DISASTER, DAMAGE, LOSS AND NEEDS ASSESSMENT

Training Guidelines

Prepared for the Government of Bangladesh by
the Global Facility for Disaster Reduction and Recovery

DISASTER DAMAGE, LOSS AND NEEDS ASSESSMENT

TRAINING GUIDELINES

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by the
Global Facility for Disaster Reduction and Recovery

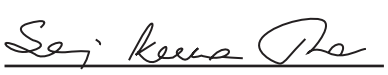
GFDRR
GLOBAL FACILITY FOR DISASTER REDUCTION AND RECOVERY

ABBREVIATIONS

ADB	Asian Development Bank
BOP	Balance of Payments
CA	Current Account
CMU	Country Management Unit
CPP	Cyclone Preparedness Program (Bangladesh)
DaLa	Damage and Loss Assessment
DFID	Department for International Development (UK)
DLNA	Damage, Loss and Needs Assessment
DMB	Disaster Management Bureau (MoFDM)
ECLAC	Economic Commission for Latin America and the Caribbean (UN)
FAO	Food and Agricultural Organisation (UN)
GOB	Government of Bangladesh
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery
HDI	Human Development Index (UNDP)
ILO	International Labour Organisation (UN)
MoFDM	Ministry of Food and Disaster Management (GOB)
NGO	Non-Governmental Organization
PAHO	Pan-American Health Organization
PDNA	Post Disaster Needs Assessment
RDRS	Rangpur-Dinajpur Rural Society (Bangladesh)
UN	United Nations
UNDP	United Nations Development Programme
WB	World Bank
WFP	World Food Programme (UN)
WHO	World Health Organisation (UN)

PREFACE

In the aftermath of the 2007 Cyclone Sidr in Bangladesh, the Global Facility for Disaster Reduction and Recovery (GFDRR) and the World Bank provided the necessary financial support as well as technical assistance to the Government of Bangladesh (GOB) in the form of a training program on how to conduct Damage and Loss Assessment (DaLa). Training guidelines have now been put together that will be made available widely in Bangladesh with the aim of establishing and institutionalizing a training program in the DaLa methodology. The need to strengthen and sustain the institutional capacity to use the DaLa methodology is essential to broaden and extend the training program to all relevant Upazilla and Union levels and among all relevant agencies involved in post-disaster management. This need is particularly pronounced in Bangladesh, given that the frequency and intensity of natural disasters, such as floods and cyclones that typically have devastating impacts on the national economy and the livelihoods of poor households, especially in the rural areas appears to have increased. The development of these training guidelines provides indispensible reference material for training programs to build institutional capacity for damage and loss assessments at the national, regional and local levels as well as for the critical sectors that generally experience extensive damage and losses. This is a significant first step to mainstreaming the methodology for disaster damage and loss assessments, and will lay the foundation for institutionalizing the training program in Bangladesh in the future.



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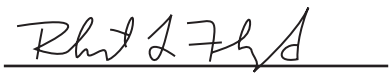

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ACKNOWLEDGEMENTS

These training guidelines grew out of a four day training event that took place in the World Bank Country Office in Bangladesh, November 17-20, 2008. The training brought together 55 participants, including those represented by the Disaster Management Bureau (DMB) of the Ministry of Food and Disaster Management (MoFDM), other government departments and ministries, Armed Forces, NGOs (Oxfam, ActionAid, Save the Children, RDRS), UN agencies (UNDP, WFP, WHO, ILO and FAO), Development Partners (DFID) and international financial institutions (World Bank and ADB). We are grateful for the inputs and questions from the participants during the training program. Their comments were very helpful, and have been reflected in the document.

Special thanks go to the former Director General of the DMB, Masud Sidiqui, who actively sought and supported the training program, and to the current Director General of the DMB, Farhad Uddin, whose continued support has been invaluable. Also, a special thanks goes to Masood Ahmad for his support in organizing the first DaLa training program in Bangladesh and for his efforts to institutionalize the methodology. Mohinder S. Mudahar took the initiative to institutionalize the DaLa methodology and the need to publish Training Guidelines for the DaLa training program in Bangladesh. His involvement and guidance stemmed from his work in Bangladesh and involvement with the JDLNA team on assessing the impact of Cyclone Sidr and floods on the agricultural sector.

The material for the training program was developed by Roberto Jovel, and the training was conducted by Roberto Jovel and Mohinder S. Mudahar (agricultural sector) at the World Bank Country Office in Bangladesh. Special thanks go to Zahed Khan and Reefat Sultana for coordinating the training program, to Tafazzal Hossain for his logistical support, and to the Country Management Unit in Bangladesh for their active support and guidance. The development of the training guidelines was supported by the Track III program of the GFDRR which is headed by Doekle Wielinga. Masood Ahmad, Roberto Jovel, Mohinder S. Mudahar, and Francis Muraya provided oversight and guidance during the preparation stages, and Anna O'Donnell assembled the training guidelines.

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Module 1: Assessment Methodology

I. Introduction

Bangladesh is low-lying deltaic country in South Asia. Formed by the Ganges, the Brahmaputra and Meghna rivers, two thirds of the country is less than 5 meters above sea level. Bangladesh is ranked as the most climate-vulnerable country in the world. In addition, it is one of the most densely populated countries and about one fourth of its 150 million residents live along the coastline, which is particularly vulnerable to natural disasters. The recurrent natural disasters in Bangladesh include floods, cyclones and related storm surges, high arsenic concentration in groundwater, salinity in the coastal areas, and earthquakes.

Over the past several years, the Government of Bangladesh (GOB) has been quite successful in reducing the impact of disasters through community involvement. In particular, the Cyclone Preparedness Program (CPP) with 40,000 volunteers and shelter programs has helped in reducing casualties from natural disasters. Response efforts typically focus on emergency relief rather than seeking ways to reduce vulnerability to natural hazards, but effective preparedness can reduce the potential impacts of the disasters on local populations. Effective response is contingent on the nature and capacity of the institutions to shift from risk to resilience.

On 15 November 2007, Cyclone Sidr struck the south-west coast of Bangladesh with winds up to 240 kilometers per hour. The storm was accompanied by tidal waves up to five meters high and surges up to 10 meters in some areas, breaching coastal and river embankments, flooding low-lying areas and causing extensive physical destruction. High winds and floods also caused damage to housing, roads, bridges, and other infrastructure. The cyclone was the second natural disaster to affect Bangladesh in twelve months; previous monsoon floods had caused extensive agricultural production losses and destruction of physical assets.

Following the cyclone, a Joint Damage, Loss and Needs Assessment was conducted to estimate the damage and losses incurred from the disaster. The total estimated damages from Cyclone Sidr amounted to US$ 1.158 billion, concentrated primarily in the housing sector (US$ 839 million), and losses amounted to US$ 516.9 million, concentrated primarily in the agriculture sector (US$ 416.3 million). Consensus in the wake of the disaster was that the impact of the disaster was mitigated by disaster preparedness efforts, such as shelters, early warning systems, and evacuation plans that assisted the affected populations.

The Damage and Loss Assessment (DaLa) methodology assisted the GOB to plan for recovery and reconstruction based on the estimates and sectors that were most affected. Short-term recovery focused on the most immediate needs arising from the humanitarian assistance phase and created a solid foundation for the medium- to long-term recovery and reconstruction stages. The early recovery stage included interventions designed to ensure food security, health care, and shelter for the affected population. The medium- to long-term stage concentrated on the recovery of sustainable production in agriculture, industry, and commerce, on restoration of livelihoods, and reconstruction of infrastructure (housing, embankments, roads, and shelters) with improved risk resistance. In addition to providing technical assistance for the Joint Damage, Loss and Needs Assessment, the GFDRR and the World Bank organized a training program in Bangladesh to build local capacity in the DaLa methodology used for the assessment. The first such training took place November 17-20, 2008.

These guidelines reflect the damage, loss and needs assessment training materials that were presented during the four day training program in Dhaka. It includes an overview of the methodology, followed by a sector-by-sector guide on how to conduct a damage and losses assessment. It then brings together the different sectors to determine the total damage and losses from natural disasters, and provides a framework for estimating needs derived from these figures. The guidelines also include case studies and exercises for each sector. It is intended to be used during future training programs, and as a reference material for those involved in conducting a damage and loss assessment following a disaster.

II. Conceptual Framework

After a natural disaster occurs, the first phase in the post-disaster recovery is to deliver humanitarian assistance to stem emergencies. Once this phase is completed, and the direct and immediate impacts of the natural disaster are addressed, then efforts turn to an economic recovery and reconstruction program. Economic recovery programs aim to kick start affected economic activities and personal income, and reconstruction programs focus on replacing destroyed physical assets. The damage and loss assessment focuses on post-disaster recovery and reconstruction and on monitoring progress in both programs.

Uses of the Damage and Loss Assessment

The damage and loss assessment is designed: (i) to quantitatively define financial needs for economic recovery and reconstruction after disasters; (ii) to define priorities in geographical areas, sectors and special groups in recovery and reconstruction programs; (iii) to ascertain capacity of government to conduct post-disaster programs on its own, and/or to define international cooperation needs; (iv) to provide basis for monitoring progress of post-disaster program execution; and (v) to provide quantitative basis for the *ex ante* disaster risk management schemes. In order to ensure the most accurate figures to capture the extent of the natural disaster, the assessment should be conducted 2-3 weeks after the disaster**.**

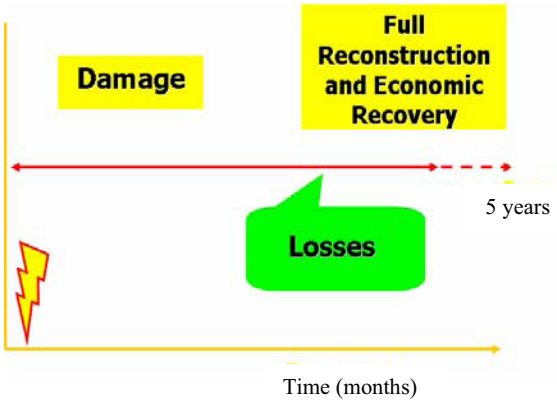
The methodology used for the Damage and Loss Assessments is a simplified version of the Economic Commission for Latin America and the Caribbean (ECLAC) methodology, which was developed to assess the effects of disasters in the Latin American and Caribbean region. Since its development, it has been expanded to be used in other places in the world, and has been used especially for the series of recent major disasters in the Asian region. This is the only methodology available to comprehensively analyze overall effects and impact of disasters on the economy and society. It is built upon individual, sectoral assessment methodologies developed by specialized agencies of the United Nations and other institutions, at the request of and under the coordination of ECLAC. These include PAHO/WHO for the health sector, HABITAT for the housing sector, FAO for the agricultural sector, UNEP for the environment, UNESCO for education sector, and ILO for labor related issues. Other existing methodologies are uni-sectoral or refer to the humanitarian assistance (emergency) stage. The ECLAC methodology has been in use since 1972 and has been continually expanded and updated.

The ECLAC Methodology: A Summary of Features

The ECLAC methodology is a stock-flow conceptual model that measures damage to assets and changes or losses in economic flows. It makes use of the national accounting system, and does a sector by sector assessment of disaster effects (a “bottom up” approach). Once these are completed, the assessment does an aggregation of standardized sectoral results to ascertain total disaster effects. This enables the analysis of disaster impact on macro-economic aggregates, on personal income and on the environment.

The immediate effects of the disaster are typically classified as damages. Damages are defined as total or partial destruction of physical assets, including buildings and their contents, infrastructure, stocks, natural resources, etc. They tend to occur during the event itself, and are measured in physical units and valued at replacement cost. Typical damage includes destruction to housing and household goods, to hospital and schools, and contents, to agriculture lands and irrigation systems, to roads and bridges, ports and airports, water supply systems, and electrical systems.

Figure 1: The timing of disaster effects



In the medium term, the effects of the disaster are typically losses, which are defined as changes in economic flows. These include, but are not limited to, production not obtained and sales not made, and corresponding higher production costs, higher operational costs and lower revenues in the provision of essential services, and unexpected expenditures (e.g. demolition and debris removal). They occur from the time of the disaster until full economic recovery and reconstruction of assets are achieved. Losses tend to occur after the natural event, and over a relatively long time period, and are valued at current prices. Typical losses include production losses in agriculture, fishery, livestock, industry, commerce, tourism, and higher operational costs and lower revenues in electricity, water supply and transport.

The Importance of Losses

In the past, the cost of disasters was identified as primarily the value of damage, and losses tended to be underestimated. This was due to (i) the urgent need to ascertain the amount of financing needed for reconstruction; and (ii) the difficulty in estimating losses. As a result, the total effects of disasters tended to be underestimated, and many social needs arising from disasters went unattended. In addition, many of the negative impacts on economic development was not fully appreciated and mitigated.

Under DaLa, losses are estimated as a part of the damage and loss assessment, and this procedure now fully captures the total effects of the disaster. This is particularly true for certain types of disasters, where the losses typically far outweigh the damage. Whereas disasters caused by natural phenomena of geological origin (e.g. volcano eruption, earthquakes) normally cause more damage than losses, disasters caused by natural phenomena of hydro-meteorological origin (e.g. drought, floods, cyclones) normally cause higher losses than damage.

To fully comprehend the impact of a disaster, the total amount of effects (damage and losses) must be compared to the size of the affected economy. For this, comparisons are usually made with gross domestic product (GDP) and other macro-economic aggregates.

Typical Results of an Assessment: Recent Examples

Table 1: 2008 Yemen floods summary of damage and losses

Sectors	*Disaster Effects, million US$*	
	Damage	Loss
Social Sectors	**199.9**	**27.7**
Housing	161.2	16.2
Health	21.4	11.3
Education	17.3	0.2
Productive Sectors	**557.3**	**688.1**
Agriculture	549.7	486.5
Industry and Commerce	7.7	201.6
Infrastructure	**112.7**	**32.6**
Water and Sanitation	30.2	3.4
Electricity	20.1	6.0
Transport	60.0	21.6
Communications	2.4	1.6
Cross Sectoral	**4.9**	**14.5**
Environment	0.2	14.5
Public Buildings	4.7	0
TOTAL	**874.8**	**762.9**

As is evident from the table above, the total damage from the 2008 floods in Yemen was estimated to be US$ 874.8 million. This included damages to infrastructure, most notably to housing, and to agriculture. The total losses from the floods were estimated at US$ 762.9 million. Losses were much higher in the productive sectors, most notably in agriculture. However, losses were also high in the industry and commerce sectors despite the relatively low level of damages.

Typically, as this table shows, the impacts of disasters are broken down by sector of the economy. Each sector of the economy can be aggregated into the major sector group of the economy-- productive, social, infrastructure, and cross sectoral-- to get a better sense of where the bulk of damages and losses are concentrated. This then gives a clear overall picture of where the greatest impact of the disaster is concentrated. However, it is important to remember that damage and losses from the disaster must be kept separate since the former deals with stocks and the latter deals with economic flows. Figure 2 and Figure 3 show a typical breakdown of damage and losses by sector, respectively. It is clear that the bulk of the damages are located in the productive sectors (63%), followed by the social sector (23%), infrastructure (13%) and other (1%). Losses, on the other hand, are overwhelmingly located in the productive sectors (90%). This type of information can assist policy makers to design an appropriate reconstruction and recovery program.

Figure 2: Distribution of damages by sector

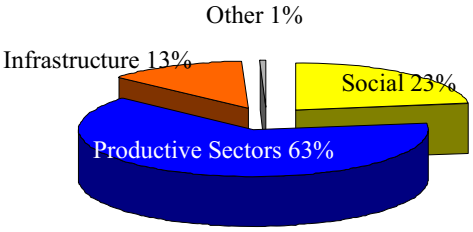
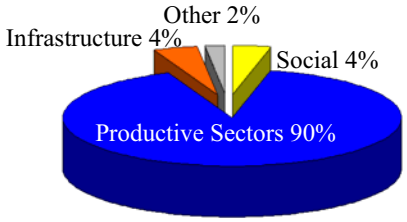
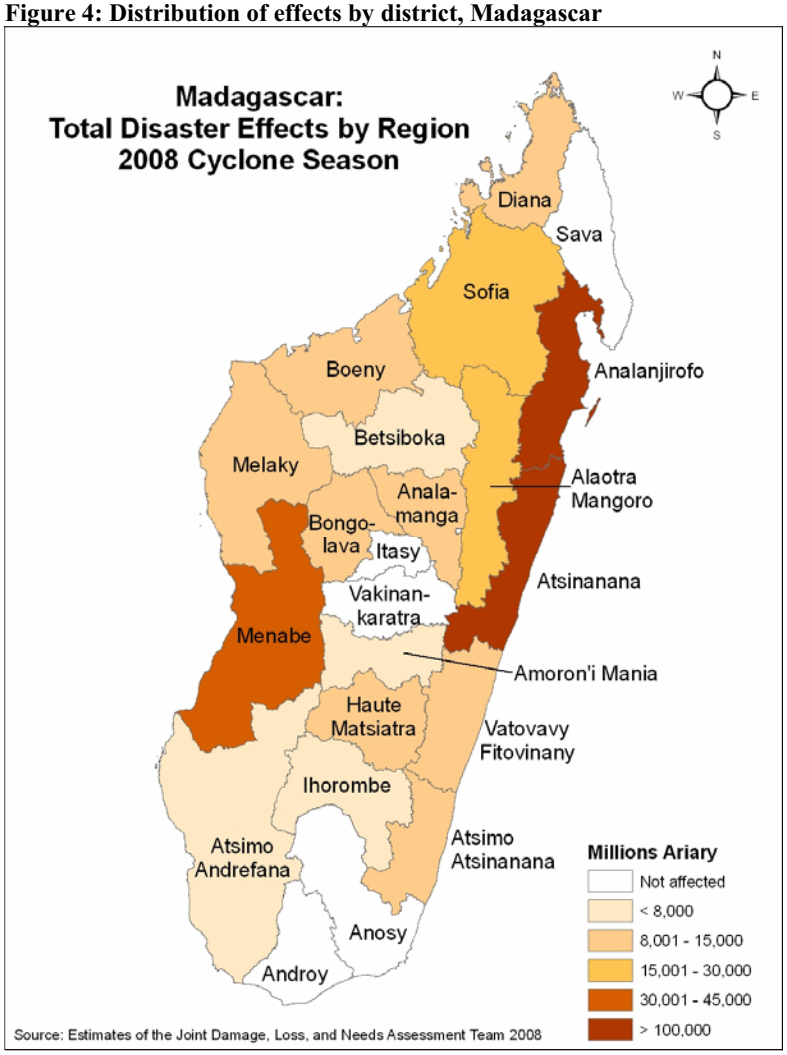


Figure 3: Distribution of losses by sector



Other ways in which the effects of disasters could be broken further is by region or district. Figure 4 shows the distribution of effects by region. The coastal districts were more severely affected than the central or southern districts. This type of information can help the central government to design and deliver recovery and reconstruction programs targeted to those areas that suffered the greatest impact.

Figure 4: Distribution of effects by district, Madagascar



Once the damage and losses have been broken down by sector and/or district, the next step is to assess the impact of the damage or losses on the economy.

A comparison of the amount of damage to the annual value of gross capital formation yields an idea of the time required for reconstruction in the countries. Figure 5 shows this distribution for damages from the Indian Ocean Tsunami (2004). From this we can see that the Maldives will face the longest recovery period, followed by Indonesia and Sri Lanka. Figure 6 shows the magnitude of losses as a share of GDP across countries. This provides an indication of possible impact on economic growth.

Figure 5: The importance of damage: damage vs. gross capital formation, % (log)

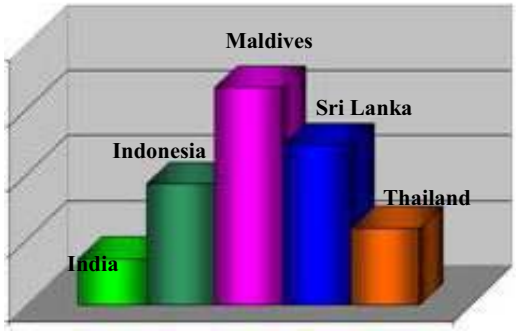
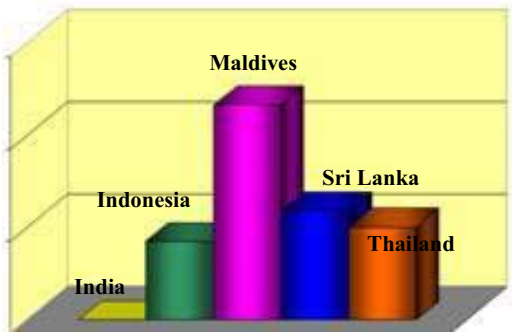


Figure 6: The importance of losses: losses vs. GDP, % (log)



From DaLa to Estimation of Macro-Economic Impacts

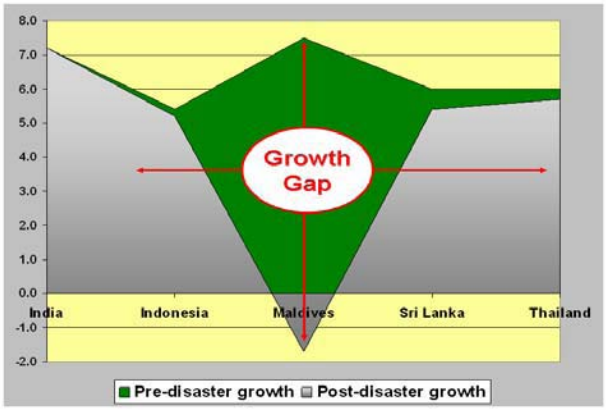
GDP Growth: Depending on the structure of damage and losses caused by a disaster and the size and structure of the affected economy, economic growth may be affected to varying degrees. Losses in production and revenue may be partially compensated by government intervention for promoting economic recovery, and/or investment in reconstruction. Recovery of growth varies over time depending on the severity of losses, the speed of reconstruction and recovery program implementation, and the size and diversification of the affected economy. This can be seen in the following table:

Table 2: Pre- and post-disaster growth rates

Growth Scenario	*India*	*Indonesia*	*Maldives*	*Sri Lanka*	*Thailand*
Pre-disaster, forecasted economic growth, %	7.2	5.4	7.5	6.0	6.0
Estimated reduction in growth rate by disaster, %	..	- 0.2	- 9.2	- 0.6	- 0.3
Post-disaster growth rate, %	7.2	5.2	- 1.7	5.4	5.7

In this table, it is clear that the expected economic growth of the economies will be negatively affected by losses in production. The construction sector will induce a positive effect derived from reconstruction and recovery activities. Overall, the net result may still be negative, which will slow down the economic growth envisaged before the disaster occurred.

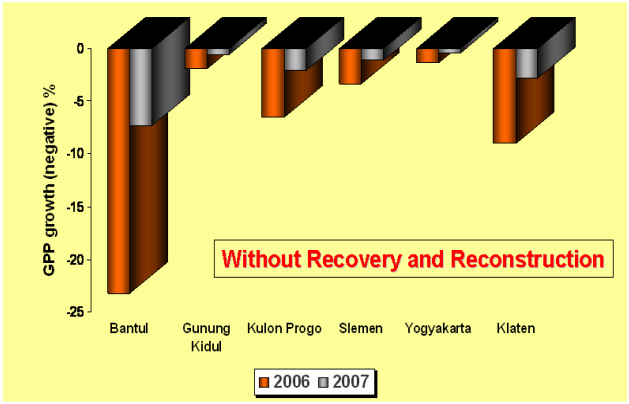
Figure 7: Impact on losses on GDP: Indian Ocean Tsunami 2004



Another example of the impact on growth can be seen in Figure 7. This shows the estimated growth prior to the Tsunami compared to the *actual* growth rates after the disaster. The difference between the projected growth and the actual growth is termed a "growth gap", and indicates the impact of the disaster on GDP growth. In this figure, we can see that the growth gap was highest for Maldives.

Figure 8 presents another example of the impact of a disaster on GDP growth. Here we can see that GDP growth after the Yogyakarta Earthquake was negative for all affected districts for the year of the disaster and the year following the disaster. This figure reflects the extent to which GDP growth rates remain negative over time without recovery and reconstruction efforts. In other words, without any interventions in recovery and reconstruction, GDP growth may remain negative for several years following a natural disaster.

Figure 8: 2006 Yogyakarta Earthquake



While GDP growth rates were negative for 2006 and 2007 for all the affected areas, in breaking down GDP growth by district, we can see that the effects of the disaster on GDP growth are particularly concentrated in the district of Bantul, followed by Gunung Kizul and Kiglan. This type of breakdown can assist reconstruction efforts to target efforts in the most affected districts.

Impact on Fiscal Budget: The assessment should also take into consideration the impact on the fiscal budget due to declines in revenues. These revenue declines can occur as a result of lower economic activity and special tax exemptions, and an increase in expenditures due to unexpected outlays for humanitarian assistance and rehabilitation.

Figure 9 presents an increase in deficit in the fiscal budget that occurred as a result of a natural disaster. Here, government receipts are compared to government expenditures, and the balance of these two indicates either a surplus or a deficit. Prior to the disaster, the State of Gujarat, India, was operating at a high budget surplus. Government expenditures were on the rise, but so were Government receipts, and the surplus was decreasing. However, as a result of a natural disaster, Government expenditures rose sharply, creating a drop in the surplus and a resulting deficit. The deficit is due to both rising expenditures, and stagnant receipts creating a growing deficit (see Figure 9).

Figure 9: Impact on government finances: State of Gujarat, India

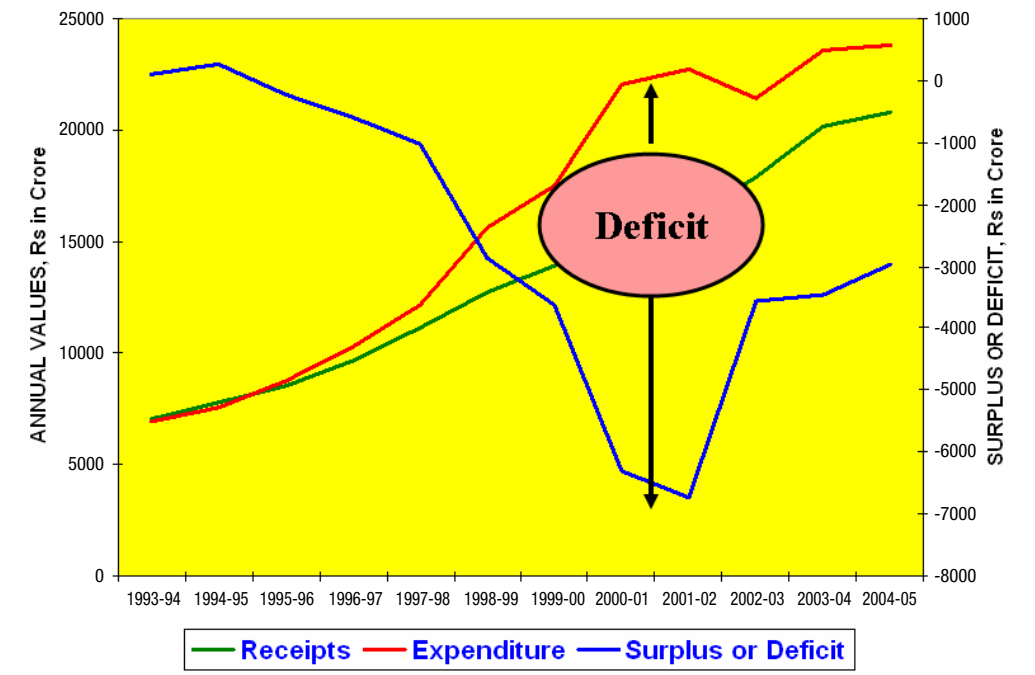


Table 3 shows a similar scenario of the effects of a natural disaster on the fiscal deficit. This is an estimation of how El Salvador's fiscal budget would look in the case of a flu pandemic. Here, the table indicates that the impact of the flu pandemic would result in a doubling of the fiscal deficit, from a deficit of US$ 74.2 million to US$ 143.2 million.

Table 3: Impact of the flu pandemic on El Salvador's fiscal budget performance

	No pandemic	*After pandemic*
A. Central Government Performance (Deficit)		
• Million US$	-74.2	
• As % of GDP	- 0.4	
B. Decline in revenues due to pandemic		11.8
Increase in expenditures due to pandemic		57.2
C. Central Government Performance (Deficit)		
• Million US$		- 143.2[1]
• As % of GDP		- 0.7

Impact on External Sector: The impact of the disaster on the balance of trade and payments should be estimated taking into consideration declines in exports due to production losses and an increase in imports, especially for goods not readily available after the disaster. The increase in imports may replace food production losses, and for construction equipment and materials, if no sufficient local production is available.

The impact of the pandemic on the country's balance of payments (BOP) is estimated on the basis of an increase in imports (e.g. medicines and equipment) and a decline in exports (e.g. agriculture) and family remittances from abroad (as current transfers). In the table below, the

[1] 143.2 = 74.2+11.8+57.2

result is an increase in the current account deficit from negative US$1.116 million to between negative US$1.431 and negative US$1.478 million depending on the intensity of the pandemic for 2006 alone. This figure is derived by subtracting the estimated losses (in this case for each scenario) from the actual BOP to arrive at the revised BOP. Since the decline in tourism income will experience a further increase in 2007, the situation of the current account balance is estimated to deteriorate further.

