ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

INTEGRATED FLOOD MANAGEMENT TOOLS SERIES

CONDUCTING FLOOD LOSS ASSESSMENTS

ISSUE 2
JUNE 2013

Global Water Partnership

World Meteorological Organization
Weather • Climate • Water

The **Associated Programme on Flood Management** (APFM) is a joint initiative of the World Meteorological Organization (WMO) and the Global Water Partnership (GWP).

It promotes the concept of Integrated Flood Management (IFM) as a new approach to flood management. The programme is financially supported by the governments of Japan, Switzerland and Germany.

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Integrated Flood Management Tools Series No.2

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Layout, design and iconography : www.lamenagerie.net

To the reader

This publication is part of the *"Flood Management Tools Series"* being compiled by the Associated Programme on Flood Management. The contained Tool for *"Conducting Flood Loss Assessments"* is based on available literature, and draws findings from relevant works wherever possible.

This Tool addresses the needs of practitioners and allows them to easily access relevant guidance materials. The Tool is considered as a resource guide/material for practitioners and not an academic paper. References used are mostly available on the Internet and hyperlinks are provided in the "References" section.

This Tool is a *"living document"* and will be updated based on sharing of experiences with its readers. The Associated Programme on Flood Management encourages flood managers and related experts engaged in assessing flood losses around the globe to participate in the enrichment of the Tool. For this purpose, **comments and other inputs are cordially invited.** Authorship and contributions would be appropriately acknowledged. Please kindly submit your inputs to the following email address: apfm@wmo.int under Subject: *"Conducting Flood Loss Assessments"*.

Acknowledgements

This Tool has exploited the works of many organizations and experts, as listed in the references. The ideas have been assimilated with special reference to Integrated Flood Management and no originality is claimed.. Acknowledgement is due to the members of the Hydrology and Water Resources Department in WMO and the members of the Technical Support Unit of the APFM for their competent technical guidance and frank discussions on the issues and for bringing various perspectives into focus. The kind contributions of Mr Katsuhito Miyake and Ms Natasa Manojlovic for enriching the contents are gratefully acknowledged. Special thanks to Ms Oksana Ekzarkho for providing additional input in the second version of the current tool.

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CONTENTS

FIGURES, TABLES & BOXES

1 INTRODUCTION

1 During flood emergencies, assessment of the extent of flooding, flood losses and resultant needs of the affected communities is essential for flood relief coordination. Depending on the severity of a flood and the level of preparedness in the affected area, this assessment has to be carried out under extraordinary circumstances, involving a variety of chaotic conditions, contingencies and time pressures. Due to chaotic circumstances and mounting public pressure, immediate estimates are usually drawn arbitrarily. These immediate assessments later provide the basis for reconstruction planning and decisions on flood management policy reform. Nevertheless, certain basic principles can be observed to avoid too unrealistic estimates and resulting repercussions.

2 The importance of assessing potential flood losses becomes evident when policy makers try to strike an optimal balance between the development needs of a particular area and the level of flood risk society is willing to accept. In this context, flood losses become a vital element in assessing the net benefits society can derive from using flood plains. This involves balancing overall benefits, such as access to land that is relatively easy to exploit for economic activities in various sectors, space for settlement, fertile alluvial soils for agriculture, and readily available navigation links, against the expected flood losses. Both positive and negative factors are assessed for the same timeframe. Moreover, the assessment of flood losses is gaining increasing importance as flood risk management (as opposed to flood control policy) becomes the leading approach utilized globally.

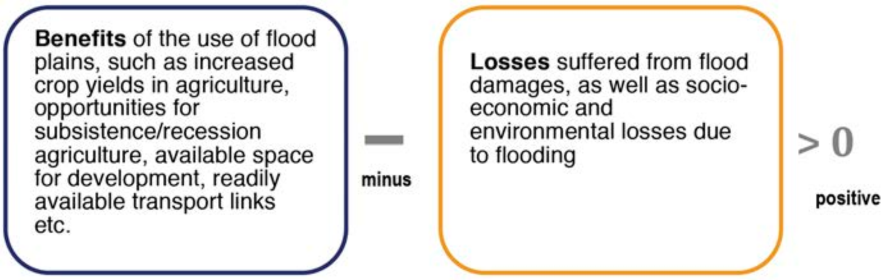

Figure 1 — Net benefits derivable from flood plains

2 WHAT THE TOOL IS FOR AND HOW IT IS PRESENTED

3 This tool sets out to provide an operational level lead-in on available concepts and methods to assess flood losses. It will enhance the activation and facilitation of local and external help and the formulation of recovery plans, as well as long-term development planning and policy reform in the realm of flood management. The tool therefore supplies crucial information for decision support and policy development in the fields of natural disaster risk management and adaptation planning for climate change. As such, it is considered most useful for the following groups:

- flood managers, such as senior public officials in ministries or departments responsible for flood loss assessments and technical experts in those departments supervising external contractors or actually undertaking the assessment (mainly personnel from nationally and locally responsible specialized agencies, mostly with an engineering background)
- Public officials in charge of emergency response, such as mayors
- Local groups and NGOs working in flood emergency response

4 Usually, simple loss assessment approaches are used, mostly due to limitations in existing records and knowledge of damage mechanisms. Hence, the flood loss assessments should include all damage dimensions including adverse social, psychological, political and environmental consequences, in order to gain a complete damage picture.

5 It is important to realize that flood loss assessments are undertaken for a variety of purposes, and that the different purposes determine the outcome. As illustrated in **Figure 2**, this tool distinguishes between several purposes and uses of flood loss assessments, depending on the context in which the assessment is undertaken.

6 The first purpose is the rapid assessment for emergency relief coordination during a flood. The second is the initial assessment of damages to inform and guide the recovery process in the first few weeks after floodwaters have receded. This is vital, for example, for insurance claims, allocation of recovery funds from national budget and guidance for external aid agencies. The third purpose is the comprehensive assessment of flood losses 3 to 6 months after the flood, to inform policy reform processes as well as national and sub-national planning of reconstruction efforts. A fourth purpose deals with the use of flood loss data for flood risk assessment and for the appraisal of flood defence and mitigation options. Unlike the first three, this process is not triggered by the flood event and is instead based on potential losses derived from synthetic stage-damage relationships or empirical data from past floods.

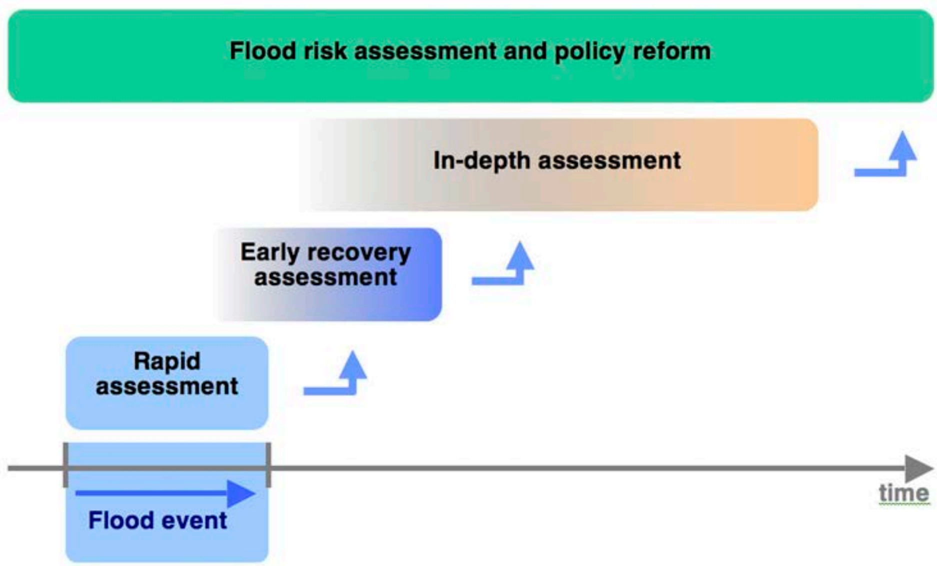

Figure 2 — Types of flood loss assessments in various phases

3 ESSENTIAL DISTINCTIONS AND CONCEPTS

3.1 Types of floods and associated losses

3.1.1 Flash floods

7 According to the definition provided by the United Nations Educational, Scientific, and Cultural Organization (UNESCO)/WMO International Glossary of Hydrology, flash floods are floods of short duration with a relatively high peak discharge (UNESCO & WMO, 2012). flash floods are short-term events that occur 6-12 hours or less after the associated rainfall. Mountainous or hilly areas with steep terrain gradients and high surface runoff are particularly susceptible. flash floods can also be produced when slow-moving or multiple thunderstorms occur over the same area. When storms move faster, flash flooding is less likely since rain is distributed over a broader area. finally, flash floods can also be triggered by the failure of hydraulic infrastructure such as dams or levees, outburst of glacier lakes, ice-jams or logjams.

