

Guidelines and best practices for post-disaster damage and loss assessment

Report from APEC Workshop on
Damage Assessment Techniques
Yogyakarta, 3-6 August, 2009



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Lokakarya APEC

Kerja Sama Ekonomi Asia Pasifik (APEC) menyelenggarakan lokakarya penanggulangan bencana alam, "Damage Assessment Techniques" di Yogyakarta. Kegiatan ini berlangsung selama 4 hari, dari 3 hingga 6 Agustus 2009. Ini menjadi ajang pertukaran informasi dan pengalaman antara anggota APEC dalam menghadapi bencana alam. Kepala Deputi Rehabilitasi dan Konstruksi Badan Nasional Penanggulangan Bencana, Bakri Beck, Selasa (4/8/2009), mengatakan, Indonesia dan



Executive Summary

The Asia-Pacific region is home to 70 percent of the world's disasters, and the intensity and frequency of disasters in the region is expected to continue to increase. Yet, despite the efforts of authorities, not enough is known about the full economic and social impact of disasters and addressing this task remains a challenge for the region.

A strategic process for post-disaster damage and loss assessment is important to provide objective information to decision makers at all levels upon which to base the analysis and development of recovery and reconstruction plans as well as mitigation proposals and the development of new policies or development plans. Results of a damage and loss assessment provide the fundamental basis in considering whether proposed investments can be economically justified.

Recent post-disaster assessments increasingly seek to identify rehabilitation and reconstruction needs in addition to measuring the direct damages and indirect losses of a disaster. Considering cross-sectoral and macro-economic impacts, such as the impact on gross domestic product and the environment or the differential impact of disasters on women, is becoming common practice in post-disaster assessments.

Participants of the APEC Task Force on Emergency Preparedness (TFEP) Workshop on Damage Assessment Techniques, held in Yogyakarta from 3 to 6 August 2009, recommend APEC Emergency Management CEOs and then the Task Force endorse common principles for damage and loss assessment.

These principles are provided in this document. They outline the general objective and scope of damage and loss assessments and advocate taking into account the human dimension of disasters and engaging local community stakeholders. The principles further highlight the need to look beyond short-term emergency needs and to set the scene for mainstreaming disaster risk reduction and broader long-term sustainable development, including climate change adaptation.

APEC member economies are further recommended to agree on easily understood assessment terminology, standards, and procedures and to recognise the importance of continuous learning and sharing of experiences and lessons learnt.



Draft APEC Principles on Disaster Damage and Loss Assessment

The various approaches to post-disaster damage and loss assessment being used in the APEC region indicates the variability of methodologies being applied and the ongoing discussion on how to appropriately measure disaster effects on a certain economy. It is evident that disaster damages and losses can only be estimated and that it is not possible to arrive at an exact incontestable figure. Even if the same methodology would be applied loss estimates typically vary greatly between similar events or even for the same event. This is due to the differences in philosophy brought to the loss assessment, the inherent complexity of such assessments and due to the variations in funds, expertise and time available for assessments.¹ The emphasis for the economic assessment of disaster effects should therefore be on achieving a transparent and consistent approach that allows for a reasonable degree of accuracy.

Developing a consistent (national or regional) approach to post-disaster economic damage assessment does not mean achieving a detailed uniform approach, but one that produces comparable results and is based on agreed principles. In the following, a preliminary list of principles is outlined that is to be understood as a first basis for further discussion within the APEC community. In addition, best practices steps are outlined, which were derived from an evaluation of currently available post-disaster assessment guidelines.

The following two sections record

- the APEC principles on disaster damage and loss assessment as they were agreed upon by participants of the TFEP Workshop on Damage Assessment Techniques as well as
- recommendations for individual APEC member economies on the management and implementation of such assessments.



“(Draft) APEC Principles on Disaster Damage and Loss Assessment

(Developed by participants of the TFEP Workshop on Damage Assessment Techniques)

The Asia-Pacific region is home to 70 percent of the world’s disasters, and the intensity and frequency of disasters in the region is expected to continue to increase. Efforts to enhance damage and loss assessment methodologies and measurement have been made by UNISDR. Despite these efforts not enough is known about the full economic and social impact of disasters and addressing this task remains a challenge for the region.

Participants of the APEC Task Force on Emergency Preparedness (TFEP) Workshop on Damage Assessment Techniques in Yogyakarta from 3 to 6 August 2009 recommend APEC Emergency Management CEOs and then the Task Force endorse the following principles, and that the TFEP urge APEC member economies to consider the recommendations below.

For the purposes of this document, damage and loss assessment includes the quantification of direct, indirect, economic, social and psychological damage incurred by a disaster.

Proposed Principles

- 1 *Disaster damage and loss assessments must be credible, meaningful and holistic to secure the commitment and resources of governments and civil society in the disaster recovery phase, and importantly, to build community and business resilience and reduce the risk of potential disasters in the affected area and throughout the wider economy.*
- 2 *APEC economies should work towards harmonising damage and loss assessment techniques in the region to allow the compilation of credible region-wide data to help build regional support and consensus for disaster risk reduction policies and initiatives, and to ensure region-wide resilience.*
- 3 *Economic damage assessments should be consistent and transparent, and based on primarily economic principles and robust evidence.*
- 4 *The damage, loss and needs assessment processes should be integrated, and prioritized, address all hazards, and accommodate the need for, and different objectives of, a rapid assessment, early recovery assessment and an in-depth assessment for longer-term rehabilitation, reconstruction and recovery.*
- 5 *To be comprehensive, in addition to direct damage and indirect losses, the damage and loss assessment methodology should allow for an estimation of macro-economic impacts (eg. national income, government debt, trade deficit, development prospects) and, to the greatest extent possible, intangible impacts (eg. social, psychological, environmental, loss of life).*
- 6 *The human dimensions of disaster should be a key consideration in damage and loss assessment, including the impact on vulnerable groups.*
- 7 *When assessing needs, the longer-term recovery phase should be viewed as an opportunity to boost and accelerate development and economic growth, and to mainstream disaster risk reduction initiatives – to build communities with greater prosperity, resilience and preparedness than before the disaster.*
- 8 *Assessors and planners should look beyond short-term emergency needs and consider broader long-term needs for sustainable development, including climate change adaptation needs.*
- 9 *Disaster damage and loss assessment should be coordinated by one government agency, involve multi stakeholders, and include relevant government agencies from appropriate levels, be that local, regional or national.*
- 10 *Local community stakeholders must be involved and surveyed in every stage of the process to ensure a realistic picture of damage, loss and reconstruction and rehabilitation needs, as well as to identify the capacity of the affected community.*
- 11 *To be meaningful, damage and loss assessments must have relevance and applicability to the jurisdiction of the decision-makers – whether national, sub-national or local – and whether public, private or civil sector.*

Proposed recommendations for individual APEC member economies (as appropriate)

- 1 *Agree on easily understood assessment terminology, standards, procedures and arrangements to allow comparable results; and train and exercise regularly a sufficient pool of assessors to use the standardized system.*
- 2 *Put arrangements in place ahead of the disaster so baseline and post-disaster data (including gender-segregated data and imaging), as well as data collection procedures and standards, can be accessed and employed quickly by the assessors.*
- 3 *Review damage and loss assessment methodologies with a view to allowing an estimation for, and consideration of:*
 - a. *cross-sectoral effects, including the impacts on the environment, land-use , infrastructure, employment, and livelihoods*
 - b. *social and psychological impacts, including on culture and values*
 - c. *disproportionate effects on vulnerable groups, including women, children, the elderly, ill and disabled*
 - d. *resources available to survivors such as savings, insurance and volunteers.*
- 4 *Re-evaluate assessments regularly to ascertain needs and priorities, as well as to assess the effectiveness and appropriateness of responses, and to identify lessons learned.*
- 5 *Recognising the importance of continuous learning and sharing data, experiences and lessons learnt in damage assessments to build consensus and support for disaster risk reduction, and to strengthen assessment methodologies, knowledge and information management."*

ADDENDUM – CEOs' Forum Consideration

These draft Principles were considered at the APEC Third Emergency Management CEOs' Forum conducted in Ha Noi, Viet Nam on 15-17 September, 2009, which determined "Key Decision No 5 – CEOs welcomed in principle the TFEP's draft principles on **disaster damage and loss assessments**, highlighting the importance of capturing the full socio-economic impact to justify resource allocations for disaster risk reduction activities."



Summary of Proceedings From the APEC Workshop on Damage Assessment Techniques

The APEC Workshop on Damage Assessment Techniques was held in Yogyakarta, Indonesia on 3-6 August 2009, co-hosted by Indonesia and Australia. Representatives from Australia, China, Indonesia, the Philippines, Chinese Taipei, Thailand, the United States and Viet Nam participated in the workshop. Representatives from the World Bank and United Nations Development Program also participated.

The workshop is part of the vigorous effort being made by the APEC Task Force on Emergency Preparedness (TFEP) in building the capacity of the region to mitigate, prepare for, and respond to emergencies and disasters. The main objective of the workshop was to develop a common understanding regarding post-disaster damage assessment techniques and policies, increase greater competencies and skills for the conduct of post-disaster economic analysis, as well as to develop a preliminary draft of best practice guidelines for the conduct of post-disaster economic damage and loss assessment.

The workshop formulated a set of principles on disaster damage and loss assessment and agreed to recommend these principles to the TFEP for its adoption.

DAY 1

Opening Session

In her welcoming speech, Mrs. Artauli R.M.P. Tobing, Head of the Policy Analysis and Development Agency, Department of Foreign Affairs of Indonesia, highlighted the importance of responding proactively and effectively to the challenges posed by disasters through expanding regional cooperation in disaster preparedness.

Mr. Bakri Beck, Deputy for Rehabilitation and Reconstruction of Indonesia's National Agency for Disaster Management explained Indonesia's efforts in incorporating disaster management into legislation. Disaster management in Indonesia comprises a wide range of policies that include disaster risk reduction, disaster prevention, emergency response and rehabilitation and reconstruction. He emphasized the importance of using the Damage and Loss Assessment (DaLA) method to ensure that development of affected areas can meet the needs of the people. He expressed his hope that through exchange of



experiences and best practices the workshop will be able to develop common principles and a definition for quantifying post disaster economic damage assessment for the APEC region.