Table 4: Impact of flu pandemic on balance of payments in Jamaica (US$ Million)

Item	*Actual BOP*	*Estimated Losses*		*Revised BOP*	
		Moderate	Severe	Moderate	Severe
Goods Balance	- 2,911			-2,953	-2,972
Exports	2,016	-8.78	-12.43	2,007	2,004
Imports	4,927	+33.50	+48.40	4,961	4,975
Services Balance	788	-206.39	-206.39	582	582
Income	- 663	-		- 663	- 663
Current Transfers	1,670	-66.52	-94.29	1,603	1,576
Current Account Balance	- 1,116			- 1,431	- 1,478

The Social Impact of Disasters: Personal Income

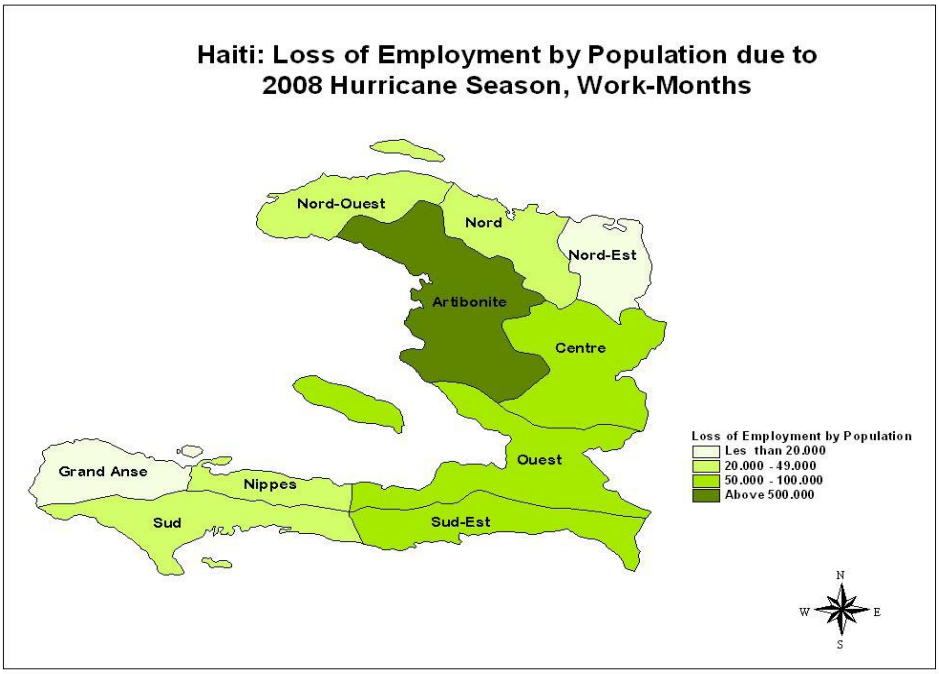
Aside from the macro-economic level, the damage and loss assessment also looks at the personal and household level by measuring losses to income and employment for populations in the affected areas. Depending on the data collected during the course of the assessment, which, in turn, will depend on the particular disaster and local context, the effects of the disaster can be broken down further to pinpoint areas or segments of the population that were particularly hard hit by the disaster.

Figure 10 provides an example of differentiating the impacts of the 2008 Cyclone Season in Haiti by gender and by sector of employment. Here we can see that males were disproportionately affected in terms of loss of employment, with losses estimated at US$ 24.6 million for men and US$10.9 million for women. In addition, we can see which of the sectors face the greatest losses, and whether these sectors employ primarily men, women or both equally. For example, the agriculture, fisheries and industry sectors saw greater losses of employment for men, whereas the commerce and tourism sector saw greater losses of women.

Figure 10: 2008 cyclone season in Haiti: loss of employment

The concentration of disaster effects can also be presented in a map that highlights the affected districts. The figure below presents the loss of employment by population broken down by district. In addition, the district of Artibonite was more severely affected than other districts. This information can help policy makers to design recovery programs that focus on this district, and on the type of employment that was lost.

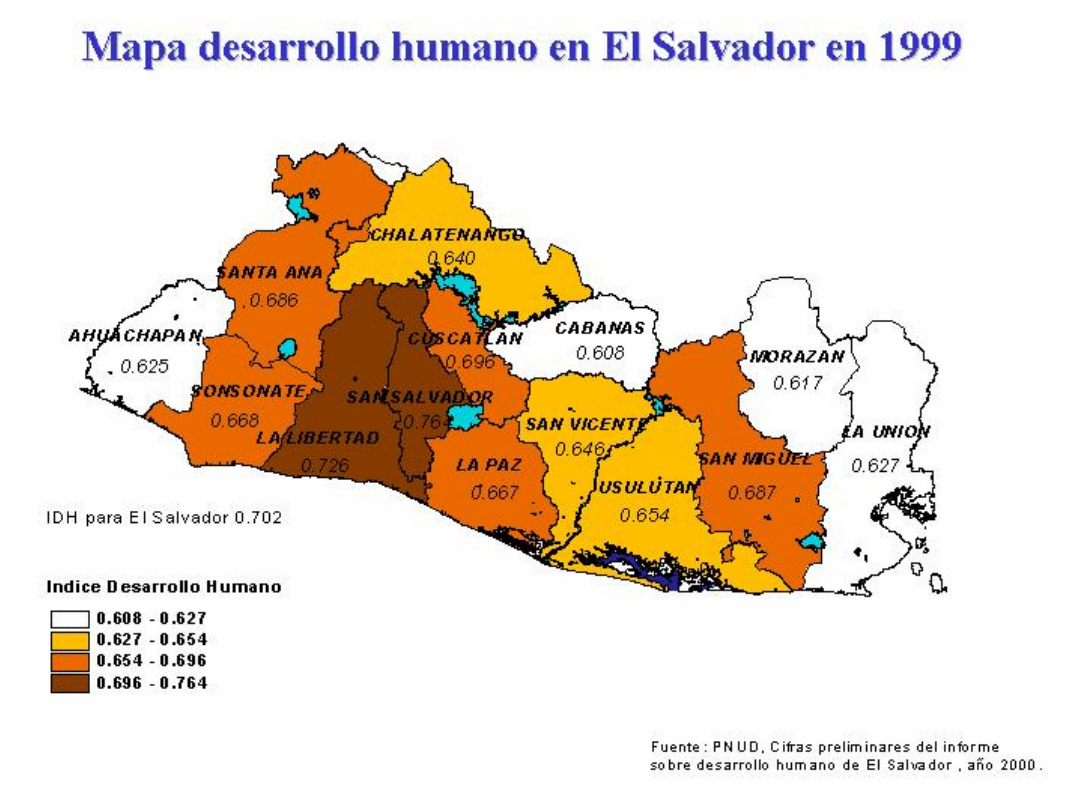
Figure 11: Haiti: loss of employment by population due to 2008 hurricane season, work-months



Depending on the data available *prior* to the natural disaster, the impact of the disaster on poverty can be determined. Figure 12 and show a pre- and post- disaster assessment of the Human Development Index (HDI) in El Salvador. The HDI combines measures of poverty,

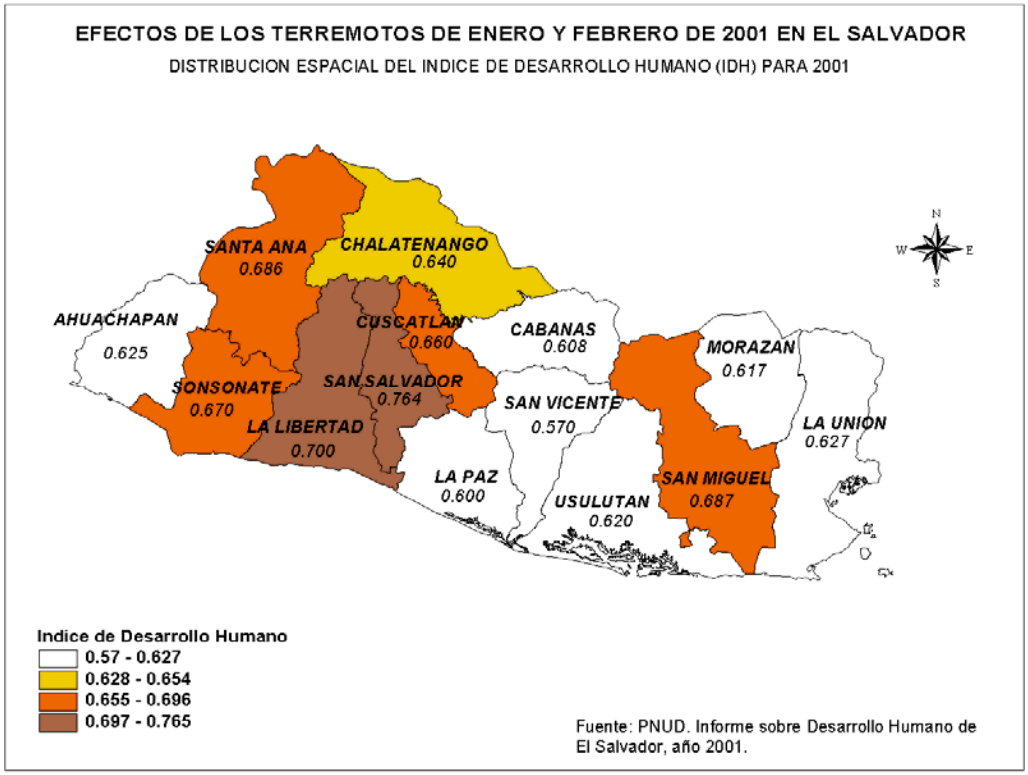
including income and health among others. When the Human Development Index is high, it reflects less poverty in the country, whereas when the index is low, the standards of living are lower. The figures below give us a picture of the *impact* of a natural disaster on the HDI (and subsequently poverty).

Figure 12: HDI, El-Salvador (1999)- pre disaster



In Figure 12, the HDI for 1999 shows a breakdown by district. While there is some variation in development between districts, overall we can see that, when compared to, the HDI has fallen in every district, as represented by each of the districts becoming lighter shades (darker colors indicate higher HDIs). In comparing the measures of the HDI by district, we can see that after the disaster poverty rates (as measured by lower HDI scores) rose in almost all districts.

Figure 13: HDI, El-Salvador (2001)- post disaster



Conclusion

The damage and loss assessment provides a simple rapid assessment toolkit to measure the impacts of a natural disaster on physical assets (damages) and economic flows (loss). The data collected during this assessment can be used to derive the relative impacts of the disaster, by comparing it to pre-disaster data. In addition, data can be broken down to further assess where the greatest damages and losses occurred. Typical ways to break down the damages and losses tend to be according to geographic area (district, province, etc.), by gender, or by level of poverty.

Assessing the damage and loss, then, provides a value for what would be needed to rebuild destroyed assets and restore pre-disaster economic flows. In addition, the assessment can provide a useful guide for where to concentrate efforts by providing a snapshot of where the natural disaster had the greatest impact. But what can be done to address issues of vulnerability? While this will be addressed in greater detail in the following sections, there is often a discrepancy between the value of damage and loss, and the value assessed for needs, since many of the destroyed physical assets could be "built back better" to avoid similar damages in future natural disasters. The damage and loss assessment is designed to guide and help governments, donors and other stakeholders in how to build back better, and to assist in identifying priorities for intervention.

III. Steps in the Application of the ECLAC Methodology

The following section outlines the steps needed to undertake a damage and loss needs assessment.

Step 1: Develop Baseline for Assessment

The baseline should provide a picture of the sector prior to the disaster (or the pre-disaster situation). This should account for a baseline of physical assets within affected area, before occurrence of disaster, and a baseline of performance on production and sales within affected area, expected before disaster occurs. This lays out the baseline for damages. The baseline should also provide a picture of the pre-disaster stock of physical assets. These can include the number and type of housing units, number and level of schools, number and category of health facilities, irrigated agricultural area, number and size of industrial facilities, number and characteristics of water supply and sanitation systems, capacity and number of electrical facilities and networks, length and type of roads, number and capacity of airports, etc..

The baseline should also account for how the sector was performing prior to the disaster. This provides a baseline of performance on production and sales within affected area, expected before disaster occurs, and will lay out the pre-disaster scenario for losses. This type of information could include a calendar of agriculture production activities (annual crops and plantations), production and sales forecasts for ongoing and subsequent years in each sector, statistical information on volume of production, yields, prices (at farmgate, wholesale and retail levels), data on volume of transport (cargo and persons) and unit costs of transport in different modes of transport, statistical information on electricity sales (volume and rates) by main sector users, etc..

Step 2: Develop Post-Disaster Situation

The second step in conducting a damage and loss assessment is to determine what the post-disaster situation is. This focuses on whether there has been total or partial destruction to physical assets and is generally determined through a field survey. Physical assets should be divided into types by size, capacity, construction material, or any other relevant criteria for the sector. Once this is done, the prevailing repair and construction costs for each type of physical asset must be obtained. Then, a preliminary calendar of repair and replacement of physical assets, based on analysis of construction sector capacity and availability of construction materials should be developed.

The post disaster sector performance should be a conservative estimation of period of recovery and reconstruction of sector. As such, it should formulate expected post-disaster performance for sector, taking into consideration the expected staged repair/reconstruction of assets (supply), the possible interim supply (temporary solutions to supply problems), and the expected recovery of production (demand). Based on this, an expected temporary production recovery schedule, income and costs can be estimated.

Figure 14: Drop in supply due to damage in water supply plant

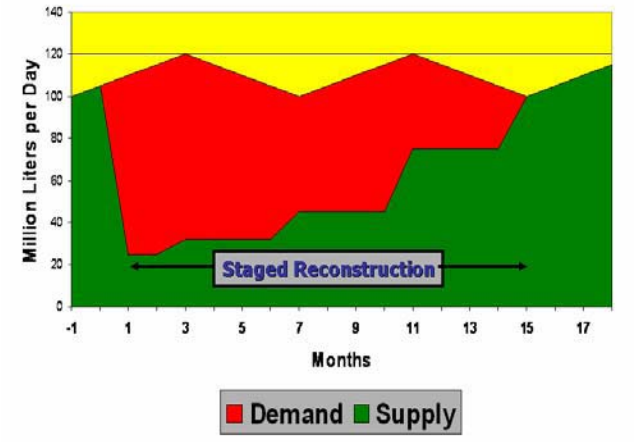
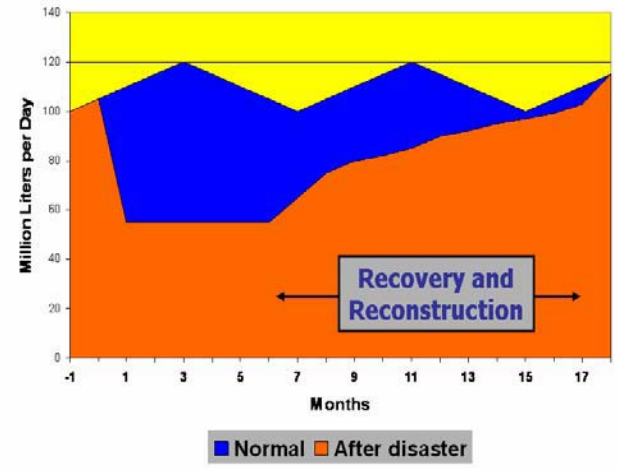


Figure 14 shows the impact of a natural disaster on a water supply plant. Damages to the plant severely restrict its ability to supply water, and here, demand far outstrips supply. The reconstruction period occurs over several months and slowly brings the water supply back to meet demands. The total reconstruction period for this example is in the range of 15 months. This time period reflects *realistic* assessments of a sector's ability to rebuild, given constraints in labor supplies, construction materials, etc..

Figure 15 shows a case where there has been a decline in demand for water because of destruction to housing units. Since houses have been destroyed, the overall demand for water supply has fallen off dramatically. Here the recovery and reconstruction period would reflect possible interim solutions to provide water services to people who have been evacuated from affected areas and whose houses have been destroyed. During the recovery and reconstruction period, demand is expected to pick up, although a realistic assessment of the time needed is in the range of 17 months after the disaster.

Figure 15: Drop in water demand due to destruction of housing units

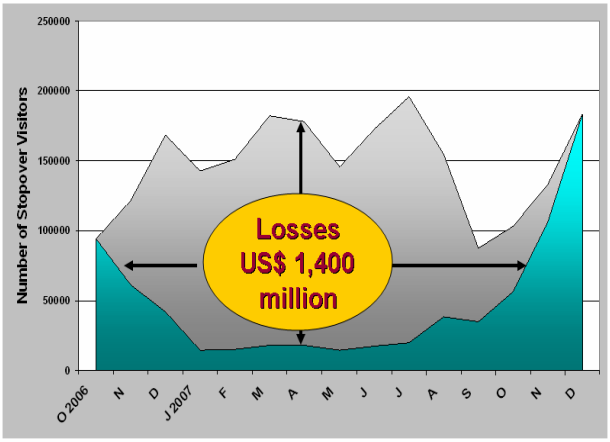


Step 3: Post-Disaster Sector Performance

The third step in conducting a damage and loss assessment is to examine the impact of the disaster in each sector. In other words, this compares a particular sector before and after the disaster through a series of indicators (the nature of each of the indicators will depend on the specific sector). The difference in both static and dynamic indicators will provide the basis for the damage and loss assessment.

Figure 16 provides an example of the impact of the disaster on the tourism sector. In this case, the difference between how many visitors were expected to have come without a natural disaster and the actual number of visitors represents the total value of losses. In this case, the losses amounted to US$ 1.4 billion (decrease in the number of stopover visitors has been converted into losses). For countries that rely on the tourism sector, a natural disaster can have a devastating effect on the economy.

Figure 16: Example of losses in tourism sector

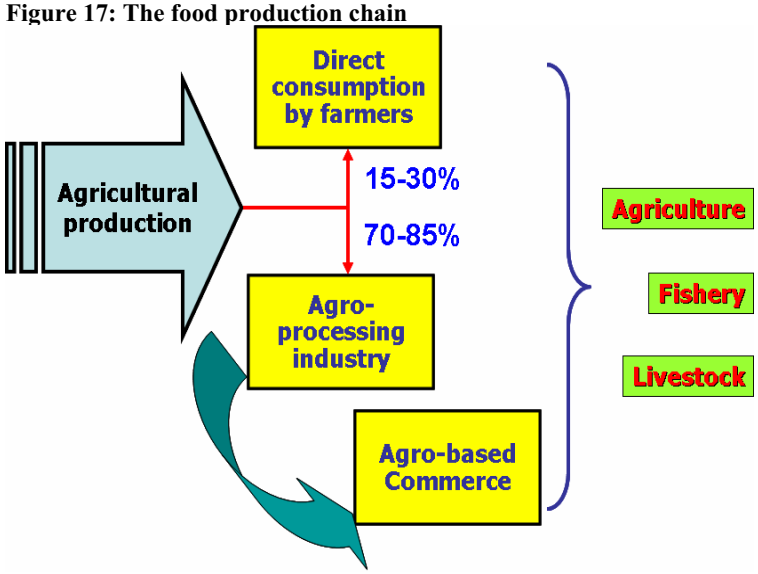


Step 4: Estimating Total Value of Damage and Losses

Once the damages and losses have been assessed for each sector and sub-sector, the total value of damages and losses for the disaster can be aggregated. In pulling together the damages and losses it is important to pay attention to linkages between sectors (i.e. food-producing chain and others), to ensure that damages and losses that have been accounted for in one sector have not been double accounted in another, thereby inflating the actual damage and loss estimates. Likewise, in the process of estimating the total value of damages and losses, particular attention should be paid to areas that were perhaps omitted from estimates of sector performance, since these gaps could underestimate the total value of damages and losses.

Double accounting often happens between sectors, since their activity is counted across different sectors. One example of this is the food production chain, since it involves the agricultural sector, as well as the commerce sectors. It is estimated that, on average, about 70-85 percent (depending on the stage of development) of agricultural production makes it to agro-processing industries and then commerce. Estimating losses, then, runs the risk of double accounting losses that have been accounted for earlier in the food production chain. To avoid duplication, agriculture, livestock and fishery losses should be measured at prices paid to producers; not at wholesale or retail market prices.

Figure 17: The food production chain



Duplications can happen in any sector. In the water supply and sanitation sector, duplications can be avoided by estimating damage and losses separately from human settlements or the housing sector. Farm roads should normally be included in the agriculture and livestock sector; not in transport (unless other arrangements are agreed upon beforehand), and the tourism sector should not include damage to roads or other transport infrastructure and assets. Damage to lands and soils is typically included in the agricultural sector but can also be included in the housing sector, as appropriate. Damage to natural resources should be included in the section on environment, avoiding duplication with other sectors when estimating total damage and losses. Fundamentally, there should be close coordination of analysis between sector assessment specialists, and special care by person entrusted with summary of damage and losses and with overall impact assessment.

Step 5: Estimate Macro-economic Impact of Damage and Losses

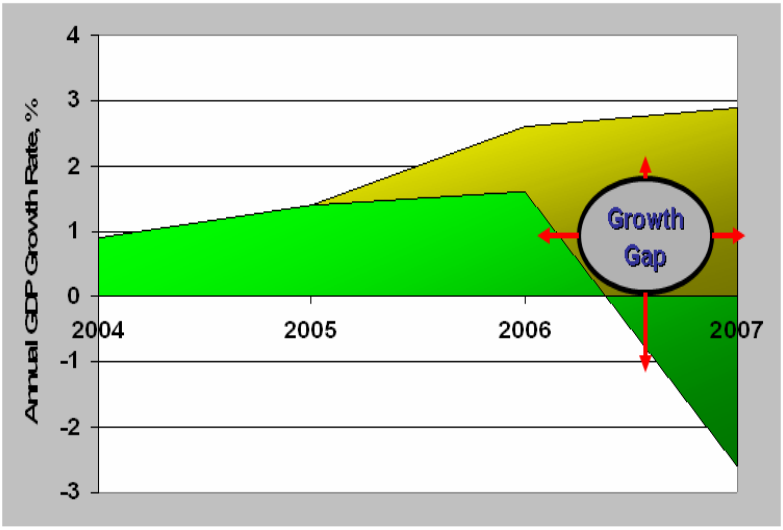
The macro-economic impact of damage and losses is generally calculated by assessing the impact on GDP, balance of trade and payments, and the fiscal budget. The table below is an example of a typical table used to conduct a GDP impact analysis. The first step in conducting this analysis is to obtain the most recent figures available for GDP *prior* to the natural disaster. As a baseline for analysis, assessors should obtain the most recent estimates or projections of macro-economic variables (GDP, BOP, fiscal budget) for current and forthcoming year(s) for non-disaster or pre-disaster conditions. The data for GDP and fiscal budget should be obtained in current values of local currency, whereas the data for BOP should be in current US dollars. Data for GDP should include a breakdown by sectors.

These values should be entered into column 1. Next, the gross losses by sector that were estimated as a part of the damage and loss assessment should be entered into column 2. These should be multiplied by the value-added coefficient (column 3) and the results entered into column 4, value-added losses. The value added coefficients capture the linkages between sectors of the economy, so when there are production losses in one sector, this value-added coefficient would capture the losses in other relevant sectors. These values are generally available from the Finance or Planning Ministry, who is responsible for determining the size of GDP. The value added losses (column 4) are then subtracted from the pre-disaster GDP (column 1) to determine the post-disaster GDP. These results are entered into column 5. The table below gives a sample of how the table is constructed.

Table 5: Example of a table used to conduct a GDP impact analysis

Sector	*Pre-Disaster GDP*	*Gross Losses*	*Value-Added Coeff.*	*Value-Added Losses*	*Post-Disaster GDP*
	1	2	3	4	5
Agriculture					
Industry					
Trade					
Tourism					
Transport					
Others					
TOTAL					

Figure 18: Disaster impact on GDP



To ascertain the impact of the disaster on GDP, convert pre and post-disaster GDP figures from previous table into constant values. Then, compare pre-disaster and post-disaster GDP growth rates to ascertain the impact of disaster. Pre-disaster growth rates include the actual growth rates published for any recent years available (including the year of the disaster), and the projected growth rates for subsequent years. The difference between the actual and the projected growth rates are the growth gap that resulted from the disaster. As shown in Tables 3 and 4, the impact on fiscal budgets and balance of payments, respectively, can also be calculated following a disaster.

Step 6: Estimate Impact on Personal/Family Income

Generally, the personal income loss estimation aims to develop a relationship between production and the labor force, for all sectors of activity, and for non-disaster conditions in affected country. From the estimates of production losses in each sector, loss in potential employment can be estimated. Next, the average monthly wages paid under normal conditions should be determined for each type of job lost. Finally, the loss to personal income can be estimated, and measured in relation to normal monthly income. This impact can be estimated by income groups. In addition, these figures can be measured according to the poverty lines to look at how the disaster has, for example, increased the number of people living in poverty. This data can also be used to differentiate the impact of the disaster on wages by district, by income level, or by gender, where relevant. Baseline data (or, pre-disaster estimates) are typically available in national accounts, in household surveys, or through the International Labour Organization (ILO).

Conclusion

This section provided a step-by-step overview in conducting a damage and losses assessment. We now turn to sector-specific assessments that will guide practitioners in conducting assessments in their own sectors.

Module 2: Conducting DaLa by Sector

IV. Sectoral Overview by Disasters

The following sections provide a sector by sector overview of how to conduct damage and losses assessments. Depending on the type of the disaster, and the sector in question, the total impact of damages and losses can vary. For example, earthquakes and floods tend to result in severe damages across all sectors, whereas the losses from earthquakes and floods tend to be located more in the infrastructure sectors. Table 6 provides an example of the severity of damages sustained in each sector, and Table 7 provides an example of losses sustained in each sector.

Table 6: Severity of damage in sectors

Sector	Earthquake		Floods		Drought	
	Damage	Losses	Damage	Losses	Damage	Losses
Social Sectors						
Housing						
Education						
Health						
Productive Sectors						
Agriculture/livestock						
Industry						
Commerce						
Infrastructure						
Water/Sanitation						
Electricity						
Transport/Comm						

Table 7: Severity of losses in sectors

Sector	Earthquake		Floods		Drought	
	Damage	Losses	Damage	Losses	Damage	Losses
Social Sectors						
Housing						
Education						
Health						
Productive Sectors						
Agriculture/livestock						
Industry						
Trade/Commerce						
Infrastructure						
Water/Sanitation						
Electricity						
Transport/Comm						

V. Productive sectors:

The productive sectors typically measured in a damage and loss assessment include agriculture, livestock, fisheries, industry, commerce, mining, and tourism. For each natural disaster, the assessment will cover the relevant sectors affected by the event.

Agricultural Sector

Damages to the agricultural sector are defined as full or partial destruction of assets in the sector. This includes destruction to agricultural land, permanent plantations, irrigation/drainage systems, storage facilities, and stored inputs/goods, farm machinery, and farm roads. Losses in the agricultural sector occur typically as a result of production losses or higher production costs. Production losses occur due to the loss of a full crop because of a disaster, or as a result of a decline in unit yields. Higher production costs occur as a result of things like more irrigation required for crops, or other increases in the use of inputs.

There are a few special characteristics in the agricultural sector when considering damages and losses because of natural disasters. The first is that agricultural production is seasonal, so damages and losses incurred in the sector will depend primarily on when in the season the disaster occurred. The agricultural sector, unlike most of the productive sectors, has a seasonality aspect in its production related to the variation of climate along the year. Therefore, criteria used to estimate production losses will vary depending on the time when a disaster occurs. In addition, the agricultural sector may sustain losses without incurring any damage to its physical assets (such as in the case of drought).

Procedure for Estimating Damage and Losses

The first step for estimating damages and losses in the agricultural sector is to conduct an initial analysis of the sector. This entails defining the type of production. These can differ based on whether crops are annual or permanent, irrigated or non-irrigated, labor-intensive or mechanized, and are for personal consumption or for domestic markets or exports. The second step is to define the calendar of production activities. For example, for annual crops, it is important to determine the planting and harvesting schedule and the number of crops planted in a given season.

Defining the calendar of production is essential to the estimation of damages and losses, since the timing of the disaster in relationship to crop production activities in the agricultural sector will determine whether there losses are estimated to be full or partial. If the disaster strikes at the end of the season, then losses are equal to the value of the entire crop production. If, however, the disaster strikes at the beginning or the middle of the season, then the estimated losses will depend on whether there is still adequate time to replant and harvest crops with little to no disruption to the next crop. If this is possible, then the losses will be “partial”, since losses are equal to the value of investment made before the crop was affected by disaster. If, however, it is not possible to replant and harvest crops, then the losses will be “total”, since losses are equal to the value of full crop production.

For plantations, if there was no destruction of trees and plants as a result of the disaster, then the estimated losses will be related to production. If, however, destruction of plants and trees

occurred, then damages can be estimated as the value of replanting trees and plants, and the losses as the sum of the value of standing production plus the value of production losses over time required for trees and plants to mature and begin producing. This might take several years, and the production losses should account for this.

Step-wise Procedure to Estimate Agricultural Losses

Step 1: Develop pre-disaster baseline

As with other sectors, the first step to estimating agricultural losses is to determine a baseline using historical data. Historical data should look at the "typical", or "normal" calendar of agricultural activities to develop a scenario of what happens in a typical year in terms of crop area, yield and production for different crops. Here it is important to use farmgate prices, and not retail prices, in order to determine value and to avoid duplication in counting losses with other sectors.

Step 2: Conduct assessment of disaster effects

The next step is to determine what would have happened if the disaster had *not* occurred. To do this, pre-disaster forecasts of production are used to establish a counterfactual (i.e. what would have been produced if the disaster had not struck). This forecast should include information such as planting intentions (cropped area), expected unit yields, and forecasted volumes of production by crops.

Step 3: Conduct post-disaster forecast

The next step is to develop an understanding of how the sector will perform given that the disaster has occurred. This should look at what the likely area, yield, and production of crops will be, given the disaster. These production estimates will depend on whether crops are estimated as fully destroyed as a result of the disaster, or whether crop yields have declined (but not be fully destroyed).

Step 4: Estimation of losses

The total agricultural production losses (Step 4) will be the pre-disaster production estimates minus the post-disaster production estimates. Losses can often continue on for several years, since, for example, trees may have been destroyed that will see a time lag of several years before they begin to bear fruit again. In the agriculture sector, typically losses are more pronounced than damages, although the extent to which this is true will vary depending on the crops (annual and perennial), timing of the disaster in the production cycle and any damages to perennial crops.

Estimation of Agriculture Losses in Case of Yield Decline

The first step to estimating agricultural losses in the case of yield decline is to obtain pre-disaster forecasts of production volumes based on area and yield forecasts (1). This procedure is similar to that mentioned in the previous section. Next, on the basis of advice from agronomists, the post-disaster volume of production must be estimated due to yield decline on the affected crops area (2). Once the production volumes have been estimated, the next step is to determine a price unaffected by disaster scarcity. This should be derived from historical information about farmgate prices. This will provide the basis for estimating the value of production losses, which can be calculated as the product of the volume of production loss (1 minus 2) multiplied by the farmgate price (3).

Assessment of Related Losses: The Food Processing Industry

When calculating losses in the agricultural sector, it is important to also identify the industries directly impacted by the effects of the disaster on the agriculture sector. Agricultural production is either directly consumed by farmers, or is processed at agro-industries. After processing, these same products are sent to markets for distribution and sale to the public and/or for export. Thus, when agricultural production is lost due to a disaster, subsequent losses in the forward links of the food chain will occur in both agro-industry and in commerce. Figure 17 shows some of the forward links in the food production chain.

Step-Wise Procedure to Estimate Agro-Industrial Losses

The first step in estimating agro-industrial losses is to obtain volume of losses in agriculture production, from the previous analysis (1). In consultation with agriculture specialists, the percent of each product retained by farmer for direct consumption must be ascertained (2). The estimated volume of loss as input to agro-industries is the difference between the total volume of production estimated in the first step, and the amount retained by farmers for home consumption (1 minus 2).