8 Due to difficulties in predicting the phenomenon and the short lead time for advance preparation, warning and evacuation, damages and loss of human life can be substantial. This often means that potential losses are closer to actual losses than with other flood types. figure 3 below provides some indication, based on flow velocity and water depth, of the damage potential of flash floods. This damage potential may vary according to types of building construction and the existence of structural reinforcements and flood proofing measures. For details on the distinction between actual and potential losses, see also **Section 3.2.2**.

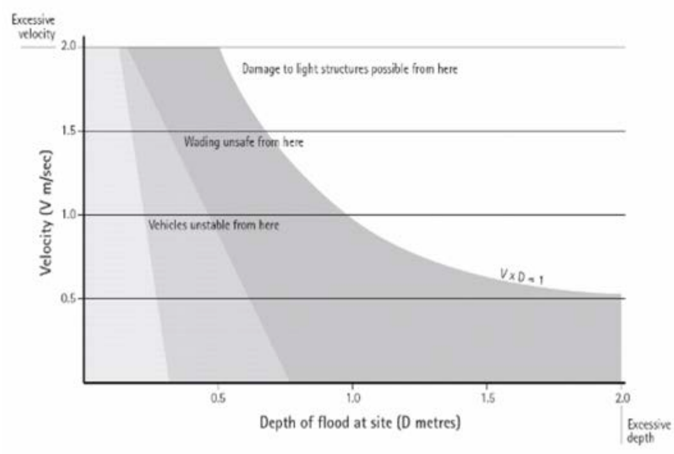

Figure 3 — Critical depth velocity relationship (State of Queensland, 2002)

3.1.2 Riverine flooding

9 Riverine flooding occurs whenever water overflows the normal confines of a river or other water body (UNESCO & WMO 2012). It can extend over large areas in the mid and lower reaches of a river system, where terrain gradients are lower. Although structural failure of buildings in these reaches is less common due to lower flow velocities, prolonged inundation may result in foundation failures, particularly if the construction is old or not to standard. As illustrated in **Figure 4**, flow velocities are higher locally, especially where levees fail. They do not, however, have the same significance for the loss assessment process as flash floods.

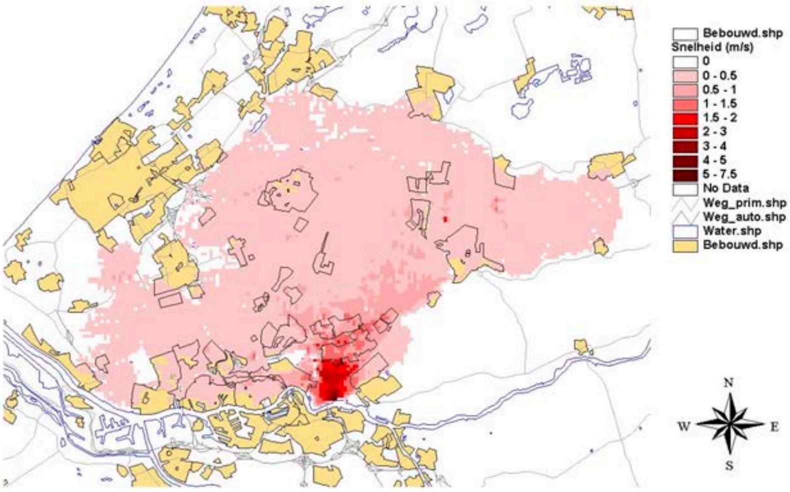

Figure 4 — Flow velocities for a dyke breach scenario in the Netherlands (Asselman & Reggiani, 2006)

10 The main parameters influencing the magnitude of flood damage are the depth of inundation (**Figure 5**) and, for a number of sectors, the inundation time (especially for agriculture), sediment and pollution loads. Due to heavy economic activity in floodplains in many parts of the world, damages and losses from riverine flooding account for substantive parts of overall flood losses.

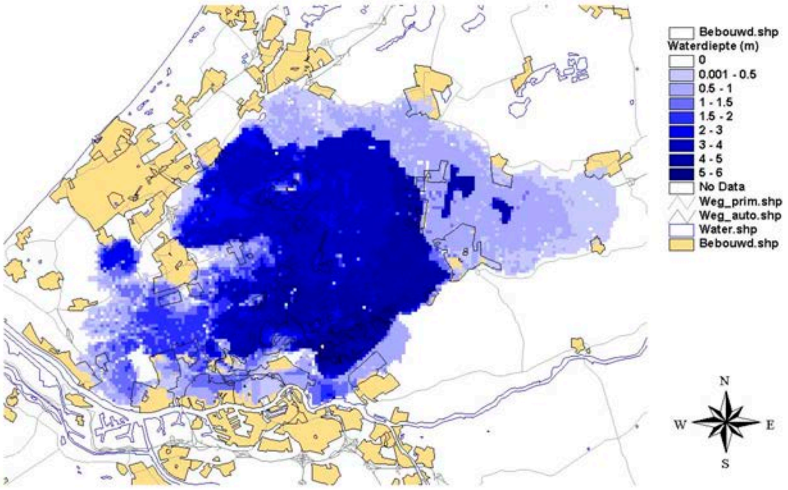

Figure 5 — Inundation depths for a dyke breach scenario in the Netherlands (Asselman & Reggiani, 2006)

3.1.3 Coastal flooding

11 Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. Coastal flooding is mainly induced by storm surges (wind-induced) or by a combination of storm surges, high tide and elevated levels of river discharge leading to backwater effects in the river delta areas. Tsunamis as sources of coastal flooding are a less frequent phenomenon. However, as has been tragically illustrated by the December 2004 Indian Ocean tsunami and in the March 2011 Japan tsunami, they can have effects on unprecedented scales (World Bank, 2005). The combination of damages induced by contact with flood waters, and wind damage to structures is characteristic to coastal floods.

3.1.4 Groundwater flooding

12 Groundwater flooding occurs as a result of water either rising up from underlying rocks or flowing from abnormal springs. It is often characterized by long-lasting flooding that can cause prolonged disruption and relatively high levels of damage. Groundwater flooding tends to occur after sustained periods of high rainfall. Higher rainfall means more water seeps into the ground, causing the water table to rise above normal levels. Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). These may be extensive, regional aquifers, such as chalk or sandstone, or localised sands or river gravel at the bottom of a valley underlain by less permeable rocks. Since groundwater moves much more slowly than surface water and takes time to flow away underground, the water from this type of flooding takes longer to dissipate[1].

[1] Further information on UK Groundwater Forum – Raising awareness of groundwater available at: http://www.groundwateruk.org/

3.2 Conceptual framework of flood loss assessment

13 A flood disaster can have two main effects on a society and economy: the total or partial destruction of physical assets, resulting in subsequent changes or losses to economic flows in the affected area (including the interruption of services). Conceptually, it is important to note the difference between flood damages and flood losses. The term "flood damage" refers to the physical damage caused to public and private assets such as infrastructure, houses, and vehicles as a result of contact with flood waters. The term "flood losses", on the other hand, refers to temporary changes in economic flows from the time of the flood disaster until full economic recovery and reconstruction.

14 The basic definitions of flood disaster effects, adopted as part of the methodology and based on the Damage and Loss Assessment (DaLA) methodology initially developed by the United Nations Economic Commission for Latin America and the Caribbean (UNESCAP, 1972) are:

- Damage: Total or partial destruction of physical assets existing in the affected area. Damage occurs during and immediately after the natural phenomenon that causes the disaster, and is measured in physical units (i.e. square meters of housing, kilometres of roads, etc.). Its monetary value is expressed in terms of replacement costs prevailing just prior to the event.
- Losses: Temporary changes in the economic flows arising from the flood disaster. Losses occur from the time of the disaster until full economic recovery and reconstruction have been achieved, in some cases lasting over several years. Typical losses include the temporary decline in output and higher production costs in the productive sectors of agriculture, livestock, fishery, industry, trade and tourism; lower revenues and higher cost of operation in services (education, health, electricity, water supply and sanitation, transport and communications), as well as the unexpected expenditures to meet humanitarian assistance needs in the emergency phase. Losses are expressed in current values.

15 In order to reduce vulnerabilities of the natural and built environment, the understanding of the social, economic and financial implications of disasters is becoming a priority. Since 1972, the DaLA methodology has been improved to capture the closest approximation of damage and losses due to disaster events and evolved into a globally recognized and applied tool to quantify the impacts of disasters and determine the financial resources necessary to achieve full reconstruction and recovery. The consistent use of this methodology helps identify the socio-economic impact of flood disaster as well as the exposure of sector assets. It also reinforces resilience by promoting the "Build Back Better" principles in reconstruction and recovery efforts.[2]

Also available to facilitate the conduction of post-disaster assessments that lead to the estimation of recovery and reconstruction needs is a set of guidance notes (in three volumes), published by the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR, 2010).