In his introductory speech, Mr. Martin Studdert, First Assistant Secretary, Attorney-General's Department of Australia, explained the role of the Attorney-General's Department in emergency management and its approach to disaster management. He also explained the aim of the workshop to improve regional capability on conducting damage and loss assessment following disasters. The outcomes of the workshop will help the TFEP to develop APEC's principles on damage assessment.

General Perspectives of Disaster Assessment

Under the theme of 'General perspectives of disaster assessment', participants heard presentations and discussed issues around existing disaster assessments, techniques used in the economic assessment of disasters, applied disaster assessment procedures, and gender perspectives in disaster assessment.

Existing Disaster Assessment

Mr. Bakri Beck shared his views about the lessons learned from the recovery efforts of the Aceh-Nias tsunami and Yogyakarta earthquake. He concluded that a disaster recovery policy must be formulated on a case by case basis, taking into account the culture, social system, and geographic condition of the affected region.

Mr. Neil Head, Director, Information and Public Awareness, Attorney-General's Department of Australia elaborated on the report of the last TFEP CEOs' Seminar held in Peru on 12-14 August 2008, where TFEP members agreed on the APEC Strategy for Disaster Risk Reduction and Emergency Preparedness and Response in the Asia Pacific Region: 2009 to 2015. He outlined the draft discussion paper prepared for the workshop and initiated a discussion among the participants on a common approach for post disaster economic damage and loss assessment.

Techniques Used in Economic Assessment of Disasters

Mr. Iwan Gunawan, Senior Disaster Risk Management Adviser, World Bank Office Jakarta, presented best practices from the field. He informed the forum that since 1970, 7,000 disasters have occurred worldwide, killing 2.5 million people and causing US\$ 42 trillion in material loss. Economic assessment is therefore not only important and crucial for the rehabilitation and reconstruction phases after a disaster but also crucial for developing risk reduction strategies in anticipation of future disasters. However, due to the lack of



standardized definitions and methods for measuring damages and losses, there is limited knowledge about how economic assessment can be implemented. This point was emphasized as he explained the various assessment approaches applied by the different organizations and governments. He provided some recommendations for the development of common APEC principles for such assessments.

Overview of Disaster Assessment Procedures

Ms. Retno Winahyu, Project Consultant for the UNDP, explained the concept of Post Disaster Needs Assessment (PDNA). PDNA is an integrated assessment framework to provide data and information for different stakeholders. PDNA consists of two components: valuation of physical damages and economic losses for the Damage and Loss Assessment (DaLA), and identification of societal recovery needs for the Human Recovery Needs Assessment (HRNA). She explained on the sectors that must be taken into account when implementing PDNA, such as food and agriculture, environment, water and sanitation, shelter, education, health and nutrition, as well as cross cutting issues (livelihood, HIV/AIDS, gender, disaster risk reduction, and governance). She recommended a number of tools to implement PDNA, i.e. social impact assessment methods, sustainable livelihood framework, and promotion of baseline preparation at the village/community level.

Gender Perspectives in Disaster Assessment

Mrs. Yulfita Rahardjo, Gender Expert from the Indonesian Institute of Science (LIPI), gave a presentation on the *Study on Women in Times of Disaster* conducted by the APEC Gender Focal Point Network. The study found that women are a particularly vulnerable group and that gender perspectives in times of disaster and emergency have been acknowledged and to some extent mainstreamed into national development policy. However, these perspectives have yet to be fully integrated into disaster management policy. Gender perspective in disaster assessment recognizes the importance of differentiating the roles and situations of women and men and the need to empower both women and men to respond to crises.



Summary and Introduction of Draft APEC Principles

Mr. Neil Head and Mr. Iwan Gunawan led the discussion on possible headings for the draft APEC principles. The workshop discussed and identified four main headings, i.e. pre-disaster planning, methodologies, special considerations, and future developments.

DAY 2

National Perspectives of Disaster Assessment

The workshop participants visited several locations that were damaged by the 2006 Yogyakarta earthquake and heard case study presentations from Indonesia, Australia, China, Thailand, and Chinese Taipei.

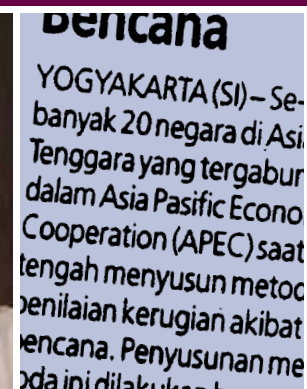
Site Inspection of the 2006 Yogyakarta Earthquake

The participants of the workshop visited Pasar Niten, a traditional market destroyed in the 2006 Yogyakarta earthquake, and the newly-built and relocated market. The participants also visited Kesangon Village, the center of ceramic crafts, which was damaged by the earthquake.

Following the site visit, Mr. Gendhut Sudharto on behalf of the Bantul Regency presented information about the local government's strategy to rebuild the region. Two key factors were the self-reliance of the people of Bantul in the recovery of their region, and the full trust they placed on their local government in planning and executing the development policy. He emphasized that every region needs different policies to recover from disasters, depending on the socio-cultural conditions.

Introduction and Discussion of Case Studies

Mr. Gary Gaffney from Victorian Bushfire Reconstruction and Recovery Authority Australia (VBRRA) shared experiences in handling the aftermath of the Victoria Bushfire. He emphasized that the response to the devastation required a multi-dimensional approach, which included immediate bushfire fighting, emergency relief, as well as rehabilitation and reconstruction. At the same time, each approach had numerous elements. To implement rehabilitation and reconstruction, the VBRRA had adopted a disaster recovery framework,



comprising four key planning components that focused on people, environment, economy, and reconstruction, with the community at the centre – ensuring a structured and interactive approach to reconstruction.

In order to implement this plan successfully, the VBRRA activities were governed by principles that take into account the safety and welfare of the people, resource allocation to areas of greatest need, community involvement, integrity of services and resources, and tailored solutions. As a concrete action, Victoria established Natural Disaster Relief and Recovery Arrangements with funds totalling A\$ 51 Million, which included packages for tourism and small and medium enterprise (SME) development.

Ms. Yuan Yi of the National Disaster Reduction Center, Ministry of Civil Affairs, China, gave a presentation on the Wenchuan Earthquake that struck in 2008 and its subsequent assessment. Considered as the most destructive earthquake in the history of modern China, the Wenchuan earthquake hit 10 provinces, took 69,227 lives, and destroyed 7.967 million houses and buildings. The total economic loss was US\$ 125.3 billion.

She explained the National Disaster Reduction Center's initiative to cooperate with related ministries, commissions, and scientific research institutions in conducting rapid assessment. She highlighted the need for the economic loss assessment to include direct and indirect losses and suggested the use of the replacement cost method for the calculation of economic losses complemented by both the market comparison method and the income method. She further suggested a series of assessments of different scope conducted before, during, and after a large-scale disaster.

Mr. Kriengkrai Khovadana, Expert from Thailand's National Disaster Warning Center (NDWC), explained the establishment of the NDWC as well as its role and responsibility in managing the early warning system. NDWC works together with other agencies of the Thai government and international organizations. Its beneficiaries include the central government, local governments, rescue units, affected communities, and the general public. He also explained about the massive tsunami drill conducted by the NDWC in 2008 in Thailand's six provinces, aimed at disseminating information to the people as well as familiarizing them with the siren, evacuation routes and shelters. In addition, Thailand has established an emergency call centre, which facilitates the collection of crucial disaster information provided from various sources, including the general public.

Mr. Wei Sen Li of the National Science and Technology Center for Disaster Reduction of Chinese Taipei talked about the basic damage assessment process, based on Chinese Taipei's experience of several major disasters of various magnitudes. He emphasized the need to assess the affected area from a bird's eye view as well as from a more detailed view, and the importance of assessment standards, community involvement, and technology application. He shared best practices of Chinese Taipei's damage assessment,



which builds upon well-defined operational mechanisms and procedures, data and information collection before, during and after a disaster, a comprehensive evaluation, traceability of the final report, and regular trainings.

Discussions of the draft APEC principles

Mr. Stephen Frost from CSR Asia led the discussion on possible draft APEC principles on post-disaster damage and loss assessment. Participants to the workshop discussed and provided inputs to the draft principles.

DAY 3

Expert Comment on Disaster Assessment

Mr. Koeswiyanto from the National Development Planning Agency Indonesia (BAPPENAS) explained the recovery system approach, which includes post disaster assessment, policy planning process, action plan for rehabilitation and reconstruction, and monitoring and evaluation.

He compared lessons learned from the recovery program of the Aceh-Nias tsunami and the Yogyakarta earthquake, and concluded that the difference was in coordination. The Aceh-Nias recovery program was coordinated by BRR with locally guided policies, while the Yogyakarta earthquake recovery program was coordinated by BAPPENAS with nationally guided policies. He also explained that the future post disaster assessment methodology will be aligned with a rehabilitation and reconstruction guidelines which also take into account disaster risk reduction concerns.

Discussion on APEC Principles on Disaster Damage and Loss Assessment

The TFEP Co-Chairs led the discussion on APEC Principles on Disaster Damage and Loss Assessment. The participants agreed on a draft of ten Principles on Damage Assessment. The principles highlight the importance of a credible, comprehensive, and relevant damage and loss assessment that involves local community stakeholders. The draft principles will be circulated to all TFEP members for endorsement and passed to APEC Ministers in November 2009.

Appendix – Discussion paper prepared for the APEC Workshop on Damage Assessment Techniques



Research for this discussion paper prepared by CSR Asia – www.csr-asia.com

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1. Introduction

Following the devastating earthquake in China's Sichuan Province last year, Australian Prime Minister Kevin Rudd and Indonesian President Susilo Bambang Yudhoyono committed to intensify joint efforts to strengthen the region's disaster preparedness and management capabilities. As part of this commitment an APEC workshop on damage assessment techniques to harmonise efforts across 21 of the Asia-Pacific region's key economies is being held in Yogyakarta from 3 to 6 August 2009. The aim of this workshop is to develop

- common understanding regarding post-disaster damages assessment techniques and policies,
- greater competencies and skills for the conduct of post-disaster economic analysis, and
- best practice guidelines for the conduct of post-disaster damage assessments.