If input/output tables are available, then these can be used to determine the industry/agriculture ratio. Losses in agro-industry can then be estimated by combining the estimated volume of loss of inputs to agro-industries with the industry/agriculture ratio. If input/output tables are not available, then wholesale and farmgate prices can be used as a proxy to ascertain the added value derived from processing. To do this, the farmgate price must be subtracted from the wholesale price to establish the price differential. The losses to agro-industry can then be estimated as the volume loss as an input to agro-industry multiplied by the price differential derived above.

Case Study 1: Agricultural Sector in Thailand after the 2004 Tsunami

This particular case study deals with a damage and loss assessment in the agricultural sector in Thailand after the 2004 Tsunami. As a result of the Tsunami, waves reached agricultural lands located in the coastal areas in six Provinces of Thailand. Both standing annual and permanent crops were washed away and lost. Oil palm plantations sustained damage due to uprooting of plants in 18% of the affected area, and salt water was deposited in soils that will limit future crop production until salt is leached by natural drainage. The table below gives an overview of the cultivated area that was flooded with salt water:

Table 8: Agriculture sector by district and crop type, 2004 Tsunami, Thailand

Province	*Rice*		*Maize*		**Oil Palm**	
	Area, Rai	Area, Hectares	Area, Rai	Area, Hectares	Area, Rai	Area, Hectares
Krabi	15	2.4	5	0.8	40	6.4
Trang	100	16.0	167	26.7	21	3.4
Phang Nga	37	5.9			8,369	1,339.0
Phuket	10	1.6			80	12.8
Ranong	184	29.4	11	1.8	1,430	228.8
Satun	122	19.5			387	61.9
Total	**468**	**74.8**	**183**	**29.3**	**10,327**	**1,652.3**

Damage and Losses Assessment

Damages in this scenario amounted to the damages incurred to permanent plantation of oil palm. The value of the oil palms that were uprooted, and thus rendered unproductive, can be estimated from similar new plantations. For this, an average cost for replanting of US$ 25,000 per hectare was estimated.

In addition, production losses occurred as a result of the disaster. This affected both standing production, including annual crops and plantations, as well as future production of annual crops and plantations. Since the waves carried away the plants, standing crop production losses were estimated at a full crop loss for that year. However, given future yield reductions because of salinity in the soil, future production losses were also anticipated to occur. Thus, for annual crops (rice and maize), agronomists indicated reductions in yield due to salinity of 35% and 10% in 2005 and 2006, respectively. In the case of oil palm trees that were not uprooted, yield declines due to salinity were expected to be 15% and 5% in 2005 and 2006, respectively. Additional production losses were also calculated for oil palm plantations. New oil palms require three years to mature and begin normal production. Thus, no production will be realized until the fourth year in the case of the replanted trees (covering 18% of affected area).

In order to determine the full impact of the disaster on agriculture, the assessment team constructed baseline data of crop production that was available at the Ministry of Agriculture and Cooperatives (MOAC) in Thailand.

Table 9: Unit yields and farmgate prices in all affected provinces

Crop	*Item*	*Krabi*	*Phang-Nga*	*Phukent*	*Ranong*	*Satun*	*Trang*
Rice							
	Unit yield, Kg/ha	17.20	50.10	17.20	13.20	64.00	64.00
	Farmgate price, US$/Kg	146.15	146.15	146.15	146.15	146.15	146.15
Maize							
	Unit yield, Kg/ha	91.20	91.20	91.20	91.20	91.20	91.20
	Farmgate price, US$/Kg	123.08	123.08	123.08	123.08	123.08	123.08
Oil Palm							
	Unit yield, Kg/ha	480.00	480.00	480.00	480.00		432.00
	Farmgate price, US$/Kg	58.97	58.97	58.97	58.97		58.97

Source: MOAC, 2003

Using this data, the assessment team was able to calculate the losses in production for annual and for permanent plantations and the results are repeated in Table 10 and Table 11.

Table 10: Estimated production losses for annual crops, Thailand 2004

Annual Crops	***Krabi***	***Phang Nga***	***Phuket***	***Ranong***	***Satun***	***Trang***	Total
RICE							
Area, hectares	2.4	5.9	1.6	29.4	19.5	16.0	
Unit yield, Kg/ha	47.20	50.40	47.20	43.20	64.00	64.00	
Normal production, Kgs	113.3	297.4	75.5	1270.1	1248.0	1024.0	
First year, 100% loss	113.3	297.4	75.5	1270.1	1248.0	1024.0	
Second year, 35% loss	39.65	104.08	26.43	444.53	436.80	358.40	
Third year, 10% loss	11.33	29.74	7.55	127.01	124.80	102.40	
Total losses, Kgs	164.26	431.17	109.50	1841.62	1809.60	1484.80	
Unit price, US$/Kg	146.15	146.15	146.15	146.15	146.15	146.15	
Value of losses, US$	24,007	63,017	16,004	269,159	264,480	217,009	**853,677**
MAIZE							
Area, hectares	0.8			29.4		26.7	
Unit yield, Kg/ha	91.20			91.20		91.20	
Normal production, Kgs	72.96			2681.28		2435.04	
First year, 100% loss	72.96			2681.28		2435.04	
Second year, 35% loss	25.54			938.45		852.26	
Third year, 10% loss	7.30			268.13		243.50	
Total losses, Kgs	105.79			3887.86		3530.81	
Unit price, US$/Kg	123.08			123.08		123.08	
Value of losses, US$	13,021			478,505		434,561	**926,087**
TOTAL VALUE OF LOSSES, US$	**37,027**	**63,017**	**16,004**	**747,665**	**264,480**	**651,570**	**1,779,764**

Table 11: Estimated production losses for permanent plantations

Plantation Crops	*Krabi*	*Phang Nga*	*Phuket*	*Ranong*	*Satun*	*Trang*	**Total**
OIL PALM, plants not uprooted							
Area, hectares	4.6	964.1	9.2	164.7	44.6	2.4	
Unit yield, Kg/ha	480.00	480.00	480.00	480.00	480.00	480.00	
Normal production, Kgs	2,211.84	462,758.40	4,423.68	79,073.28	21,392.64	1,057.54	
First year, 100% loss	2,211.84	462,758.40	4,423.68	79,073.28	21,392.64	1,057.54	
Second year, 15% loss	331.78	69,413.76	663.55	11,860.99	3,208.90	158.63	
Third year, 5% loss	110.59	23,137.92	221.18	3,953.66	1,069.63	52.88	
Total losses, Kgs	2,654.21	555,310.08	5,308.42	94,887.94	25,671.17	1,269.04	
Unit price, US$/Kg	58.97	58.97	58.97	58.97	58.97	58.97	
Value of losses, US$	156,530	32,749,056	313,060	5,595,955	1,513,829	74,841	40,403,272
OIL PALM, uprooted plants							
Area, hectares	1.2	241.0	2.3	41.2	11.1	0.6	
Unit yield, Kg/ha	480.0	480.0	480.0	480.0	480.0	480.0	
Normal production, Kgs	552.96	115,689.60	1,105.92	19,768.32	5,348.16	264.38	
First year, 100% loss	552.96	115,689.60	1,105.92	19,768.32	5,348.16	264.38	
Second year, 100% loss	552.96	115,689.60	1,105.92	19,768.32	5,348.16	264.38	
Third year, 100% loss	552.96	115,689.60	1,105.92	19,768.32	5,348.16	264.38	
Fourth year, 100% loss	552.96	115,689.60	1,105.92	19,768.32	5,348.16	264.38	
Total losses, Kgs	2,211.84	462,758.4	4,423.68	79,073.28	21,392.64	1,057.54	
Unit price, US$/Kg	58.97	58.97	58.97	58.97	58.97	58.97	
Value of losses, US$	130,442	27290880	260884	4663296	1261524	62368	33669393
TOTAL VALUE OF LOSSES, US$	**286,972**	**60,039,936**	**573,944**	**10,259,251**	**2,775,353**	**137,209**	**74,072,665**

The table below gives an estimate of the value of damages to oil palm plantations. The team estimated that the total value of damage was US$ 74.3 million.

Table 12: Estimated value of damage in oil palm plantations

Total area affected, in hectares	1,652.3
Area where trees were uprooted (18% of total area affected) in hectares	297.4
Unit value for replanting of oil palm trees(in US$ per hectare):	25,000
Value of damage	**US$74.3 million**

Once the damages and losses were assessed for rice, maize and oil palm in the affected provinces, a summary of damages and losses could be calculated. This is presented in the table below:

Table 13: Damage and crop production losses from the 2004 Tsunami, Thailand

Item	*Krabi*	*Phang Nga*	*Phuket*	*Ranong*	*Satun*	*Trang*	***Total***
Damage	28800	602550	57600	1029600	278550	15300	**74353500**
Losses	323999	60102953	589949	11006916	3039833	788779	**75852429**

The table above gives the initial estimation of the damage and losses from the Tsunami. Production losses deal with both the annual crops (rice and maize) and the perennial crop (oil palm) Losses include the several year period needed to fully recover in terms of economic flows, and this calculation is presented in the table below:

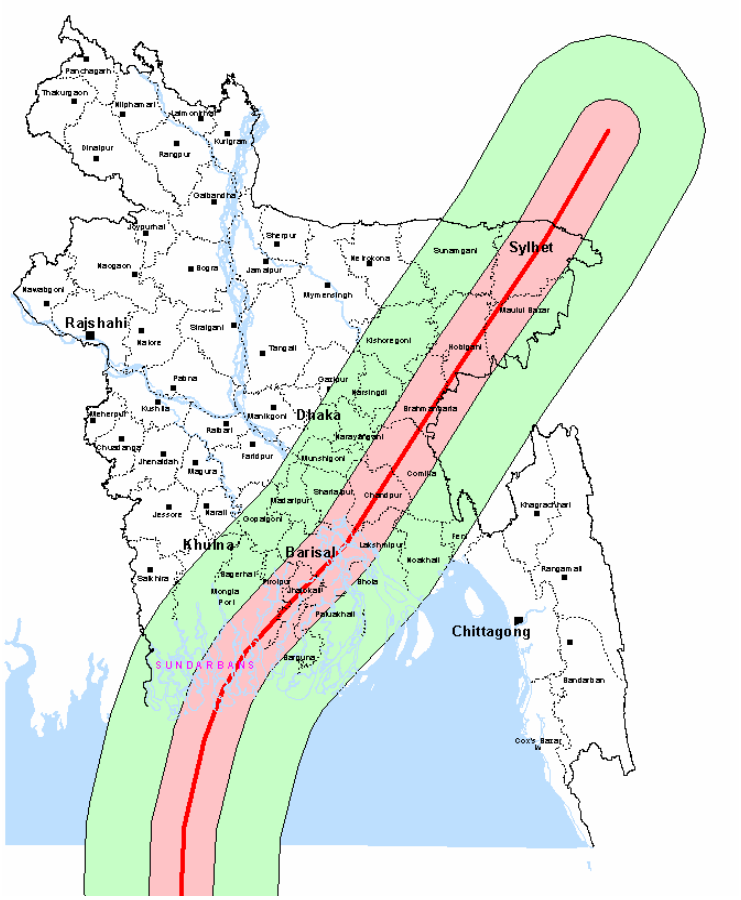
Table 14: Losses estimated for the 2004 Tsunami, Thailand

Loss/Year	*2004*	*2005*	*2006*	*2007*	**Total**
Losses, Million US$	43.3	13.9	10.2	8.4	**75.9**

Case study 2: Agricultural Sector in Bangladesh after Cyclone Sidr

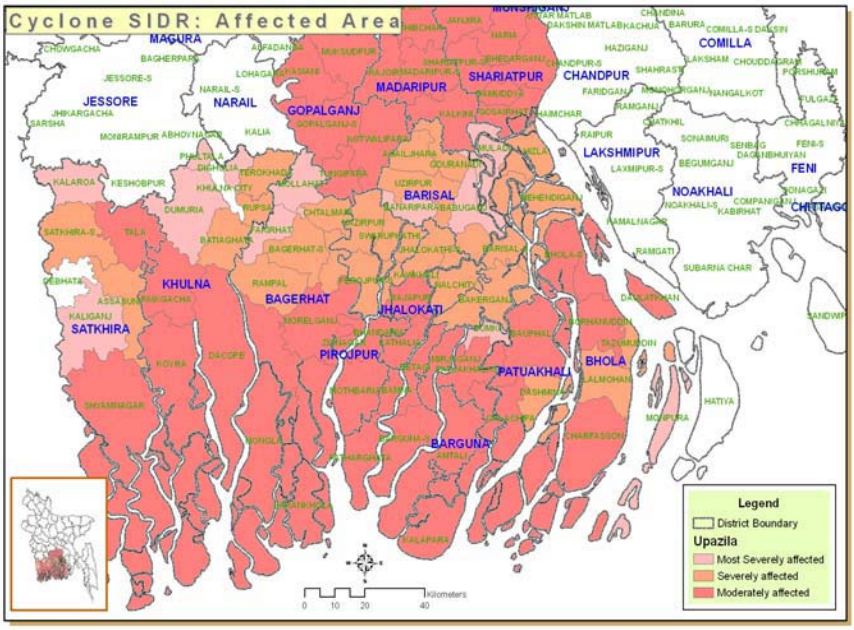
This particular case study deals with damage and loss in the agricultural sector in Bangladesh after Cyclone Sidr in 2007. Cyclone Sidr made landfall on the south-west coast of Bangladesh on November 15, 2007. A category 4 storm, the cyclone brought winds of up to 240 km/hr and tidal waves and surges of up to 6 meters high. Figure 19 shows the path of Cyclone Sidr.

Figure 19: The path of Cyclone Sidr



The disaster affected 2.3 million households (about 10% of the population), of which around 1 million were considered to be severely affected. Around 3,500 people lost their lives, over 1,000 went missing and 55,000 were injured. A Joint Damage, Loss and Needs Assessment conducted shortly after the disaster estimated the total damage to be US$ 1.2 billion, and losses to be US$ 0.5 billion. Almost 80% of the losses (US$ 0.4 billion) were concentrated in the agricultural sector. The coastal districts were the severely affected districts by Cyclone Sidr.

Figure 20: Cyclone Sidr, affected areas



The agricultural sector in Bangladesh is quite significant, with a 21% share of GDP (direct) and 33% as indirect contributions. Around 40% of the population in Bangladesh lives below the poverty line, and 85% of poor live in rural areas and are engaged in agriculture. Around three quarters of the population in Bangladesh is rural, and marginal and small farmers make up 80% of farm families (see Table 15). The rural landless in Bangladesh are around 30% of the population. These figures indicate the important role that agriculture plays in terms of sustaining livelihoods of the poor and rural populations. Thus, the effects of the disaster have disproportionately affected a particularly vulnerable segment of the population.

Table 15: Land distribution and farm size in Bangladesh

Farm size	*% Farm families*	*% Area*	*Av. Farm size (ha)*
Small	80	41	0.35
Medium	18	42	1.61
Large	2	17	4.70
Total	100	100	0.68

Cyclone Sidr caused significant damages to rural infrastructure and economic assets, a loss of agricultural (crops, livestock, and fisheries) production, a loss in rural household income, and an increase in unemployment in the rural areas. The sub-sectors examined during the damage and loss assessment were crops, livestock and fisheries. For each of these sectors, the relevant ministries were responsible for coordinating information.

Crops

Approximately 2.2 million farm families were affected by Cyclone Sidr. The extent of damage and loss depends on the location of each family. The total damage and loss for the crops sub-sector is estimated to be about US$412 million, although Cyclone Sidr induced an increase in salinity, and sand/sediment deposition also had an adverse impact on crop production and agricultural land that is not accounted for in this figure. Furthermore, the quality of the standing crop as well as the stalk (used as fodder) was also affected adversely.

Total losses to crops were estimated as follows. The team determined the total standing area under a crop, and then identified the affected crop area. Next, for a particular crop, the team assessed the totally damaged crop area (A) and the partially damaged crop area (B). The total damaged crop area was equal to (C=A+aB). The possible loss in production was calculated as (Q=CxY), and the estimated value of production loss for one crop was (V=QxP). The estimated total loss was the sum of the value of production loss for all crops. The table below gives a breakdown of estimated crop losses:

Table 16: Breakdown of estimated crop losses

Crop	*Possible losses in potential production (MT)*
Rice	804,958
Vegetables	177,955
Pulse Crops/Lentil	41,630
Mustard	21,744
Betel Leaves	25,416
Banana	93,383
Papaya	24,488

In addition to the crops above, betel nut and coconut trees were also damaged over 4,250 acres and 475 acres of land, respectively. This implies output loss over several years as well damage that is equal to the replanting cost of these trees.

Other crop related effects included an **i**ncrease in soil salinity, soil erosion, sediment deposition on soil, reduced output quality of standing crop, reduced quality of stalk (used as fodder), and destruction of Boro seed beds. Some of these effects are likely to last for more than one year. Rice is a staple crop in food-deficit Bangladesh. It is estimated that Aman rice production declined by about 0.8 million MT. This is about 7% of Aman rice production and 3% of total rice production. Almost 50% of the loss was in 4 severely affected districts, and most of the affected farmers were marginal and small.

Livestock

Livestock is an important sub-sector for the rural landless and marginal and small farmers. Raising livestock is not only a labor-intensive activity but it also generates regular monthly income from the sale of milk, eggs, poultry, and goats. Most of the damage to the livestock sub-sector was caused by the tidal surge (hence drowning of animals and birds) and falling trees. The total assessment of damage and losses are presented in the table below:

Table 17: Damage and loss for livestock

Damage and Loss, Sector	*Amount (US$ millions)*
Damage	Positive
Loss	19.3
Public	0.16
Private	19.2

The assessment team traveled to the affected areas to assess the impact on livestock and estimated the animal and poultry deaths, as follows:

Table 18: Livestock, animal and poultry deaths

Animal	*Number of deaths*
Cows	37,391
Buffalo	7,211
Goat	59,804
Sheep	3,517
Chicken	2,219,328
Ducks	353, 691

Once the number of deaths was determined, the estimated value of these damages was derived by estimating the value of each animal. Thus, the total estimated value is equal to the number of deaths multiplied by the average price. Almost 75% of the deaths were in the 4 severely affected districts. Most of the livestock owners were landless households and marginal and small farmers.

Other livestock related effects of the disaster included the damage (total or partial) to animal and poultry sheds (private); damage to sheds and buildings (public), damage to pasture (brackish water), loss of fodder, and loss of milk, meat and eggs. The table below gives the breakdown of estimated damage to the livestock sub-sector:

Table 19: Breakdown of estimated damage to the livestock sub-sector

Sector	*Value (US$ million)*
Public Sector Infrastructure	0.16
Private Sector	19.17
-Infrastructure	1.01
-Feed	4.90
-Dead animal/poultry	13.26
Total	**19.33**

Fisheries

The fisheries sub-sector is one of the fastest growing agricultural sub-sectors in Bangladesh. Most of the growth is attributed to fish and shrimp aquaculture. The cyclone-affected coastal districts are important for aquaculture, particularly for shrimp (bagda) aquaculture because of the presence of brackish water. Approximately, 75 percent of all shrimp in Bangladesh is produced in Cyclone Sidr-affected coastal areas. The damage and loss from Cyclone Sidr consists of damage to fisheries infrastructure (such as ponds, dighis, and ghers), damage to private fishing equipment (such as boats and nets), and damage to public infrastructure (such as boundary walls, roofs, and electric lines in fisheries-related public buildings). The following table presents the damage and losses in the fisheries sub-sector:

Table 20: Damage and loss assessment fisheries

Damage, Loss and Ownership	*Value (US$ million)*
Damage	2
Loss	4.7
Public	0.11
Private	6.6

The table below provides a breakdown of physical damage and loss:

Table 21: Breakdown of physical damage and loss

Damage/Loss	*Units*
Damage to ponds/dighis/ghers	113,914 number and 87,096 acres
Loss of fish/shrimp/fingerlings	
Fish	5,414 ton
Shrimp	707 ton
Damage to fishing equipment	
Boats	1855 number
Nets	1721 number

Damages to the fisheries sector also include damage to fish ponds, dighis and ghers. Until such time that ponds, dighis and ghers are rehabilitated and restocked, fish and shrimp production will remain low. While loss of fish, shrimp and fingerlings were also included in the assessment, washed away fish and shrimp loss to individual households may not be a total loss to the economy since catch in the open water fisheries is likely increase. The table below gives a breakdown of damage and losses in the fisheries sub-sector:

Table 22: Breakdown of damage and loss in the fisheries sub-sector

Damage/Loss	*Value (US$ million)*
Public sector damage	0.11
Private sector Damage and Losses	6.6
Washed away fish loss	2.56
Washed away shrimp loss	2.02
Washed away fingerlings loss	0.13
Damage to boats and nets	1.89

Losses to Agro-industry

Losses in agricultural production (crops, livestock and fisheries) imply a reduction in marketable surplus, and a reduction in supply of raw material to agro-industry. Through forward linkages, this results in losses in value added, in employment, in business/commerce, and in household income/business income.

Macroeconomic Impact

The next step in the assessment was to calculate the effect of damage and losses to the agricultural sector on economic growth, balance of payments and the fiscal budget. Since there was an overall loss to agricultural output, economic growth was adversely affected. The balance of payments was also negatively impacted, due to (a) an increase in rice imports ($200 million), other foods and agricultural inputs; and (b) a decrease in shrimp exports. The fiscal budget was negatively impacted, due to increased expenditure for (a) relief; (b) agricultural recovery; (c) livelihood recovery; and (d) agricultural reconstruction.

Socio-economic impact

The socio-economic impacts of the disaster were felt in five broad areas. First, the disaster directly caused an increase in poverty, particularly rural poverty through loss of livelihoods and income sources. Second, a reduction in food supply and access had an adverse impact on human nutrition for the affected population. Third, there was a decline in rural farm and rural non-farm employment and hence decline in household income for 2.3 million households. Fourth, the disaster caused a reduction in the availability of feed, seed, saplings, fertilizer,

boats, nets, fingerlings, and agricultural equipment. Finally, there was an increase in retail prices for rice, vegetables, milk, fish and other critical agricultural products and inputs, which negatively affected agricultural producers.

Recovery and Reconstruction Needs

The results of the damage and loss assessment provided the initial figures to the Government of Bangladesh to design interventions to address the most affected sub-sectors and populations. This includes needs for food security, agricultural recovery, livelihood recovery and agricultural construction. Since total rice production is estimated to decline as a result of the disaster, the Government of Bangladesh needs to import about 0.5 million MT additional quantity of rice in order to ensure food security and maintain stable rice prices. The table below lays out the estimated needs from the assessment.

Table 23: Estimated needs based on the JDLNA

Program	*Amount (US$ million)*
Rice Imports	200
Agricultural Recovery	50
Livelihood Recovery	300
Agricultural Construction	25
Total Needs	**575**

The Agricultural Recovery Program includes estimates for seed, saplings, fertilizer, agricultural equipment, storage drums, feed, fodder, vet. medicine, sheds, restocking, shelters, fingerlings, boats, nets, safety equipment, rehabilitation of ponds/ghers, post harvest management needs, training etc. The Livelihood Recovery Program estimates that the likely needs are for micro-credit, crop loans, micro-enterprise loans, cash grants, community infrastructure and training. Finally, that Agricultural Infrastructure Program's likely needs are for rehabilitating damaged crops, livestock and fisheries related infrastructure and physical assets.

Exercise 1: Damage and Loss Assessment in the Agricultural Sector after the 2004 Tsunami in Thailand

Background

A powerful earthquake of magnitude 9.5 in the Richter scale, with epicenter located just off the Northern part of the island of Sumatra, occurred in the early hours of 26 December 2004. It created a tsunami that expanded over the Indian Ocean and affected the coastal areas of many countries in Asia and Africa.

Estimates of the economic and social impact of the disaster were undertaken under the leadership of the World Bank in Indonesia, Sri Lanka, Maldives Islands, and India. In Thailand, however, only individual sector assessments as well as preliminary global assessments of the macroeconomic impact were carried out by different government institutions, in some cases with assistance from international organizations.

The Asian Disaster Preparedness Center (ADPC) undertook a comparative study of the economic impact of the tsunami in the entire region, with a view to identifying common vulnerabilities and risks whose solution may be best approached in a cooperative fashion and thus generating significant economies of scale for the countries.

As part of the regional study, ADPC first undertook the estimation of the total amount of damage and losses sustained by Thailand. In order to ensure the validity and accuracy of results in the comprehensive estimation for Thailand, and their compatibility with the available assessment of the other countries, ADPC resorted to the use of a damage and loss assessment methodology developed originally by the United Nations´ Economic Commission for Latin America and the Caribbean (ECLAC), which was also used – to a varying extent – in the national assessments undertaken under the leadership of the World Bank.

Original information used in the sectoral assessments undertaken by the Government of Thailand as well as by international organizations was collected. In addition, statistical data in regard to sectoral and global development was obtained. These data were processed using the aforementioned ECLAC methodology.

This report provides the basic information required for the estimation of the effects caused by the tsunami on the agriculture sector of Thailand, as collected by ADPC in 2005. It also describes the basic assumptions required for the assessment.

The Effects of the Tsunami on Agriculture

a) Agricultural lands affected

The waves of the tsunami reached agricultural lands located near the coastline of six Provinces in Thailand. The standing crops were either washed away; and the salt content of the water deposited in the soils will have a negative effect on the unit yield of future crops. Oil palm plantations sustained similar losses, and about 18 per cent of them were uprooted by the action of the waves, and will require re-planting. The affected area for each crop is given in Table 1.

Table 1
Agricultural area affected by Tsunami in Thailand

Province	*Rice*		*Maize*		*Oil Palm*	
	Area, Rai	Area, Hectares	Area, Rai	Area, Hectares	Area, Rai	Area, Hectares
Krabi	15	2.4	5	0.8	40	6.4
Trang	100	16.0	167	26.7	21	3.4
Phang Nga	37	5.9			8,369	1,339.0
Phuket	10	1.6			80	12.8
Ranong	184	29.4	11	1.8	1,430	228.8
Satun	122	19.5			387	61.9
Total	**468**	**74.8**	**183**	**29.3**	**10,327**	**1,652.3**

Source: Ministry of Agriculture and Cooperatives (MOAC) and FAO

b) Effects on production and assets

The resulting effect on production includes the loss of the standing crops, as well as reductions in productivity in the following two years, especially in the case of the most salt-sensitive crops and plantations.

The replacement cost of the oil palm plantations that were uprooted must be considered as damage to assets of the sector, and the corresponding period of maturity for the new plants must be taken into consideration in the estimation of losses.

Damage and Loss Assessment

a) Baseline information

While the Ministry of Agriculture and Cooperatives (MOAC) did not have forecasts of production for the year when the tsunami occurred, data on average production and farm-gate prices for the previous agricultural year are available. Since these have remained relatively stable in recent times, they may be used as a baseline for the preliminary estimation of losses.

Table 2.
Unit yield and farm-gate prices of affected agriculture products in Thailand

Crop	*Item*	*Province*					
		Krabi	Phang-Nga	Phuket	Ranong	Satun	Trang
Rice	Unit Yield, Kg/Rai	295	315	295	270	400	400
	Farmgate price, Baht/Ton	5,700	5,700	5,700	5,700	5,700	5,700
Maize	Unit Yield, Kg/Rai	570	570	570	570	570	570
	Farmgate price, Baht/Ton	4,800	4,800	4,800	4,800	4,800	4,800
Oil Palm	Unit Yield, Kg/Rai	3,000	3,000	3,000	3,000		2,700
	Farmgate price, Baht/Ton	2,300	2,300	2,300	2,300		2,300

Source: Ministry of Agriculture and Cooperatives (MOAC)

b) Estimates of Production Losses

Estimates are to be made of the losses in production arising from the disaster, for both annual and plantation crops. They should include:

- The loss of the standing crop at the time of the tsunami, and
- The loss of future production due to decline in unit yield due to soil salinity.

The value of the standing crop losses may be obtained through the combined use of data contained in Tables 1 and 2.

Future production losses for annual crops can be estimated assuming that unit yields will decline by 35 and 10 percent in each of the two subsequent years (2005 and 2006) for rice and maize, in view of declining soil salinity brought about by natural leaching through rainfall. In the case of oil palm plantations, future production may be estimated by assuming a decline in unit yields of 15 and 5 percent in 2005 and 2006, respectively. In addition, until the oil palm trees are replanted and reach maturity (estimated as three years), there will occur full losses of production in 18 percent of the area devoted to this activity, which is where palm trees were uprooted.

c) Estimates of Damage

Damage to oil palm plantation assets may be estimated as the value of replanting the trees in 18 per cent of the total plantation area affected by the tsunami, as indicated in Table 1. An average cost of US$ 25,000 per hectare may be assumed for these estimations.

Industrial Sector

In cases of disasters the industrial sector sustains damage to its assets, such as buildings and furniture, machinery and equipment, and stocks of inputs and manufactured goods. In addition, it sustains losses in its economic flows due to stoppage or decline in production, shortage or higher cost of raw materials and inputs, and decreased demand for its products.

Typical losses in the industrial sector include a loss of production and increased production costs. Loss of production can be due to damage to premises and machinery required for industrial processing, lack or shortage of raw materials and inputs essential for processing, and decline in demand due to decreased overall economic activity. Increased production costs can be due to acquisition of raw materials from alternative sources, higher transport costs, and higher energy and electricity costs.

Effects of Disasters on the Industrial Sector

The overall effects of disasters on the industrial sector have often been underestimated and not well understood, for several reasons. First, it is difficult to assess damage to numerous individual industrial plants, many of which are small and medium sized. Second, assessing losses was not a standard procedure in the past.

Procedures for Damage and Loss Assessment in Industry

Step 1: Develop pre-disaster baseline.

The first step in conducting a damage and loss assessment in the industry sector is to breakdown the sector by large, medium, small and micro-enterprises and to separate out agro-industries (these are covered in detail in the agricultural sector). Next, baseline information must be constructed. This step will include establishing a static baseline on physical assets (by type, capacity, numbers of machines, etc.), and a dynamic baseline on industrial production (normal annual and monthly production figures).

Step 2: Conduct assessment of disaster effects

The next step is to conduct a field survey of disaster effects. A field survey is essential for industry sector specialists to obtain a feeling of disaster effects on assets and on production capacity, as well as to develop a typology of affected industries. In addition, it provides the opportunity to learn of possible problems in replacing specialized or large equipment and machinery (obsolete technologies, delivery times, etc). Typically, it should be complemented by visits to industrial associations to enlist their assistance in obtaining information from their associates on (i) pre-disaster industry performance; (ii) damage and losses sustained; and (iii) financial requirements for recovery and reconstruction.

Step 3: Conduct Post-disaster forecast

Next, in order to assess losses to the industrial sector, a post-disaster assessment of the sector performance must be conducted. This should develop conservative schedule of repair and replacement of assets, with special reference to specialized machinery and equipment, and to develop preliminary post-disaster performance for the sector, taking into consideration the calendar of staged recovery of production capacity (supply), possible constraints in raw materials and inputs (supply), the calendar of recovery of demand, and any additional demands from disaster reconstruction.