2 Further improvements have been made by WHO, PAHO, World Bank, Inter American Development Bank, UNESCO and ILO. Find further information, DaLA training courses and guidance notes on https://www.gfdrr.org/node/71#DaLA, in (GFDRR 2010), as well as in ECLAC's Handbook for estimating the socio-economic and environmental effects of disasters (UNECLAC, 2003).

3.2.1 Types of flood losses

16 The term "flood loss" has a broad meaning, depicting primary, secondary and tertiary losses, as well as intangible losses such as losses to human life. To arrive at realistic estimates of the impact of a flood while only considering flood damages, that is, direct tangible losses, usually does not do justice to the purpose of assessment. Indeed, it would probably send a misleading message to policy makers about the true impact and consequences of a flood event.

The following distinction is most commonly applied (Emergency Management Australia, 2002):

Box 1 — Types of flood losses

- **Direct losses** — Losses induced by the physical contact of flood waters with humans, property or any other objects.
- **Indirect losses** — Losses induced by the direct impacts and occurring (in space or time) outside the flood event; for example, transport disruption, business losses that can't be made up, and losses of family income.

In both loss categories, there are two clear sub-categories of loss, depending on whether or not they can be assessed in monetary values:

- **Tangible losses** — Loss of things that have a monetary (replacement) value; for example, buildings, livestock, and infrastructure.
- **Intangible losses** — Loss of things that cannot be bought and sold; for example, lives and injuries, heritage items, and memorabilia.

17 Primary losses due to floods are those due to direct contact with flood waters, the related sediment and debris transported, and structures being undermined by erosion. Secondary effects are those that occur because of the primary effects. Among the secondary effects of a flood are disruption of services, utility supplies such as electricity, gas and drinking water, transportation systems, disease outbreaks and other health effects, especially in under-developed countries. Tertiary effects are the long-term changes that take place as a consequence of the floods, such as changes in the river morphology, degradation of land, the development value of specific areas, losses of jobs as consequence of disruption of services and higher insurance rates.

18 These distinctions are further illustrated in **Figure 6**. The Flood Hazard Research Centre (FHRC), based in the UK, has published one a flood loss assessment manual that serves as one of the most authoritative resources on the topic (Johnson et al., 2006). This manual, together with a number of subsequent works by the FHRC, provides important guidance on the issue of flood loss assessment[3].

19 One of the most basic decisions that must be made in flood loss assessment is which loss categories to include and how to assess each of these categories. This decision will be influenced by the type of assessment to be carried out, as well as the time and resources available for its completion. National practices vary as to which categories are included (Messner & Meyer, 2005).

3 For more information and news on FHRC at http://www.fhrc.mdx.ac.uk/resources/publications.html

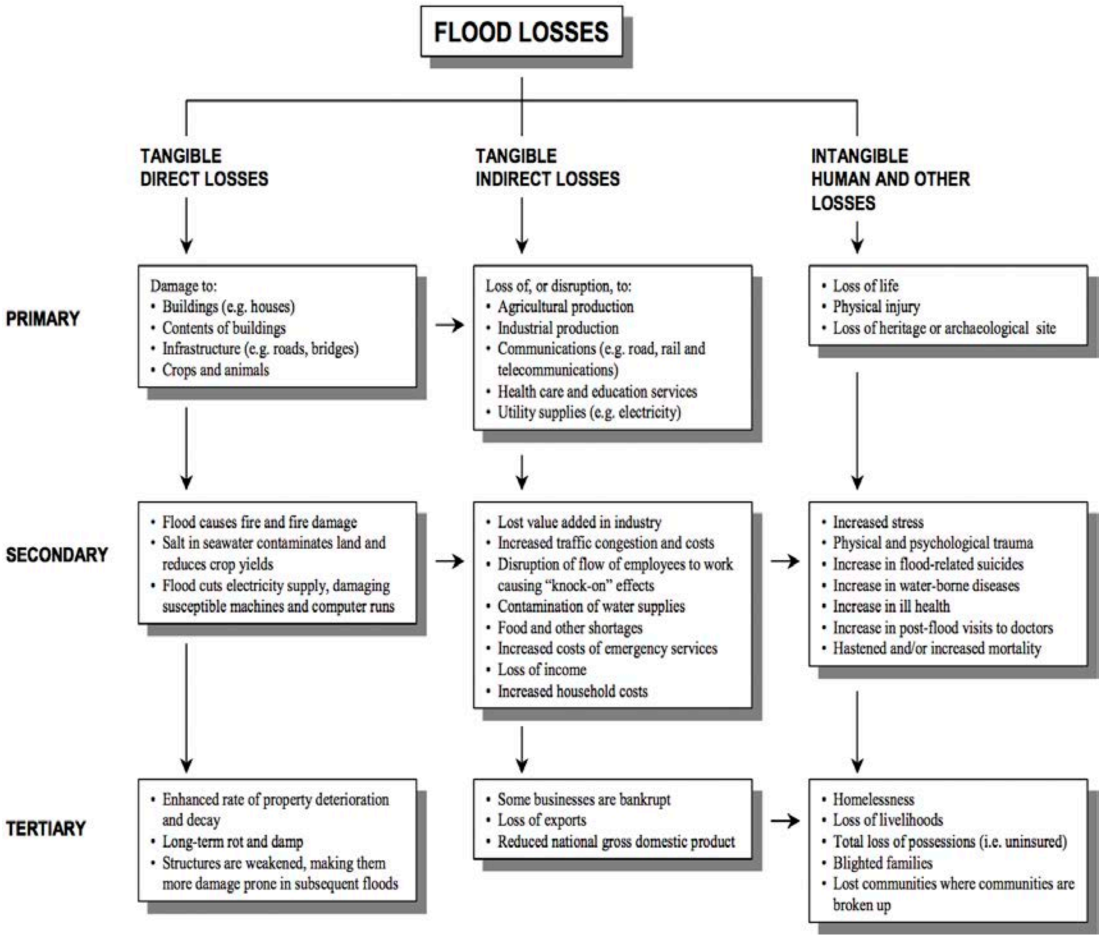

Figure 6 — Categorization of flood losses (Parker, 1999)

3.2.2 Actual and potential losses

20 Another important distinction can be made between actual and potential flood losses. When assessing damages based on the experience of past floods or synthetic stage-damage relationships, the assumption applied is usually that the flood strikes without the household or affected community having taken any preparatory action. Such preparatory action could involve moving cars to higher ground, emptying basement storages and the ground floor and sealing the entrances and windows of buildings.

21 The flood awareness and preparedness levels of local communities and households, however, significantly influence the level of actual losses. **Figure 7** illustrates this effect by comparing the behaviour, based on different warning lead-times, of an experienced community with that of an inexperienced community.

22 **Figure 7** effectively demonstrates that for an integrated approach to flood management, flood management project appraisals should take into account not only the benefits of flood defences (structural measures), but also the benefits of flood risk awareness, flood preparedness and mitigation measures.

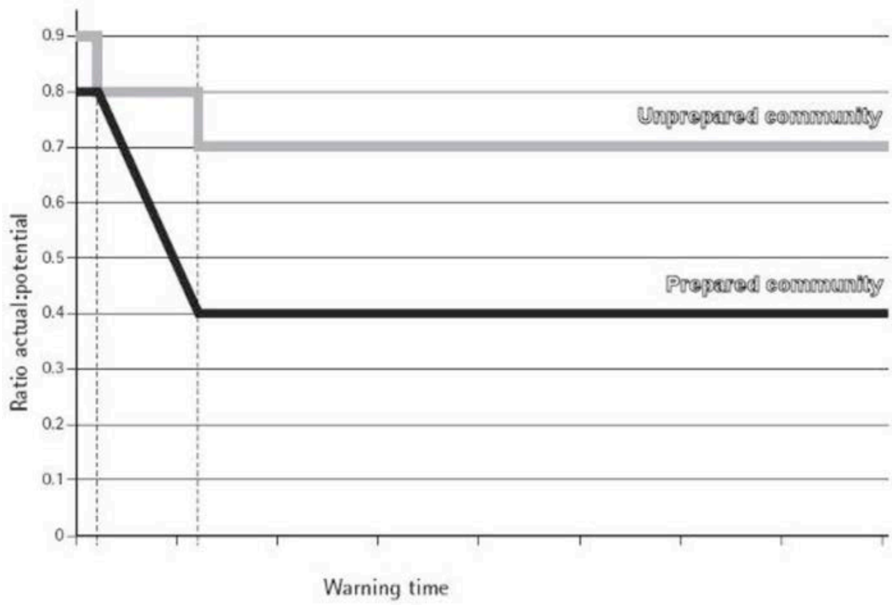

Figure 7 — Relationship between actual and potential damages (State of Queensland, 2002)

3.3 Economic and financial assessment

> *"The intention of economic analysis as part of a flood loss assessment is to assess the deviation from likely economic activity as a result of the flood, not to take into account the financial losses to individual enterprises. This is not always easy to do, and you will commonly have to make approximations to this ideal."*
> (Emergency Management Australia, 2002).