The workshop is being organised by the APEC Task Force of Emergency Preparedness, chaired by Australia and Indonesia, as part of the Task Force's vigorous effort in building capacity in the region to mitigate, prepare for, and respond to, emergencies and disasters.

The purpose of this paper is to initiate a discussion among representatives of the APEC economies participating at the workshop on a common approach for post-disaster economic damage assessment. On this account, the paper briefly outlines the most commonly used methodologies and tools for such assessments and discusses a few basic ideas and concepts of damage and loss assessments. In addition a preliminary set of principles for economic damage and loss assessment is provided, which serves to guide thoughts and considerations around a common standardised approach to economic damage assessment in the APEC region.

2. Definition and scope of post-disaster damage and loss assessment

Disaster loss assessment is the estimation of losses that have occurred or that could occur as a result of some specified event defined in space and time. It is a critical element of disaster management, as the techniques and estimates of loss assessment support the risk management process by evaluating risk management strategies and determining relief and recovery needs.²

A damage assessment presents, usually quantitatively and often also in monetary terms, the physical, and much less often the social and psychological, damage incurred by a disaster.³

To get a better understanding of the impact of disasters, post-disaster assessments usually aim to analyse both the damages and losses that communities experience. The aim is to define the magnitude of the damage and loss attributed to a disaster event, and the physical, and thus financial, resources needed for recovery and their appropriate allocation. Assessments that go further and help understanding the causal factors that underlie losses allows synthesis of losses for given risks and assists in evaluation of alternative mitigation strategies.

² Handmer et al., 2005

³ Kelly, 2008

A comprehensive outline of a loss assessment process can be found, for example, in the Disaster Loss Assessment Guidelines published by Emergency Management Australia (see Figure 3 in Annex 1)⁴

2.1. Scope of post-disaster assessments

To ensure that reconstruction after a disaster takes into account disaster mitigation and vulnerability concerns, immediately after the emergency stage, an assessment must be made of the direct and indirect effects of the event and their consequences on the social well-being and economic performance of the affected country or area. This assessment need not entail the utmost quantitative precision, but it must be comprehensive in that it covers the complete range of effects and their cross-implications for economic and social sectors, physical infrastructure and environmental assets.

Common damage assessment and loss assessment (DaLa) approaches usually focus on determining

- Direct damages: Assets affected by a disaster, including immovable assets and stock (such as final goods, goods in process, raw materials, materials and spare parts). The main items in this category include the total or partial destruction of physical infrastructure, buildings, installations, machinery, equipment, means of transportation and storage, furniture, damage to farmland, irrigation works, reservoirs and the like. A distinction should be made between public and private sector damage in order to determine where the weight of the reconstruction effort might fall.
- Indirect losses: The flows of goods and services – expressed in current values – that will not be produced or rendered over a time span that begins after the disaster and may extend throughout the rehabilitation and reconstruction periods. Indirect damages result from the direct damage to production capacity and social and economic infrastructure. Examples include losses of future harvests due to flooding or prolonged droughts; losses in industrial production due to damage to factories or a resulting shortfall in access to raw materials; and greater transportation costs as the need for alternative routes or means of communication imply longer.⁵

Damage data are crucial in defining reconstruction needs while loss data are an indicator of economic recovery needs.

A broadly acknowledged and applied DaLa methodology is provided by the UN Economic Commission for Latin America and the Caribbean (ECLAC) and commonly used by the World Bank. In addition to direct damage and indirect loss this methodology also considers macroeconomic effects.

- Macroeconomic effects: Describe the effects of the disaster on the functioning of the economy and the resulting macroeconomic imbalances arising from the event. Macroeconomic effect estimates are a complementary way to assess direct damages and indirect losses from a different perspective. The most important macroeconomic effects of a disaster are those that have a bearing on growth in gross domestic product and in sectoral production; the current account balance (due to changes in the trade balance, tourism and services, as well as outflows to pay for imports and foreign services, etc.); indebtedness and monetary reserves; and public finances and gross investment.

⁴ EMA, 2002

⁵ UN ECLAC, 2003

Direct damages usually occur at the moment of the disaster or within the first few hours and can be easily evaluated during a quick assessment. Depending on the magnitude of the disaster, the indirect losses and macroeconomic effects can extend over a period of up to five years and will only become apparent at different times after the disaster and are, therefore, more difficult to identify during a rapid assessment. Adding the direct damage and indirect losses will provide an estimate of the total losses caused by the disaster. Since macroeconomic effects reflect the repercussions of direct damages and indirect losses, they must not be added.

It has to be considered that disasters may also have a positive result. A damage and loss assessment, therefore, needs to be aimed at determining the net effect, giving due consideration to both negative and positive results.⁶

Indirect losses and intangible damage/benefits

Most of the indirect losses are not evident when the assessment is carried out, and although they can be identified when the damage is estimated, it is not always possible to measure them in monetary terms. In this respect, indirect effects in cases of slowly evolving disasters (such as droughts or extended flooding) will occur for as long as the causing phenomenon lasts. The estimate of these effects must be extended throughout the period required to achieve the partial or total recovery of the affected production capacity.

Some major indirect effects may be difficult to identify and impossible to quantify, which may lead to so-called “intangible” damage or benefits, which are those not easily expressed in monetary terms such as loss of lives, health impacts, memorabilia, ecological damages, destruction of community life or cultural artefacts.

A comprehensive evaluation of the disaster effects must include an assessment or at least a global discussion of such intangible damage or benefits, since they considerably affect living conditions and standards.

Source: UN ECLAC, 2003 and Handmer, 2003

2.2. Valuation criteria

Objective and accurate criteria are needed to assess the impact of disaster damage and losses in order to arrive at a true assessment which can provide the basis for defining rehabilitation and reconstruction programmes. Valuation criteria may vary over a range or variety of situations as more than one alternative for the monetary estimate or valuation of disaster damage and losses and the impact to the economy of the affected country or region need to be applied. This is due to the fact that damage valuation criteria depend on how the results of the evaluation are to be used and because of the diversity of the goods affected by a disaster which requires the use of many sources and information that are not always comparable.

⁶ Ibid.

The decision for what valuation option is applied depends on the needs of the analysis, the characteristics of the asset being valued, the availability of information at the time the valuation is made and, most importantly, the time the sectoral specialist has available to carry it out. The most common damage valuation criteria include:

- The depreciated value of lost assets or “book value”: The value of the lost or damaged asset is estimated in its pre-disaster condition, taking its age into account in order to arrive at the value of its remaining useful life. This valuation method would be suitable for fixed production assets and others that, while not necessarily used in production processes, are subject to depreciation and obsolescence. In countries that have high inflation rates, the book value is not representative of an asset or good’s actual market value and an attempt could be made to estimate its original value and adjust it for inflation. As this process, however, is complicated there would be no alternative but to use the replacement cost (with or without depreciation).
- The replacement costs: Replacement costs need not only account for certain technological advances (because of the age of a lost asset, it is unlikely that an identical product would still be on the market), but also for features making a replaced good more resistant to the impact of future incidents.

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

Regardless of the valuation option that is adopted, damage to assets should initially be quantified in physical units as this will facilitate defining the most appropriate valuation criteria. Examples of physical units include for example number of pieces of machinery and production equipment, square meters of construction destroyed, kilometres of highways by class, hectares of crops affected, tons of agricultural products lost.⁷

Valuation of indirect damages

Indirect damage stemming from the interruption of the production or service flows over a given period must be valued at producer or market prices, as appropriate.

In the case of production sectors, losses must be assessed at producer prices because they represent the value of what was not produced as a result of the disaster.

In the case of interrupted service production (e.g. number of medical consultations or transportation costs increased due to detours) the most suitable approach is to value services not generated as a result of the destruction of infrastructure, based on the prices or fares paid by the final consumer or end user.

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

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

Source: UN ECLAC, 2003

2.3. Economic analysis

Sound economic analysis builds the decision basis for mitigation proposals and expenditures. In the U.K., for example, for decades, central government funds have been made available for flood works only if the proposals satisfy cost-benefit criteria following government guidelines.

The principles of economics are different from those governing financial accounting in private-sector enterprises. The objective of an economic analysis is to assess the impact of an event on the economy of the area under concern which is usually a large political jurisdiction with responsibility for economic management. Selection of other smaller areas, such as a region or town, involves a large degree of judgment and acceptance that much of the economic activity flowing into and out of the area will not be captured.

In summary economic assessment is about:

- Losses and gains for all members of a defined economy, rather than individual commercial

entities or households

- Changes to economic activity in the defined economy of a specified region, rather than to components within it
- Counting all impacts on this defined economy, both positive and negative
- Depreciated rather than replacement values, with the interest being on the market value of the asset or activity damaged by the disaster
- Avoiding double counting, by counting losses once and not counting losses made up later or by other businesses in the same economy⁸

Thus it appears that economic assessment is not about distributional affects or commercial profit and loss of an individual business, property or household. The following example clarifies the difference between a financial and an economic analysis: A food production facility has suffered income losses as it was not able to transport its goods to its customers due to blocked roads from flooding. However, another competitor was able to substitute the goods from its own stock and therefore had an increased income as an indirect effect of the flood. Therefore, this incidence would not affect the economic impact of the flood.⁹

2.4. Gender perspective in post-disaster assessment

There is a growing awareness in the international community that full development can only be achieved when women and the resources they represent are fully integrated in the development process and women are empowered to improve the economic, social and political conditions of developing countries within a framework of sustainable development.