Step 4: Estimation of damage and losses

The next step in the methodology is to estimate the damage and losses to the sector. Production losses should be estimated on the basis of the time that equipment and machinery will require for their repair or replacement. The estimation of losses should take into account: (i) the pre-disaster production goals for each industrial establishment; (ii) the possibility of constraints to production brought about by shortage or non-availability of raw materials and essential inputs such as electricity or water; and (iii) a possible drop in demand of industrial products due to overall decreased economic activity in the affected area. Increased production costs must also be estimated, considering increased cost of raw material and inputs, payment of overtime salaries to employees, temporary need to rent equipment and machinery, and higher electricity costs. A possible increase in demand of certain industrial products required for reconstruction must be considered.

Step 5: Estimate effects on balance of payments and on fiscal budget

Finally, estimating the effects on the balance of payments will reflect the value of imports arising from the disaster in the sector that is driven by the acquisition of raw materials and other inputs from abroad for industrial process and the acquisition of construction materials and equipment for repair and replacement of assets. An estimated value of traditional exports that will not be made due to decline in production of the sector should also be made. These estimates will be used to determine the overall impact on balance of payments.

Estimating the effects on the fiscal budget will depend on whether the industries are publically or privately owned. In the case of government-owned industries, the effects on the fiscal budget must estimate a decline in revenues as well as an increase in operational expenditures. Again, these estimates will be used to determine the overall impact on the fiscal budget.

Typical Sources of Information

Sources	**Information required**
Ministry of Industry	Most recent industrial census or surveys
Ministry of Planning	Time series of industrial production and prices
Statistical Office	Data on small and medium enterprises (SMEs)
Industry Associations	Industrial GDP, by branches of activity
Chambers of Special Industries	
Central Bank	

Results of Typical Assessments

Table 24: 1999 Floods in Venezuela

Industrial branch	*Disaster Effects, million Bolivars*	
	Damage	*Losses*
Pharmaceutical (57)	1,130	830
Medical equipment (2)	300	300
Pasta factories (4)	125	125
Ironworks (315)	2,700	1,880
Bakeries (40)	1,600	1,600
Clothing (337)	405	400
Footwear (17)	625	625
Mechanical shops (17)	595	600
Radio stations (27)	395	350
Others	725	690
TOTAL	**8,600**	**7,400**

Table 25: 2004 Tsunami in Indonesia

Type of Industry	***Disaster Effects, Rp billion***	
	Damage	*Losses*
Very large industries	540	41
Large industries	44	169
Small to medium industries	800	246
Agro-industry	---	3,549
TOTAL	**1,384**	**4,005**

Commerce Sector

In case of disasters, the commerce sector sustains damage to its assets (which includes buildings, furnishings and equipment, and stocks of merchandise) as well as losses in economic flows (because of declines in sales, higher operational costs, and a loss in sales because of an overall decline in consumer demand). As in the case of the industrial sector, the overall effects of disasters to the commerce sector have not been adequately estimated and not well understood in the past, due to (i) the existence of a large number of commercial establishments, many of which are small and medium sized and located in a scattered fashion; and (ii) the assessment of losses was not a standard procedure in the past.

Typical losses in commerce include losses in sales due to (i) damage to premises and furniture; (ii) lack or scarcity of goods to sell; and (iii) decline in overall public demand of goods caused by post-disaster economic situation. Higher operational costs due to (i) rental of alternative premises; (ii) acquisition of goods from alternative, higher unit cost, sources (domestic or foreign); (iii) higher electricity costs; and (iv) payment of overtime to employees.

Procedures for Damage and Loss Assessment in the Commerce Sector

Step 1: Develop pre-disaster baseline.

The first step for assessing damages and losses in the commerce sector is to break the sector down into categories for analysis. These include sectors like large public markets, shopping centers, large commercial establishments, small to medium shops, and micro-sized neighborhood shops. These categories serve to differentiate between these diverse types of commercial establishments. Once these categories are established, pre-disaster information for each of the categories must be established to develop a baseline from which to determine the full impact of the disaster. Information for the baseline could include the type, size, number of assets, as well as the volume of sales for each commercial category, per year and month.

Step 2: Conduct assessment of disaster effects

Once the baseline is established, the next step is to conduct a field survey of the disaster effects. The field survey is essential to commerce sector specialists in order to obtain a good understanding of the disaster damage and losses in the sector, to develop categories of commercial establishments for analysis, and to learn of possible problems in recovery, including *inter alia* shortages of goods for sale, depressed public demand for merchandise acquisition, etc. Field surveys and interviews are done by visiting chambers of commerce and trade associations to enlist their assistance to secure information from their associates on (i) pre-disaster volume of sales; (ii) damage and losses sustained; and (iii) financing expectations for recovery and reconstruction.

Step 3: Conduct post-disaster forecast

The next step is to forecast indicators for the sector based on the post-disaster realities, including a calendar for repair or replacements of premises, and a schedule for sales recovery. This should develop conservative schedule for repair and reconstruction, as well as for replacement, of commercial premises. In addition, this step should develop preliminary post-disaster performance for the sector, giving due consideration to (i) schedule of premises

recovery and replacement; (ii) possible constraints in supply of goods (origin and time of delivery); (iii) calendar of recovery in overall public demand; and (iv) possible special demands of repair and reconstruction goods and materials.

Step 4: Estimation of damage and losses

Based on this, Step 4 is to estimate damages and losses in the sector. While the assessment of damages to physical assets in the commerce sector might be more straightforward, losses must take into account losses in sales, as well as increased operational costs. Sales losses are to be estimated on the basis of the time that the commercial buildings will be closed until they are repaired or rebuilt, or the finding of suitable alternative premises. The estimation of these losses should take into account the pre-disaster volume of sales for each commercial establishment category, the occurrence of shortages or outright unavailability of merchandise to sell, and a possible drop in demand of merchandise due to overall decreased economic activity in the affected area. However, it is important to note that there could be a possible increase in demand of certain goods required for reconstruction. Increased operational costs must be estimated giving due consideration to the need to rent space and premises on a temporary basis, payment of overtime salaries to workers, higher unit prices of merchandise, due to alternative sources of acquisition, and higher prices and shortages of electricity, water, etc.

Step 5: Estimate effects on balance of payments and on fiscal budget

Finally, the last step is to estimate the impact on balance of payments and on fiscal budget. To do this, the estimated value of imports of goods, not domestically available, as well as imports of construction material and equipment not available locally. In addition, the estimated value of traditional exports that will not be made due to insufficiency of merchandise for sale. To determine the effect on the fiscal budget, the overall decline in government revenues must be estimated. This includes a reduced tax income from lower sales as well as from lower exports. For government-owned commercial enterprises, the declines in sales must be estimated, as well as the increases in operational expenditures.

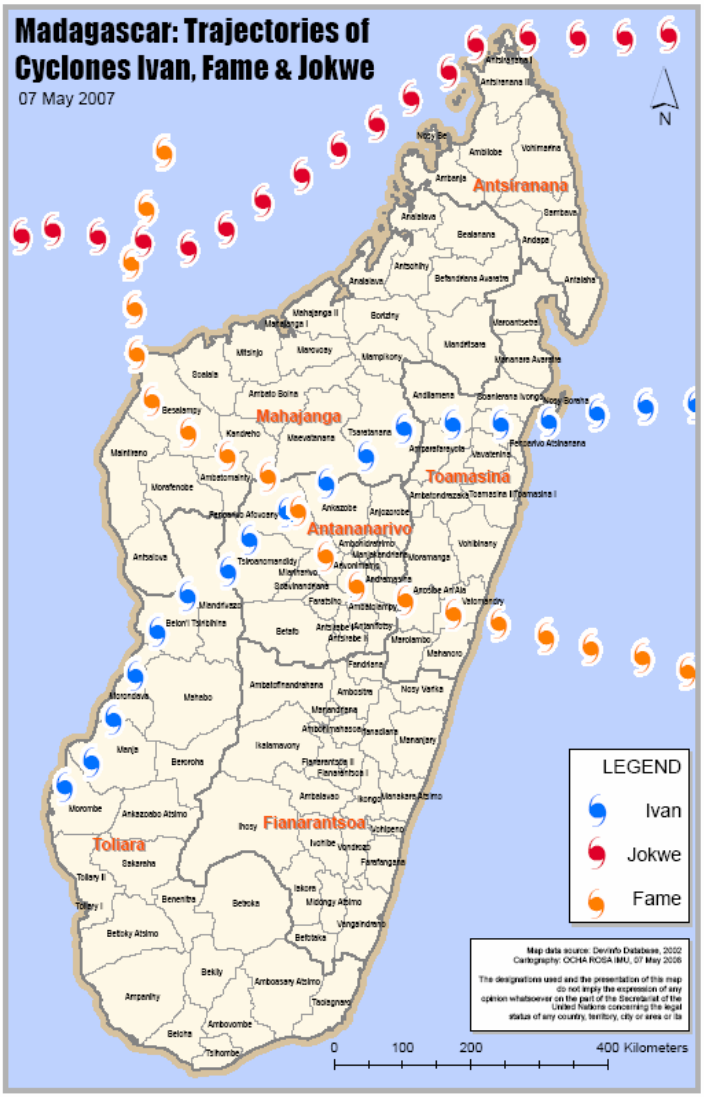
Typical sources of information to obtain the necessary information for the damage and losses assessment are provided below:

Sources	**Information Required**
Ministry of Commerce and Trade	Most recent commerce census or survey
Ministry of Planning	Time series of commerce and trade volume and prices
Statistical Office	Information on small and medium enterprises
Trade Associations	Gross domestic product, by commerce categories
Chambers of Commerce	
Central Bank	

Exercise 2: Industry and Commerce after the 2008 Cyclone Season in Madagascar

Description of Case Study

In the first few months of 2008, three consecutive cyclones struck Madagascar affecting 17 of 22 regions. The paths of Fame and Ivan crossed in the central plain around the capital of Antananarivo, while Jokwe grazed the northern tip of the island. These cyclones were accompanied by heavy rainfall, especially in the northeast and northwest.



These category three and four storms caused extensive physical destruction to infrastructure, and affected the livelihoods of an already struggling population.

Madagascar remains a country that is extremely vulnerable to natural disasters, and this problem stands to be exacerbated by issues of climate change in the future.

The conjunction of these events affected 342,000 people out of a total population estimated in 2008 at over 19 million. Among those affected, 191,404 lost their homes and over 100 people died.

In the wake of the disasters, the Government of Madagascar, together with an international team of experts, undertook a comprehensive damage and loss and needs assessment, and to define a comprehensive and feasible recovery plan.

Table 1 presents an overall summary of the damage and losses broken down by sector.

Table 1: Overall summary of damage and losses (Ariary Millions)

Sector	*Effects*		*Ownership*	
	Damage	*Losses*	*Public*	*Private*
INFRASTRUCTURE	*199,781*	*20,971*	*24,230*	*190,038*
HOUSING AND PUBLIC BUILDINGS	194,372	16,100	22,415	188,057
ELECTRICITY	3,503	2,958		
TELECOMMUNICATION	1,289	185	660	791
WATER SUPPLY AND SANITATION	617	1,729	1,155	1,191
SOCIAL SECTORS	*17,821*	*8,326*	*22,976*	*281*
EDUCATION	5,277	1,060	6,055	281
HEALTH	11,230	5,691	16,921	
FOOD SECURITY AND NUTRITION	1,314	1,576		
PRODUCTIVE SECTORS	*17,822*	*211,557*	*149,055*	*25,692*
AGRICULTURE, FISHERIES AND LIVESTOCK	10,462	159,564	148,854	
INDUSTRY AND COMMERCE	6,696	26,765		
TOURISM	664	25,228	201	25,692
CROSS CUTTING SECTORS	*357*	*476*	*0*	*0*
ENVIRONMENT	357	476		
TOTAL	**235,780**	**241,330**	**196,261**	**216,011**

Disaster Effects on Industry and Commerce

The winds and rain of the cyclones and the subsequent flooding caused extensive damage in the industrial and commerce sectors of the affected districts in the country. The strong winds destroyed roofs and windows of the shops. Rainfall entering through the broken roofs and through windows caused damage to the furniture, machinery and equipment, as well as destruction of inputs and goods stored within the affected buildings. Floodwaters that entered subsequently into the buildings further destroyed the contents in the shops. Affected were micro-enterprises that are usually run from homes, as well as small to large industries and shops having separate facilities.

In addition to damage to physical assets, production and sales were affected negatively as well. In fact, electricity supply was suspended for different time periods, due to the damage sustained by the transmission and distribution systems. Furthermore, in some cases, production and sales would not be re-initiated until the damage to sector facilities could be repaired, and until input flows could be re-established. In the commerce or trade sector, resumption of sales could be achieved sooner than in the case of industry, since the stocks and buildings could be repaired more promptly. In the industrial sector, machinery repairs or replacement usually took longer.

The assessment team took into consideration the fact that there exist hundreds of individual industries and commerce shops, and the impossibility of visiting and assessing damage for each. While the field trip enabled visits to many of the affected shops for the estimation of damage and losses, a private enterprise was engaged in order to carry out a sample survey of factories and shops. The sample survey provided data on the extent and estimated value of damage to buildings, machinery, furniture and stocks, as well as details as to the period of stoppage of production and sales and the resulting losses.

The sample survey data and the information collected by the assessment team was used to extrapolate the damage and loss estimations to the entire affected areas, using as a basis the most recent industry and commerce survey for the country, provided by the Statistical Institute, and also a detailed survey of damage to housing conducted by the government. The report of the INSTAT provides information on the number of industrial and commerce shops existing in all districts of the country, as well as data on the average monthly turnover of production and sales. The survey of damage and destruction of housing units provided an overall picture and structure of damage that was applied to the industry and commerce sector as well.

The exercise to be carried out requires the estimation of the value of damage in the industry and commerce sectors, as well as the losses in production, in the affected districts.

Available Information

Data on the number of existing industries and commercial shops and their monthly average production and sales were provided by INSTAT, as shown in the following table.

Table 2
Number of industries and commercial establishments, by size, and average monthly turnover

District	*Existing Number of Industries*			*Existing Number of Commerce*			*Average monthly sales per Shop, million Ariary*		
	Micro	SME	Large	Micro	SME	Large	Micro	SME	Large
Melaky	64	2	3	644	13	2	0.357	1.491	212.630
Analanjirofo	476	11	1	4,817	55	0	1.005	7.128	139.935
Diana	1,304	56	7	13,182	297	6	0.537	10.010	28.034
Amoron	118	4	1	1,189	18	0	0.355	21.265	76.055
Vato	436	91	2	4,403	480	1	0.370	8.484	239.212
Alaotra	607	10	0	6,136	53	0	0.720	64.323	0.000
Arsinana	962	91	9	9,728	480	8	0.791	84.857	322.011
Atsimo	61	2	0	612	13	0	0.735	3.047	0.000
Haute	599	36	0	6,053	192	0	0.416	8.664	0.000
Atsimo	443	46	1	4,481	239	0	1.897	8.953	19.994
Boeny	500	66	3	5,055	348	2	0.587	14.814	446.515
Sofia	280	50	0	2,832	264	0	0.251	1.594	0.000
Ihorombe	52	4	0	527	23	0	0.212	5.252	0.000
Menabe	180	2	0	1,822	8	0	0.617	219.855	0.000
Bongolava	124	1	0	1,254	3	0	0.722	5.000	0.000
Anamalanga	10,352	702	175	104,675	3,684	156	1.286	48.820	393.685
Betsiboka	74	6	0	753	30	0	0.286	4.247	0.000
Total	**16,632**	**1,180**	**202**	**168,163**	**6,200**	**175**	**11.144**	**517.804**	**1,878.100**

Source: Statistical Institute

Information obtained through the special sample survey for the two sectors yielded the average values for damage and for losses included in the following two tables.

Table 3
Average value of damage in industry and commerce shops

Damage Component	***Damage, million Ariary***			
		Commerce		
	Industries	**Micro**	**SME**	**Large**
Buildings	1.30	0.15	0.15	0.15
Machinery and Equipment	2.20			
Stocks	2.50	0.06	0.12	1.00

Table 4
Average value of losses in production and sales in industry and commerce establishments

Sector	***Average Losses in Production/Sales***	
	Period of Stoppage	Monthly Output Reduction, %
Industries	4 Weeks	50
Commerce	4 Weeks	25

Information from the survey conducted by the housing sector assessment team, combined with data from the most recent household survey, provides data for the destruction caused by the cyclones, and is included in the following table.

Table 5
Destruction of housing units by type of construction materials

District	*Total Number of Houses*	*Units Destroyed*		*Destruction Factor*	
		Local Materials	Durable Materials	Local Material	Durable Material
Melaky	38,437	386		0.0100	0.0000
Analanjirofo	189,678	99,575	4,230	0.5250	0.0223
Diana	105,411	664	70	0.0063	0.0007
Amoron	153,838			0.0000	0.0000
Vato	243,667	1,861	42	0.0076	0.0002
Alaotra	193,413	1,029	15	0.0053	0.0001
Arsinana	246,092	15,517	8,245	0.0631	0.0335
Atsimo	137,916	985	104	0.0071	0.0008
Haute	250,566	2,898	9	0.0116	0.0000
Atsimo	221,894			0.0000	0.0000
Boeny	118,964	438	37	0.0037	0.0003
Sofia	206,006	1,355	139	0.0066	0.0007
Ihorombe	42,029	3		0.0001	0.0000
Menabe	85,150	142	21	0.0017	0.0002
Bongolava	71,036			0.0000	0.0000
Anamalanga	531,485	499	200	0.0009	0.0004
Betsiboka	51,768			0.0000	0.0000
Total	**2,887,350**	**125,352**	**13,112**	**0.0434**	**0.0045**

Suggested Step-Wise Procedure for Assessment of Damage and Losses

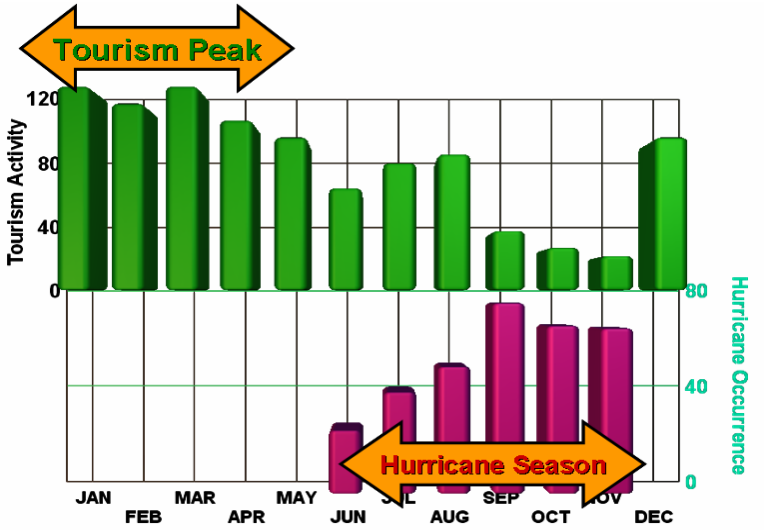
The following steps are suggested for the estimation of damage and losses in this exercise:

1. Estimate number of affected establishments, for the two sectors, breaking it down by micro, small to medium and large sizes
    - Obtain destruction rates from housing sector assessment data and apply as required to micro, SME and large establishments, as follows:
        i. For micro enterprises, destruction rate from local-material houses
        ii. For SMES and large enterprises, destruction rate for durable-material units
    - Combine with number of shops of each size and type taken from INSTAT data
    - Obtain number of affected shops for each sector and each size and type of establishment
2. Estimate value of damage for each sector, with breakdown by size of establishment
    - Using number of affected shops obtained under step 1
    - Multiply by average value of damage to buildings, machinery, stocks obtained in sample survey
    - Obtain value of damage for each sector, by type and size of shop
3. Estimate value of losses for each sector, with breakdown by size of establishment
    - Using number of affected shops obtained in step 1
    - Multiply by value of average losses estimated by combining period of stoppage obtained from sample survey and the value of average monthly output/sales per type and size of establishment taken from INSTAT data
    - Obtain value of losses for each sector, by type and size of shop

Tourism Sector

Tourism is very vulnerable to disasters of every kind and origin, due to the exposed location of assets in vulnerable coastal areas, the seasonality, and volatility of tourism demand. Any negative impact on tourism is reflected in foreign exchange earnings, declines in domestic employment, and declines in government revenue. In countries where the tourism sector represents a large share of overall economic activity, the vulnerability to disasters is even greater.

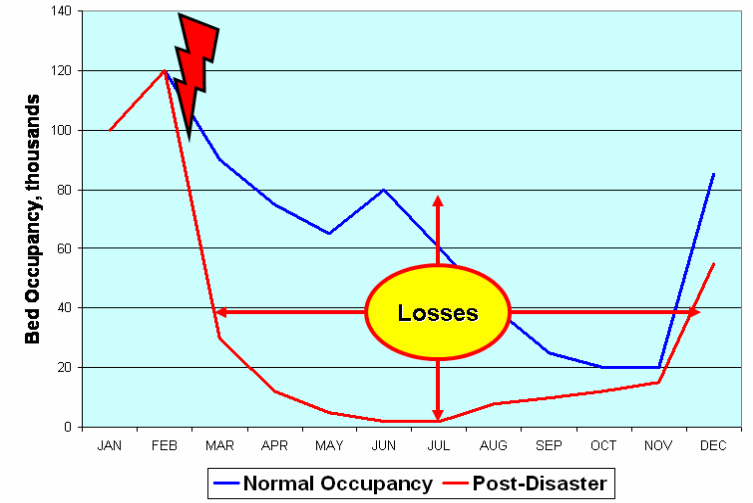
Figure 21: Timing of disaster and impact on tourism



Types of Damages and Losses

Damages in the tourism sector are measured by the total or partial destruction of physical assets (buildings and facilities: hotels, restaurants, etc.), equipment and furnishings, associated environmental assets (coral reefs, beaches, etc.), and basic services (water and sanitation, electricity, transport and communications). One typical service that is affected in the tourism sector is bed capacity. As the figure shows, the impact of the disaster resulted in a decline in the availability of beds as a result of the disaster. This negatively affected the entire tourism season, as the occupancy rates declined, even as capacity was restored.

Figure 22: Impact on bed occupancy



Losses in the tourism sector are measured by a decline in revenues due to the temporary non-availability of assets, and the decline of tourists´ arrivals. In addition, losses encompass the higher operational costs associated with the aftermath of a disaster. This includes the temporary costs of electricity, water and other services, and post-disaster promotional costs. Figure 22 shows the difference in bed occupancy in a "normal season" as opposed to post-disaster. The difference between these two areas constitutes losses incurred to the tourism sector, in terms of decline in bed occupancy.

Procedure for Damage and Loss Assessment in Tourism

Step 1: Develop Pre-disaster baseline.

The first step in conducting a damage and loss assessment in tourism is to obtain pre-disaster information to establish a baseline scenario. This will include both a static baseline of assets, and a dynamic baseline that includes tourist arrivals, seasonality, and income.

Step 2: Conduct Post-disaster forecast

Step 2 estimates the post-disaster sector performance. This must be developed through combination of calendar of staged recovery of bed capacity (supply), and a schedule of possible recovery of tourists arrival (demand). The recovery of bed capacity depends on the capacity of the construction sector, whether there is available financing, and bureaucratic requirements (construction permits, etc.). Recovery of demand depends on the implementation of information campaigns to usual tourist target groups, and promotion campaigns to new target groups.

Step 3: Estimation of damage and loss

The next step estimates damage and loss to the sector by subtracting the estimated values in the post-disaster scenario from the pre-disaster estimates. *Criteria for Estimation of Damage:* The replacement value of physical assets must be estimated by a civil engineer or architect, developing a typology of affected buildings. The contents of the affected buildings must be estimated for each of the types of assets. Damage to environmental assets and services should be estimated by environmental economist. If associated services (electricity, water and sanitation, transport) are owned or provided by public enterprises or by separate private enterprises, their replacement or repair value would be estimated under other sectors. *Criteria for Estimation of Losses*: For the estimation of losses it is essential that the period of reconstruction, replacement or repair of assets be accurately estimated. The decline in demand or utilization by tourists of the sector's facilities depends on (i) the time required to rebuild, repair or replace physical and environmental assets, and/or; (ii) tourists overcoming their fear, or the lack of information. Operating costs may increase temporarily while facilities are under replacement, reconstruction or repair.

Step 4: Estimate effects on balance of payments and on fiscal budget

The next step estimates the impact on the balance of payments and on the fiscal budget. For the BOP, estimates for loss in foreign exchange due to non-arrival of tourists and disbursement of foreign exchange for information and promotion campaigns must be estimated. For the fiscal budget, a decline in tax revenues (tourist and sales taxes, special exemptions), and cost of government participation in information and promotion campaigns must be estimated.

Typical Sources of Information:

Sources	**Information Required**
Ministry of Tourism	Most recent survey on tourism sector
Ministry of Planning	Time series of tourist arrivals
Statistical Office	Average length of stay and expenditures
Chamber of Tourism	GDP for tourism and subsectors
Central Bank	

Exercise 3: Estimation of the Economic Impact of the Tsunami on the Tourism Sector in Sri Lanka

Introduction

On December 26, 2004, Indian Ocean Tsunami caused extensive damage to tourism sector facilities located in the coastal areas of Sri Lanka. As a result, the arrival of international tourists declined sharply in the months immediately after the disaster, causing significant losses in revenue for the sector.

The tourism authorities launched an international promotion campaign to recuperate the sector performance. Data on tourism arrivals for the months following the disaster provide information on such recovery. Based on this information, estimate the revenue losses in the sector.

Estimation of Tourism Losses

The Sri Lanka Tourism Board keeps detailed statistics on the arrival of international tourists to the country. The following table shows the relevant data from October 2004 through July 2005, so that pre-disaster trends can be observed and the behavior of international tourists' arrivals after the tsunami can be determined.

Table 1
Monthly arrival of international tourists in Sri Lanka,
under normal and post-tsunami conditions

Year	*Month*	*Total Tourists*		*Asian Tourists*		*Non Asian Tourists*	
		Normal	Post-Tsunami	Normal	Post-Tsunami	Normal	Post-Tsunami
2004	OCT	59,442		25,836		33,606	
	NOV	64,971		25,944		39,027	
	DEC	66,159		28,230		37,929	
2005	JAN	49,950	38,178	18,471	17,835	31,479	20,343
	FEB	43,584	36,645	14,559	16,692	29,025	19,953
	MAR	38,418	50,418	13,218	24,628	25,200	25,790
	APR	30,672	42,261	12,375	19,818	18,297	22,443
	MAY	30,162	40,878	10,113	21,492	20,049	19,386
	JUN	32,119	45,699	15,183	21,924	16,936	23,775
	JUL	50,525	56,745	20,173	22,764	30,352	33,981

Source: Sri Lanka Tourism Board

To estimate the losses in revenues for the sector, make use of the information on pre-disaster and post-tsunami arrivals given above. Take into consideration that tourists coming from the Asian region spend an average of 7.8 days and US$ 560 per stay, while non-Asian tourists normally stay for 11 days and spend US$ 830 per stay.

The behavior of tourist arrivals given in the table above is also given in chart format in the graphs that follow.

Figure 1: Arrival of total tourists in Sri Lanka

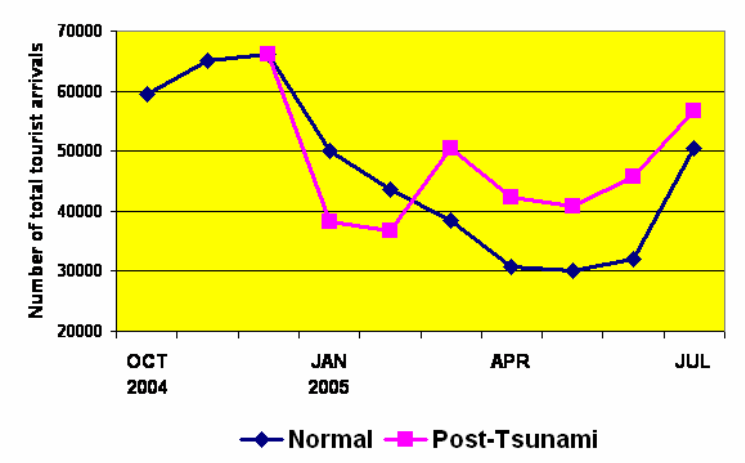


Figure 2: Arrival of Asian tourists in Sri Lanka

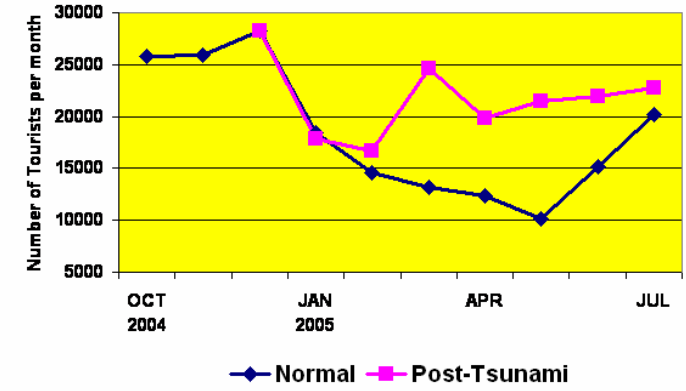
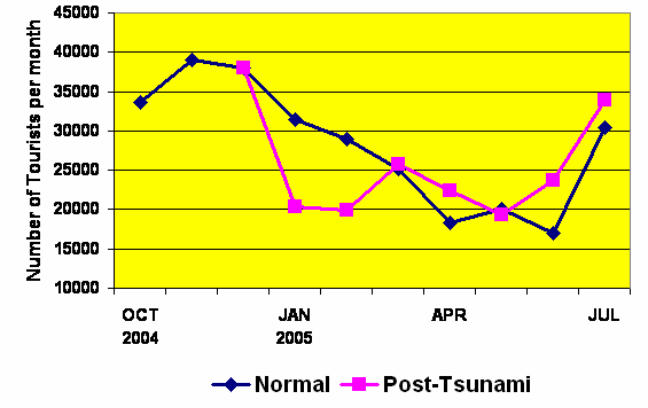


Figure 3: Arrival of non-Asian tourists in Sri Lanka



VI. Social Sectors

The social sectors typically measured in a damage and loss needs assessment include housing, education and health.

Housing Sector

Typical Effects of Disasters

Housing is by far the most affected sector in cases of disasters, especially in those events caused by earthquakes. In cases of disasters, the housing sector sustains damages to assets and loss in its economic flows during the period of time required for recovery and reconstruction.