23 Financial assessment is concerned with the question of what level of losses an individual business, property or household has suffered due to flooding. The difference between economic assessment and financial assessment can be illustrated with an example. A food production facility has suffered income losses because it was not able to transport goods to customers due to roads that were blocked as a result of flooding. However, another competitor was able to substitute goods from its own stock and therefore benefited from an increased income as an indirect effect of the flood. This incident would therefore not affect the economic impact of the flood.

3.4 Stage-damage curves and unit loss approach

24 Stage-damage curves are graphical representations of the losses expected to result at a specified depth of flood water. Such curves are typically used for housing and other structures, where stage or depth refers to depth of water inside a building and damage refers to the damage expected as a result of that depth of water (Emergency Management Australia, 2002).

25 Stage–damage curves can be developed by:

- Using data on building contents and structure repair costs to produce synthetic or artificial estimates of damage curves, or

– Using information on losses measured following flooding combined with estimates of water depth to construct stage-damage curves of actual losses.

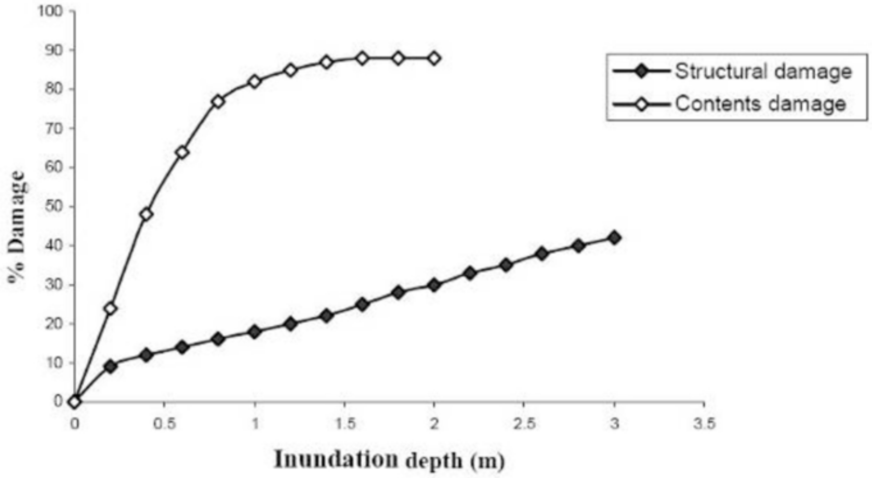

Figure 8 — Example of stage-damage curves for potential contents and structural damages (Emergency Management Australia, 2002)

26 The unit loss approach refers to the calculation of loss to individual properties, which are then added together to give a total loss figure for the event in question. For losses from flooding, this usually involves calculating the loss to each property (or unit) by survey, stage-damage curves, or the use of average figures. The losses for each unit (property) are then added together to give an estimate of total event loss.

4 FLOOD LOSS ASSESSMENT PROCESS AND METHODS

4.1 Rapid assessment during the flood

27 The purpose of assessment during a flood is mainly to have a factual basis for emergency response and relief coordination, to have an understanding about the overall flood situation, its impact and consequences, and to come up with a set of policy recommendations to address attendant issues in the post-event phase. During this phase, emphasis is placed on having a basis for avoiding (further) loss of life, minimizing suffering of the affected population and avoiding knock-on effects (secondary disasters).

28 Importantly, a flood assessment during this phase is also the basis for deciding which levels of administration are to be invoked for the response, that is, if local or regional emergency response forces are in a position to contain the situation, or if assistance from the national level is necessary.

29 Assessment at this stage will need to be made with very limited time and locally available assets, as well as under unsettled circumstances. Based on the above-mentioned emphasis on action, essential information for the emergency response at this stage would include:

- People killed, displaced or affected by flooding (including specified needs for humanitarian response);
- Assets that have been flooded (inundation map), search and rescue and evacuation requirements;
- People and assets at risk of being flooded further (hazard or risk map), based on the status of flood defences and needs for further evacuations;
- Status of lifelines (evacuation/access roads, hospitals, electricity grid, communication, water and food supply), hospitals and shelters;

– Current and expected river water levels at various locations as well as weather conditions.

30 The focus of assessment during this phase is placed on emergency response rather than loss assessment. The current tool does not include a detailed discussion on this topic. Further guidance on this issue is available from various sources, especially national and international bodies working on emergency response and relief coordination. A short list of readily available guidance material is provided in the following:

- *Multi Cluster/Sector Initial Rapid Assessment* (IASC, 2012a), and an *Operational Guidance for Coordinated Assessment in Humanitarian Crises* (IASC, 2012b), published by the Inter-Agency Standing Committee[4];
- *United Nations Disaster Assessment and Coordination (UNDAC) Field Handbook*, published by the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA); provides a rapid assessment methodology on a sectoral basis (UNOCHA, 2010);
- *United Nations High Commission for Refugees (UNHCR) Handbook for Emergencies;* provides checklists for initial assessments as well as guidance on the provision of safe drinking water (UNHCR, 2007);
- *Community Damage Assessment and Demand Analysis*, published by the All India Disaster Mitigation Institute; provides guidance on a staged assessment process for the local level (All India Disaster Mitigation Institute, 2005);
- *Post-Disaster Damage Assessment and Need Analysis*, published by the Asian Disaster Preparedness Centre; provides ready-made templates for early reporting of damages and needs (ADPC, 2000);
- *Integrated flood Management (IFM) Tool on Flood Emergency Planning*, published by the WMO/Global Water Partnership (GWP) Associated Programme on flood Management (WMO, 2011).

31 While in more developed economies the option of air reconnaissance to establish the factual basis for emergency response may be readily available, in many of the world's flood stricken regions it is not. In many circumstances, non-availability of inundation maps restricts the response of emergency services. For those areas, either alternative methods can be utilized or an international response can be triggered through the Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters[5].

32 At this stage a meaningful flood damage assessment is impossible as flood waters have not yet receded and therefore the entire extent of damage may not be possible to be assessed. The realities of international disaster response require, however, even at this stage a preliminary estimation if there are indications that national coping capacities are exceeded. Depending on synthetic stage damage data readily available or experience from earlier floods this estimation can be significantly improved. Developing relevant data and information about potential flood losses in good time, i.e. before the next flood, helps to prevent situations where rapid assessments are way out of dimension.

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4 Case studies and training material on the use the MIRA Manual in Central Asia (Afghanistan, Pakistan and Tajikistan) can be found at http://assessments.humanitarianresponse.info/central-asia

5 The International Charter aims at providing a unified system of space data acquisition and delivery to those affected by natural or man-made disasters through Authorized Users. Each member agency has committed resources to support the provisions of the Charter and thus is helping to mitigate the effects of disasters on human life and property. For more information, see http://www.disasterscharter.org/home

4.2 "Early recovery" assessment

33 In the immediate aftermath of a flood event, i.e. 1-3 weeks after the flood (peak), the purpose of an "early recovery" assessment lies in guiding the recovery process and in providing early indications for reconstruction in particular with a view to:

- Facilitate the design of financial mechanisms for speedy recovery (who will bear the cost),
- Lay the foundation for priority setting in allocation of recovery assets,
- Provide indications on the coping capacity of the government to repair key infrastructure, such as important road links and flood defences to withstand the next flood, and to
- Provide early indications on mistakes that have been made in past planning and development practice that need to be borne in mind for reconstruction planning.

34 Early recovery is a multidimensional process of recovery that begins in a humanitarian setting. It is guided by development principles and seeks to build upon humanitarian programmes and catalyze sustainable development opportunities. It aims to generate self-sustaining, nationally owned, resilient processes for post crisis recovery. Early recovery encompasses the restoration of basic services, livelihoods, shelter, governance, security and rule of law as well as environmental and social dimensions of the disaster, including the reintegration of displaced populations.

35 In 2005, the IASC Cluster Working Group on Early Recovery (CWGER) was established in order to fully capitalize on "recovery opportunities". CWGER has 19 United Nations and non-United Nations members from the humanitarian and development communities, with the United Nations Development Programme (UNDP) as the designated cluster lead. The guidance note on early recovery published by CWGER has been widely used for early recovery assessment in the aftermath of flood disasters. The IASC cluster system provides the framework and guidance for global inter-agency support to post-crisis countries. Moreover, it also offers conceptual and practical guidance on early recovery through the development of assessment, programming and coordination tools for application in crisis-affected countries. In addition, it helps the development of effective coordination structures for early recovery through the establishment of early recovery networks, and the development of inter-agency early recovery strategic frameworks and plans in support of government-led recovery efforts (Cluster Working Group on Early Recovery, 2008).

36 The focus of assessment at this stage is necessarily on tangible and direct losses, as most intangible losses need a longer time to be assessed. Furthermore, at this stage indirect losses may not be fully apparent or may not have completely materialized. This is especially relevant to indirect losses concerning trade and industry, and loss assessments may need to be based on best estimates of affected business.