The UN ECLAC *Handbook for Estimating the Socio-economic and Environmental Effects of Disasters*, therefore, points out that it is important to treat the differential impact of disasters on women as

“a broad theme that cuts across the entire spectrum of social, economic and environmental sectors. Similarly, this theme should not be considered the exclusive province of women, nor should analysis of such issues be relegated exclusively to a team member chosen to conduct gender analysis. Instead, it should be seen as a social subject of multisectoral scope on which all specialists in each discipline must cooperate.” (UN ECLAC, 2003)

Against this background estimating a disaster's overall impact on women includes

- quantification of all the direct damages sustained by women taking into account all the property they possess and
- estimating the indirect losses that only affect women including loss of productive employment outside the home, loss of household production and income, the increase in reproductive work, and other damage of a financial nature stemming from outstanding debts or loans.¹⁰

⁸ Handmer et al., 2005

⁹ WMO and GWP, 2007

¹⁰ UN ECLAC, 2003

Integrating a gender perspective into post disaster assessments, thus, involves considering not only the direct macro-level impact of a disaster but also the indirect impact at micro level, for example by not only accounting for the total number of destroyed houses but also the loss of household goods directly linked to women's income generation (e.g. weaving tools, cooking equipment, income-generating property such as poultry or compound garden). It involves collecting sex disaggregated data and identifying the particular needs of women, such as particular needs that need to be addressed by women relief workers. The inadequate recognition of this micro aspect hinders the development and implementation of effective gender-responsive disaster management programs and activities.¹¹

3. Overview of different approaches to damage and loss assessment

This chapter provides a brief overview on available guidelines and tools for post-disaster (economic) assessment. The different guidelines and tools are not described in full length but rather their underlying principles and concepts for economic damage assessment are pointed out.

Table 1 attempts to provide an overview on the different approaches to post-disaster assessment. It has to be noted that this is an evolving area where a number of new approaches are currently under development such as the post-disaster needs assessment or early recovery needs assessment approach.

Table 2 provides an overview of the post-disaster assessment guidelines and tools discussed in this paper and list their main distinctive features.

¹¹ Raharjo, 2009

Table 1: Different post-disaster assessment approaches

Assessment approach	Description
Damage assessment	Analyses the total or partial destruction of physical assets, both physical units and replacement cost.
Loss assessment	Analyses the changes in economic flows that occur after a disaster and over time, valued at current prices.
Needs assessment	Estimates (usually based on the damage assessment) the financial, technical, and human resources needed to implement the agreed-upon programs of recovery, reconstruction, and risk management. Also evaluates and “nets out” resources available to respond to the disaster.
Rights-based assessment	Evaluates whether people’s basic rights are being met. Has its origins in the UN Universal Declaration of Human Rights
Joint Damage, Loss and Needs Assessment (JDLA)	Combines a damage assessment and needs assessment with sector-based needs assessment. Helps identify short- to long-term recovery and reconstruction needs. Predecessor of the PDNA
Early Recovery Needs Assessment (ERNA)	Under development by UN: Allows capturing needs at lower geo-political levels, e.g. district or village level.
Post-Disaster Needs Assessment (PDNA)	Under development by UN, EC, World Bank: Combines the DaLa and ERNA approach
Socio-economic impact assessment	Allows capturing the socioeconomic impact for intangible elements such as health, the environment, and memorabilia in addition to the economic impact.
Rapid assessment	Undertaken after a major event, and conducted in one week or less. Provides immediate information on needs, possible intervention types, and resource requirements.
In-depth assessment or sector assessment	More specialised and separate assessment for certain sectors which is usually carried out at a later stage. In-depth assessment in order to guide reconstruction planning.

Table 2: Overview of different post-disaster assessment guidelines

Guideline/tool	Scope and purpose	Methodology
UN ECLAC Handbook	Provides guidance in the assessment of the social, economic and environmental effects of disasters Focuses on the value of lost assets and the definition of reconstruction requirements	Considers cross-sectoral subject areas such as environmental damage and the differential effects on women and the overall macroeconomic effect Distinguishes 3 types of break-downs for damages and losses: total direct damage and indirect losses; total damage to assets and production and increased costs or decreased income in the provision of services; total damage to public and private sectors
World Bank Handbook on Post-Disaster Housing and Community Reconstruction	Assists public officials and World Bank staff engaged in large-scale post-disaster housing reconstruction programs Provides principles and procedures for organising and carrying out Post-Disaster Needs Assessments (PDNAs)	Under development ¹²
WMO and GWP Flood Loss Assessment Tool	Provides guidance in conducting flood loss assessment	Outlines hierarchy of different types and stages of flood loss assessments Categorises different types of flood loss
EMA Disaster Loss Assessment Guidelines	Provides guidance in estimating direct and indirect losses	Application of an averaging, synthetic or survey approach in measuring losses Measuring potential losses as opposed to actual losses Measuring the net loss to the economy Calculation of annual average damages (AAD) for cost-benefit analysis of mitigation options
Hazus-MH MR 3 Earthquake Model	Provides tool to make earthquake loss estimates at a regional scale Focuses on economic losses that can be directly derived from building and infrastructure damage	Addresses regional earthquake impacts Displays inputs and outputs on GIS-based maps Modular framework for flexible application Provides default values and data sets for the estimation of damage and loss estimates Direct economic loss estimates are derived from damage state information for buildings and lifelines
Socio-economic impact assessment (SEIA) model for emergencies	Provides a framework for measuring the socio-economic impact of emergency incidents and for identifying the resilience and recovery ability of a regional economy	A 'with and without the emergency' comparison Outlines methodologies to measure the cost and value of environmental loss and impact

¹² Draft Handbook available at <http://tcgi.centraldesktop.com/postdisasterhousinghandbookpubliccommentsspace/FrontPage>

3.1. UN ECLAC Handbook for Estimating The Socio-Economic And Environmental Effects Of Disasters

The *Handbook for Estimating the Socio-Economic And Environmental Effects Of Disasters*¹³ developed by the UN Economic Commission for Latin America and the Caribbean (ECLAC) was initially used in Latin America and the Caribbean region, but since the late 1990s it has been applied in post-disaster assessments worldwide. The framework outlined in the UN ECLAC Handbook represents a damage assessment and loss assessment (DaLa).

The purpose of framework is to determine an amount of damage that can reflect the socio-economic impact of a disaster on the economic performance of an affected country or region with the aim to inform on the domestic capacity for dealing with reconstruction tasks and the need for international cooperation.

However, to reduce the costs of conducting parallel needs assessments, the DaLa is complemented by sector-specific assessments, which provide more detailed insight into the socio-economic impact of a disaster. For this purpose, cross-sectoral subject areas such as the environment and employment and income are considered. The framework further considers the differential effects on women, whose action is essential both during reconstruction and in mitigating the future impact of disasters. Methodological considerations with regards to the cross-sectoral and macroeconomic effects are briefly outlined in Annex 2.

The *Handbook* classifies disaster damages and effects into direct damages, indirect losses and macroeconomic effects (as defined in section 2.1) and is aimed at determining the net effect, giving due consideration to both negative and positive disaster effects. While damage is measured in physical units and valued at replacement costs, losses are valued at current prices.

In order to estimate the overall monetary impact of a disaster national accounts are used as a means of valuation. This allows determining the value of destruction of physical assets and of changes in the flows of all sectors of economic activity down to the level covered by the national accounts of the affected country.¹⁴

The methodology allows for the quantification of the damage caused by any kind of disaster, whether man-made or natural, whether slowly evolving or sudden.

Once the social, economic and environmental impacts of a disaster have been assessed, the handbook suggests a recapitulation of damages in order to arrive at an analysis overview, which marks the culmination of the assessment and lays the basis for the subsequent macroeconomic analysis. The overview should include the total amount of damage and losses, together with breakdowns that identify the most affected sectors, geographic areas and population groups. In addition to quantifying the total impact in monetary terms, this overview must make it possible to identify the sectors and geographical areas requiring priority attention in order to provide valuable input for defining reconstruction strategies, plans and projects.

¹³ UN ECLAC, 2003

¹⁴ Jovel, R. personal communication on 30 July 2009

The following three types of breakdowns should be made:

- Total direct damage and indirect losses
- Total damage to assets and production and increased costs or decreased income in the provision of services
- Total damage to public and private sectors: The breakdown of the total damage into public and private sectors will enable the determination of some characteristics of reconstruction programmes, by defining the relative efforts required from the state and from private individuals or enterprises. Even though the cost of reconstructing public infrastructure must be met by the government – which allows a determination of the amount of future public financing requirements – the latter may also have to establish financial schemes or credit lines for the private sector affected by the disaster, especially in the case of the lowest-income population or of strategic sectors of the national economy.

Best practice process steps and success factors:

Experience from past damage and loss assessments based on the UN ECLAC methodology has shown that:

- Not all disasters are at scale justifying a ‘full-blown’ assessment
- Maintaining consistency between different levels of assessment detail is crucial
- Ensuring traceability of the original data source is important as is keeping central repository of all assessment reports and their original data sources for long-term and macro analysis
- Pre-disaster arrangements and preparations are a condition precedent to ensure an efficient assessment process and include at a minimum arrangements for baseline data availability and clarified roles and responsibilities¹⁵

3.2. Post-Disaster Needs Assessment (PDNA)

According to Kelly (2008) there are two significant disadvantages of the damage assessment and loss assessment (DaLa) approach:

- Damage assessments tend to be challenged in capturing social or psychological impacts. Thus real damage experienced by the disaster survivors may be underreported and recovery assistance may be less than needed to address the full impact of a disaster.
- Damage assessments do not usually take into account resources available to the disaster survivors. In some circumstances, survivors may have considerable resources with which to engage in recovery (e.g. savings and insurance). This could lead to more assistance being provided than is really needed.

¹⁵ Gunawan, I. and Adriani, M. (2009)

Based on these limitations Kelly (2008) argues for amalgamating the damage, needs and rights-based approaches into a single assessment process that meets the principle-based requirements of the rights-based approach, but has the practicality of the damage or needs-based approaches.