The types of damages can include total or partial destruction of housing units and in-house components of electricity and water supply/sanitation systems, household goods, and equipment and products of home-based micro-enterprises. Types of loss include cost of demolition and rubble removal, temporary loss of rental income (of houses under rental modality), cost of temporary housing to homeless (met by government, international assistance and/or private sector), and the cost of associated transport to/from temporary camps and place of work.

Figure 23: Example of housing damages and losses from the Yogyakarta Earthquake

Procedure for Damage and Loss Assessment

The following provides a step-by step guide to developing a damage and loss assessment for the housing sector.

Step 1: Develop pre-disaster baseline.

The pre-disaster baseline should include a definition of the sector position in affected area: (i.e. a deficit or surplus of housing), a typology of existing housing units, by size, type of construction material used, value of housing, ownership of housing (private or government owned), and rental properties. The monetary value of each of these categories is ascertained through the value of monthly rentals, and of monthly payment on mortgages. Finally, it is important to determine the number of unoccupied housing units in the affected area or in nearby areas.

Step 2: Post-disaster forecast.

The post-disaster forecast should determine the need for providing temporary housing facilities for people rendered homeless by disaster and the length of time that this temporary housing is needed. In addition, the forecast should define a preliminary plan of repair and reconstruction of housing units, taking into consideration (i) the capacity of construction

sector; (ii) the availability of skilled labor; (iii) the availability of construction equipment and materials; and (iv) adequate funding for reconstruction.

Table 26 presents pre- and post-disaster assessment of housing stock affected by the Yogyakarta Earthquake and the Aceh Tsunami. In each of these the housing stock is compared to a pre-disaster stock to provide an assessment of the impact of these natural disasters on the housing stock.

Table 26: Housing stock affected by Yogyakarta Earthquake and Aceh Tsunami

Item	*Yogyakarta Earthquake*	*Aceh Tsunami*
Pre-disaster housing stock	984,058	832,208
Number of houses fully destroyed	154,098 *(15.7%)*	127,325 *(15.3%)*
Number of houses partially destroyed	199,160 *(20.2%)*	151,653 *(18.2%)*

Step 3: Estimation of damage and losses

Estimation of damages

To estimate damage to the housing sector, a typology of the types of housing units that exist in the local context is typically developed. Field surveys then estimate how many of each type of house was fully destroyed and how many were partially destroyed. Using data on current construction unit costs – obtained through interaction with local professional builders – an average reconstruction and repair cost for each type of housing unit is developed.

Figure 24: Residents sift through the rubble left by Yogyakarta Earthquake

Estimation of loss

Define conservative calendar of housing repair and reconstruction, by stages. Estimate cost of temporary housing scheme according to the cost of land acquisition, building temporary quarters, water supply and sanitation and electricity, and transport to/from work. In addition, losses should include and estimate of the cost of demolition and removal of rubble and an estimate of the loss of rental income.

Table 27 presents an example of a damage and loss estimation for the Yogyakarta Earthquake in Indonesia.

Table 27: Damage and loss estimation, Yogyakarta Earthquake (Indonesia)

District	*Disaster Effects, Rp Billion*		*Ownership (Rs Billion)*	
	Damage	*Losses*	*Private*	*Public*
Bantul	3,419	333	3,752	0
Sleman	1,723	175	1,898	
Gunung Kidul	1,299	129	1,428	
Yogyakarta	358	35	393	
Kulonprogo	621	62	683	
Klaten	6,278	627	6,905	0
Others	216	22	238	
TOTAL	**13,915**	**1,382**	**15,296**	**0**

Step 4: Estimate effects on balance of payments and on fiscal budget

After conducting an in-depth analysis of construction sector capabilities, estimate the need and cost of importing construction equipment, materials and labor (imported component of damage), and the value of exports that will not be made due to full utilization of internal capacity.

Estimate amount of unexpected expenses made by government to meet temporary housing costs, rental amounts that the government will not collect in case of government-provided housing schemes and tax revenues that will not be obtained in case of special tax relief programs (i.e. tax not collected on private sector rental of houses).

Information Requirements

The above assessments are made with information gathered from a variety of sources. The following list gives an overview of information that is needed to conduct the assessment and a list of possible sources for that information:

Sources	**Information required**
Statistical Office	Most recent housing census or survey
Housing Ministry	Most recent household surveys
Planning Ministry	Construction costs
Builders Associations	Construction sector capacity
Building contractors	Value of monthly rentals
Private banks	
Central Bank	

Education Sector

The following is a step-by-step guide on how to conduct a damage and loss assessment for the education sector.

Effects of Disasters on Education

Education is negatively affected by disasters of every kind. Schools and associated facilities sustain damage to their assets. They also sustain losses in their economic flows, during the time required for replacement or rehabilitation of assets.

Damage to Education Assets

The following components of educational assets can sustain damage from disasters: (i) school buildings; (ii) furniture; (iii) equipment; (iv) education materials. The value of damage may be estimated by a trained architect or civil engineer.

Losses in Education Sector

Several kinds of losses may occur in the sector as a result of disasters. For example, the payment of unexpected, temporary rental of premises to substitute assets under repair or reconstruction. In addition, losses could include payment of overtime salaries to teachers or other workers in the sector. Incremental cost of training, replacement of dead teachers, the cost of demolition and removal of rubble, expenditures to repair school premises that sustain damage when used as temporary shelters, or loss of revenue in private schools, when classes are stopped.

Procedure for Damage and Loss Assessment

Step 1: Develop a pre-disaster situation

The first step of the damage and loss assessment is to develop a static baseline of education assets. To do this, a typology of schools in the affected area must be defined by level of education (primary, secondary, technical and university), size and construction materials, level and number of teachers, level and number of students, and whether the facilities are publically or privately owned.

The second aspect of developing the baseline for the education sector is to define a dynamic baseline of education flows. This requires obtaining information on the normal calendar of school year, cost of rental of educational facilities, fees charged to students, the value of food provided to students, and the value of transport provided to students.

Step 2: Estimate the post-disaster situation

The post-disaster assessment is generally a survey to determine number of affected assets that were either totally destroyed or partially destroyed. This requires obtaining present construction costs of school buildings, and unit replacement costs of equipment and materials. Then, a preliminary calendar of repair, replacement and reconstruction of assets should be developed, based on an analysis of construction sector capacity and of acquisition procedures for educational equipment and material.

Step 3: Post- disaster sector performance

The final step of the assessment is to examine the sector's performance post-disaster. First, it is necessary to ascertain the period of use of schools as temporary shelters and to estimate the cost of repairs to damaged infrastructure. In addition, it is important to determine the likely duration of school year suspension, and to define a preliminary program (and costs involved) to compensate education time loss through the use of alternative premises for classes, "doubling up" in utilization of undamaged premises to compensate for the non availability of damaged premises, overtime payment to teachers when required; and the cost of accelerated training and specialization of new teachers.

The total estimate of damages and losses should include: (i) demolition costs of damaged premises; (ii) costs of rubble removal and disposal; and (iii) costs of not providing food and transport to students (this latter cost typically will have to be partially absorbed by parents).

Table 28 presents the summary of damages and losses to the education sector from Yogyakarta Earthquake in Indonesia.

Table 28: Summary of disaster effects: Yogyakarta Earthquake in 2006

Location	***Disaster Effects, Rp Billion***		***Ownership, Rp Billion***	
	Damage	**Losses**	**Public**	**Private**
Central Java	320	12	245	88
Yogyakarta	1,363	44	910	486
TOTAL	**1,683**	**56**	**1,154**	**585**

Health Sector

The health sector is significantly affected by disasters. It sustains damage to its assets, and losses in its economic flows during the post-disaster period. In addition, the health sector must face increased requirements after disasters, including attending to affected people's health, and preventing the occurrence of any epidemics.

Damage and Losses in the Health Sector

Damage

Damage to assets includes buildings (hospitals, health centers), equipment and furniture, and medical materials. Assessing the value to damages is done by a trained engineer, and it must be done for each of the medical facilities affected.

Losses

In the health sector, losses continue to incur until reconstruction of assets has been completed, and/or prevention or control of epidemics has been accomplished. Losses are more difficult to estimate; participation of health professionals (including epidemiologists) is essential.

Typical losses expected after disasters include higher-than-normal costs of medical care for the affected population due to the increased number of patients, higher unit cost of alternative, temporary medical facilities, and long term medical treatment and psychological care of affected people. Losses of revenue in damaged facilities during the period of rehabilitation and reconstruction and unexpected expenditures to monitor and control possible epidemics.

Two key issues for conducting a loss assessment are (i) defining the duration of the period required for rehabilitation and reconstruction of building and health facilities; and (ii) estimation (e*x ante*) of the possible occurrence and scope of epidemics and of the requirements for their control.

Procedure to Estimate Losses in the Health Sector

Step 1: Define pre-disaster baseline

The first step in estimating losses in the health sector is to determine a baseline. This would establish the characteristics of existing medical facilities in the affected area (location, installed care capacity, etc.), as well as in unaffected neighboring areas that can be used as temporary backup for medical attention to affected population. Some issues to examine include whether there is free medical attention or whether there are direct costs associated with this. In addition, the description of health management system, its financial resources and the manner in which costs are covered is important to determine, as well as the socio-demographic situation in the affected area, and the past history of the main epidemiological indicators. Prevailing unit costs of medical and health services rendered by public and private institutions is also important.

Step 2. Damage assessment

Damage assessment should provide quantitative information to ascertain the remaining, unaffected installed capacity of the sector in the area. This information must be combined with the baseline data on health attention facilities in nearby areas that can be used for backup care.

Step 3. Define reconstruction plan

Taking into consideration the existing construction sector capacity and specialized equipment replacement availability, define a preliminary plan for the restoration of health facilities and services. Define the period required for availability of facilities and services.

Step 4. Define need for disease prevention and monitoring

Based on an analysis of the pre-disaster health environment and the post-disaster situation, utilize the services of an epidemiologist to define the possible need to monitor possible increase in morbidity levels and undertake prevention campaigns in vector control, and vaccinations.

Step 5. Estimate losses

Estimate the unexpected costs to treat injured persons (increased work load in service) during emergency stage, including overtime of medical personnel, medical supplies, transport cost of injured to neighboring facilities, and use of higher-cost private facilities. Estimate amounts needed for the surveillance of diseases that may arise or increase as a result of the disaster, above normal budget appropriations. Estimate any additional budget requirements for vaccination campaigns, vector control campaigns and medium-term medical and psychological treatment of affected people. Estimate lower revenues in existing public and private health facilities during reconstruction period. Estimate costs of demolition and debris removal in health sector facilities.

Case Study 3: The Health Sector after the El Niño 1997-1998 in Ecuador

A. Damages

The damage and losses methodology provides a useful starting point for assessing the impact of El Niño on the health sector in Ecuador. The estimation of damage looks at damage to infrastructure (hospitals and health centers), and medical equipment and material. The total estimated damage was estimated at US$3.2 million. Table 29 provides an overview of the assessment of damages.

Table 29: Assessment of damages from El Niño 1997-1998, Ecuador

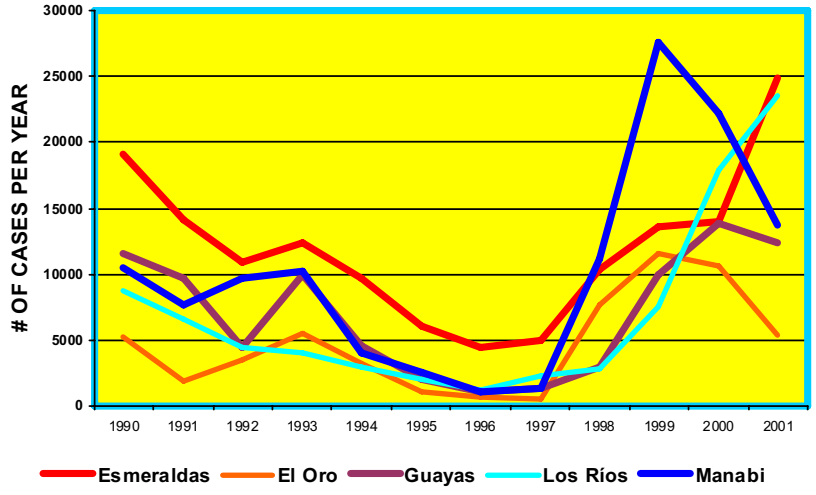
Assessment of Damages	**Million US$**
Damage to hospitals and health centers	1.8
Damage/destruction of medical equipment	1.3
Damage/destruction of medical material	0.1
Total	3.2

B. Losses

In the case of the El Niño 1997-1998, several epidemics were identified that resulted from the disaster. These included malaria, cholera, dengue fever, leptospirosis, acute diarrheic disease, acute respiratory infections, and chagas disease. In addition to the losses incurred by deaths and hospitalizations from diseases and epidemics, losses were incurred from increased out-patient healthcare, and in-hospital revenue losses.

As Figure 25 shows, the cases of malaria in Ecuador rose sharply in the period after El Niño in all of the affected districts. The fact that it rose sharply across numerous districts implies that there is a direct link between the onset of malaria cases and the natural disaster. This correlation is confirmed by similar patterns of other diseases that all rose sharply in the months after the disaster.

Figure 25: The case of malaria



The estimated malaria related losses are reported in Table 30.

Table 30: Malaria related losses

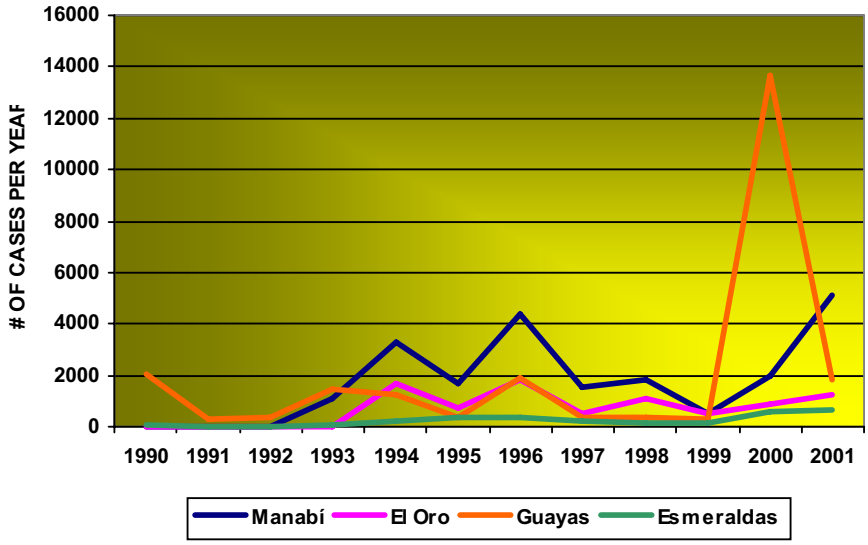
Year	*Increase in # of cases*	*% due to El Niño*	*Cases due to El Niño*	*In-Hospital cases (6%)*
1998	24,072	80	19,260	1,160
1999	59,340	70	41,450	2,490
2000	67,495	60	40,500	2,430
2001	69,051	50	34,530	2,070
Totals			**135,830**	**8,150**

Treatment costs: were estimated at Outpatient: US$ 3.50 and in hospital US$ 40/day, over 4 days average. This brings the total estimated losses from malaria to US$ 1,779,405, of which outpatient losses are estimated at US$ 475,405 and in hospital revenue losses are estimated at US$ 1,304,000.

Dengue Fever:

After the El Niño disaster, there was also a sharp rise in cases of dengue fever (see Figure 26).

Figure 26: The case of dengue fever



Dengue-related losses were most acute in 1998, where 284 new cases were attributed to El Niño. With an estimated treatment cost of US$ 40 per day over an average of four days, the loss incurred from dengue fevers is estimated at US$ 45,440. New cases of dengue fever in 2000 were not due to El Niño.

Cholera

The total number of cases in cholera that are estimated to have occurred as a result of El-Niño is 3,589. The largest share of these occurred just after the disaster in 1998 (3,261 cases) and dropped off after that (125 cases in 1999 and only 3 cases in 2000). Losses because of hospitalization was calculated using a per patient cost of hospitalization of US$ 90. This amounted to a total cost or loss of US$ 305,010.

Leptospirosis

The total increase in the number of cases of leptospirosis was estimated at 481, with the bulk of the cases occurring in 1998 (381). In 1999, 27 cases were reported, in 2000, 62 cases were reported, and in 2001, 21 cases were reported. With in-hospital expenses estimated at US$ 40 per day for an average of a 4 day recovery period, the total estimated losses from leptospirosis is estimated at US$ 78,560.

Acute Diarrheic Diseases (ADD)

Increases in the incidence of Acute Diarrheic Diseases (ADD) were estimated at 26,730 in 1998 and 3,576 in 1999. The total number of cases of ADD is estimated at 30,326 cases. Given an estimated unit treatment cost of US$ 5 per person, the total estimated cost, or losses is US$ 151,680.

Acute Respiratory Infections (ARIs)

An increase in the number of cases of ARIs in 1998 and 1999, attributable to El Niño: 27,681. With an estimated treatment cost of US$ 5 per person, the total cost (or loss) was US$ 138,405.

Chagas Disease

Chagas disease occurs exclusively in the Americas, particularly in poor, rural areas of Mexico, Central America, and South America (see Figure 27). In the provinces affected by El Niño, the total population at risk for Chagas disease is 3.4 million, of which 20% are children below 15 years in age. The annual incidence of Chagas before El Niño was 1.6%. After the 1997-98 event, incidence rates rose to 3.4%; an increase of 1.8%. This means that 61,250 additional cases of Chagas have resulted, 12,250 of which are children under 15. If untreated, within 15 years, 50% of the 12,250 children will develop heart disease, for which the cost of treatment is very high (a conservative estimate is US$ 5,000 per person).

Figure 27: The case of Chagas disease: geographical distribution

The cost of diagnosis and preventive treatment for this population group is only a fraction of the cost to treat these heart conditions. These are estimated at diagnosis in 680,600 children at US$ 5 per child: US$ 3.4 million, and preventive treatment of 12,250 children at US$ 100 each: US$ 1.225 million.

If no action were taken now to treat these children-patients, within 15 years (circa 2014) 6,125 30-year olds would develop heart disease. At a conservative treatment cost of US$ 5,000 each, the cost to society would be US$ 30.6 million instead. In other words, an investment of US$ 4.4 million in diagnosis and preventive treatment now would prevent a loss of US$ 30.6 million: a 6.6 benefit/cost ratio.

Losses in Outpatient Health Care

Lower revenues: In 1997, there were 277,850 outpatient visits less than the preceding year due to accessibility problems (flooding). With an average unit revenue from each outpatient visit estimated at US$ 5/person, the total revenue loss is estimated to be US$ 972,465.

Increased costs: From 1998 through 2000, the number of outpatient visits increased due to different diseases caused by El Niño. At a cost of US$ 3.50 per visit, the increased number of visits resulted in a higher cost of US$ 2,388,980.

In-Hospital Revenue Losses

Hospitalization losses: In 1997 and 1998, the number of hospital patient discharges, decreased, in comparison to the preceding years, by 16,274 cases. The average hospital stay is 4 days at a US$ 40/day, resulting in estimated losses of US$ 2.6 million.

Surgery losses: In comparison to preceding year, the fall in the number of surgeries in 1998 and 1999 amounted to 8,996 cases. The average cost for surgery is US$ 400/person, leading to an estimated loss of US$ 3.6 million.

Table 31 summarizes the damages and losses to the health sector as a result of El Niño (1996-97) in Ecuador.

Table 31: Summary of damages and losses (in million US$)

Component	*Damages*	*Losses*
Infrastructure, equipment and materials	**3.20**	**---**
Prevention/control campaigns	**---**	**1.59**
Increased costs for health care	---	**7.13**
- Malaria		1.78
- Dengue		0.04
- Cholera		0.31
- Leptospirosis		0.08
- ADDs		0.15
- ARIs		0.14
- Chagas Disease		4.63
Decreased revenues in health care	---	**7.16**
- Outpatient care		0.97
- In hospital care		2.60
- Surgery		3.59
TOTAL	**3.20**	**15.88**

Exercise 4: The Health Sector after the Gujarat Earthquake

Description of Case Study

Real-life data for the health sector of the State of Gujarat (India) is used to show loss estimation procedures (see figure below for the location of Gujarat). The baseline data to be used refers to the period prior to and after the Gujarat earthquake that occurred in early 2001.

The earthquake caused extensive damage and destruction in urban areas and only minor effects on rural areas in the State of Gujarat. Damage and destruction of medical facilities, equipment and supplies were widespread. The value of damage to health sector assets in the State was estimated at Rs. 220 Crore, or US$ 47 million. No comprehensive estimation of losses for the sector was ever made, however.

The following health and medical facilities were destroyed by the earthquake (See photos above), as provided by the Gujarat State Department of Health and Family Welfare:

Description	*Number of destroyed units*
Health Centers	22
Sub-Centers	105
Dispensaries	15
Anganwadis	192
Total	**334**

The example to be used for the estimation of losses in the health sector is that of losses arising due to the increased incidence of malaria in the Kachchh District after the 2001 earthquake (increased government expenditures to treat malaria victims and to control the vector that spreads the disease). A detailed study made by the Gujarat State Health and Family Welfare Department revealed that significant increases in malaria incidence occurred in the Kachchh District after the earthquake. This was due to several reasons, some of which arose directly from the earthquake:

- Increase in vector breeding
- Higher than normal requirements of water storage due to irregular water supply
- Abandoned partially-filled water storage tanks in the affected area
- Increased human-vector contacts
- The occurrence of normal rainfall season after the disaster
- Population displacement and migration after earthquake, and
- Labor migration from malaria-endemic areas.

Baseline Data for Analysis

A) Number of Cases

Epidemiological data available at the Gujarat State Department of Health and Family Welfare provides information on the annual number of malaria cases that occurred in the Kachchh District from 1975 to 2001, with a distinction between cases caused by *Plasmodium Vivax* and *Plasmodium Falciparum* (See Table 1).

In addition, monthly data on malaria incidence in the same District is available from the same source for the period January 2001 to June 2002, as indicated in Table 2, which can be used for the estimation of post-disaster losses. The time variation of malaria incidence for this period can be observed in Figure 1 that clearly shows the increased incidence of the disease after laborers from other malaria endemic regions moved into Kachchh to participate in the reconstruction program.

The year 1985 may be considered a typical year of malaria incidence in Kachchh District. The number of cases for each type of malaria may be seen in Table 3. From such data, the monthly variation of malaria for a non-disaster year may be derived.

Figure 1: Variation of monthly rates of malaria cases in Kachchh District January 2001 to June 2002

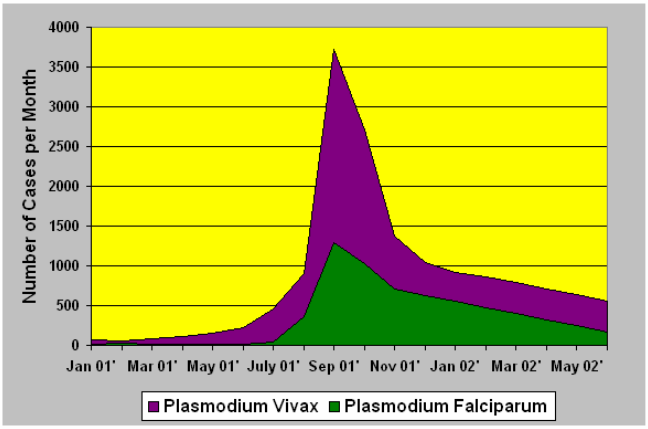


Table 1
Number of reported cases of malaria in Kachchh District, Gujarat 1975 to 2001

Year	**Number of Malaria Cases**		
	Plasmodium Vivax	**Plasmodium Falciparum**	**Total**
1975	33,780	4,877	38,657
1976	55,879	8,160	64,039
1977	34,169	3,198	37,367
1978	13,798	885	14,683
1979	12,115	688	12,803
1980	15,565	1,962	17,527
1981	13,798	1,695	15,493
1982	13,763	996	14,759
1983	8,512	665	9,177
1984	4,082	337	4,419
1985	2,329	367	2,696
1986	1,644	369	2,013
1987	1,115	189	1,304
1988	5,323	2,214	7,537
1989	26,972	14,403	41,375
1990	21,089	4,832	25,921
1991	7,398	994	8,392
1992	5,913	4,841	10,754
1993	5,061	2,282	7,343
1994	7,876	6,393	14,269
1995	7,018	2,638	9,656
1996	3,939	632	4,571
1997	9,657	2,407	12,064
1998	8,756	1,249	10,005
1999	5,044	791	5,835
2000	2,371	209	2,580
2001	10,886	4,175	15,061

Source: Gujarat State Department of Health and Family Welfare

Table 2
Number of reported monthly cases of malaria in Kachchh District, Gujarat
January 2001 to June 2002

Year/Month		**Number of Cases**		
		Plasmodium Vivax	**Plasmodium Falciparum**	**Total**
2001	January	64	19	83
	February	53	24	77
	March	86	19	105
	April	106	15	121
	May	156	16	172
	June	227	15	242
	July	455	43	498
	August	905	366	1,271
	September	3,716	1,295	5,011
	October	2,702	1,022	3,724
	November	1,379	711	2,090
	December	1,037	630	1,667
2002	January	915	550	1,465
	February	855	475	1,330
	March	795	400	1,195
	April	711	320	1,031
	May	632	245	877
	June	552	170	722

Source: Gujarat State Department of Health and Family Welfare

Table 3
Number of malaria cases in 1985 in Kachchh

Month	**Number of Malaria Cases**		
	P. Vivax	P. Falciparum	Total
January	216	57	273
February	227	49	276
March	121	4	125
April	120	5	125
May	118	2	120
June	114	3	117
July	49	0	49
August	152	2	154
September	306	6	311
October	374	31	405
November	370	56	426
December	162	64	226

B) Malaria Treatment Costs

In the absence of unit treatment costs, international values are to be used throughout the exercise, as described below:

An average of Rs. 45 (US$ 1) per person per malaria treatment course is to be adopted for outpatients, following the experience in Africa. Other international studies indicate that between 3 to 7 days of in-hospital care are required to deal successfully with severe types of malaria. It is to be assumed that an average of 5 days of in-hospital care would be required in the case of the Kachchh District malaria patients. It is to be further assumed that the daily

cost of malaria hospitalization treatment in the District was in the order of Rs. 1,900 per day, or a total of Rs. 9,000 per patient treated.

In order to determine the cost of the treatment of malaria cases due to the disaster, it is to be assumed that 50% of the *plasmodium falciparum* cases are to be treated in hospitals or other medical facilities, due to their complexity and severity. The balance is assumed to be treated as outpatients in both the urban and rural areas.

C) Vector Control Costs

For the estimation of the cost of controlling the mosquito vector in Kachchh it is to be assumed that a combination of indoor residual spraying with insecticides in the rural areas, and spray fogging in urban areas would be adopted. Again in the absence of actual costs for the disaster area, the values obtained in similar countries for Africa are to be adopted: US$ 3.50 and US$ 2.15 (Rs 155 and Rs 100) per person in urban and rural areas, respectively. Data on urban and rural population for the District is to be used for the estimation of these losses, as shown below:

Table 4
Urban and rural population in Kachchh District, 2001

Area	*Number of Persons*
Urban	474,892
Rural	1,108,333
Total	1,583,225

Suggested Step-Wise Procedure for Assessment of Losses

The following steps are suggested for the estimation of losses in this exercise:

(i.) Define the baseline for the assessment
- Long-term trends
- Monthly variation of malaria incidence under "normal conditions"

(ii.) Define the number of cases due to the disaster
- Estimate period required to achieve recovery to pre-disaster conditions
- Estimate the number of malaria cases due to disaster, for each type of disease

(iii.) Estimate the cost of medical care
- Use unit costs for each type of treatment
- Combine with number of cases of malaria

(iv.) Estimate costs of vector control
- Determine unit costs for vector control in urban and rural areas
- Combine with population data for District

(v.) Estimate total losses, through addition of
- Medical care costs, plus
- Vector control costs.

VII. Infrastructure

Infrastructure facilities normally sustain significant damage during disasters of every kind. What is not usually recognized is that, in addition, they normally sustain equally significant losses that affect everyone's life. The latter refer to increased operational costs and lower operational revenues in the utilization of these facilities.

The infrastructure sectors that are typically considered in a damage and loss assessment are electricity, water supply and sanitation (WSS), transport (including road, railway, air, and sea water and river navigation transport), and telecommunications.

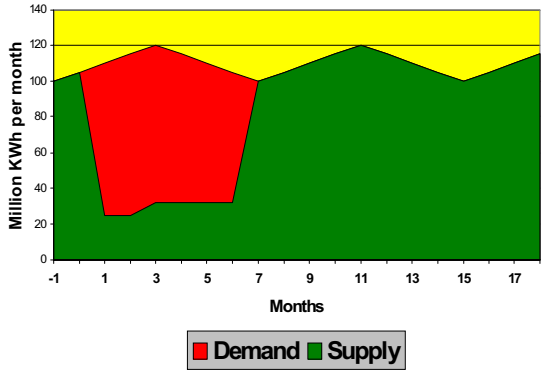
Electrical Sector

The electrical sector is affected by disasters of all kinds. Following a disaster, it sustains damage to its physical assets, such as power plants, transmission lines, substations, and distribution grids. Any assessment of damages in the sector should contain a breakdown of damage in each of the components of the electrical sector (power generation plants, transmission subsystems, and distribution grids), and an indication of the most realistic time period required for each component to return to pre-disaster conditions and capacity. This should take into consideration the availability of required spare parts and equipment and of financing. The assessment of damage is generally done by a civil or electrical engineer.

In addition, losses occur into the sector's economic flows, resulting in lower revenues, increased operational costs, and unexpected expenses to meet temporary requirements. Losses continue to occur until full capacity and supply has been reestablished in all system components (internal constraint), or user demand has been restored to pre-disaster levels (external constraint).

Therefore, the estimated period of recovery in each case – based on the best information available at the time of the assessment – is of special relevance. The assessment of losses is a more difficult and complex task than that of estimating damage, and requires the cooperative participation of trained and experienced civil and electrical engineers as well as economists.

Figure 28: First case showing a drop in electricity supply due to damage to power plants

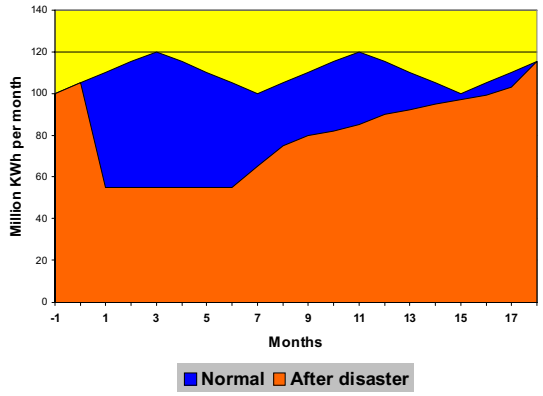


Assessing Losses in the Electricity Sector

Higher operational costs may be incurred into when a damaged power plant must be substituted with another one that has higher unit operational costs (hydro versus thermal), when power and energy must be imported from another nearby system at prices that are higher than the damaged system's own production costs, or when overtime payment of

personnel and related increased costs are incurred, for the immediate rehabilitation stage following the disaster, to reestablish service.