37 ECLAC has provided a standard and internationally accepted methodology for estimation of socio-economic and environmental losses (UNECLAC, 2003). The underlying methodology is based on (i) physical assets that will have to be repaired, restored, replaced or discounted in the future and (ii) flows that will not be produced until the asset is repaired or rebuilt. The ECLAC methodology further conducts the assessment on a sectoral basis, similar to the framework displayed in **Figure 9**, below.

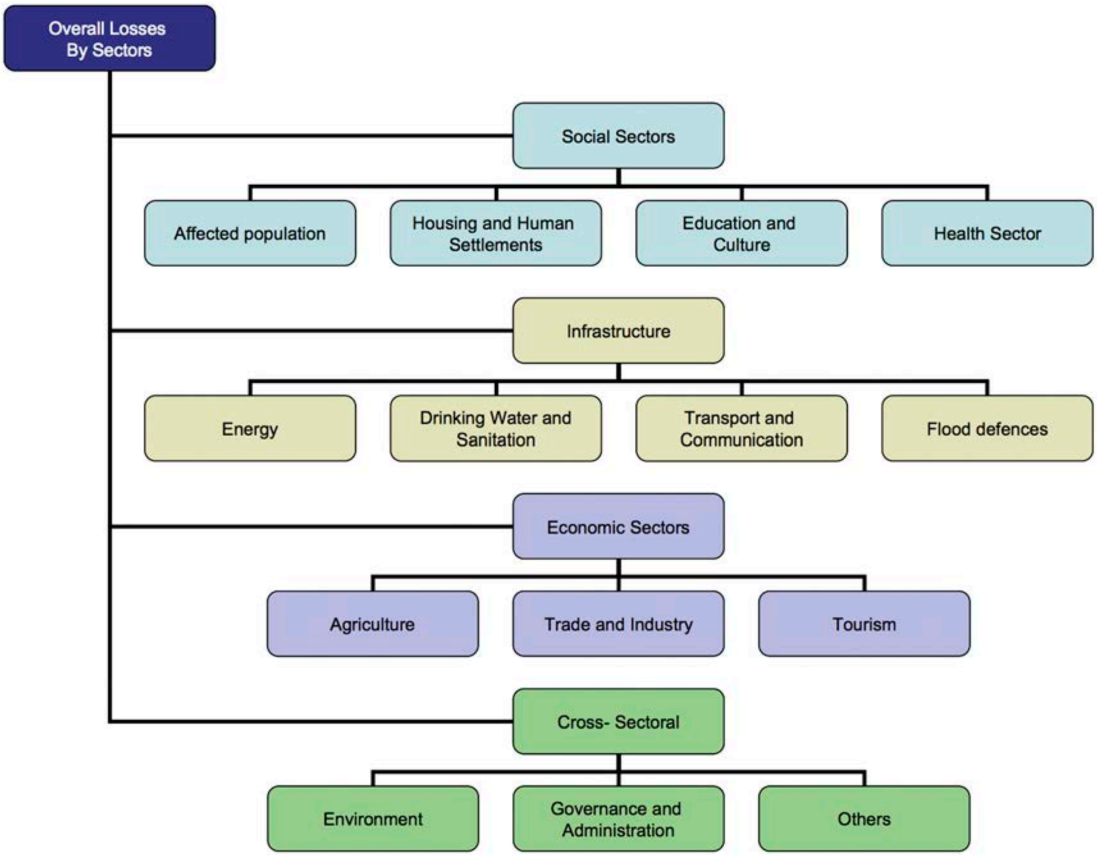

Figure 9 — Disaggregation of losses by sectors (UNECLAC, 2003)

38 Further methodological guidance for the assessment of losses for each sector is available from (UNECLAC 2003). The same methodology has been applied by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) in the creation of a practical spreadsheet-based software application called the Disaster Impact Calculator (UNESCAP, 1972).

39 Considering presently available methodologies, it is advisable to base assessments on actual costs and damages, that is, replacement cost – how much it would cost to replace the assets and income lost based on their original specification and location.

40 As demonstrated by **Table 1** on the next page, when reporting, a further distinction can be made between damage to public and private property. It is essential not only to look at the totals in relation to the national economy, but also to see examine is bearing the losses of flooding. For example, the economy of a country may be only marginally affected whereas damage to the economy of the most affected region or province may exceed that region's coping capacity.

Table 1 — Summary of distribution of flood damages (in Rs and US$), using the example of the 2010 Pakistan floods (Pakistan National Disaster Management Authority (NDMA))

	Direct Damage	Indirect Losses	Total (Rs mil)	Total (US$ mil)	Reconstruction Cost (PKR Million) Option 1	Option 2	Option 3
Agriculture	*315,547*	*113,257*	428,805	*5,045*	*21,879*	*56,925*	*89,134*
Crops	289,823	92,917	382,740	4,503	--	--	--
Livestock	27,815	20,341	48,155	567	--	--	--
Others	380	0	380	4	--	--	--
Private Sector	14,463	9,468	23,931	282	8,636	8,636	10,923
Transport & Communication	62,491	50,420	112,911	1,328	200,260	200,260	200,260
Energy	13,184	13,116	26,300	309	9,038	9,038	9,038
Banking & Finance	110	57,141	57,251	674	39,358	39,358	39,358
Housing	91,843	43,171	135,014	1,588	126,075	143,676	187,491
Irrigation & Flood Management	23,600	0	23,600	278	36,294	36,294	83,499
Education	22,047	4,418	26,464	311	42,907	42,907	42,907
Health	1,562	2,661	4,222	50	4,151	4,151	4,151
Water Supply & Sanitation	3,194	6,112	9,306	109	6,292	6,292	7,982
Governance	3,141	2,835	5,976	70	4,900	4,900	4,900
Environment	992	0	992	12	17,746	17,746	17,746
Disaster and Risk Management	0	0	0	0	2,295	2,295	2,295
Livelihood	0	0	0	0	58,076	58,076	58,076
Total	**552,173**	**302,599**	**854,771**	**10,056**	**577,908**	**630,554**	**757,761**
Percent of 2009/10 GDP	***3.8***	***2.1***	***5.8***	***5.8***	***3.9***	***4.3***	***5.2***
Memo items: Provincial-/Area-wise distribution of damages and reconstruction cost:							
Azad Jammu & Kashmir	5,411	1,891	7,303	86	13,190	13,886	16,009
Balochistan	41,988	10,689	52,676	620	27,258	34,359	58,116
FATA	4,057	2,214	6,271	74	7,595	7,873	9,544
Federal	22,860	70,257	93,117	1,095	95,911	95,911	96,866
Gilgit-Baltistan	3,648	517	4,165	49	6,627	6,893	10,027
Khyber-Pakhtunkhwa	67,643	31,982	99,625	1,172	105,957	109,942	179,844
Punjab	153,246	66,026	219,272	2,580	93,521	107,903	117,650
Sindh	253,317	119,023	372,341	4,380	227,850	253,791	269,704

41 From a social perspective, it is necessary to examine which social groups or classes are affected disproportionately, and merely counting the absolute value of losses in monetary terms cannot accomplish this goal. Instead, it is necessary to relate losses to the ability of members of respective groups to recover from those losses (for example, through savings, insurance, reconstruction assets, social support network, income and livelihood). In other terms, a poor family or community without many savings or other recovery assets may have great difficulty in recovering from a nominally small monetary loss, whereas a property owner with flood insurance may not be as affected even though the nominal monetary loss may seem to be very large. Such an assessment would help minimize the risk of those most in need being overlooked in the recovery efforts.

42 Furthermore, collecting data about the effect of flood losses on men, women, children and the elderly, is helpful in identifying and targeting the specific needs of those particular groups in the recovery process.

43 Even though establishing all this information in the first weeks after a large flood event may be a challenge, it is of essence to try, because that information is required for decisions on making available recovery assets in, for example, the form of small grant schemes. This concept is referred to as *"vulnerability assessment"* and generating this information for flood prone areas before the next flood occurs is advisable. Local institutions, such as volunteer fire brigades, faith-based organizations, citizen associations or community flood management committees can play a key role in this process. In South Asia, models for Community Flood Management Committees have been successfully created and tested[6].

6 Guidance can be drawn from the APFM pilot projects in South Asia: http://www.floodmanagement.info/?page_id=2231

44 Sources of information could include:

- Strategic sources such as dedicated government institutions, research centres and experts;
- Pre- and post-flood maps;
- Reconnaissance missions by land, air or water;
- Surveys;
- Secondary data analysis;
- Interpersonal communications (for example, through social media tools such as Twitter);
- Remote sensing data.