In contrast to a DaLa, a post-disaster needs assessment (PDNA) estimates (usually based on the damage assessment) the financial, technical, and human resources needed to implement the agreed-upon programs of recovery, reconstruction, and risk management. It also evaluates resources available to respond to the disaster and considers them in calculating the disaster net effect. It provides

“an integrated assessment framework and process to support the identification and selection of response options covering recovery interventions from early- to long-term recovery in a Recovery Framework”¹⁶

Specialised assessments are often carried out to refine the results of an initial PDNA in a particular region or sector, or to develop data needed for project planning, such as site-related risk assessments and house-by-house damage assessments or a full housing sector assessment.¹⁷

The PDNA comprises two components:

1. The valuation of physical damages and economic losses through a DaLa
2. The identification of societal recovery needs through a Human Recovery Needs Assessment (HRNA)

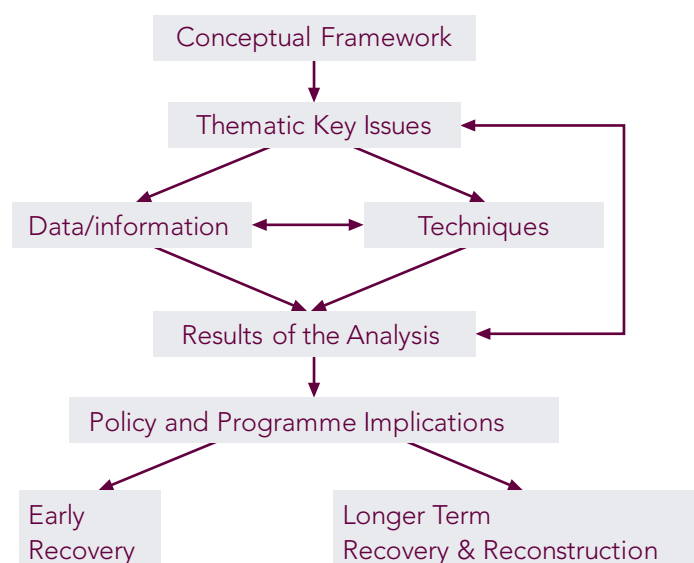
The elements of a PDNA are described in Figure 1 which highlights the unique feature of the PDNA which is the consideration of both early recovery needs and long-term development concerns:

- An early recovery view generally focuses at local level (constituencies, villages, and households) and basic needs and the ability to resume and sustain vital functions of the society. An early recovery assessment usually takes place at the time of relief efforts and can take up to 18 to 24 months. The data source is primary and secondary and to a large extent qualitative. The aim is to provide information crucial for stimulating life sustaining projects.
- The assessment of long-term needs generally takes place at a macro geographical level (regional and/or national) and can take up to two to three years or even longer. As opposed to early recovery assessment the focus is on damages, losses, and recovery requirements related to public goods, industry, markets, and investments. This requires the collection of primary and secondary quantitative data in addition to qualitative data which are crucial in developing programmes that ought to strengthen the regional or national economy.¹⁸

¹⁶ The Recovery Framework provides a strategic plan for guiding and reflecting all the decisions that need to be made to coordinate the recovery of a geographical area after a disaster.

¹⁷ World Bank, 2009

¹⁸ Winahyu, R. 2009

Figure 1: Elements of a PDNA (Source: Winahyu, 2009)

The PDNA provides a series of sector reports that conform to an agreed template and support the development of the Recovery Framework. It further provides prioritised response options drawn directly from the assessment which are proposed by and represent the advocacy stance of the sector teams. In case a sufficient baseline is available, the PDNA can also indicate the overall opportunities for “building back better” through shifting development patterns.¹⁹

Efforts to create unitary assessment procedures are underway, such as the *Handbook on Post-Disaster Housing and Community Reconstruction*, which is currently being prepared by the World Bank support of the Global Facility for Disaster Reduction and Recovery (GFDRR). The handbook which is expected to be publicly available in the fourth quarter of 2009, aims to provide a decision tool for use in the field by the World Bank staff, counterpart organizations, and other international practitioners who develop and carry out large-scale post-disaster local housing and community reconstruction projects. The handbook will outline the principles and procedures for organising and carrying out Post-Disaster Needs Assessments (PDNAs).

The development of the handbook and the PDNA concept has been motivated by inter-agency communication at national and global level, formalised in the ‘Joint Declaration on Post-Crisis Assessments and Recovery Planning’, signed in October 2008 by the United Nations, European Commission and the World Bank.²⁰

The PDNA guide to be outlined in the Handbook is supposed to bring together the two strands of DaLa and Early Recovery Needs Assessment (ERNA) in order to provide a full geographical breakdown in assessment results down to the district or village level.²¹

¹⁹ Winahyu, R. personal communication on August 3, 2009

²⁰ United Nations, European Commission and the World Bank, 2008

²¹ Roberto Jovel, personal communication on July 30, 2009

Best practice process steps and success factors:

- Close interaction between the national government and the respective country-representatives of the United Nations, the World Bank, the European Commission and other international partners at a headquarters level to ensure well coordinated resources support.
- Pre-disaster planning of the PDNA and early collaboration between the relevant partners
- One assessment team, one assessment process and one assessment output.
- Clear management structure including high level management team, PDNA coordination team, sectoral teams, technical support cell, and report secretariat.²²

3.3. WMO and GWP Flood Loss Assessment Tool

The World Meteorological Organisation (WMO) and the Global Water Partnership (GWP) have published, as part of their Associated Programme on Flood Management (APFM) and the 'Flood Management Tool Series', guidelines to conduct flood loss assessments. As indicated by its name, this tool focuses on flood losses only and can therefore not readily be applied to the damage and loss assessment procedure for other disasters.

The tool outlines a hierarchy of different types and stages of flood loss assessments (see Figure 2 below) which builds upon the following three types of assessment:

A. Rapid assessment:

The purpose of a rapid assessment is to inform emergency relief coordination during the flood. Emphasis of actions is therefore on having a basis for avoiding (further) losses of life, minimising misery and suffering of the affected population and avoiding knock-on effects (secondary disasters). As such, the focus of assessment during this phase is placed on emergency response rather than loss assessment.

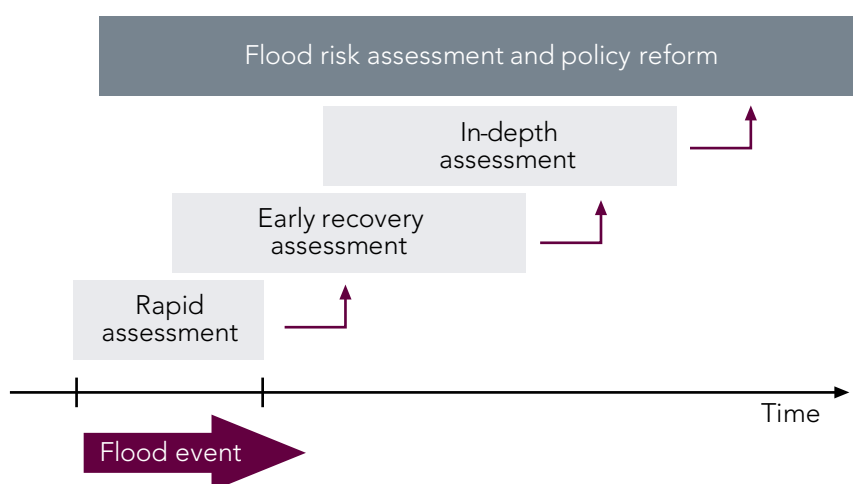
B. Early recovery assessment:

This includes an initial assessment of damages in the first few weeks (1-3 weeks) after the flood (peak) in order to inform and guide the recovery process and in providing early indications for reconstruction, for example in an insurance context, for allocation of recovery funds from national budget or for guidance to external aid agencies. The focus of assessment at this stage is necessarily on tangible and direct losses, as most of the intangibles need longer times to be assessed and the indirect losses may not yet be fully apparent or might not have fully materialised yet. A standard and internationally accepted methodology, applicable to all kinds of disasters, is provided by the UN ECLAC (see previous section). WMO and GWP advise to base early recovery assessments on actual costs and damages, i.e. how much it would cost to replace the assets and income lost according to their original specification and location (replacement costs).

C. In-depth assessment of flood losses:

This assessment will usually be carried out 3 to 6 months after the flood in order to guide reconstruction planning as well as future flood management policy adjustments. WMO and GWP suggest that the best time to conduct an in-depth assessment is after 6 months, as most losses, including indirect and intangible losses can be assessed with sufficient reliability. As in-depth assessments may receive a number of data collected in the earlier phases, planning and delimitations that have been undertaken for the earlier appliances of loss assessments are crucial. The assessment at this stage can usually be based on reconstruction costs²³, according to a (preliminary) reconstruction plan that may provide for reconstruction in different locations according to different specifications.

Figure 2: Types of flood loss assessment in various phases (WMO and GWP, 2007)



One of the basic decisions to take in any flood loss assessment relates to which loss categories to include and how to assess each one of them. An overview of different flood loss categories as provided by the Flood Loss Assessment Tool is provided in Figure 4 in Annex 3. Loss categories are categorised into tangible direct losses, intangible indirect losses and intangible human and other losses. These three categories of losses are further divided into primary, secondary and tertiary losses. The WMO and GWP tool does not suggest which categories to include in a loss assessment. This decision will not only be influenced by the type of assessment carried out, but also by the time and resources available for its completion.

Another important distinction made by this tool is between actual and potential flood losses. The determination of actual flood losses takes into account preparatory actions taken to reduce the impact of a flood while the determination of potential flood losses is based on the experience of past floods or synthetic stage-damage relationships. Again, the tool does not make a general suggestion on which type of losses to estimate.

²³ The cost of reconstruction includes the replacement of lost assets but excludes the value of production losses and the amount of increased spending and decreased revenues in the provision of services, and must also include the financial cost of reactivating production when necessary. (UN ECLAC, 2003)

3.4. EMA Disaster Loss Assessment Guidelines

The Queensland Department of Emergency Services, other Queensland agencies, Emergency Management Australia (EMA) and the Bureau of Meteorology collaborated with the Centre for Risk and Community Safety at RMIT University to produce a set of guidelines on loss assessment that is applicable at sub-national and local level (in the following referred to as the EMA Manual 27 Guidelines).