Figure 29: Second case showing a drop in user demand due to partial destruction of city and to lower economic activity



Procedure for the Assessment of Losses in the Electrical Sector

Step 1. Analyze sector performance prospects without disaster

The first step in assessing losses is to establish a baseline scenario, or what the prospects for performance would have been without the disaster. The electricity company normally has projections of performance of the electrical sector system components for the current year. Should those projections not be available for some reason, or when the analysis must cover smaller geographical areas, the electrical specialist undertaking the assessment should develop such expected performance, including *inter alia*, overall or user sector historical sales, by volume and value, and the expected rate of growth of demand.

Step 2. Projection of post-disaster electricity demand

Since the recovery of total electricity demand depends on the speed of reconstruction of damaged assets in all user-sectors (industrial, agriculture, residential, etc), the electrical sector specialist must work in close cooperation and coordination with specialists of these other sectors. A demand/supply recovery curve is to be developed on the basis of such close consultation and coordination, taking special care to be as realistic as possible in regard to the timing of the staged reconstruction and recovery of activity in the user-sectors.

Step 3. Projection of future electricity supply

The projection of future electricity supply will depend on the type of losses sustained in the sector. These have been divided into two different cases. In the first case, one or more power plants have been put out of commission due to damage, but alternative plants are available on stand-by mode. In this case, service provision is only suspended briefly until the alternative units can be brought into line. However, unit generation costs of the alternative power plants are normally higher than the ones of the damaged units. The resulting increase in operational costs, over the time required for the damaged power unit to be repaired, must be estimated. In addition, if the alternative power capacity belongs to an independent nearby system, the cost of interconnection must be ascertained and accounted for as a loss.

In the second type of scenario, damaged components of the electrical system cannot be substituted promptly by stand-by facilities, and power supply must be discontinued. In this case, the electrical sector specialist, in close cooperation with construction/maintenance engineers of the affected electrical enterprise, must estimate the time required to bring back into line the affected system components, taking into consideration all normal constraints. Once this is done, the sector specialist must estimate the losses in revenues due to the non-sale of electricity to users, taking into consideration demand and rates.

Step 4. Estimate total losses

Total amount of losses can be obtained by the addition of the individual losses described before. To do that, one must compare the performance of the sector before the disaster with that for the situation prevailing after the disaster. This can be done by comparing the projection of revenues before and after the disaster, for the length of time required to achieve full recovery, and ascertain revenue losses, and by determining the increased operational costs arising from the use of alternative power sources and from inter-connecting to nearby electrical systems having idle capacities. The sum of both of these estimates will be equal to the total losses for the sector. As indicated previously, losses occurring in user-sectors due to lack of electricity are to be estimated in those sectors.

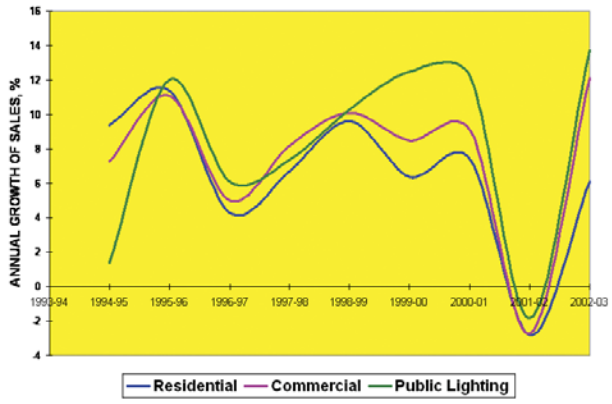
Case Study 4: Loss Assessment of the Electricity Sector in Gujarat

The data for this example are based on real data, taken from the electrical sector of Gujarat, after the Kutch earthquake in 2001. The damage assessment report shows that the earthquake caused extensive damage to urban areas and only minor effects in the rural sector. Minor damage was sustained by thermal power plants and severe damage occurred in transmission and distribution systems. The total amount of damage was estimated as Rs 183.7 Crore. At the time, no estimation was done of losses for the sector.

Estimation of Losses

The demand of electricity in the residential, commercial and public lighting sectors decreased after the occurrence, and remained depressed over more than one year.

Figure 30: Negative impact of disaster on electricity sales



Electricity sales were depressed in both the residential and the commercial sector. Figure 31 and Figure 32 show the actual versus forecasted sales in both sectors:

Figure 31: Losses in sales in residential sector

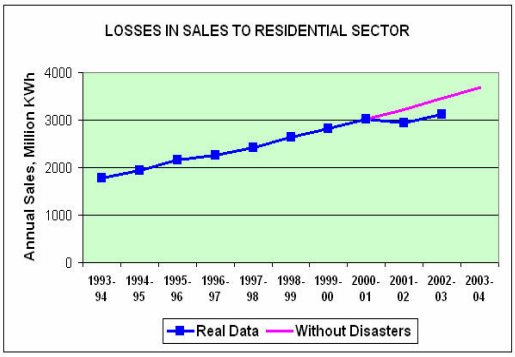
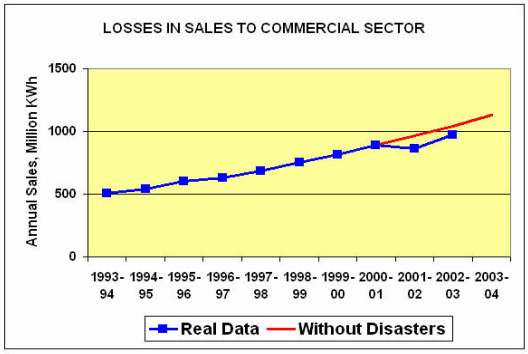


Figure 32: Losses in sales in commercial sector



Losses in sales translated to a loss in revenues to the electrical sector. Table 32 shows a summary of estimated revenue losses for 2001 and 2002:

Table 32: Summary of estimated revenue losses in electrical sector 2001-2002

Sector	*2001-02*	*2002-03*	**Total**
Residential			
Projected, million KWh	3,229	3,451	
Actual, million KWh	2,937	3,117	
Loss, million KWh	292	334	626
Loss, Rs. Crore	78.6	90.7	169.3
Commercial			
Projected, million KWh	963	1,042	
Actual, million KWh	866	971	
Loss, million KWh	97	71	168
Loss, Rs. Crore	45.5	33.1	78.6
Public Lighting			
Projected, million KWh	699	783	
Actual, million KWh	613	697	
Loss, million KWh	86	86	172
Loss, Rs. Crore	21.3	24.1	45.4
Total Loss, Rs. Crore	**145.4**	**147.9**	**293.3**

Total Effects of the Disaster

The total estimated damage and loss to the electricity sector is presented in Table 33.

Table 33: Total effects of the disaster

Effect	***Value, Rs Crore***
Damage to Assets	183.7
Estimated Losses	293.3

Water Supply and Sanitation

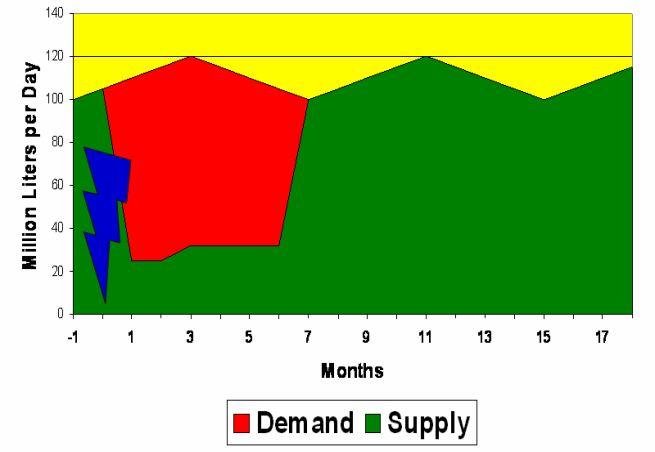
The water supply and sanitation (WSS) sector is very susceptible to natural disasters. It sustains damage to its assets, as well as losses in its economic flows. Damages to assets must be broken down by subsystems, which are drinking water supply, waste water, and solid waste. In addition, damages affect individual components: dams, wells, treatment plants, pumping stations, pipelines, storage tanks, distribution grids, sewerage facilities, latrines and septic tanks, solid waste collection and disposal facilities. Assessing damages requires the expertise of a civil or sanitary engineer.

Typical losses in the water and sanitation sector components tend to fall into three categories: higher operational costs, lower operational revenues, and unexpected costs for temporary operation of damaged systems. Loss is relatively more difficult to estimate (than damage) and their estimation requires the combination of civil and sanitary engineers and economists. In the water and sanitation sector, loss occurs until the replacement of assets and full restoration of service is achieved, or the demand from the users recovers its original levels. Thus, the estimation of that period for each system component is of paramount importance.

Losses in the WSS sector: two cases

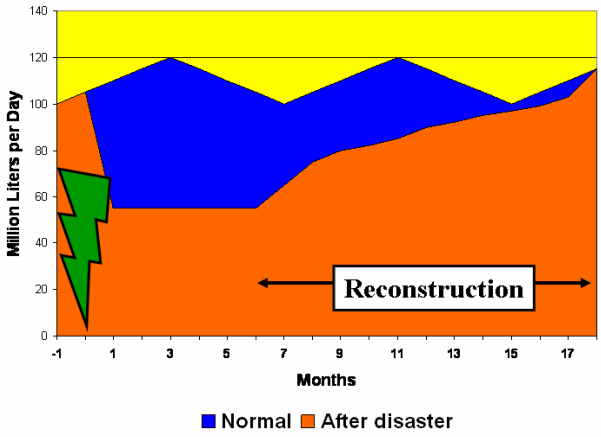
The following figures represent two cases in the water supply and sanitation sector where lower revenues occurred as a result of a natural disaster. Figure 33 shows a drop in supply due to damages to water production facilities, and Figure 34 shows a drop in demand because of partial destruction of a city.

Figure 33: Drop in supply due to damage to water production facilities



Increases in operational costs also lead to higher losses in the WSS sector, and indications of these can vary. Some examples include cost increases due to the higher application of chemicals to ensure water quality, the use of tanker trucks to distribute emergency water, clean up of water treatment plants, de-silting of sewerage systems, longer route for collection of solid waste, the use of alternative far-away water sources, and longer hours of pumping in wells.

Figure 34: Drop in user demand due to partial destruction of the city



Procedure for the Estimation of Losses

Step 1. Define pre-disaster baseline

In order to assess the impact of the natural disaster on the WSS infrastructure, a baseline must be constructed that describes how the sector was operating prior to the natural disaster. For the WSS sector, this includes defining the characteristics of the system's main components (geographical location, installed production, treatment, conveyance, storage, distribution and disposal capacities), and determining the characteristics of any existing nearby production, treatment, storage, distribution and disposal capacities that can be used as alternative temporary solutions. In addition, the baseline should include information on the statistics on water supply, wastewater and solid waste demands by users, and their seasonal variation, as well as financial information on all water supply and sanitation enterprises (including monthly operational data on revenues and costs, and differentiated rates charged to each user sector).

Step 2. Damage assessment

The second step is to conduct a damage assessment of the WSS sector. This should provide a breakdown of damage to each component of the system. In addition, it should provide the most realistic time periods for rehabilitation and reconstruction of system components, on the basis of equipment availability, specialized materials and parts, and financing.

Step 3. Develop rehabilitation and reconstruction plan

In the third step of the damage and loss assessment, a preliminary proposal should be developed that presents a staged recovery from the immediate post-disaster period until pre-disaster service level and quality are achieved. This should take into consideration the estimated time required for reconstruction, as per damage assessment, the possibility of resorting to utilize alternative system components available in nearby areas, and the possible temporary, more intensive use of production facilities.

Step 4. Estimate higher operational costs

Higher operational costs can include, but are not limited to, the increased use of chemicals to ensure water quality, operation at higher than normal daily schedule to meet increased

demands or to meet higher water conveyance or distribution losses, tapping alternative water sources having higher operational costs (wells or nearby systems with idle capacity), operation of wells at lower efficiencies due to excessive drawdown in cases of drought, deepening of shallow and deep wells to obtain higher yields, operation of wastewater treatment plants at higher-than-normal costs due to flooding of facilities, pumping costs to clean up sewerage systems silted by flooding, and higher transport costs for solid waste disposal due to use of longer roads.

Step 5. Estimate lower revenues

Revenues can be impacted due to the temporary inability to meet water demands in view of damage sustained by system components or because of lower demand caused by destruction of houses in city. In addition, the temporary inability to treat wastewater due to damage to plants, equipment and facilities can also negatively impact revenues.

Case Study 5: A Theoretical Example on the Assessment of Loss in WSS

Disaster Information

An earthquake affects a city of 175,000 inhabitants. The water supply system is based on several deep wells that tap groundwater aquifers of deteriorating quality due to over-extraction. Damage was caused to wells, pumping stations, storage facilities, and transmission and distribution lines.

Baseline Information

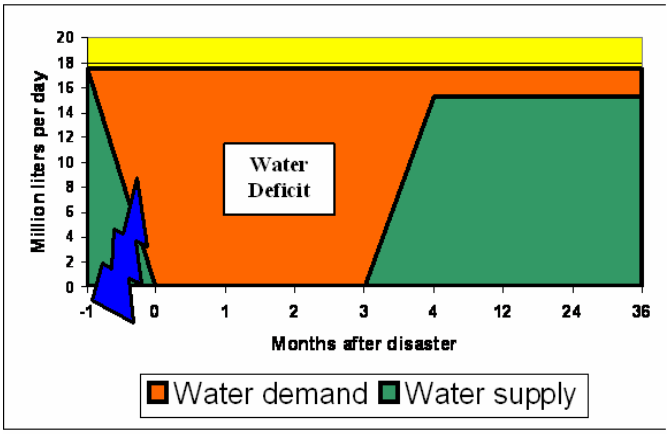
The baseline information for the sector can be summed up as follows:

- Average daily water consumption was 100 liters per person
- Average water losses due to leaks in the pipeline system were 17%
- Average monthly charges were Rs 10 per cubic meter of water
- Pumping costs were Rs 4 per cubic meter of water

Post Disaster Situation

For a period of 90 days, water was only distributed via 14 tanker trucks, while the system was being repaired, at a daily cost of Rs 400 per truck. Leaks in the pipeline system rose to 42%. A decision was adopted to use surface water sources instead of the wells, but the new source would take three years to be made available. In the mean time, repaired wells would be used at an increased rate of extraction, with which only 87% of the demand could be met.

Figure 35: Water demand and supply



Estimation of Losses

Loss in the WSS sector is estimated based on three factors: (i) estimates of increased operational costs for WSS companies; (ii) lower operational revenues; and (iii) unexpected costs for temporary operation of damaged systems.

Increased Operational Costs: Typically, after a disaster, the operational costs for WSS companies will increase. The following example of the impacts of an earthquake on the WSS sector illustrates this case. The earthquake caused damage to the WSS sector that necessitated a temporary provision of water during emergency period. The cost of this is estimated as the use of 14 tanker trucks to distribute water for 90 days at a daily rate of Rs 400 per truck for a total cost of Rs 504,000. In addition, the earthquake caused an increased

operational cost in that the pumping costs of wells rose. Where the pre-disaster water demand was 6.39 million m^3 per year (175,000 persons * 100 l/d * 365 days) and ground-water extraction at well site was 7.47 million m^3 (demand plus losses of 17%), the water supply in post disaster conditions was 6.4 million m^3 per year (87% of normal). As a result, post disaster groundwater extraction was 7.89 million m^3 (water supply plus 42% losses). The increase of groundwater extraction in post-rehabilitation period amounted to 7.89 – 7.47 million m^3 per year: 0.42 million m^3 per year. The cost of increased pumping during 2.75 years, assuming same unit pumping rates (0.42 million m^3 * Rs 4/m^3 * 2.75 years) is estimated at Rs 4.62 million.

Estimation of Lower Revenues: The estimation of lower revenues is split into two time periods: the first 90 days after the disaster, and the remaining time period until the sector was fully operational, or 2.75 years. During first 90 days, the WSS enterprise did not bill customers for water distributed through tanker trucks. Thus the loss of revenue can be calculated as the volume of water not supplied (175,000 persons * 100 l/d * 90 days): 1.58 million m^3 leading to a loss of revenue of Rs 15.8 million (1.58 million m^3 * Rs 10/ m^3). During remaining 2.75 years, the volume of water not supplied is equal to 13% of the demand (.13 * 6.39 million m^3 * 2.75 years), or 2.29 million m^3. The corresponding loss of revenue is equal to the volume not supplied times the water rate (2,29 million m^3 * Rs 10/ m^3), or Rs 22.9 million.

Summary of Losses

Table 34: Summary of losses

Losses	*Rs million*
Increase in operational costs	**5.1**
Distribution through tanker trucks in 90 days	
Increase in pumping costs	0.5
	4.6
Decrease in revenues	**38.7**
In first 90 days	15.8
Remaining 2.75 years	22.9
Total	**43.8**

Transport

The transport sector is frequently and intensely affected by disasters of every kind. The sector sustains damage to infrastructure and vehicle stock, and losses in its economic flows. In this sector, losses are usually higher than damages.

Assessment of damages in the transport sector is typically broken down in a number of subsectors. These include road transport, railroad transport, air transport, water transport, and communications. Any assessment of damages should also include damages to individual components such as primary, secondary and tertiary roads, bridges and drainage structures, railroads, vehicles and rolling stock, ports, river navigation channels, boats and ships, airport terminals and planes, and communications system components.

In the transport sector, typical losses include increased transport costs and lower revenues. Transport costs can rise because of use of lower quality or longer roads, change to different transport modes, delays in transit or cargo loading/unloading times, and use of lower capacity vehicles. Lower revenues tend to be measured within transport companies, port and airport enterprises, and communications enterprises.

Road Transportation Losses

For road transportation, losses typically include higher costs of transportation. These tend to result from the utilization of alternative, longer routes, the use of lower quality road surfaces, and the utilization of alternative, higher-cost transport modes. In addition, costs may rise because of unexpected expenses to temporarily relocate road sections and bridges.

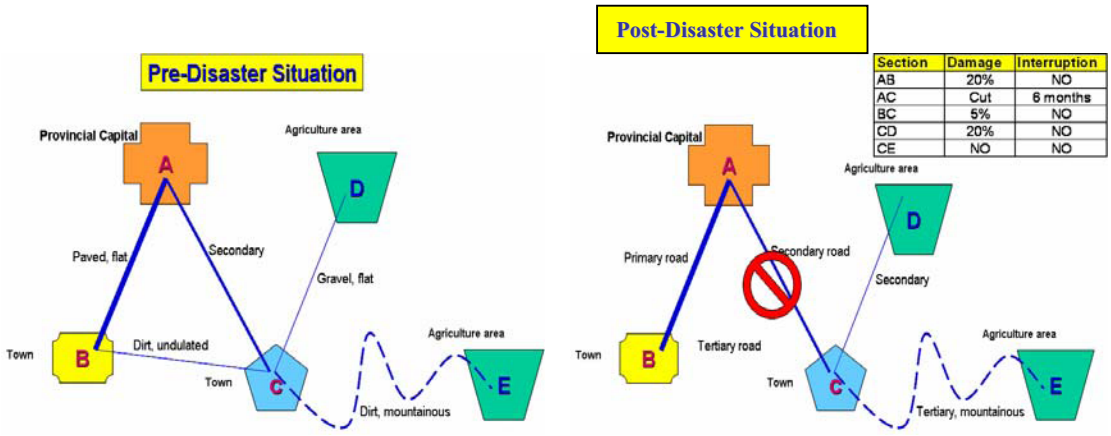
Estimation of Higher Transportation Costs

To estimate higher transportation costs, a comparison of pre-disaster traffic flows and post-disaster traffic flows must be constructed. Next, the marginal operating costs of vehicles in the pre- and post-disaster traffic conditions must be estimated. This should include any alternative modes of transport (i.e. air). For the marginal operating costs, the estimates should be done in US$ per km for each type of vehicle. Next the estimated time required for repair and reconstruction of damaged road sections must be determined. Finally, an estimate of the amount of increase in transport costs must be determined.

Example of Loss Estimation in Road Transport

The following example describes how to estimate losses in road transport. Figure 36 gives a hypothetical transport network. Here it shows several different types of roads that connect towns with agricultural areas and the provincial capital. The left hand side provides the transport network pre disaster. After the disaster, the secondary road that connects A to C has been damaged or destroyed, thereby impeding traffic that would normally use this road.

Figure 36: Transport networks, pre- and post- disaster



In order to estimate losses from this disaster, data on transport should be obtained to compare pre- and post-disaster scenarios. This is given in the following table:

Table 35: Pre- and post-disaster transport data

Item	*Pre-Disaster*					*Post-Disaster*			
	AB	AC	BC	CD	CE	AB	BC	CD	CE
Distance, km	150	150	98	75	82				
Normal speed, km/h	65	45	40	40	35	55	35	35	30
Truck and rig speed, km/h	60	40	35	30	45	25	25	25	25
Vehicle flow, thousand trips/month									
Light vehicles	100	45	35	40	20	150	70	25	25
Medium passenger	20	20	15	20	5	50	120	10	10
Trucks and buses	20	10	10	10	15	35	35	5	30
Rigs and trailers	120	5				130	25		
Average duration of journey, hours									
Cars and medium sized passenger	2.31	3.33	2.45	1.88	2.34	2.73	2.80	2.14	2.73
Trucks and rigs	2.50	3.75	2.80	2.14	2.73	3.33	3.92	3.00	3.28

By comparing the pre- and post-disaster data, the higher transportation costs can be estimated. For this, the following marginal operating costs were used:

Table 36: Marginal operating unit costs, US$/vehicle-km

Vehicle	*AB*	*BC*	*CD*	*CE*
Light vehicles	0.30	0.55	0.45	0.60
Medium passenger	0.65	1.20	1.10	1.15
Trucks and buses	0.90	2.00	1.50	1.85
Rigs and trailers	1.40	2.30	2.20	2.20

Using these costs, the value of monthly losses in each road section can be calculated. The results are presented in the following table:

Table 37: Value of monthly losses in each road section, thousand US$

Vehicle	*AB*	*BC*	*CD*	*CE*	**Total**
Light vehicles	2250	1887	-506	246	**3876**
Medium passenger	2925	12348	-1125	472	**14620**
Trucks and buses	2025	4900	-563	2276	**8638**
Rigs and trailers	2100	5635	0	0	**7735**
TOTAL	**9300**	**24770**	**-2194**	**2993**	**34869**

Water Transportation Losses

For water transportation, losses are measured as higher operational costs, lower port revenues and lower transport enterprise revenues. Higher operational costs can occur as a result of longer waiting times at ports, transfer to higher cost alternative transport modes, use of smaller vessels and increased number of trips, dredging of river and port channels, and use of lower capacity vessels during drought times.

Air Transportation Losses

Losses in air transportation can occur because of lower revenues to airports and airlines and higher operational costs because of the disaster. Lower revenues of airports and airlines can be due to the temporary closing or partial operation of airports, and the reduction in number of passengers and tourists. Higher operational costs typically occur because of the use of alternative, far-away airports, and because of airplanes flying at lower capacity.

Telecommunications Losses

For the telecommunications sector, lower revenues for enterprises in the sector can be due to either the temporary inoperation of land-based telecomm system components (i.e. flooding of switchboards or cable lines), or to very brief inoperation of wireless systems to realign antennas.

VIII. Cross Cutting Sectors

Environment

Types of Disaster Effects

The ecosystems that provide goods and services to society and the economy are environmental assets. For the purpose of damage and loss assessments, environmental assets may be divided into physical, biotic, perceptual environment, and the inter-linkages between them. The physical environment includes things like climate, air, soil and water. The biotic environment includes human beings, flora and fauna. Perceptual environment includes landscape, scientific and cultural assets. In addition to each of these categories, damages can occur to the inter-linkages between the categories.

Disasters may damage both natural assets and built assets. When damage to environmental assets occurs, the environmental services they render may decrease in quality and quantity (losses in environmental services). Services provided by environmental assets include (i) regulation of the water cycle; (ii) carbon sequestering; (iii) maintenance of biodiversity; (iv) recreation; and (v) degradation and transformation of waste. After a disaster, these environmental services can be temporarily eliminated or reduced in quality and quantity.

Some examples of damages include changes in the quantity or quality of natural assets. This includes damages to natural assets, such as to water and air quality because of pollution, to soils and beaches through erosion or sedimentation, and to forests through fire. In addition, destruction can occur to built assets, which prevent or make it more costly to use environmental services. This includes water mains or distribution grids breaking down, destruction of roads leading to tourist resorts, destruction of fishing boats and gear, among others.

Losses are temporary changes in environmental flows of goods and services, until the natural or built assets are restored to pre-disaster conditions. Some examples include:

- Loss of fishery catch until the sea returns to pre-disaster conditions or until the destroyed equipment and boats are replaced
- Drop in tourism revenues due to damage to natural and built assets (beaches, hotels, roads, etc)
- Higher costs due to temporary use of air masks, purchase of bottled water, vaccinations, etc
- Temporary loss in agricultural production due to flooding of soils

Procedures for Assessment

Step 1: Develop pre-disaster baseline data

The first step for conducting an assessment of damages and losses to the environment sector is to establish the pre-disaster scenario through collection of baseline data. Before an assessment of damage and losses is made, a quantitative baseline is required for the value of environmental assets, and environmental services rendered by the assets. This type of

information is not readily available in all cases. Where quantitative data is not available, often times qualitative data sources can be used to construct the baseline scenario.

As a general rule, only a few environmental assets and services can be measured in terms of their market value Thus, indirect ways of measuring them must be adopted, and, depending on what kind of data is available, one must resort to using different procedures or ways to value damage and losses.

Step 2: Assessing damage

Environmental damage may be estimated as the value of totally or partially destroyed assets. When full destruction occurs, damage is equivalent to the existing market value of assets. When no market value is available, and it is necessary to revert the destruction of assets, damage may be approached indirectly as the value of investments required to restore the assets.

Examples

- When agricultural lands are destroyed and cannot be brought back into production, the value of damage is the commercial or market value of the lands
- When lands in a slope are eroded, damage may be estimated as the cost of soil conservation and stabilization

Step 3: Indirect estimation of damage

In the absence of a market for environmental assets and services, damage may be estimated in an indirect fashion. Damage to soils caused by mudslides or landslides may be estimated as the value of the agriculture, livestock or forest production that will not be obtained from them over a relatively long period of time (i.e. 10 years). Damage to some assets may also be estimated indirectly as the value of the services they will not provide over a long period of time.

Step 4: Assessing loss

Losses will occur over the time period required for environmental assets to recover or be replaced. They should be estimated as the present value of the environmental services that will not be received over the recovery or replacement period. It will not always be possible to estimate these losses. In some cases, however, they will have been estimated in other sectors (losses in agriculture, fishery, tourism, etc).

Danger of double accounting

It is very frequent that the sectors that make use of environmental assets and services will estimate damage and losses. Thus, special care must be exercised in the assessment to avoid multiple accounting of the same type of damage and loss.

Alternative Assumptions: To Estimate Damage and Losses

Air Pollution

A volcanic eruption pollutes air and reduces visibility for inter-urban transport in the affected area. Air can only be cleaned by rainfall in the next three months. It is not possible to estimate the value of damage. Loss, however, may be estimated as:

(i) Higher health care costs to the population in the affected area to treat respiratory problems and to acquire breathing masks;

(ii) Higher inter-urban transport costs due to using longer routes to avoid visibility limitations; and
(iii) Drop in arrival of tourists from abroad.

Loss will normally be estimated by health, transport and tourism sector specialists.

Water Resources Affected

When water resources are affected, there are typically two different types of cases. First, changes in quantity and quality of water available (natural assets affected). For the first case, it is not easy to estimate the value of damage, but it may be estimated indirectly as the value of the works required to restore the quality and quantity of water to pre-disaster levels. When water resource development works are destroyed (built assets), the value of damage is equivalent to the cost of rehabilitation or replacement of the system.

Losses in the case of water pollution are estimated as the addition of:

(i) Decline in revenues and higher operational costs of the water treatment plants;
(ii) Costs incurred by users in the purchase of water filters and bottled water; and
(iii) Costs of medical attention to people who may become ill after consuming polluted water.

Second, the destruction of water resources development works (damage to built assets). In the second case of damage to water works, losses are estimated as higher costs and lower revenues of the water supply utility.

Water Works Affected

In the case of partial destruction of water works that provide water for human and industrial use, damage is equivalent to the cost of rehabilitation of water works and the restoration – through reforestation – of the watershed. Losses could include higher operational costs due to need to pump water from far-away alternative water source and lower revenues for the water utility over the period of rehabilitation of service.

In the case where floods have destroyed irrigation systems, damage is estimated as the value of rehabilitation or reconstruction of the system. Losses are estimated as the value of production that will not be obtained during the rehabilitation or reconstruction period.

Land and Soils

Natural and man-made events may permanently or temporarily affect lands and soils. Here, damage can be estimated as either the market value of the lands (both urban and agricultural), provided they are not distorted by other factors, or the value of agricultural production that will not be obtained over a long time period (i.e. 10 years). If lands and soils can be recovered over time, losses may be estimated as the amount of revenues (urban case) and the amount of production (agriculture case) that they will not provide until they are fully recovered.

Biodiversity

Drought, wild fires, hurricanes and intense rainfall may negatively affect forests and mangroves. Damage is estimated as

(i) The market value of wood and other related goods less their production costs;
(ii) In the case of natural forests not under exploitation, damage may be indirectly estimated as the value of the environmental services (carbon sequestering, etc) that will not be rendered over a long time period; and
(iii) If forests are to be assisted in their recovery after a fire, damage may be estimated as the amount required for their recovery.

Losses are estimated as the present value of environmental services that the assets will not provide during the time of recovery.

The Assessment Team

Typically, the assessment team should include engineers, biologists, etc for the estimation of damage. However, for environmental services, environmental economists tend to be best suited to estimate losses.

Case Study 6: Damage and Loss Assessment to the Environment after El Niño 1997-1998 in Costa Rica

***Damage and Loss Assessment**:* Because of extensive forest fires during El Niño 1997-1998 in Costa Rica, the following damage and losses occurred:

- Destruction of 3,200 hectares of primary forest, that are not recoverable except in the very long term;
- Destruction of 6,100 hectares of secondary forest, not recoverable except in the very long term; and
- 7,200 hectares of forest to provide shade to coffee plantations, of which 60% are not recoverable and 40% that require five years to recover.