4.3 In-depth assessment 3 to 6 months after the flood

45 An in-depth assessment of the full economic impact of a flood event can only be reliably conducted 3-6 months after the event. Perhaps the best time to conduct an in-depth assessment of flood losses is after 6 months because by that time most losses, including indirect and intangible losses, can be assessed with sufficient reliability. During this period a flood loss assessment is necessary to guide reconstruction planning as well as adjustments in future flood management policy. At this stage, the process may receive a number of data collected in the earlier phases as indicated in **Figure 2**. Those data could otherwise be lost but usability of those data largely depends on the planning and delimitations that have been undertaken for the earlier appliances of loss assessments as discussed in **Sections 4.1** and **4.2**.

46 For professionals charged with conducting a flood loss assessment, the question on what steps or process to follow in order to deliver the desired result is crucial. **Figure 10** provides a general process overview in 12 steps developed by Emergency Management Australia, which allows for a structured way of working as well as monitoring progress, and delivering a transparent and verifiable result.

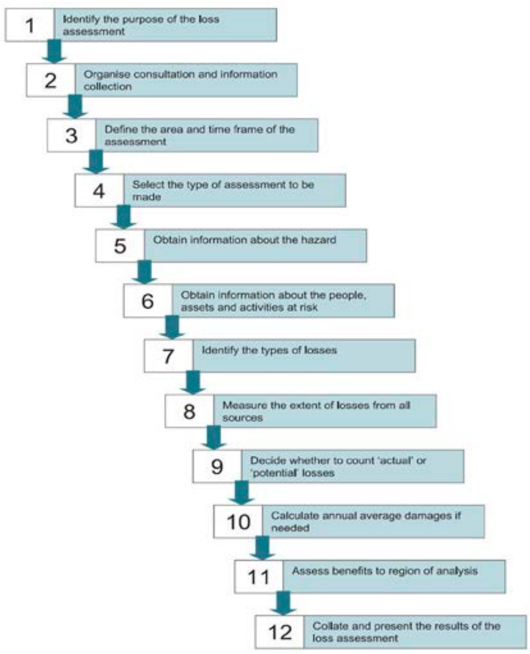

Figure 10 — The Loss Assessment Process (Emergency Management Australia, 2002)

47 A detailed description of each step is provided in the **Annex** *Loss Assessment Process*. Each assessment is case-specific and a balance must be struck to achieve an assessment result that is both quick and accurate.

48 At this stage, an assessment can usually be based on reconstruction costs, assessed according to a (preliminary) reconstruction plan. This plan may be detailed enough to provide for reconstruction in different locations according to different specifications.

49 Flood loss data areas sets for emergency response, rehabilitation and reconstruction efforts. They also play an equally important role in flood risk assessment and development planning. Even though the details of flood risk assessment cannot be covered in this tool, one important concept to remember for this type of application is that of *"average annual flood losses".*

50 Assessing the losses caused by an individual flood event will provide no indication of justifiable levels of investment in flood mitigation measures. This justification should come from the benefits that a particular mitigation option provides over its lifetime, and it can be calculated by converting flood loss data into average annual losses. Average annual losses can be calculated by combining the statistic likelihood of the occurrence of flood events of varying magnitudes in any given year with the potential losses for each of those flood events. **Figure 11** below illustrates this concept, with the black line representing flood events with a statistic probability of exceedance of 10%, 1% and 0.01%. The grey line represents this relationship after a levee has been introduced, providing protection against floods smaller than the flood that statistically has a 1% probability of being exceeded in any given year This has been referred to as the *"100 year flood"*; however this terminology is misleading as flood events occur randomly.

51 The average annual flood losses prevented by introducing the levee are represented by the dark grey area under the black line. For a detailed explanation and calculation examples, see (WMO 2007; 2013). Information on methodologies to assess flood management measures' economic return of investment can be drawn from WMO publications.

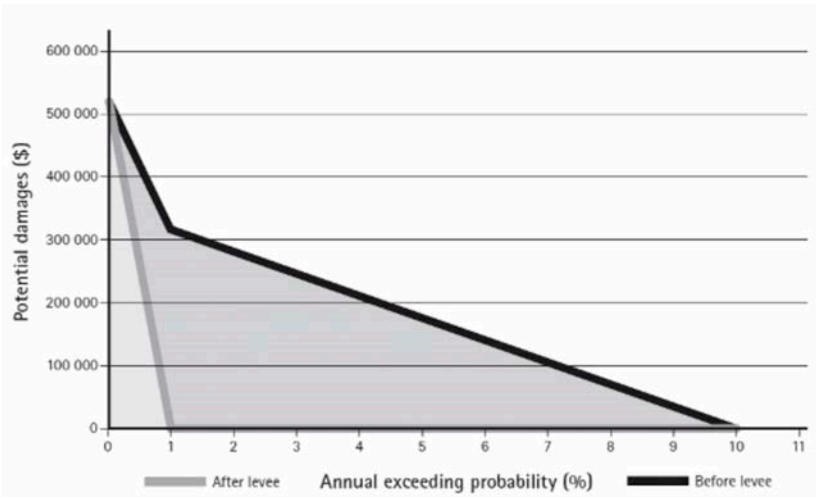

Figure 11 — Potential flood damages vs annual exceedance probability (State of Queensland, 2002)

52 One obvious shortcoming with this method of calculation is that it does not take human behaviour in the form of risk perception into account. This refers to the *"levee effect"*, or the phenomenon where the building of a levee usually leads to increased investment in the

protected flood plain, therefore leading to an increase of potential losses. Indeed, the main incentive for agricultural areas and regions where food security is yet to be achieved to provide flood protection up to a certain standard is to attract such investment.

53 What is not desirable in most cases, however, is to encourage residential or industrial property to be newly built in high risk areas. floodplain zoning and regulation are the essential tools to prevent unwanted developments on the floodplain, and hypothetical flood loss assessments are serve as a foundation for setting adequate standards of protection and delineating specific zones and uses of the floodplain.

5 EXAMPLES OF FLOOD LOSS ASSESSMENTS

5.1 Damage, loss, and needs assessment for disaster recovery and reconstruction after the 2008 cyclone season in Madagascar

54 Three cyclones struck Madagascar in early 2008 and caused considerable human and economic loss. The government, together with international donors, implemented an integrated approach for the economic recovery and reconstruction of destroyed physical assets. The methodology focused on estimating damage caused to facilities, changes in economic flows, their impacts upon the population's social and economic living conditions, and the geographic zones affected. These estimates were based on quantitative data gathered in the field by the Government of Madagascar and all its development partners. The data gathered was also supplemented by the results of on-going field evaluations by the United Nations system.

The participation of these entities in addition to the quantitative data gathered, led to a qualitative needs perspective that accommodated crosscutting challenges such as governance (or, more specifically, coordination of the transition phase), the environment and diversity, and risk management. The implementation of this methodology demonstrated the government's efforts to viably reduce the country's vulnerability to disasters while simultaneously incorporating issues associated with climate change (Government of Madagascar, 2008).

5.2 Flood loss estimation modeling in Japan based on Geographical Information Systems (GIS)

55 The flood loss estimation modelling approach based on Geographical Information Systems (GIS) was developed by the Ministry of Construction of Japan in order to carry out damage estimations once the extent of the flood has already been calculated. The approach utilizes a distributed flood inundation model created through the use of GIS consisting of property information and stage-damage functions, and describes damage to each property category for a given flood depth and duration. This methodology can be used to estimate damage potential under various flooding scenarios and, by being coupled with flood simulation applications, can serve as a tool for rapid economic appraisal of flood control project benefits as well as for assessing relative merits of different flood control options. By combining a flood inundation simulation model with a loss estimation model in order to account for direct flood damage, the GIS-based modelling approach is an expansion of existing methodology. In the loss estimation modelling, direct flood damages are categorized into three main groups: urban, rural and infrastructure damages.

In this approach, GIS plays an integral role in pre- and post-processing of spatial input and outputs. The model also integrates a physically-based distributed hydrologic model and a flood damage estimation model. It considers all the physical processes in a river basin for flood inundation simulation and utilizes stage-damage relations for different land cover features in order to estimate the economic losses caused by floods. The results of application in the Japanese river basin show that the model can simulate flood inundation parameters well (Dutta & Herath, 2001).

5.3 Flood damage assessment in Prague

56 The flooding throughout Europe in 2002 constituted one of the most severe flood events in more than a century. During this event, the Vltava river exceeded the water level of the major 1890 Prague floods. In order to evaluate flood losses, a methodology for assessing direct flood damage potential using the Monitoring Land Use / Cover Dynamics (MOLAND) database combined with a flood extent map, hazard map (and connected flood depth) and economic asset data (Kasanko et al, 2003). The study area includes the central part of the city of Prague that was flooded in 2002. Combined with existing information on land use and flood depth, maps of the flooded areas provide information that can be used for flood damage assessment, urban and rural planning and validating flood simulation models.

