of tourist operators or entrepreneurs may have detailed information for the baseline, and is also likely willing to cooperate in the assessment.

3.4.3 Post-Disaster Situation and Performance

It's essential to make a detailed field visit to obtain first-hand knowledge about the effects of the disaster on the sector's infrastructure and facilities. This information is used for the assessment of value of damage and to estimate losses. During the visit, special interviews are held with hotel owners and tourism operators to obtain their view on the situation and to determine their special needs for recovery and reconstruction. Other important information gained through interviews is whether insurance is available, and whether it covers both infrastructure and revenue losses.

Any existing reports from the emergency phase—no matter how partial in coverage—must be gathered and used to guide the field visit. This will ensure that all affected assets of the sector are visited and assessed. It's likely that hotel owners have commissioned assessments by private appraisers and/or that the insurance companies covering the assets have done their own estimations. The assessment team should make every effort to obtain such information prior to its estimations.

The assessment team for the sector should visit private construction contractors operating in the affected area to obtain information on typical unit construction and repair costs that could be used in the estimation of damage. The team should also gather opinions on the required length of the repair/reconstruction.

During the field visit, the assessment team should obtain data directly from hotel owners and tourism operators on actual bed occupancy since the disaster occurred. This can be used as a comparison to the normal or non-disaster trends and conditions.[46]

Using this field information in combination with the baseline data collected prior, the assessment team develops a scenario for how the sector's bed capacity will be restored over the time of reconstruction. Projections on tourist recovery should also be made, dealing separately with domestic and foreign tourists, and keeping in mind that reconstruction of bed capacity and demand for tourism services do not necessarily match. The recovery of foreign tourist arrivals may be uncertain, but information on previous disasters can be used in the projections. Campaigns to adequately inform potential clients abroad can also be factored in.

The above described estimations and projections should enable the preparation of a calendar of sector recovery over time, which can be used for the subsequent estimation of losses.

[46] Be careful not to use optimistic estimates for hotel occupancy based on the large humanitarian assistance crews whose stay is not long term or tourism related, and which may distort the estimates about real decline in foreign tourist arrivals.

3.4.4 Estimation of Damage and Losses

The value of *damage* must be estimated as the cost to rebuild or repair all the buildings and associated facilities that were (totally or partially) destroyed, as well as the replacement value of the destroyed furniture, equipment and other goods in the buildings, under the assumption they are replaced or rebuilt to the pre-disaster standards of quality and quantity.[47] Needless to say, these costs are based on the actual unit costs of construction and repair obtained by the assessment team after visiting reputable building contractors, and/or after revising the insurer's estimations.

A clear definition of the time frame required for reconstruction and restoration of nominal bed capacity is made as part of the damage assessment. It will provide essential inputs for the estimation of losses.

To avoid double accounting in the assessment, the team must make sure that damage to environmental assets and services for tourism is properly included in the assessment of the environment sector. In addition, only when damaged roads, and water, sanitation, electricity and communications services are owned and operated by hotels, should they be included within the tourism sector. If not, they should be included in the sectors of transport, communications, water supply and sanitation, and electricity respectively.

For the estimation of *losses*, the assessment team may initially assume that losses occur over the time required to reconstruct bed capacity; and then should carefully introduce the most likely recovery pattern for foreign tourism that will enable full recovery of demand. Putting it differently, losses are to be estimated over the period of time defined by:

- Repairs or rebuilding of the physical or environmental assets that were damaged, and/or
- Foreign tourists overcoming fear or lack of information.

The assessment team should be aware that tourist arrivals from abroad may decline for an entire tourism season, considering the time required to rebuild assets and the need to design and undertake information and promotion campaigns abroad. The demand of domestic tourists is likely to follow a different (and more positive) trend and time frame.

[47] Improvement in quality and quantity, in the form of a "building back better" reconstruction strategy, remains a consideration for the subsequent estimation of post-disaster needs.

Summarizing, the assessment team must develop the post-disaster schedule of sector performance, which combines a calendar of staged recovery of bed capacity (the supply side of the sector) with the schedule of possible recovery of domestic and foreign tourist arrivals (the demand side). In turn, recovery of bed capacity depends on the country's construction sector capacity, the timing for reconstruction financing, and the bureaucratic requirements for reconstruction permits and licenses. Also, recovery of demand will depend on the opportunity and efficiency of information campaigns to regain the trust of traditional, as well as new, tourist target groups.

In addition to losses in revenue, the sector may also sustain higher costs of operation. As such costs would affect enterprise performance, they must also be included in the assessment. Costs may include overtime payment to personnel, and higher costs for obtaining water (for instance by bringing in tanker trucks) and electricity (by renting portable power units) while regular services are repaired. Numerous other unforeseen costs are possible.

3.4.5 Inputs for Macro-Economic and Personal Impact Analyses

The tourism sector assessment team must make additional estimates of effects that go beyond damage and losses, and that would have a bearing at the macro-economic and personal or family levels. These estimates are then delivered to the appropriate assessment team members dealing with impact analysis.

The macro-economic impact analysis needs to examine the following:

- The estimated value and time frame of revenue losses, expressed in current values, for use in the analysis of disaster impact on gross domestic product.
- The estimated corresponding values and time frame of foreign exchange losses due to the temporary non-arrival of foreign tourists, for use in balance of payment analysis.
- The estimated value and time frame of information and promotion campaigns to regain foreign tourists trust, also for use in the balance of payments analysis.
- The estimated value of temporary decline in government revenues corresponding to the decline in foreign tourism arrivals (including tourism and sales taxes, tourist visas and permits, etc.) for the analysis of fiscal impact.
- The amount of expected government financing in the information and promotion campaign, for the fiscal sector analysis.

For the analysis of personal or household income decline, the tourism sector assessment team must deliver the data and time frame on losses of tourism revenue to the expert on the subject.

WWW.GFDRR.ORG