Payment for Forest Conservation*:* The Costa Rican Government has a system of payments to forest owners for the conservation of forests over 20 years. The following are the environmental services paid for and the schedule of payments (US$/Hectare):

Services	*Primary Forest*	*Secondary Forest*
Carbon sequestering	38	29
Water Protection	5	3
Biodiversity protection	10	6
Recreation	5	3
Total	58	41

Use of Forest Areas*:* The forest areas tend to have a multiplicity of benefits. For example, in the coffee plantation areas, forests have secondary environmental benefits aside from agricultural production. These have typically been included the production of wood, the protection of water cycle and flood control, soil maintenance and stabilization, and biodiversity. The total value of these environmental benefits has been estimated in the following table:

Environmental benefit	*Estimated value (US$/hectare/year)*
Wood production	56 (14 m3/ha @ US$ 4/m3/yr)
Other (3) services	21
Total	**77**

Based on these figures, the following damage and loss estimates were generated:

Damage and Loss Assessment	*Disaster Effects,(Thousand US$)*	
	Damage	Losses
Damage to primary forest (estimated indirectly as loss of environmental services in 20 years, in 3,200 hectares)	2,150	
Damage to secondary forest (estimated indirectly as loss of environmental services in 20 years, in 6,100 hectares)	2,897	
Damage to shade trees in coffee plantations (indirectly estimated for 4,320 hectares)	3,858	
Loss in environmental services in coffee areas (5 years, 2,880 hectares)		610
TOTAL	**8,905**	**610**

IX. Summary of damage and losses

Once the damage and loss for individual sectors have been assessed, it is important to do a summary of damages and losses. This adds together the individual damage and losses for all sectors, and subtracts any possible duplication between sectoral estimates. This is important to get an overall picture of the disaster effects. Only damage and losses that can be measured in terms of national accounts should be included. Those impacts that are not included in the national accounts are to be accounted for separately (i.e. impact on informal sector, on women, environment, etc).

It is important to avoid common duplication in conducting overall disaster assessments. Losses to the agriculture, livestock and fishery sectors should be measured at prices paid to producers; not at wholesale or retail market prices. Water supply and sanitation damage and losses should be estimated separately from human settlements or housing sector. Farm roads are normally included in the agriculture and livestock sectors, not in transport (unless other arrangements are agreed upon beforehand). The tourism sector should not include damage to roads or other transport infrastructure and assets. Damage to lands and soils should be included in the agricultural sector and also in housing, as appropriate. Damage to natural resources should be included in the environment section, to avoid duplication with other sectors when estimating total damage and loss.

Once the damage and losses from each sector are aggregated, and gaps and duplications have been addressed, the total effects of the disaster can be broken down in different ways to help policy makers in developing a plan of action to address post-disaster needs. The following figures use the example of the Yogyakarta Earthquake in 2006 to show how information can be broken down further.

Yogyakarta Earthquake 2006

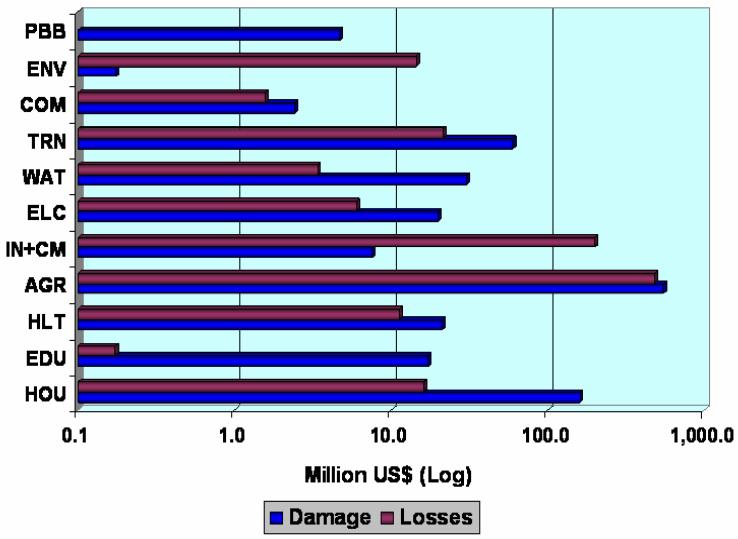
From the table below, we can see the estimates of damage and losses to each of the relevant sectors and subsectors. Summarizing the results in a table allows us to see where the greatest magnitude of damage and losses has been. In this case, the damage and losses sustained in industry make up the largest percentage of the total.

Table 38: Damage and losses from the Yogyakarta Earthquake, 2006

Sector	***Total Effects, Rp Billion***	
	Damage	*Losses*
Housing	13,915	1,382
Transport and Communications	90	---
Energy	225	150
Water and Sanitation	82	4
Education	1,683	56
Health	1,569	21
Culture and Religion	654	--
Agriculture	66	640
Trade	184	120
Industry	4,063	3,899
Tourism	36	18
Government	137	--
Banking and Finance	48	--
Environment	--	110
TOTAL	**22,751**	**6,398**

Typically, one of the first ways to break down the effects from a damage and loss assessment is into type of ownership. Depending on who the damages accrued to, there would be different strategies for reconstruction. Damage and losses in the public sector are generally of primary importance for the government to address. Damage and losses in the private sector, on the other hand, necessitate strategies such as reduced taxation, and other incentives, but are not usually targets of direct intervention on the part of the government.

Figure 37: 2008 floods in Yemen: breakdown of effects by sector



Next, the effects of the disaster are typically broken down by sector. This allows policy makers to address the sectors that were most affected, and gives a relative picture between all the different sectors where damage and losses are concentrated. As we can see from the following figure, the greatest damages were sustained in the agriculture sector, followed by industry. The greatest amount of losses was sustained in agriculture, housing and tourism.

Another way to break down results is to disaggregate damage and losses by district. This can give an idea of the geographic location of the disaster, since not all districts in a country will necessarily be affected by any given disaster in the same way. This can either be done in a bar graph, or by using maps to highlight the most affected districts. The following two figures give examples of these breakdowns.

Figure 38: 2008 hurricane season in Haiti, damage effects by district

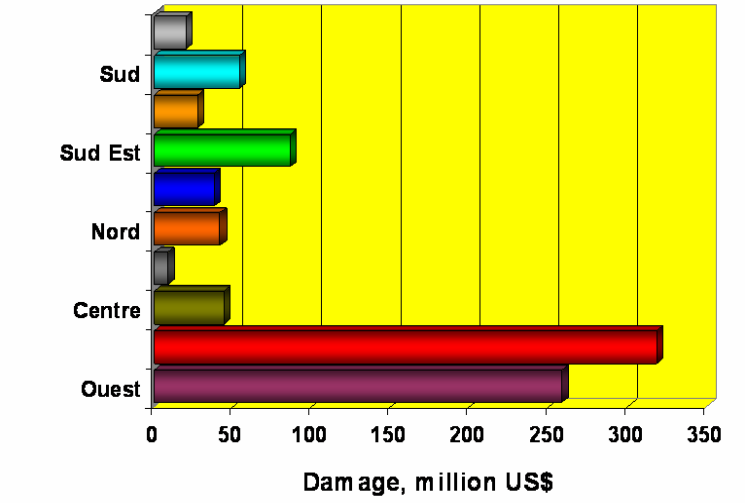
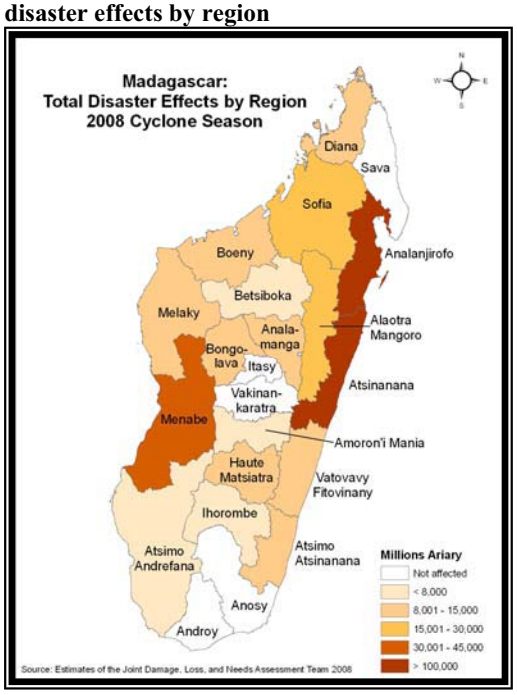


Figure 39: 2008 cyclone in Madagascar: total disaster effects by region



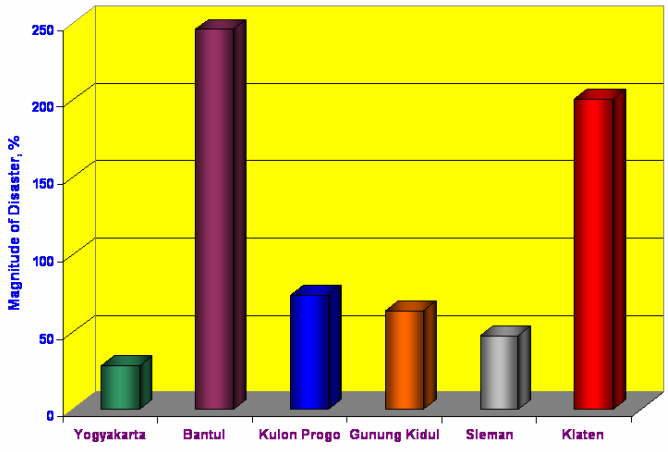
Relative Size of Disaster Effects vis a vis the Affected Economy

The relative size of disaster effects is typically measured in relation to Gross Domestic Product (GDP). For example, damage tends to be presented in relation to the annual rate of gross capital formation, the construction sector in GDP, and versus the national debt. Losses, on the other hand, are compared to total GDP and to total exports. Figure 40 shows the magnitude of the Yogyakarta Earthquake by province.

Defining priorities for recovery and reconstruction

Once the effects of the disaster are well understood, the task turns to defining priorities for recovery and reconstruction. For example, sector breakdowns can help policy makers in defining priority sectors to address, since they represent the most affected and have the greatest need. In breaking down damage and losses further by sector, the priority needs for recovery and reconstruction can be more adequately addressed.

Figure 40: 2006 Yogyakarta Earthquake magnitude of disaster per province



Module 3: Assessing impacts of natural disasters

X. Macro-Economic Impact of Disasters

This is a summary of the *ex ante* assessment of losses arising from the occurrence of influenza pandemic in Jamaica, analyzing two scenarios: a moderate pandemic of 1957 intensity and a severe event of 1918 intensity. The ECLAC methodology of damage and loss assessment has been applied for the case of Jamaica. The results show the amount of expected losses to the economy in all sectors of activity, as well as the impact of such losses on the overall economic performance in Jamaica.

Typical Impacts on Macro-Economic Variables

Gross Domestic Product (GDP)

Depending on type and severity of disasters, a number of impacts can be expected to occur in the year of the disaster and the subsequent years that will affect GDP. First, a decline in productive sector of GDP can occur because of losses sustained during and after the disaster. Second, the recovery of the productive sector and GDP will vary based on the economic recovery program implementation. Finally, an increase in construction sector GDP can be expected from the implementation of reconstruction program. All of these usually combine to affect GDP growth rates.

Balance of Payments (BOP)

Depending on the severity and duration of disaster effects (damage and losses), an increase in imports can be expected (of foodstuffs and other products) to compensate for losses of domestic production. In addition, an increase in imports of equipment and materials for reconstruction program, or a decrease in traditional exports due to losses in domestic production has been shown to occur. Finally, an increase in foreign exchange income from proceeds of insurance and reinsurance of damaged assets and production can be expected. These usually combine to create a possible increase in the balance of payments deficit.

Fiscal Budget

Depending on type and severity of disaster, an increase in current government spending to meet humanitarian assistance needs can be expected. In addition, government tax revenues typically fall because of reduced economic activity. And finally, increased operational costs and declining revenues for state-owned or operated enterprises is typical. These create a possible increase in the fiscal deficit.

Procedure for Macro-Economic Impact Analysis

Step 1: Develop baseline

The first step for conducting a macro-economic impact analysis of the effects of a disaster is to develop a baseline for analysis. To do this, a time series of past performance of GDP, BOP, the fiscal budget and inflation must be constructed, and a forecast of performance for current and future years. This creates a counterfactual scenario, or, what would have happened had the disaster not struck.

Step 2: Post-disaster forecast

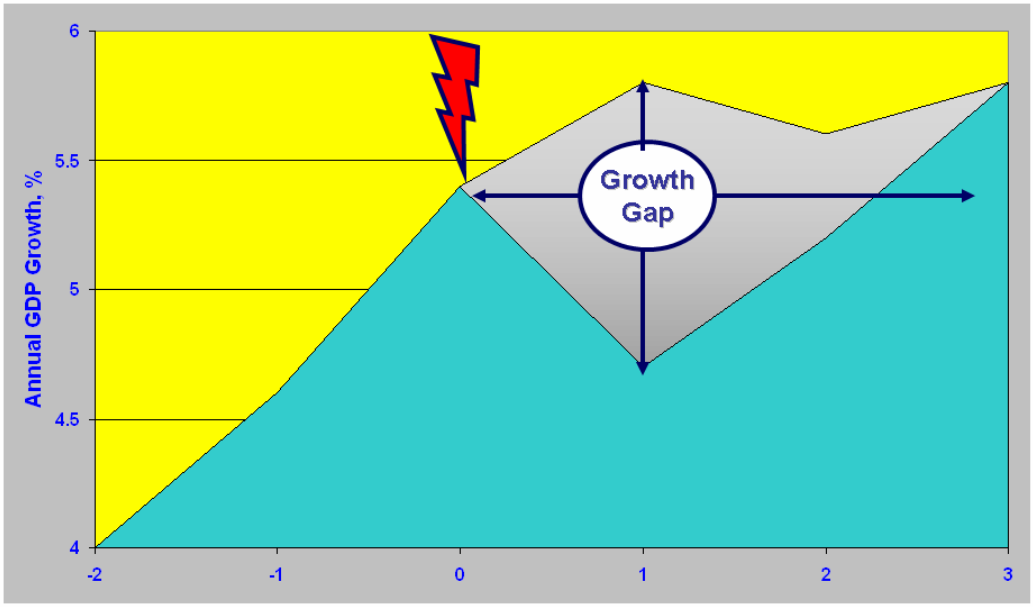
Next, a post-disaster forecast of macro-economic performance should be developed. For the analysis of GDP, it is important to use the latest pre-disaster projection on GDP performance for the current year (and subsequent years where disaster effects are still to be felt).

Step 3: Estimate loss

Next, superimpose estimated loss, as estimated in sector-by-sector assessment, ensuring no duplications. Then, superimpose the positive effects of economic recovery and reconstruction programs, taking into consideration all possible delays in execution. Estimate the post-disaster value and growth rate of overall and sectorial GDP, and compare these results with the pre- or non-disaster forecasts, to ascertain the impact of the disaster on economic performance.

Figure 41 shows an example of the effects of a disaster on GDP. In this figure, the incidence of a disaster, cause a sharp decline in GDP growth rates. When compared to what was forecasted for this same period, a growth gap can be determined.

Figure 41: Superposing losses, economic recovery and reconstruction effects on GDP growth



For the analysis of balance of payments, use the latest pre-disaster projection on BOP performance for the current year (and subsequent years where disaster effects are still to be felt). Next, superimpose estimated higher imports and lower exports of goods and services, as estimated in sector-by-sector assessment. Then, superimpose the likely effects of economic recovery and reconstruction programs, taking into consideration any possible delays in execution. Estimate the post-disaster position of the balance of payments, and compare these results with the pre-disaster forecasts, to ascertain the impact of the disaster on balance of payments.

For the analysis of impact on the fiscal budget, use the latest pre-disaster projection on fiscal budget performance for the current year (and subsequent years where disaster effects are still likely to be felt). Next superimpose estimated government losses in revenues and increases in

expenditures, as estimated in sector-by-sector assessment, and ensuring no duplications. Estimate the post-disaster performance of the government budget, and compare these results with the pre-disaster forecasts, to ascertain the impact of the disaster on fiscal performance.

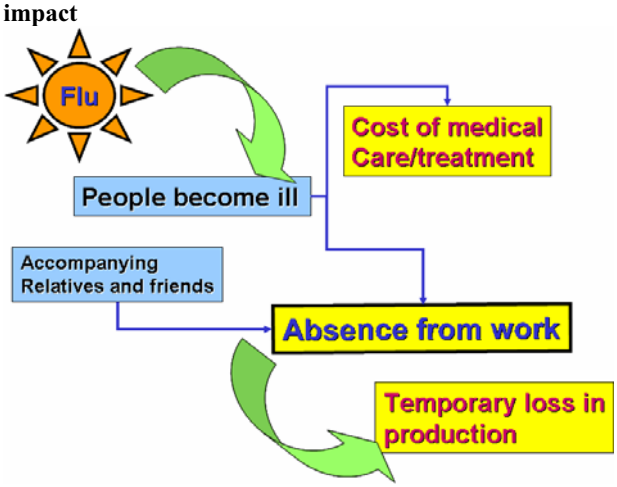
XI. Disaster impact at personal/household level

This section provides a brief overview of the qualitative effects of the influenza epidemic. This initial description will form the basis for the quantification of effects and impacts of the disease on the economy and society of Jamaica.

From Effects on Population to Socio-Economic Impact

When the flu pandemic arrives, people will become ill, and significant amounts of money will be required for their medical care and treatment. People that contract the disease will be absent from work for different periods of time. Healthy people (relative and friends) will also have to take care of the ones who are sick and will also be absent from work. The absence of labor from work will result in temporary losses in production in all economic activities.

Figure 42: From effects on population to socio-economic impact



The objective of the exercise will be to estimate (i) the costs of providing medical care to the sick population (over and above the normal budget appropriations of the health sector), and (ii) the drop in production in all sectors of the economy, including agriculture, livestock, industry, mining, commerce, transport and communications, etcetera. In other words, it is an issue of supply for the economy.

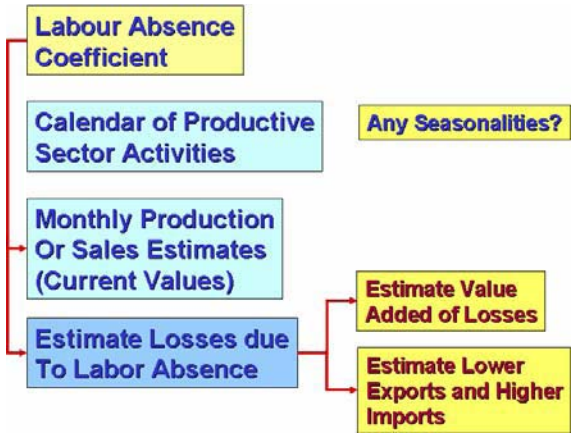
In addition to the problem of supply, when news about the occurrence of the flu pandemic spreads through international mass media, tourists will not come precisely at the start of the high tourism season (which begins at the end of the calendar year). The flow of tourism will remain depressed until world health authorities can certify that the flu pandemic has been overcome. An entire tourism season is expected to be lost. This was the case of the recent SARS outbreak in 2003. Employment and income in the tourism sector will drop accordingly, since travel to Jamaica will only be made under the most-essential travel mode (possibly by Jamaican nationals living abroad). Contrary to the previous cases of sectors, the tourism sector problems will represent a problem of external demand.

Loss Assessment Methodology: a Population Based Approach

The methodology used is that developed by ECLAC to estimate damage and losses arising from disasters that has been in use for the past 35 years in the Latin America and Caribbean region. While the ECLAC methodology was initially developed to assess disaster effects and impact after disasters have occurred, the methodology – with only minor modifications – may be used to make ex ante estimations of disaster effects and impact through the analysis of disaster scenarios. Therefore, the methodology has been used to estimate the effects and impact of the flu pandemic health crisis by using population as the basic input for the analysis. The basic input is, then, the temporary absence of the labor force.

An analysis is made of the calendar of productive sector activities (some of which have seasonalities that must be taken into consideration, such as the harvesting season coinciding with the arrival of the pandemic). Monthly values of production are developed for each sector of activity. These are then combined with the weighted labor absence coefficient to estimate gross losses in production for each sector. From these gross losses, estimates are made of their corresponding added value (which will be used when estimating impact on GDP) and the reduction in exports and increase in exports (to be used in the analysis of the balance of payment and trade).

Figure 43: Individual sector analysis



Results of the Assessment: The case of El Salvador

Using the Surge Flow model developed in the United States of America, estimates were made of the number of people that will become ill with the virus, and that will be absent from work while they are ill and also beyond to recover from the disease. In addition, the number of persons that will refrain from working due to the need to take care of ill relatives or friends has been estimated. The table shows the sum of both cases, for two scenarios of the pandemic intensity; a moderate one similar to that of 1957 and the severe one that is equivalent to that of 1918. From the data, weighted labor absence coefficients are derived for each scenario that will be used throughout the analysis. Table 39 shows the estimates were made by the Pan American Health Organization (PAHO) of economically active population that will be absent from work (patients and accompanying relatives) based on the flu surge model.

Table 39: Labor absences because of flu pandemic, moderate and severe scenarios

Days of Absence from Work	*Moderate Scenario*	*Severe Scenario*
1	81,449	81,449
2	967,149	967,149
3 to 4	497,353	394,372
5	8,862	101,540
10	1,564	17,919
12	8,261	94,548
25	1,453	16,685

The occurrence of the flu pandemic

It was assumed that the flu pandemic would occur in two waves, the first of which would start in the fourth quarter of 2006 and the second one in the second quarter of 2007. Thru use of the Flu Surge model, the absence of labor was estimated and the following weighted labor absence coefficients were derived for the estimation of production losses.

Table 40: Labor absence coefficients under different flu pandemic scenarios

Time Period	*Flu Pandemic Scenario*					
	Moderate			Severe		
	1st Wave	2nd Wave	Total	1st Wave	2nd Wave	Total
Monthly	0.0454	0.0091	0.0545	0.0647	0.0129	0.0777
Annual	0.0038	0.0008	0.0045	0.0054	0.0011	0.0065

Based on these estimates, the following loss was estimated:

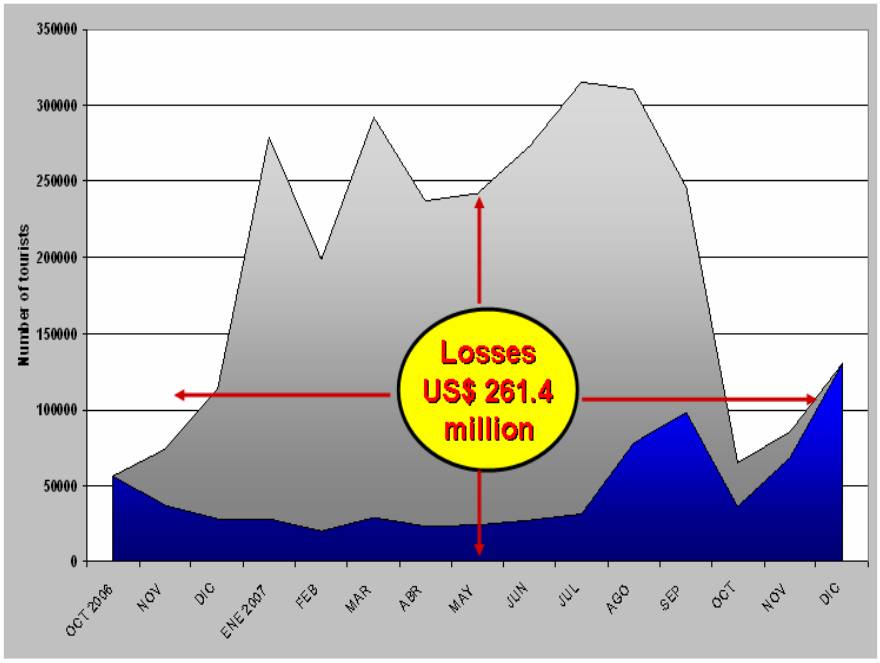
Table 41: Summary of losses, million US$

Sector	*2006*		*2007*		*Total*	
	Pandemic Scenario		Pandemic Scenario		Pandemic Scenario	
	Moderate	Severe	Moderate	Severe	Moderate	Severe
Social	**42.01**	**114.32**	**8.41**	**28.58**	**50.42**	**142.9**
Health	42.01	114.32	8.41	28.58	50.42	142.9
Productive	**72.44**	**94.64**	**253.62**	**256.60**	**326.07**	**351.14**
Agriculture	13.40	16.98	0.39	0.56	13.79	17.53
Industry	30.00	42.42	2.39	3.41	32.39	45.83
Tourism	14.48	14.48	246.87	246.87	261.36	261.36
Commerce	14.21	20.27	3.90	5.56	18.11	25.83
Mining	0.35	0.50	0.07	0.10	0.42	0.60
Services	**28.74**	**40.98**	**5.75**	**8.20**	**34.49**	**49.18**
Transport	10.05	14.32	2.01	2.86	12.06	17.19
Construction	4.75	6.77	0.95	1.35	5.70	8.12
Banking	13.95	19.89	2.79	3.98	16.74	23.87
Total	**143.20**	**249.95**	**267.78**	**293.27**	**410.98**	**543.22**

Relevance of Estimated Loss

Loss caused by the flu pandemic in El Salvador equals between 2.2% and 2.9 % of GDP, or to about one-sixth of the magnitude of the earthquakes in 2001. A disaster of singular consequences: no damage to infrastructure assets and significant decline in production and generalized income decline. Overall losses would be very high and all key actors in the economy -private entrepreneurs, the central government, and private individuals and households- would be affected to varying degrees. Such negative impact may be mitigated through the design and timely application of specific strategies in each of the affected sectors. The government and the private sector should initiate joint actions at the earliest possible time in this regard.

Figure 44: Most affected sector: tourism



The tourism sector is expected to follow a different pattern after the flu pandemic. Rather than reducing its sales due to the absence of local labor, this sector will sustain very high losses due to the absence of tourists from abroad, in a fashion similar to the case of SARS in SE Asia in 2003. Foreign tourists, upon learning that a country has the flu, will abstain from traveling to the country, until such time as international organizations (WHO/ PAHO) certifies that the disease has been eradicated. Most estimates indicate that only the most essential travel will be undertaken, possibly by country nationals living abroad, down to about 10% of the normal number of trips.

The agricultural and livestock sectors are presently facing a shortage of sufficient labor and imports workers from neighboring countries for harvesting, a situation that will be worsened by the pandemic. Specialists highlight certain crops, harvested in the 4th quarter of the year, that are susceptible to losses when not collected in a timely fashion. These include seasonal crops, such as corn, sorghum, beans and rice, and plantation crops, such as coffee, sugarcane, and cotton. Estimates of production losses in the 4th quarter of 2006 for these crops were made. Livestock production losses were also estimated for both the 4th quarter of 2006 and the 2nd quarter of 2007. These are presented in Table 42.

Table 42: Losses in agriculture and livestock, million US$

Sector/ Activity	*2006*		*2007*		*Total*	
	Pandemic Scenario		Pandemic Scenario		Pandemic Scenario	
	Moderate	Severe	Moderate	Severe	Moderate	Severe
Cereals	2.53	3.61	0.00	0.00	2.53	3.61
Production	2.40	3.43			2.40	3.43
Processing	0.13	0.18			0.13	0.18
Agroindustry	8.92	10.59	0.00	0.00	8.92	10.59
Production	7.31	8.72			7.31	9.72
Processing	1.61	1.87			1.61	1.87
Livestock	1.95	2.78	0.39	0.56	2.34	3.33
TOTAL	**13.40**	**16.98**	**0.39**	**0.56**	**13.79**	**17.53**

Table 43: Losses in industrial sector, million US$

Industry Branch	*Production 2006*	*2006*		*2007*		*Total*	
		Pandemic Scenario		Pandemic Scenario		Pandemic Scenario	
		Moderate	Severe	Moderate	Severe	Moderate	Severe
Sugar industry	67	1.52	1.82			1.52	1.82
Rest of the sector	7,529	28.48	40.61	5.70	8.12	34.18	48.73
TOTAL	**7,596**	**30.00**	**42.62**	**5.70**	**8.12**	**35.70**	**50.54**

The commerce sector will be affected by remittances, since 51.3 % of commerce sales are financed from family remittances. Their value will also be affected as those living abroad will also get the flu, at slightly higher rates since they do not all have medical insurance coverage. The table below presents losses in the commerce sector.

Table 44: Losses in commerce sector (excluding tourism), million US$

Gross Commerce Sales	*2006 Sales*	*2006*		*2007*		*Total*	
		Pandemic Scenario		Pandemic Scenario		Pandemic Scenario	
		Moderate	Severe	Moderate	Severe	Moderate	Severe
Paid for with family remittances	1,748	7.94	11.32	2.65	3.77	10.58	15.09
Paid for with domestic resources	1,660	6.28	8.95	1.26	1.79	7.53	10.74
Total	**3,408**	**14.21**	**20.27**	**3.90**	**5.56**	**18.11**	**25.83**

Losses to the health sector are, in fact, increased costs for the provision of health care. They were estimated on the basis of prevailing unit costs of medical care and medications, and combined with the estimated figures of population that will become ill, to arrive at the total cost for the sector.

Table 45: Losses in the health sector, thousand US$

Higher expenditures in	*Pandemic Scenario* Moderate	Severe
Monitoring/evaluation	14	14
Prevention and containment		
• Vaccination	9,642	9,642
• Anti-virus medication	6,817	25,767
• Non-pharmaceutical measures	1,009	1,009
Health System response		
• Ambulatory care	17,964	17,964
• In-hospital care	12,509	33,506
• Expansion of services	2,355	49,305
Social communications costs	109	109
TOTAL	**50,417**	**137,315**

Impact of Pandemic on Personal Finances: Employment and Income

From value of losses in each and all sectors of the economy, estimates may be made of the decline in employment and income of individuals. Labor coefficients, which relate value of production to number of people employed in each sector, are used to ascertain losses in employment (number of person-months of employment). Daily wage information must be combined with loss of number of person-months or employment to obtain income loss for individuals in each sector.

Since the flu pandemic will cause labor force absenteeism, a corresponding temporary decrease in personal and household income will occur. Persons employed under permanent conditions are not expected to sustain such personal losses. Wage earners, on the other hand, are expected to temporarily lose personal income. In addition, all employees are expected to face increased expenditures to cover both partial costs of medicines and medical care, and increased food costs. This will result in an overall decline in personal wellbeing, although temporary in nature. The following tables show some examples of calculations done to estimate the impact of the flu pandemic on employment and income.