Subsequently to the 2002 floods, a new methodology was introduced, where constructing 'synthetic' stage-damage curves and these are based on hypothetical analysis. Quality of damage assessment depends on the quality of the classification. The classification offered by the MOLAND database signifies a high level of detail. The concept of damage function is used when calculating flood damage. In order to assess flood damage correctly, impact parameters need to be incorporated within a method. The results provide an average estimate and should not be considered a detailed cost assessment of the damage, since they strongly depend upon the quality of damage functions and availability of detailed datasets (Genovese, 2006).

5.4 Asian Development Bank's Project Report – "Nepal: Emergency Flood Damage Rehabilitation Project"

57 As part of the post-flood damage and needs assessment conducted after the 2008 monsoon floods in the eastern and far-western regions of Nepal, the Asian Development Bank, with the participation of United Nations agencies and the Government of Nepal, set up the Emergency flood Damage Rehabilitation Project to create a preliminary estimate of flood damage. The project supported increased disaster preparedness and the mitigation of damage from future recurrent floods by enhancing the government's disaster management capacity and improving the disaster recovery system. It further contributed to sustainable economic growth by minimizing the devastating impact of the floods and reducing future risk from similar disasters.

58 The project focused on augmenting incomes and self-reliance by reviving agriculture in the affected farmland and restoring the livelihoods of affected persons, as well as rehabilitating damaged infrastructure. It included mitigation of the risk of damage from recurrent floods by enhancing cost-effective construction specifications for rehabilitated infrastructure, and supporting capacity building and the government's disaster preparedness. Project-financed restoration brings infrastructure back at least to original productivity and efficiency levels. Thus the economic benefits of the Project's restoration activities are those benefits that accrued at the time of initial construction but were lost due to flood damage. While most restoration works aimed to meet immediate emergency needs, the restoration of permanent structures improved their ability to withstand future floods.

The project focused on four major sectors, agriculture, irrigation, water and sanitation, and roads, and contributed to reducing the vulnerability and risks of the affected population, who were displaced, poor and disadvantaged. finally, the project performed well and established a satisfactory operating modality between central agencies and district administrations, as well as between the different stakeholders at central and district levels. In addition, due to the lessons learned and experience gained in implementation, the second phase of the project will benefit from some restructuring, including increased focus on road maintenance, strongly promoting the use of building groups, and facilitating access to credit by the rural poor for developing financially viable business activities. There are very clear efficiency gains to be realized for scaling up the project through additional financing, especially by being able to implement pre-designed subprojects and to utilize project structures and staffing at both the central and district levels (ADB, 2009).

6 CONCLUSIONS AND RECOMMENDATIONS

- **Flood loss assessment**, or the evaluation of potential damages related to floods, provides a powerful indicator for the assessment of vulnerability, thus permitting user to analyze different flood management strategies supporting the decision-making process. Also, this analysis provides and overview of different aspects of the risk, facilitating costing of flood management measures and the allocation of adequate budgets.
- **Collection of data and derivation of stage-damage curves for specific areas before the flood is of prime importance:** Governments are well advised to build required capacities within their own ranks for flood damage assessment and communication well in advance of a flood in order to minimize confusion and provide post-flood relief coordination efforts with workable estimates. In fact, these efforts should complement efforts for flood risk assessment undertaken to provide policy makers and planners with the requisite decision support.
- **Close involvement of local stakeholders:** This includes volunteer organizations, the private sector, farmers, residents, and other local institutions and provides the basis for flood loss assessments. It is crucial that the assessment process is designed to facilitate input by these stakeholders.
- **The assessment purpose defines the outcome of the assessment:** To some extent, assessment takes place on a case-by-case basis. There is no agreed formula for assessment in all contexts.
- **Evaluation of the burden of economic losses:** It is necessary not only to look into the overall economic losses, but also at who has to bear these losses, what kind of mechanisms for burden sharing are in place and what bearing that has to the development perspective of the particular group.
- **Transparency:** It is important to stress that economic flood loss assessments, in particular the in-depth assessment prepared with enough lead time, should be undertaken according to agreed, transparent procedures. This in turn leads to higher levels of confidence in the

assessment results, allows decision makers to make informed decisions and ensures long-term comparability of datasets.

- **Overall assessment of net benefits:** It is necessary for long-term policy formation in the public domain (concerning flood management policy as well as development policies) to base decisions not only on assessed flood losses, but to ensure that these losses are embedded into an assessment of the net-benefits derived or derivable from flood plains.
- **Institutional support:** Countries should strive to provide relevant institutional support and framework conditions for orderly flood loss assessments. This includes having, at the appropriate levels, designated institutions that are obligated by law to assess flood losses and are equipped with adequate human and financial resources.

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ANNEX: THE LOSS ASSESSMENT PROCESS

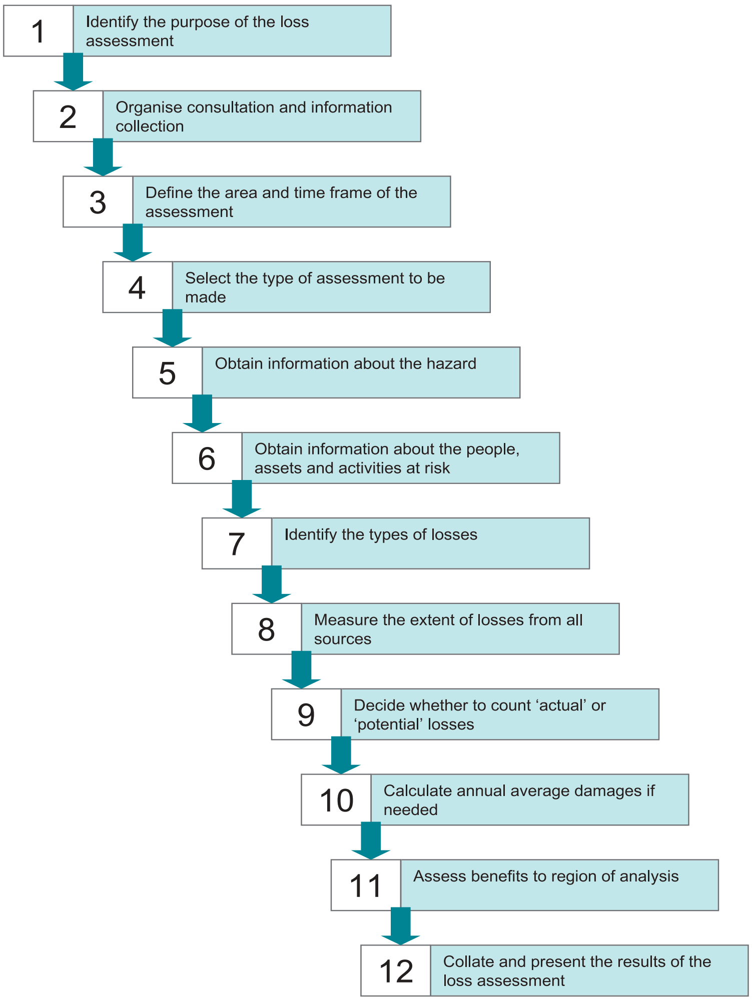
The following pages are excerpted from the Disaster Loss Assessment Guidelines Emergency Management Australia (2002), Australian Emergency Manuals Series, Part III, Volume 3, Guide 11

3. DISASTER LOSS ASSESSMENT PROCESS

Overview of sequence of actions to follow in the loss assessment process

Every loss assessment should be approached in a logical structured way, getting information directly and by consultation, and setting it out clearly as the study progresses. The process is set out in Figure 2, which will be the key to all the steps in both the Guidelines and the Case Study.

Figure 2: The loss assessment process



The step-by-step assessment process shown in Figure 2 is for use with inundation hazards. Much of the supporting material is generic and can be applied to all hazards. So with minor modifications, the assessment process set out in these Guidelines could be applied to other hazards. The modifications you might have to make are set out in Table 20, which identifies differences in economic analysis for different hazards.

The steps outlined in Figure 2 are in a logical sequence, but this does not have to be followed slavishly. The starting point should always be to identify the purpose of the assessment, but beyond that, progress will often be iterative—especially going back to steps between 1 and 6 as more information emerges to modify what has already been covered.

For example, the extent of resources available may not become apparent until some preliminary scoping work has been done. It may be necessary to collate material on the hazard and other components of the risk, and to make a preliminary assessment of the types of damage, before being able to argue for significant resources for the full assessment task. Some key decisions may be made before or as the assessment commences, such as the approach to be used and whether actual to potential loss ratios are to be considered.

Precis of the loss assessment process—a process guide

Estimates of disaster loss may serve many purposes, and these are set out in the Guidelines. Although they consider losses from inundation, the principles in this Process Guide can be applied to assessments of loss from other hazards. There has to be a standard approach to loss assessment, primarily to:

- ensure that works done to provide mitigation or warning systems etc. produce a sound return on the investment;
- have a common measuring tool for assessing alternative mitigation proposals; and
- assist with post-disaster recovery planning and management-knowing the extent and type of losses to be expected in existing areas is a great help in recovery management by enabling better targeting of resources to identified key areas.