The EMA Manual 27 Guidelines seek to be easy in implementation without requiring in-depth specialist training or extensive experience in loss assessment. They cover direct and indirect losses and under both loss categories tangible as well as intangible losses.

They provide a step-by-step procedure (see Figure 3 in Annex 1) from identifying the purpose of the assessment through to presenting the results, which can be thought of in terms of five broad tasks:

1. Define the purpose, identify the stakeholders and resources available, and define the area and time frame
2. Select the type of assessment, i.e., averaging, synthetic or survey approach
3. Establish the information base about the hazard, people, assets and activities, and types of loss
4. Measure the loss
5. Analyse and present the results to be consistent with the purpose of the assessment and as appropriate consider actual and potential losses, average annual losses, and net economic loss

While this procedure has been set-up for inundation hazards, with minor modifications it can be applied to other hazards (see Table 3 in Annex 4).

The guidelines set out three general approaches to measuring losses which are as follows:

- a.) The averaging approach: This approach is based largely on pre-existing average data on losses for example an average loss per flooded property. It is the least expensive and quickest method, enables comparability, and only requires limited expertise. While it may be the most appropriate approach in the future as data sets are developed and tested, currently it has certain limitations: it may under or over value indirect and intangible losses. In addition it treats very serious and dangerous flood hazards the same as shallow flooding which results in little damage.
- b.) The synthetic approach: This approach is a detailed assessment based on pre-existing databases covering a range of average building types and contents. It is probably the most flexible and currently the most widely used of the three approaches. It can make use of a variety of existing computer packages with their own stage-damage curves for calculating residential and small business direct losses. However, EMA (2002) argues that the extensive use and availability of calculation packages disguises considerable debate over the accuracy of the stage -damage curves and resulting figures.

c.) The survey or historical approach: This approach is based on detailed surveys of a recent event to establish the actual loss. It is different from the synthetic approach as it generalises from loss data obtained from the area in question whereas the synthetic approach applies loss data generated synthetically or from other areas. A characteristic of the survey approach is that it incorporates all the unique attributes of the event in question including the details of the response and people's preparedness. This makes the approach less suited for comparisons and difficult to use without a recent disaster to generate losses. It is also very sensitive to the resources and expertise used to collect the data.

Table 4 in Annex 5 outlines for each approach how the different loss categories are being measured and clearly shows that only surveys enable collection of detailed data for some categories of loss. In most assessments some combination of the three approaches will be necessary. Data collected by 'synthetic' or 'averaging' approaches are usually used to estimate losses of a hypothetical hazard event.

The EMA Manual 27 Guidelines recommend that, wherever possible, potential losses should be used rather than actual losses. This is due to the fact that actual losses, which take into account all kinds of measures that people take to minimise the damage wherever possible (e.g. heeding warnings or moving cattle and valuable items to high ground), may discriminate against well prepared or poorer communities. Also it is difficult to determine the correct ratio between actual and potential or predicted loss.

Since they are based on economic principles, the guidelines require measuring the net loss to the economy of the area of analysis. The guidelines highlight that assessment of benefits is particularly important within a regional context because post-disaster aid and insurance payouts are more likely to partly offset the tangible losses suffered, as the area of analysis becomes smaller.

Care is, however, needed in the application of net economic loss and it may not be appropriate as an indicator of what should be spent on mitigation. The EMA Manual 27 Guidelines do not include intangible losses and benefits as part of the calculation of "net economic loss" because the current state of knowledge about intangibles does not support the level of quantification necessary for this calculation. Therefore the guidelines suggest that any assessment should calculate the total and net economic losses and then set out why one approach is selected for use. This transparency would highlight local economic circumstances and assist with comparability.

While the EMA Manual 27 Guidelines do not provide any guidance in the estimation of (reconstruction) needs, they outline steps to calculate annual average damages to conduct cost-benefit analysis to assess mitigation options. Since the future pattern of disaster events cannot be known any investment in disaster mitigation has to be economically justified in terms of benefits expected on average every year which can be achieved by calculating annual average damages.²⁴

²⁴ For further details on calculating annual average damages see EMA, 2002

Post Disaster Survey by GeoScience Australia

Post disaster survey activity is central to acquiring knowledge of community vulnerability to natural hazards and the logistics that emergency services can potentially face following an event. The vulnerability of infrastructure and the injuries attendant to its failure is generally poorly understood. In the Australian context Geoscience Australia has invested significantly over several years in a number of systematic population-based surveys of impacted community infrastructure. These have included severe flooding events, localised tornado wind impacts (Edwards et al, 2004), tropical cyclones (Edwards et al, 2007) and bushfire impacts. Data has been captured electronically in the field using hand held computers, GPS units and digital cameras. Areal imagery and satellite based remote sensing data such as synthetic aperture radar (SAR) have also been sourced to complement the information. The scope of survey work has also progressively broadened to include critical infrastructure alongside buildings as the failure of the former can add greatly to the emergency response requirements.

Additional measures to physical damage and casualties are needed to assess community impact and recovery prognosis. The cost of damage repair and the impacts upon economic activity, direct and indirect, are also important. The resilience of communities, physically, socially and economically also needs to be understood and considered. This, in turn, can inform the deployment of relief resources to promote recovery. Geoscience Australia includes damage cost assessment as part of their post disaster activity. Further, they collaborated on an economic modelling of relief funding transfer options for the Johnstone Shire region in North Queensland following TC Larry (2006) in assistance to the recovery taskforce (Wittwer and Mullaly, 2006).

Effective post disaster survey activity requires a broad engagement of hazard and vulnerability expertise. Geoscience Australia has actively promoted the broad engagement of domain experts in survey activity with considerable success with the wind engineering community and progress with earthquake engineers (Edwards et al, 2006). With an expanding Australian Government role in supporting regional neighbours in their disaster reduction initiatives GA is now developing a regional post disaster focus for the future.

Source: www.ga.gov.au

3.5. US Federal Emergency Management Agency's HAZUS-MH MR 3 Earthquake Model

The Hazards U.S. Multi-Hazard (HAZUS-MH)²⁵ is a risk assessment methodology for analysing losses from floods, hurricanes and earthquakes. It applies geographic information systems (GIS) technology to produce estimates of hazard-related damage before, or after, a disaster occurs. Developed by the Federal Emergency Management Agency (FEMA) HAZUS-MH provides three models: a flood model, a hurricane model, and an earthquake model. In addition to these three hazard-specific models HAZUS-MH can perform multi-hazard analysis by providing access to the average annualised loss and probabilistic results from the hurricane wind, flood, and earthquake models and combining them to provide integrated multi-hazard reports and graphs.

Loss estimates analysed in HAZUS-MH include:

- Physical damage to residential and commercial buildings, schools, critical facilities, and infrastructure
- Economic loss including lost jobs, business interruptions, repair and reconstruction costs
- Social impacts including estimates of shelter requirements, displaced households, and population exposed to scenario floods, earthquakes and hurricanes

Extensive national databases are embedded within HAZUS-MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges which allow the use of default data in the calculation of loss estimates.²⁶

In the following features of the earthquake model are explained in further detail, since the assessment approaches applied by the flood and hurricane model are based on these and follow similar principles. The HAZUS-MH MR 3 Earthquake Model is based on an earthquake loss estimation methodology which addresses regional impacts of earthquakes such as service outages for lifelines, estimates of fire ignitions and fire spread, potential for a serious hazardous materials release incident, and indirect economic effects. One of the model's strength is the ability to readily display inputs and outputs on GIS-based maps that can be overlaid.

Based on the needs and particular resources (e.g., ability to provide required data) of the user, three different types of analyses can be conducted, i.e. default data analysis, user-supplied data analysis and advanced data and models analysis.

The methodology is built upon a modular framework which allows the user to select the estimation of certain losses. Loss estimates analysed in HAZUS-MH MR3 Earthquake Model include:

- Direct physical damage to general building stock, essential and high potential loss facilities, lifelines-transportation systems and lifelines-utility systems

²⁵ Federal, State and local government agencies and the private sector can order HAZUS-MH free-of-charge from the FEMA Publication Warehouse.

²⁶ With an increasing interest in the application of the HAZUS loss estimation methodology and software application for international use, the National Institute for Building Sciences (NIBS) has led efforts to evaluate steps that need to be taken to develop an internationally applicable version.

- Direct social losses including casualties and displaced households
- Direct economic losses of buildings and lifelines
- Indirect economic losses such as those related to supply shortages and demand effects

In the following the methodology for estimating direct economic building losses and indirect economic losses will be briefly explained.

Direct economic losses: buildings. The HAZUS-MH MR3 Earthquake Model converts damage state information for buildings and lifelines²⁷ into estimates of dollar loss for structural and non-structural repair costs caused by building damage and the associated loss of building contents and business inventory. Building damage can also cause additional losses by restricting the building's ability to function properly. To account for this, business interruption and rental income losses are estimated. This estimation module is limited in its consideration of the economic loss to those losses that can be directly derived from building and infrastructure damage, and that lend themselves to ready conversion from damage to dollars. The types of economic data that the user will be expected to supply include repair and replacement costs, contents value for different occupancies, annual gross sales by occupancy, relocation expenses and income by occupancy. Based on the availability of data and the desired depth and accuracy of analysis default values provided by the model can be used.

Indirect economic losses. The Indirect Loss Module is a computational algorithm that accounts for earthquake induced supply shortages and demand reductions. It is a version of a computable general equilibrium model designed to rebalance a region's inter-industry trade flows based on discrepancies between sector supplies and demands. It is based on input-output modelling techniques, which are widely utilised to assess the total economic gains and losses caused by sudden changes in the demand for a region's products²⁸. Running this module requires a number of user inputs such as the current level of employment and income or the composition of the economy. The module produces two reports on the results: i) The percent and level of indirect economic impact for the study region economy in terms of employment and income effects for a region that receives outside aid after the disaster. ii) The percent and level of indirect economic impact for the study region economy in terms of employment and income effects for a region that does not receive outside aid after the disaster.