Table 46: Temporary income decline after pandemic

Employment Categories			*Economically Active Population*	Monthly income, US$/mo.			
				Non-disaster conditions	Lower income according to type of medical care		
					Ambulatory	In hospital	In ICU
Country			**2,784,000**				
Urban	**Total**		**1,609,152**				
Areas	Micro-enterprises	More than 5 employees	415,161	244	218	139	26
		Less than 5 employees	212,408	175	156	100	19
	Domestic Employees		62,757	160	143	91	17
	Self-employed	Industry and Construction	104,595	190	170	108	20
		Commerce and others	384,587	220	196	126	24
Rural	**Total**		**1,174,848**				
Areas		Agriculture	249,068	98	88	56	10
		Others	372,427	177	158	101	19
		Self-employed	475,813	79	70	45	8

Table 47: Number of persons affected by temporary personal income decline

Type of Medical Care for the Sick	*Average length of absence, days*	Income reduction factor
Ambulatory	3	0.107
Hospitalization	12	0.429
Intensive Care Unit (ICU)	25	0.893

Table 48: Aggravation of poverty

Poverty level	Monthly Income, US$/mo.	
	Urban	Rural
Poverty	76.10	49.20
Extreme Poverty	38.10	24.60

Some Strategies to Mitigate the Impact of a Flu Pandemic

After estimating the losses that would be caused by the flu pandemic, specific strategies may be designed to reduce their impact on the population and the economy. The amounts involved can be derived from the estimates presented here. These strategies may be sector specific or general in nature; they may have a national, regional or international scope for their implementation.

Strategies of National Scope

These strategies have two objectives: (i) to increase awareness and achieve full appropriation of government authorities on flu pandemic consequences; and (ii) to reduce the negative impact of the flu pandemic on the wellbeing and income of the population. Specific Prevention activities could include a presentation of the socio-economic impact study to national health authorities, meeting with Ministers of the Presidency, Economy, Finance, Agriculture, Labor, Health, Industry, as well as representatives of the tourism sector (public and private) to present and discuss results of the analysis, and formulating a plan for the reduction or mitigation of the negative impact of the pandemic on production, employment and income, including assignation of responsibilities and financial resources.

Specific Mitigation activities could include developing a legal provision of national scope to ensure all persons that may have to be hospitalized, or may have to accompany relatives that are hospitalized, retain their work status after the flu pandemic. It could also include a legal provision of national scope to assign priority to those who are hospitalized, or have to accompany relatives that are hospitalized, in the assignation of overtime work for post-pandemic production recovery. In addition, a special savings and loans program to assist in the provision of funds to overcome the temporary decline in earnings due to the flu pandemic, providing above-normal interest rates for savings and below-normal rates for loans could be developed. Finally, it could include a special program to attend to the needs of the poor and indigent during the flu pandemic, as well as to attend to the needs of orphans that lose their parents due to the pandemic.

Sector-Specific Strategies:

Health Sector: The specific strategies must be defined by specialists in the sector. Nevertheless, some strategies are already obvious, such as the expansion of hospital capacity – in terms of beds, mechanical respirators, et cetera – to meet the envisaged demand of the pandemic. In addition, the acquisition of adequate stock of antiviral medicines and protective masks to meet the envisaged demand must be undertaken, and the earliest possible acquisition of anti-flu vaccines to cover the higher risk population groups procured. Finally, analyzing the feasibility of closing schools as a means to reduce contagion rates could be explored.

Agriculture and Livestock: Alternatives to reduce losses in production and income of wage earners are very limited. Some strategies could include resorting to import workers for the harvest season. However, this may not be an option, as people could be ill in neighboring countries as well. Similarly, late harvesting is not an option either, since the involved products are very perishable and/or they sustain sharp decline in quality and price due to delays in harvesting. Harvest activities cannot be advanced in time, since the maturation of products is a function of climate and no possibility exists of introducing short-period seed varieties without having certainty about the occurrence of the pandemic. Mechanizing harvest activities is not an option since some of the products – especially coffee – would not allow it and because topography would prevent it. The only option seems to be the payment of overtime to able workers in order to reduce the loss in agricultural production as much as possible. This, however, would result in higher costs of production. This is feasible in the case of milk collection in the livestock sector as well. Overtime work to recover cattle meat output once the pandemic is over is also feasible, using both able and flu-recovered workers.

Other sectoral strategies: Payment of overtime salary to workers to recover pre-pandemic levels of production in the industrial sector, once the pandemic period is over. Same for the commerce sector, provided that the demand for goods recovers promptly, especially after family remittances from abroad recover their pre-pandemic levels.

Tourism Sector: Possible strategic association between the tourism sector and health sector to strengthen capacity of the latter to deal with the flu pandemic and thus reduce the duration of the non-arrival of foreign tourists could be explored. In addition, a special program to retain workers of the sector to avoid their migration to other sectors of the economy could be developed, or a program of special maintenance and expansion of tourism facilities, based on the use of re-trained workers of the sector could be explored. Other approaches could include the formulation of post-pandemic joint campaigns – involving tourism sector, health sector

and government authorities – to promote tourism in traditional and non-traditional foreign markets through special packages and incentives, and formulation of special campaigns to attract more domestic tourists.

Cooperation Strategies

Taking into consideration the high financial requirements to face the flu pandemic, some economies of scale may be achieved through regional cooperation. Some of these could include a plan for the temporary exchange of specialized personnel, equipment and medicines on a regional and the international level, as well as joint acquisition of antiviral medications, vaccines and equipment to lower unit costs and ensure adequate and timely supply.

Module 4: Estimating Needs

XII. From DaLa To Post-Disaster Needs Assessment (PDNA)

Defining post-disaster needs is important to determine which post-disaster activities are most urgent. These can be economic recovery programs to restore personal and family income, essential services, and production activities in the affected sectors. These can also be reconstruction programs to repair or replace the damaged physical assets. The scope and financial needs of the economic recovery and reconstruction programs must be defined on a solid quantitative basis. Financial resources must be assigned on the basis of the spatial, sectoral and affected population groups criteria. The damage and loss assessment provides the quantitative inputs required for planning and monitoring these post-disaster programs.

Table 49: Yogyakarta Earthquake 2006

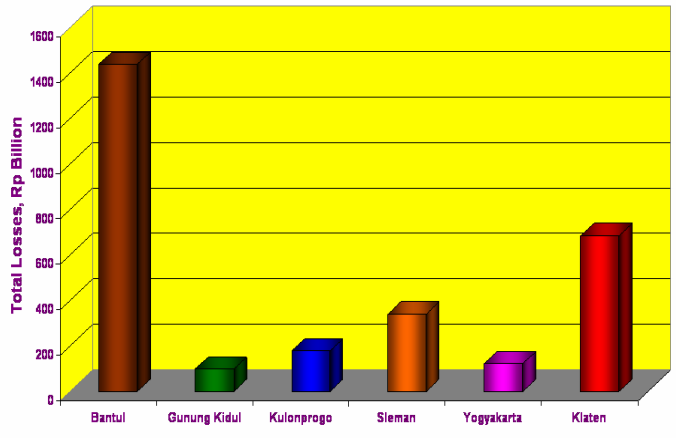
Sector	***Disaster Effects, Rp Billion***	
	Damage	*Losses*
Housing	13,915	1,382
Transport and Communications	90	0
Energy	225	150
Water and Sanitation	82	4
Education	1,683	56
Health	1,569	21
Culture and Religion	654	0
Agriculture	66	640
Trade	184	120
Industry	4,063	3,899
Tourism	36	18

The damage and loss estimates by sectors, such as in the example above, can provide a useful tool for designing reconstruction and recovery programs.

From Losses to Economic Recovery Plan

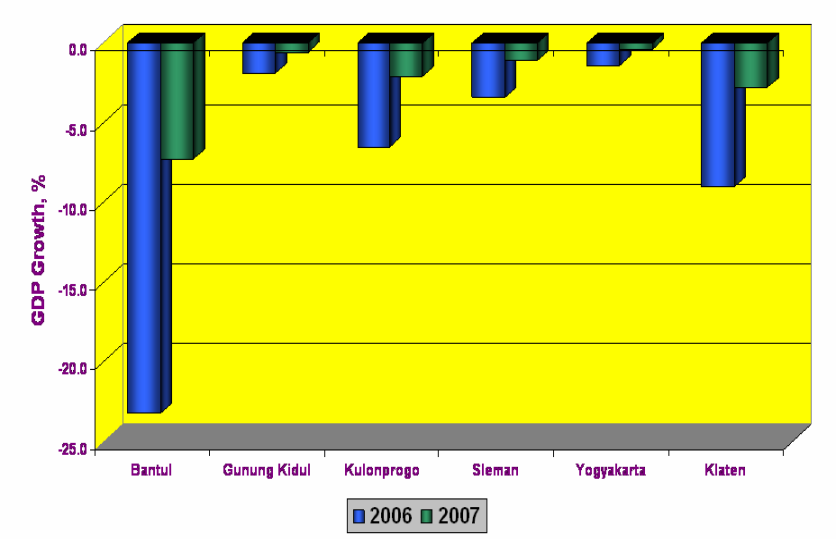
Some components of an economic recovery plan include modifications to public policies to mitigate macro-economic and individual impact. These can include income generation schemes for most affected population groups, with special reference to those that are not creditworthy or provision of soft term financing to re-start production activities in micro, small and medium sized enterprises. In addition, these could include facilitation of construction permits to provide minimum delays of reconstruction start and execution.

Figure 45: Losses by district, Yogyakarta



The scope and priorities of each subprogram must be defined on the basis of criteria arising from loss assessment. This can determine the most affected sectors, geographical areas, and population groups. A comparison of the amount of production losses versus GDP for each affected sector provides a measure of impact on sector performance. When such impact is high, special sectoral production recovery programs must be designed. Financial needs for each sector and sub-sector can be estimated from the value of production loss. In this way, estimates of loss can serve as an indicator of financial needs for economic recovery.

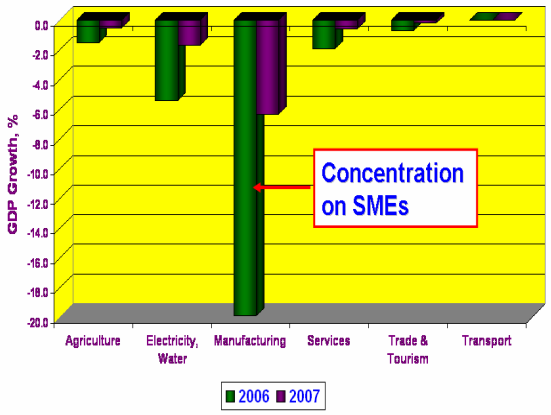
Figure 46: GDP growth by district, Yogyakarta



From Damage to Reconstruction Needs

The damage and loss assessment (DaLa) can also be used for reconstruction planning. The DaLa provides an initial assessment of the value of damages that, when taken together with estimates for technological improvement, relocation costs, cost of mitigation and inflation, make up the needs for reconstruction. The reconstruction program determines what the financing needs are for each sector, and determines the priorities for reconstruction (both by sector and by location). This provides the basis for the financing formula that is able to direct government funds, private sector funds, insurance reimbursements, international grants and international loans (both reallocations from existing loans as well as new loans).

Figure 47: Sector priorities for economic recovery, Yogyakarta



The value of damage must be supplemented, to define financial needs of reconstruction program, by introducing criteria from reconstruction strategy and inflation rates. Thus, the reconstruction strategy should aim to "build back better". It can do this with improvements in quality, technological

innovation, introducing mitigation measures, and relocating people to safe areas.

Reconstruction Needs

Financial needs for reconstruction can be defined, focused and prioritized on the basis of the damage assessment. The criteria for assigning financial resources include per capita damage figures, sector distribution of damage, and spatial distribution of damage.

Figure 48: Sector priorities for reconstruction , Yogyakarta

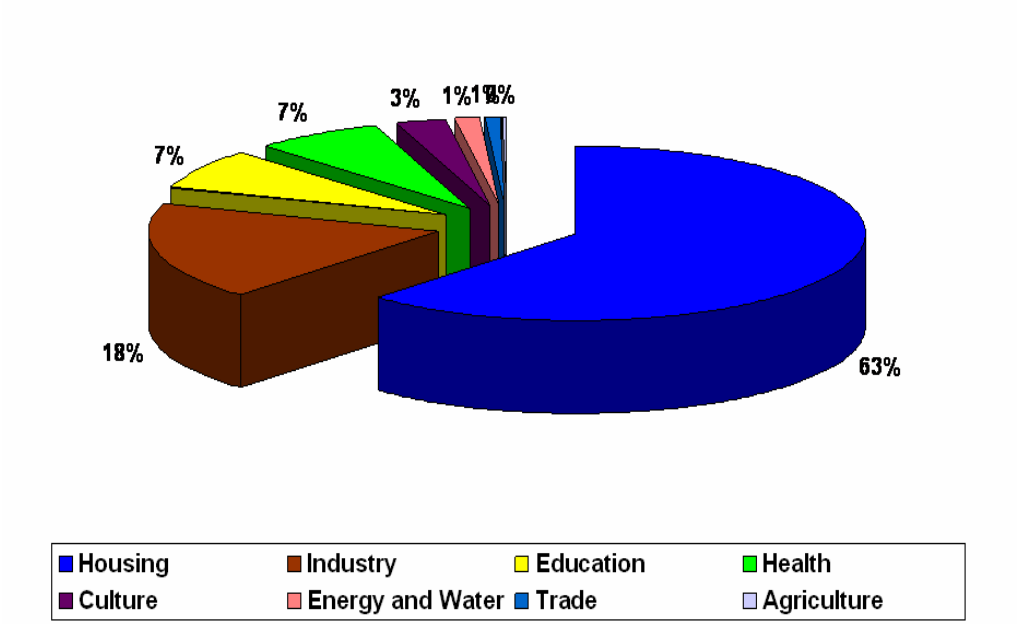


Figure 49: Total damage by district, Yogyakarta

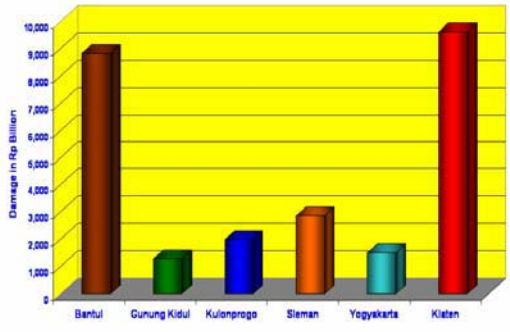
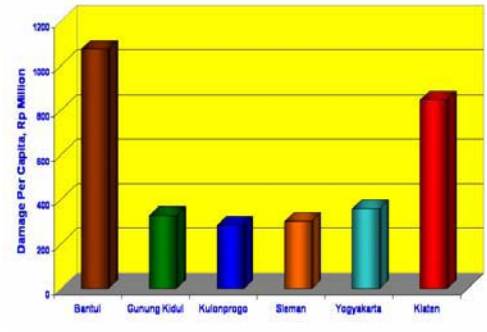


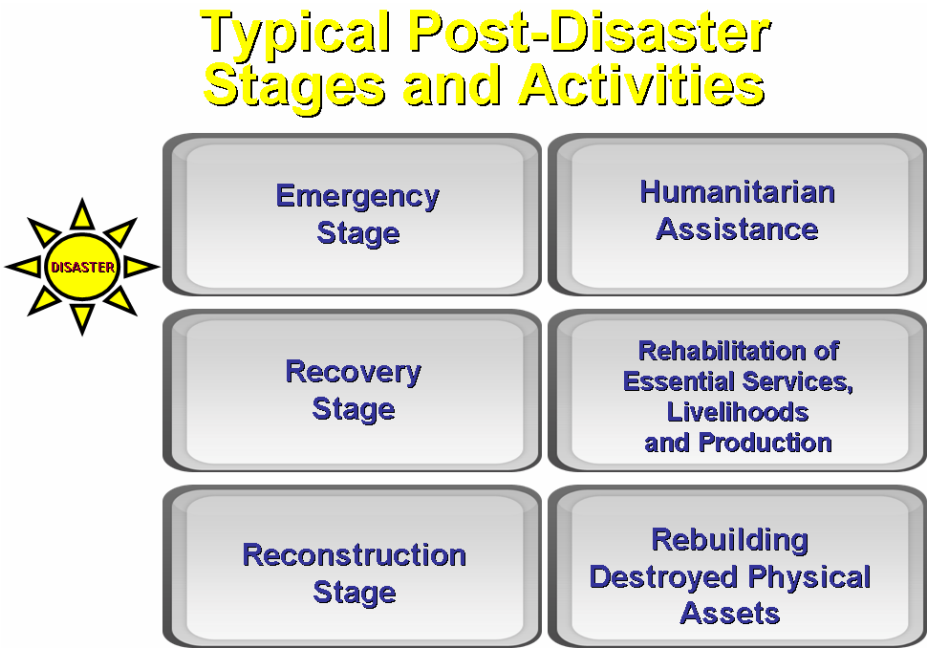
Figure 50: Total per capita damage by district, Yogyakarta



Module 5: Undertaking Assessments

XIII. How to Undertake a Damage, Loss and Needs Assessment

Introduction



Division of Labor

Generally, the United Nations has been most active in the immediate aftermath of disasters for providing humanitarian assistance to affected areas. The World Bank and others have been more active in the medium- to longer-term recovery and reconstruction efforts. The damage and loss assessment is a methodology that focuses on what the needs are for the recovery and reconstruction phases. In order to estimate those needs, a damage and losses assessment is done for each relevant sector of the economy. This is then followed by an impact assessment that measures impacts at both the macro-economic level, as well as at the personal/household level.

Methodologies for Assessment:

The methodology for the damage and loss assessment aims to address what is needed in the post-disaster recovery and reconstruction phases. This differs from other methodologies, developed primarily by the United Nations, to assess the humanitarian needs in the immediate aftermath of the disaster.

Conceptual Framework

Damage: Damage is defined as the total or partial destruction of physical assets. This includes buildings and their contents, infrastructure, stocks, natural resources, etc. Typical damages include damages to housing and household goods, hospital and schools, and contents, agriculture lands and irrigation systems, roads and bridges, ports and airports, water supply systems, and electrical systems. Damages typically occur during or immediately after a disaster. They tend to be measured in physical terms, and a monetary replacement value is assigned to it.

Loss: Loss is defined as changes in economic flows caused by the disaster. They typically include production not obtained and sales not made, and corresponding higher production costs, higher operational costs and lower revenues in the provision of essential services, and unexpected expenditures (such as demolition and debris removal). Examples include losses in agriculture, fishery, livestock, industry, commerce, tourism and higher operational costs and lower revenues in electricity, water supply and transport. Losses typically occur from the time of the disaster until full economic recovery and reconstruction of assets are achieved and are measured in monetary terms at current prices.

Why Do We Need an Assessment?

The objectives of assessment are (i) to obtain a quantitative estimation of the value of destruction or damage to assets and of changes or losses in economic flows due to the disaster, (ii) to identify the impact of the disaster on the overall functioning or performance of the economy of the affected country or area, and also on individual persons or on households; (iii) to identify the capacity of the government to undertake on its own all recovery, reconstruction, and disaster risk management programs and activities; (iv) to ascertain whether international assistance should be provided, its scope and timeframe; (v) to identify specific public sector actions to be undertaken by the government in the short, medium and long term to ensure recovery and reconstruction; and (vi) to estimate financial, technical and human resource needs to implement the agreed upon programs of recovery, reconstruction and risk management, duly broken down into actions at the central, provincial, district or community levels.

Scope of Assessment

The assessment should cover the entire area affected by the disaster and broken down by geo-political divisions, and also cover all sectors of economic activity that may have sustained positive or negative disaster effects.. The list of sectors to be assessed is defined on the basis of economic activities included in country's system of national accounts.

Table 50: List of typical sectors, Republic of Macedonia

Number	*Sector of Economic Activity*
1	Agriculture, hunting and forestry
2	Fishing
3	Mining and quarrying
4	Manufacturing
5	Electricity, gas and water supply
6	Construction
7	Wholesale and retail trade
8	Hotels and restaurants
9	Transport, storage and communications
10	Financial intermediation
11	Real estate, renting and business activities
12	Public administration and defense
13	Education
14	Health and social work
15	Other community, social and personal services

Table 51: Example of typical sector assessment: agriculture

Destruction of physical assets	*Losses in economic flows*
Permanent plantations	Production in standing crops
Pasture	Future production of crops
Agricultural land and soils	Higher costs of production:
Irrigation/drainage systems	Irrigation
Machinery and equipment	Seeds
Storage facilities	Fertilizer
Inputs	Pesticides
Stored agricultural products	Labor

How is an Assessment Done?

The process for assessment typically follows a five step process which is outlined as follows:

(i) Sector-by-sector assessment
(ii) Aggregation of individual sector assessments, ensuring no double accounting or gaps
(iii) Analysis of macro-economic impact
- Gross domestic product
- Balance of Payments
- Fiscal budget

(iv) Analysis of personal/household impact
(v) Estimation of needs for recovery and reconstruction

When is the Assessment Done?

The time period required for typical assessment ranges from two to four weeks depending on the complexity of the disaster and extent of damages to the affected areas. The assessment should begin after a series of certain conditions have been met. First, relevant government officials must be available to participate in the assessment. In addition, there must be an availability of baseline information of the disaster effects. Otherwise an accurate estimation of the disaster effects cannot be provided. Finally, there must be adequate access to and within the affected areas, in order for field surveys to be conducted. The damage and loss

assessment should not begin until after the most urgent needs have been met by humanitarian assistance, and when there is no further risk of secondary effects from the natural disaster (i.e. secondary shocks from earthquakes, further flooding, etc.).

There is a relatively small window of opportunity to complete an assessment of disaster effects, given the urgent need to obtain financial support for recovery and reconstruction. Speed tends to be more important than focusing on achieving full accuracy. Nevertheless, assessors should aim to achieve the highest possible accuracy by combining the best available professionals, the best possible information, and adequate and reliable methodological tools for assessment.

Who Should Do the Assessment?

Sectors	*Sub-Sectors*	*Discipline or Profession Required*	
		Essential	Desirable
Productive Sectors	Agriculture, livestock, Fisheries	Agronomist Agricultural economist Fishery economist Livestock economist	Agriculture extentionist Fishery biologist Veterinarian Food balance/ security specialist
	Industry	Industrial Engineer Industrial economist	
	Commerce and Trade	Trade economist	
	Mining and quarrying	Civil engineer Mining economist	
	Tourism	Civil engineer Tourism economist	
Social Sectors	Education	Sociologist	
	Health	Civil engineer Medical doctor Epidemiologist	Public health specialist Nutrition specialist
	Housing	Architect Civil engineer	Urban planner
Infrastructure Sectors	Transport	Civil engineers Railway engineers Transport economist	
	Communications	Civil engineers Communications experts	
	Electricity	Civil engineers Electrical engineers Economist	
	Water and sanitation	Civil engineers Sanitary engineer	Public health specialist
Environment		Environmental economist	Biologist and other related disciplines
Macro-economic analysis		Macro-economists Development economist Statistical office representative	Fiscal sector specialist
Personal/household impact analysis		Labor economist	
Gender impact analysis		Gender specialist	

Information Requirements

The damage and loss assessment analyzes sector by sector impacts of a natural disaster. As such, it requires certain information to be able to construct a baseline. This baseline provides a snapshot of the sector or of the country prior to the disaster, and allows for the assessment of impacts that the disaster had on sectors, as well as the economy as a whole. General sources of information include, but are not limited to: most recent population census; most recent household survey; annual production statistics; production forecasts; annual reports for utilities; annual economic and social surveys; and other economic and financial reports.

The type of data needed will vary by sector, but can include:

Sector	*Information Required*
	Productive
Agriculture	Calendar of production activities
	Area for different crops (seasonal, annual or permanent crops)
	Production volume for each crop
	Unit prices for each crop(at farmgate, wholesale, and retail levels)
	Expected unit yields for all crops
	Forecasted volume of production
Livestock	Animal stock
	Unit prices paid to owners for animals
	Production, annual or monthly (milk, cheese, eggs, etc.)
	Prices paid to producers
Fishery	Boats and nets (number and capacity)
	Monthly catch (in volume or weight)
	Prices paid to fishermen
Commerce	Most recent commerce census or survey
	Time series of commerce and trade volume and prices
	Information on small and medium enterprises
	Gross domestic product, by commerce categories
	Periodic surveys carried out by trade and industry ministries or by central bank
Industry	Most recent industrial census
	Time series of industrial production and prices
	Data on small and medium enterprises
	Gross domestic product, by branches and activity
Tourism	Most recent survey on tourism sector
	Time series of tourist arrivals, seasonality, and income
	Average length of stay and expenditures
	Gross domestic product for tourism and subsectors
	Static baseline on assets

XIV. Baseline information

The following section provides an overview of baseline information that should be collected for each of the sectors:

Table 52: Baseline information for damage and loss assessment after disasters

PRODUCTIVE SECTORS	
AGRICULTURE	
Calendar of production activities	
	Seasonal or annual crops
	Plantations
Production forecast (for each crop, and years)	
	Surface area, hectares
	Expected unit yield, Kg/Ha
	Forecasted production volume, Kgs
Statistics on unit prices, US$/Kg (past three years)	
	Farmgate price
	Wholesale price
	Retail price
Post-disaster production (for each crop)	
	Surface area, hectares
	Expected unit yield, Kg/Ha
	Forecasted production volume, Kgs
Production losses (for each crop)	
	Volume losses, Kg
	Farmgate price, US$/Kg
	Value of losses, US$
Agricultural infrastructure	
	Irrigated area, hectares
	Farm roads, kms
	Farm machinery, number and capacity
	Storage facilities
INDUSTRY	
Industry branches	Large enterprises
	SMEs
	Micro-enterprises
	Agro-industries
Industrial production in past three years	
	Large enterprises
	SMEs
	Micro-enterprises
	Agro-industries
Wholesale price for typical products (past three years)	
GDP by industry branches (past three years)	
Most recent industrial census	
Industry associations and chambers	
COMMERCE AND TRADE	
Commercial establishment categories	

	Government owned
	Privately owned
Trade volume and retail level prices (past three years)	
GDP by commerce category	
Most recent commerce census	
Most recent survey carried out by government, or by private sector	
TOURISM	
Number and location of assets	
Statistics on tourist arrivals (past three years and projections)	
Average length of stay and average expenditure (past three years)	
GDP for sector	
Most recent tourism sector survey	
SOCIAL SECTORS	
HOUSING	
Types of housing units	Poor families
	Medium income housing
	High income housing
Construction costs, US$/Unit	
	Poor families
	Medium income housing
	High income housing
Repair costs, US$/Unit	
	Poor families
	Medium income housing
	High income housing
Household goods, typical, US$/Unit	
	Poor families
	Medium income housing
	High income housing
House ownership	
	Government owned
	Privately owned
	Rented premises
Most recent housing census	
Most recent household survey	
Analysis of construction capacity	
EDUCATION	
School year calendar	
Number and level of schools	
	Government owned
	Privately owned
Typical furnishings, equipment and materials	Value in US$
Construction and repair costs, US$	
Food provided free to students?	
Transport provided free to students?	
HEALTH	
Main epidemiological indicators, past three years	
Unit costs of medical care, for main illneses, US$	
Characteristics, capacity and location of health facilities	

Human resources in health facilities	
Equipment and medical supplies in ea health facility	
Description of health management system	
Typical unit costs of vector and disease control	
INFRASTRUCTURE	
WATER SUPPLY AND SANITATION	
Organization of the sector	
	Government owned
	Private enterprises
Subsectors and systems	
	Water supply
	Waste water disposal
	Solid waste
Service coverage	
	Urban/Rural systems
	Collective/individual systems
Typical consumption per capita	
Average rates charged to users	
ELECTRICITY	
Organization of the sector	
	Government owned
	Private sector
Electricity sales by sector (past three years)	
Rates paid by each user sector (past three years)	
Electrical demand projections (current and next 2 years)	
Location and capacity of assets	
TRANSPORT	
Subsectors	
	Road transport
	Railway transport
	Air transport
	Water transport
Transport facilities (characteristics, unit costs)	
	Primary, secondary and tertiary roads
	Vehicle stock
	Bridges and culverts
	Cost of operation per type of vehicle, US$/Km
	Ports and airports
COMMUNICATIONS	
Subsectors (characteristics and unit costs, and revenues)	
	Postal services
	Land based telecommunications
	Cellular phone communications
MACRO-ECONOMIC INDICATORS	
GROSS DOMESTIC PRODUCT	
Historical data, for past three years	Constant values
	Current values
	Total GDP

	By sector of economic activity
	By smallest available geographical area
Projections for next three years	
	Total GDP
	By sector of economic activity
For current year and before and after disaster	
	Total GDP
	By sector of economic activity
Exchange rate, per quarter, for three years	
Consumer price index, for three years	
VALUE ADDED COEFFICIENTS (most recent)	
	For each and all sectors of economic activity
BALANCE OF TRADE (history and projections)	
	Current account balance
FISCAL BUDGET (history and projections)	
	Tax revenues
	Expenditures

Annexes

Annex 1: Agenda for DaLa Training Program in Dhaka, Bangladesh

Post-Disaster Damage, Loss and Needs Assessment Training
November 17 – 20, 2008
World Bank Office, Dhaka
Morning Sessions from 9:30 to 12:30, followed by lunch/prayer break, and
Afternoon Sessions from 1:30 to 4:30 pm

Date	Time	Training Subject and Activity
Nov. 17	a.m.	1. Welcome address by Director General, Disaster Management Bureau Remarks by Representative, UNDP Remarks by Representative, World Bank 2. General Introduction 3. Conceptual framework of the DaLA methodology 4. Generic assessment procedure
	p.m.	Productive sectors 5. Agriculture, fisheries and livestock 6. Industry and commerce 7. Tourism Case studies in agriculture (2): floods and drought
Nov. 18	a.m.	Social sectors 8. Housing 9. Education 10. Health
	p.m.	Infrastructure 11. Electricity 12. Water supply and sanitation 13. Transport and communications Case study: Assessment in electrical sector
Nov. 19	a.m.	14. Summary of damage and losses 15. Analysis of macro-economic impact - Gross domestic product - Balance of payments - Fiscal budget 16. Analysis of disaster impact at personal and household level
	p.m.	17. Environment sector Case study: Health crisis and multi-sectoral impact
Nov. 20	a.m.	18. From damage and losses to estimation of financial needs for recovery and reconstruction 19. How to undertake a damage, loss and needs assessment 20. General discussion
	p.m.	Closing ceremony 21. Presentation of certificates

Annex 2: Participants from the DaLa Training Program in Dhaka, Bangladesh

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