As outlined above, the HAZUS-MH MR 3 Earthquake Model is based on complex algorithms in order to arrive at estimated damage and loss assessments. Economic assessments are used for the estimation of direct and indirect losses with results of direct economic loss estimations being dependent on the quality of direct damage estimates. A major benefit of the model is the provision of default values which allows a fast and easy calculation of loss estimations. It is apparent that the provision and use of default values is based on a comprehensive compilation and calculation of historic data for the U.S. and cannot be readily applied in damage and loss assessments elsewhere.

²⁷ Damage state information is the result of the direct physical damage calculation and is predicted in terms of one of four ranges: slight, moderate, extensive, and complete.

²⁸ Input-output modelling traces the flows of goods and services among industries and from industries to household, governments, investment, and exports. These trade flows indicate how much of each industry's output is comprised of its regional suppliers' products, as well as inputs of labour, capital, imported goods, and the services of government.

3.6. Socio-economic impact assessment (SEIA) model for emergencies

The SEIA model was developed by a Ministerial Taskforce on Bushfire Recovery of the Victorian Government (Australia) with the aim to address in particular one issue that has been challenging the EMA Disaster Loss Assessment Guidelines and similar frameworks, i.e. the challenge of capturing the socioeconomic impact for intangible elements such as health, the environment, and memorabilia. With the development of the SEIA it was sought to provide a framework for measuring the socio-economic impact of emergency incidents that would also enable identifying the resilience and recovery ability of a regional economy and that regions' social wellbeing.

The model's distinctive features include:

- A 'with and without the emergency' comparison:

A comparison of social and economic impacts and conditions based on the occurrence of the bushfire, compared to circumstances if the bushfire had not occurred was made. This comparison included the benefits from government, State Government Recovery insurance and other non-government recovery support sources in order to establish the net-economic impact. It has to be noted that this is a methodologically inappropriate approach. Rather the appropriate methodology of an economic analysis is to compare social and economic conditions with and without the emergency, to establish the impact of those bushfires.

- Social and economic profile:

A social and economic profile of the residential and business sectors of the region prior to the emergency was established in order to assist in the analysis of intangible and indirect costs and benefits. For this local government profile data and population based surveys (household surveys) were used to collect data on a range of indirect and intangible impacts and costs.

- Other concepts that assisted in measuring intangible losses include the 'expected value procedure' as a method of estimating 'willingness-to pay', defining criteria to address 'household disruption' as an indirect loss element and specific economic formulae such as 'contingent valuation method' and 'value added forgone' to measure the cost and value for example of environmental loss and impact.

The SEIA model was tested in the economic assessment of the 2006/07 Great Divide bushfires.

Challenges and obstacles faced were:

- Sourcing of relevant data and information: a major obstacle was lack of data and the variable means of data collection which affected data quality. There were major data gaps in particular with regards to small business other than tourism where there is usually limited post-emergency impact data collected and where information is only obtained through survey and direct interview.

Best practice process steps and success factors:

- In order for the SEIA-Model to be replicable for emergencies that occur in Victoria, and to enable

it to be efficiently implemented, it is essential to identify and use existing data sources and regularly collected post-emergency databases.

- The SEIA-Model's implementation essentially relies on a whole of government approach, whereby the collection, use and analysis of post-emergency information is shared and coordinated across various government departments and organisations.
- A commitment to standardise and consistently collect essential loss, damage and impact data post an emergency incident.
- Where there are difficulties in obtaining the specific data required, averaging and extrapolation techniques become relevant.²⁹

4. Review of post-disaster assessment reports

A look at past post-disaster assessments indicates an evolution from an approach focussing on damages and losses to an approach taking increasingly into account post-disaster needs through JDLNAs or PDNAs. A number of post-disaster assessment reports are provided on the GFDRR website³⁰ and the World Bank website³¹.

Earlier post-disaster reports focused on preliminary estimates of a disaster's damage and reconstruction costs. The 2005 Pakistan Damage and Needs Assessment Report³², for example, presents estimates for the loss of public and private assets (direct damage at book value), the loss in income (indirect loss), and the cost of short and medium to longer term reconstruction of private and public assets (at replacement costs). Reconstruction costs measure the cost of rebuilding lost assets and restoring lost services and in the case of this report, are defined to include the additional costs incurred for earthquake resistance. The report focuses on damage and needs estimates for the following sectors: social and environmental aspects, housing, livelihoods, agriculture, transport, education, health, water supply and sanitation, energy, governance and institutions, and the industry and services.

In Indonesia the DaLa approach was applied to both the assessment after the 2006 Yogyakarta Earthquake and the 2004 Tsunami in Aceh Province. Both assessments were conducted by a multi-agency expert group including the National Development Planning Agency (BAPPENAS), Provincial Development Planning Agencies (BAPEDAs) and international donor agencies such as The World Bank, ADB, GTZ, JBIC, ILO, and various UN organisations. Both assessments included an estimation of damages and losses as well as of the economic and social impacts for the following sectors and areas

- Social sector, e.g. housing, education, health, family planning, religion and culture
- Infrastructure, e.g. transport, energy, communications, water supply and sanitation

²⁹ Office of the Emergency Services Commissioner, 2008

³⁰ Post-disaster assessment reports by GFDRR available at <http://gfdr.org/index.cfm?Page=Track%20III:%20DRR%20in%20Recovery&ItemID=14>

³¹ Post disaster assessment reports by World Bank available at <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTURBANDEVELOPMENT/EXTDISMGMT/0,,contentMDK:20196047~menuPK:1415429~pagePK:148956~piPK:216618~theSitePK:341015,00.html>

³² Asian Development Bank and World Bank, 2005

- Productive sector, e.g. agriculture, fisheries, enterprises, industry, trade, and tourism
- Cross-cutting sectors, e.g. public administration, financial sector, and environment

In addition the economic and social impact was evaluated which included a closer look at impacts on employment, livelihoods and the fiscal system. Results of the assessment were used to derive recommendations for the rehabilitation and reconstruction process. Experience from these assessments showed that a strong involvement of provincial governments and local communities and other relevant local stakeholders is crucial in order to arrive at a realistic picture of damages, losses and needs as well as recovery capacities.³³

After the 2008 earthquake in Wenchuan China the National Disaster Reduction Center of China initiated a rapid assessment of the affected population and infrastructure. Based on historical and socio-economic data of the affected region it was possible to complement the rapid assessment with a vulnerability analysis. Dynamic monitoring of the affected area was made possible through the usage of remote sensing images from 22 satellites provided by the international community as well as aerial photographs. The rapid assessment was followed by a more comprehensive assessment to determine the spatial intensity distribution of the earthquake and by an assessment of direct economic losses. Indirect economic losses were evaluated qualitatively while direct economic losses were assessed through applying the replacement cost, market comparison and income approach. Experience from the Wenchuan Earthquake assessment showed that large-scale disasters require consecutive assessments of different scope and analytical precision which should ideally start with baseline data arrangements before a disaster occurs.³⁴

An increasing number of reports go much further in assessing post-disaster needs. The Yemen Damage, Losses and Needs Assessment Report³⁵ for the October 2008 tropical storm and floods, for example, does not only provide an estimation of damages and losses but also reports on estimated recovery and reconstruction needs

- to restore the livelihoods of the affected individuals and households and the output of enterprises back to pre-disaster levels and
- to rebuild back the destroyed physical infrastructure assets and restore the services to their pre-disaster functioning level.

The recovery and reconstruction needs, which serve as the basis for the preparation of a detailed recovery and reconstruction plan, are expressed in monetary terms are outlined for the following sectors: productive sector, social sector, infrastructure, cross-cutting sectors (including religious facilities, cultural heritage, and environmental protection) and livelihoods.

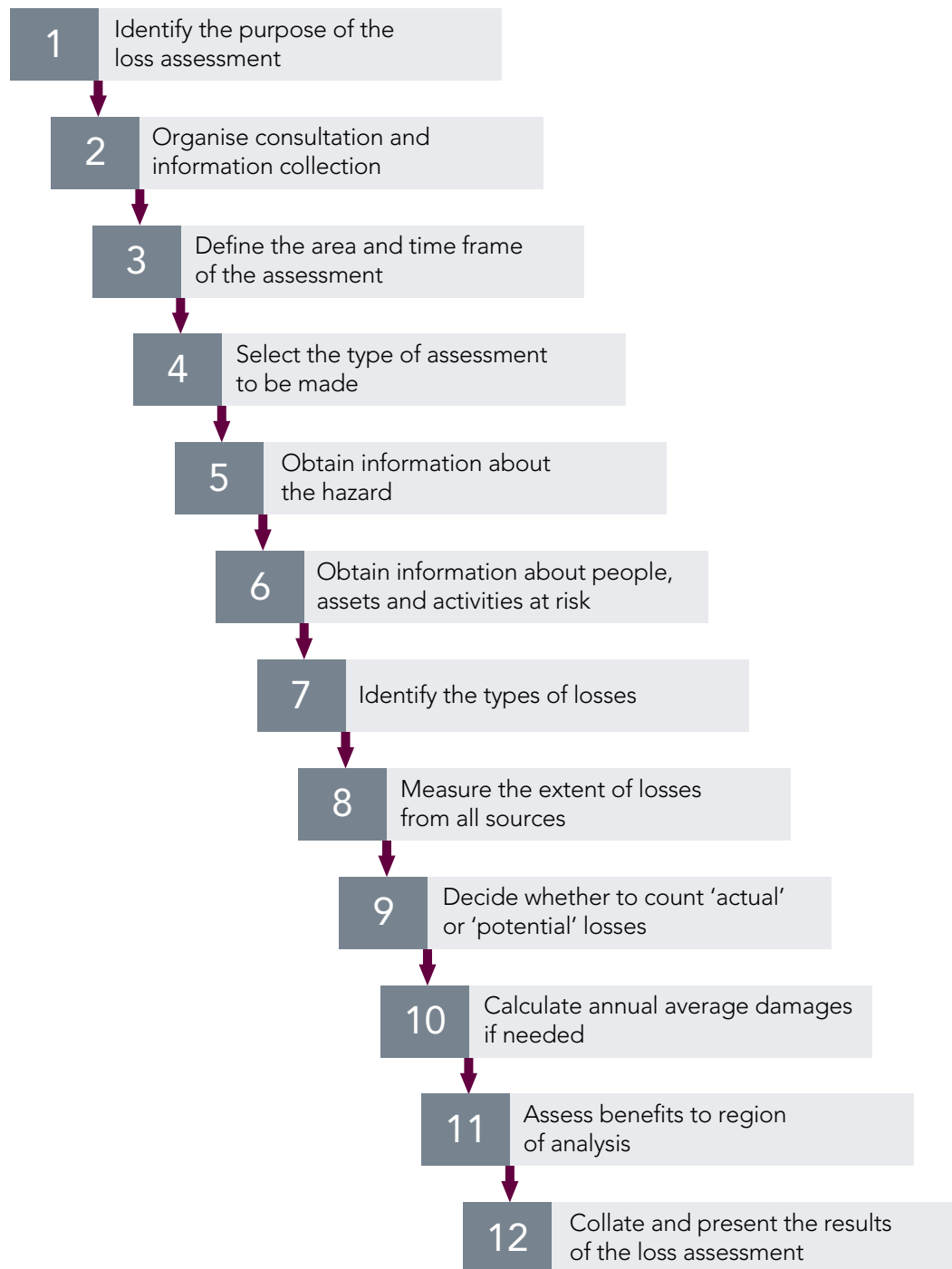
³³ The Consultative Group on Indonesia, 2005 and The Consultative Group on Indonesia, 2006

³⁴ Yuan Yi, 2009

³⁵ Government of Yemen et al., 2009

Annex 1: The loss assessment process according to the Queensland Guidelines

Figure 3: The loss assessment process (EMA, 2002)



Annex 2: Methodological considerations for estimating cross-sectoral and macroeconomic effects

Economic assessment of the impact of a disaster on the environment

To carry out the economic assessment of the impact of a disaster on the environment, the UN ECLAC Handbook outlines a procedure of successive stages which are to be conducted in close co-operation between environmental specialists, sectoral specialists and macroeconomists. Those stages are as follows:

1. Description of the environmental state before the disaster, representing the baseline for assessment
2. Identification of the impacts of the natural disaster on the environment;
3. Qualitative environmental assessment
4. Classification of the effects on the environment
5. Economic valuation of the environmental impact
6. Overlap with other sectors

This procedure is based on the acknowledgement of the use value of natural resources which from an economic perspective, are considered assets (natural capital) from which goods and services are derived that help increase people's well-being.

(UN ECLAC, 2003)

Macroeconomic assessment

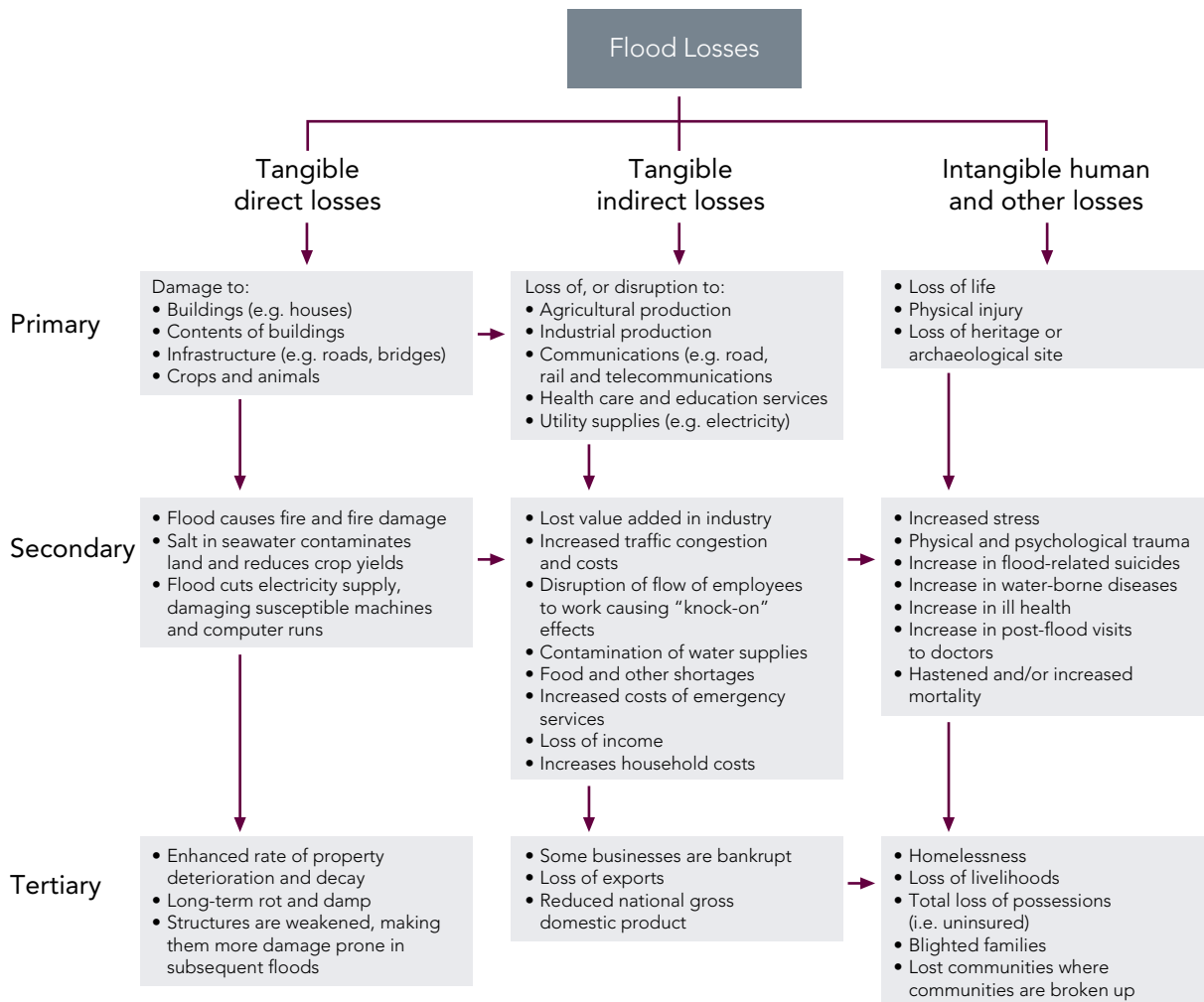
The macroeconomic assessment should provide a summary of the damage that offers an overview of the full magnitude of the disaster's socio-economic impact, both for the country's economic development as a whole and for each of its main variables. It should determine and specify the sectors or areas in which the effects were most severe and the period of time for which they will continue to be felt. Consequently, it should include, not only the disaster's effects on the economic growth rate, income, the external sector, public finances, employment, price levels and inflation, but also possible damage to natural resource endowments.

The overall assessment essentially measures a "delta" value, that is, the difference between the situation expected in the period before the disaster happened and the situation that the affected country or region is expected to experience as a result of the direct and indirect damage.

(UN ECLAC, 2003)

Annex 3: Categorisation of flood losses by WMO and GWP

Figure 4: Categorisation of flood losses (WMO and GWP, 2007)



Annex 4: Applying economic analysis to disaster mitigation measures

Table 3: Factors to be considered in applying economic analysis to disaster mitigation measures, compared to flooding (EMA, 2002)

Factor	Bushfire	Cyclone	Earthquake	Flood	Severe storm*
Risk definition					
Ease of mapping exposure to hazard	Good, but event extent depends on many local factors	Good, but individual tracks unknown until happen. Much loss is from associated weather	Good for known faults and soil conditions. Poor for intra-plate earthquakes. Micro-zonation possible	Good from past data and models. Events have predictable extents but floods can occur anywhere	Poor
Probability estimates for AAD	Difficult. Risk changes over time with fuel load	Possible	Possible but requires detailed study	Good, for river floods on basis of past records	Some information
Past records	Yes	Yes	Yes	Yes	Poor
Loss severity					
Function of parameters	Locational factors (for example, slope). Hazard characteristics (for example, fuel, wind). Building parameters	Hazard parameters (distance from coast, velocity, depth of storm surge etc). Building parameters	Hazard parameters (shake etc). Soil conditions. Building type and details. Associated fire risk	Function of flood depth and velocity, duration, warning time. Building types and contents	Local storm characteristics (wind, rain, hail floods). Building construction
Past loss records	Some, percentage salvaged not clear	Some, needs to be disaggregated	Good for major events. Poor otherwise	Yes, but financial rather than economic. Can be estimated	No. Difficult to standardise
Frequency	Recurrent, quite frequent	Annual season. But strikes infrequent for most areas	Infrequent, little experience	Relatively frequent and recurrent in hazardous areas	Frequent, but rare in same area
Mitigation opportunities					
Prevention/exclusion	Yes, requires public participation	No for high winds. Yes for storm surge	No	Yes. Either for larger area or individual properties	No
Long-term individual loss reduction	Yes: construction improvements	Yes: improved buildings, sea defences	Yes: improved buildings	Yes: improved buildings	Yes: improved buildings
Short-term loss reduction	Yes: individual responses, fire fighting	Yes: response to warnings	Yes: save lives and reduce building and other losses	Yes: response to warnings and flood information	Yes: in response to warnings

*Tornadoes, very heavy rain, flash floods, hail and high winds.

Annex 5: The three approaches to loss assessment

Table 4: Review of basic elements of the three approaches to loss assessment (EMA, 2002)

Loss assessment approach	Direct loss			Indirect loss	Intangible loss
	Houses/ small business	Commerce, farming ($>1000 \text{ m}^3$)	Infrastructure		
I Averaging	Average loss per flooded structure	Average loss per m^2 for types of enterprise and surveys	Average per km of road and surveys	Examine \$ flow and use surveys or % of direct	Identify types and magnitude Surveys
II Synthetic	Standard stage: damage curves for type of property	Stage: damage curves applied to m^3 for different types of business	Stage: damage and average loss per km depending on type of infrastructure	Examine \$ flow and use surveys	Identify types and magnitude Surveys
II Survey (based on sampling)	Survey: new stage-damage curves	Surveys	Surveys	Surveys	Surveys

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