Loss assessments have to be:

- transparent-so the assessment procedures can be followed easily;
- consistent and standardised-to enable meaningful comparisons;
- replicable-to enable the assessments to be checked; and
- based on economic principles-so assessed losses represent properly the real losses to the economy.

There are two categories of loss to be assessed:

Direct losses: Those losses resulting from direct contact with the hazard, for example, flood and wind damage to buildings and infrastructure

Indirect losses: Losses resulting from the event but not from its direct impact, for example, transport disruption, business losses that can't be made up

In both loss categories, there are two clear sub-categories of loss:

Tangible losses: Loss of things that have a monetary (replacement) value, for example, buildings, livestock, infrastructure etc.

Intangible losses: Loss of things that cannot be bought and sold, for example, lives and injuries, heritage items, memorabilia etc.

There has to be a clearly defined area and time-period set for any loss assessment. Structured mechanisms have to be set up for consultation, assembly and processing of data on the hazard and on assets and activity affected by the hazard, so there is a logical progression of work.

Figure 2 listed the 12 steps in making any loss assessment. This Precis sets out each step with a brief introduction, (drawn from more extensive description that follows) and then provides a basic checklist to follow in completing each step. User judgment will prevail in deciding whether every step will apply to, or be needed, in every loss assessment.

Step 1: Identify the loss event and purpose of the assessment

Define what the assessment is intended to be used for, what problem(s) its results might be used to address, and what level of accuracy it hopes to achieve. Detailed description of the event, its timing and location come later. At this stage there has to be a definition of the event, in sufficient detail to define the area and time boundaries.

So step 1 in the loss assessment should address these issues in whatever detail and form is considered both sufficient and appropriate:

STEP 1 CHECKLIST:

- ➢ Define the primary purpose of the loss assessment.
- ➢ Define what was (or could be) the event generating the loss.
- ➢ Include any other background information that might put the assessment into context.

Step 2: Organise the consultation and information-gathering processes

No loss assessment can be successful unless a clear process has been set up beforehand to define and manage it. There has to be a centre for operations and collecting/processing data; a set work plan with milestones for consultation, assessment, feedback and final reporting; and a timeframe within which all this has to happen. Budget limitations may need to be set and observed.

A loss assessment involves input from a lot of people and organisations, and from assembled bodies of knowledge. This generally needs a committee or board, made up of stakeholders, to advise on the project. The consultation process not only means talking to people, but also covers setting up and running surveys, collecting and manipulating database information, and generally getting access to information in any form that would add value to the overall loss assessment. So consultation and information gathering has three aims:

- Public relations—letting people know who's doing what, when, where and why.
- Sharing information—getting to know the scope of loss and defining losses into the categories mentioned in the introduction to this Process Guide.
- Consultation—not just for this loss assessment, but also where policy or the law requires it to be done.

When setting up the consultation processes and defining what is being sought by such consultation, develop a table similar to Table 3:

Table 3: Defining the consultation processes

Type of information	Source	Method and responsibility
Hazard type		
Direct loss information		
Tangible loss information		
Indirect loss information		
Intangible loss information		

So these are the steps to follow generally in organising the consultation and information-gathering processes:

STEP 2 CHECKLIST:

- ➣ Set up a process to manage and conduct the detail of the assessment, and define its goals.
- ➣ Draw up a detailed management process to track inputs and activities, their timing, progress, actual versus budgeted cost, progress reporting, review mechanisms and form of delivery of the assessment.
- ➣ Define the processes that will be used to consult and gather different types of information, bearing in mind the purpose of the assessment.
- ➣ Prepare a table to define what information is to be collected, where from, by what means and by which person or agency.

Step 3: Define the area and timeframe of the assessment

In any loss assessment there has to be a clear boundary within which the impact of the event on the economy of that area can be defined and evaluated. There may be some information needed beyond that area, and the originally defined study zone may enlarge or contract as adjusting information comes in. It is important to define the area being assessed, especially when estimating indirect losses and benefits in the form of insurance payouts and aid.

When defining the area of the assessment, make sure it represents the local economy affected by the actual or hypothetical disaster—not just a nominal space such as shire boundary, or a convenient topographic line such as a range or a watercourse. The nominated area can be sub-divided for detailed study of some specific loss components, and needs to be able to have flows of goods and services in and out defined clearly. Keep the study area in harmony with the budget for the assessment, and/or the extent of resources available to conduct it.

There also has to be a timeframe set to define how long after the disaster event the assessment will be considering losses associated with it. Clearly, any assessment needs start and finish dates, especially if the event being assessed is one of a sequence in (say) a cyclone season. Use an extended timeframe of at least 3–6 months to assess indirect and intangible losses—unless indirect and intangible losses are judged to be unimportant in the event in question. Ideally, the loss assessment should be conducted six months after the event. If the assessment has to be done much sooner after the event, there may have to be estimates made of the likely indirect losses.

So these are the steps to follow in defining both the study area and the timeframe for the assessment:

STEP 3 CHECKLIST:

- ➣ Define the study area in a way that includes the area impacted directly as well as its surrounding local economy.
- ➣ Define the core period date from the event’s first effects to the end of the assessment period, during which losses from that event will be considered.
- ➣ Set the timeframe for the assessment itself to begin and end, allowing time for losses to be counted from any extension of the core study dates.

Step 4: Decide the type of assessment to be made and level of detail

There are three commonly used approaches in assessing losses after a disaster event, or in a simulated event for evaluating the effectiveness of mitigation measures. They are:

- An averaging approach, based largely upon pre-existing data for losses from similar previous events.
- A synthetic approach, based upon predictions of losses technically derived-rather than historical-data and options.
- A survey or historical approach, where surveys after the event being assessed are used to establish actual losses.

Some combination of approaches would normally be used as, for example, surveys are the usual method for assessing losses to large businesses, most infrastructure and intangibles. In selecting appropriate assessment methods, take account of the advantages and disadvantages of each method (set out in step 4). Note any limitations that may have to be considered in meeting the various selection criteria. See Table 4.

Decision criteria	Averaging method	Synthetic method	Direct survey method
Event within last 5 years	✔	✔	✔✔
Need for consistency etc.	✔✔	✔✔	✔

STEP 4 CHECKLIST:

➢ Examine the selection criteria in Table 4 and establish which are relevant and how relevant they are.

➢ Select the appropriate approaches against the relevant criteria.

➢ List and weight the criteria that were considered in deciding on the form of assessment to be followed as illustrated in the table above.

➢ Nominate the assessment approaches selected and comment on any limits to the depth of detail or any constraints on using this approach.

➢ Remember that more than one approach would normally be used.

Step 5: Describe the extent/timing of the hazard event so affected assets can be defined

Detailed definition of the hazard event is a critical part of any loss assessment. A ‘hazard’ refers to the natural event, such as flood water, hailstorm or earthquake. It does not include human assets or activities. When combined with information on people, assets and activities, hazard information provides the basic data for loss assessment. Hazard event size and **occurrence probability** is essential for calculating average annual damages (AAD), which in turn are needed for cost-benefit analysis of alternative mitigation options.

The aim of this part of a loss assessment is not to go into precise definition of the extent and characteristics of the hazard event for its own sake, but to focus on key aspects of the hazard in sufficient detail for the purposes of the assessment.

The starting point is generally a map, in whatever format best describes:

- the extent of the affected or assessed area, and
- the route of a moving hazard such as a cyclone.

A map or maps would of course be supported by a wide range of source data from:

- the time sequence or duration of the event,
- automated or manual field measurements during and after the event (such as flood depths and flow rates),
- logs of significant events such as flood heights at key locations, effectiveness of levees etc.,
- photographs, television or private videotape records, and eyewitness accounts, and
- reports on any other secondary disaster impact events (such as resulting contamination events or building/infrastructure failures).

So to address this part of the loss assessment, these are the typical steps to follow:

STEP 5 CHECKLIST:

➢ Obtain a map or other descriptions of the hazard for the affected area.

➢ Obtain other information on the hazard, as relevant to loss assessment.

➢ In the absence of a map, obtain field data or local estimates of relevant hazard characteristics.

➢ Record, index and store all documented information about the hazard event, its progress or lifecycle, identifying the source of each item.

➢ For a loss assessment this information is needed only in the context of hazard impacts on people, assets and activities.

Step 6: Obtain information about the people, assets and activities at risk

Closely associated with step 5 above is the need to make a record of people, things and activities that were or could be affected by the hazards event. If the loss assessment is being carried out for a hypothetical event, the same kind of information needs to be assembled, but from projections and simulations of the event.

Disaster loss assessment is a measure of damage and disruption to assets and the effect this has on people and businesses in the affected and other areas. Environmental losses may also be important. Unfortunately, loss assessment sometimes also has to measure the extent of death and injury resulting from the disaster event.

There are many details to record in compiling the record from which the loss assessment is made, and the Guidelines describe available data sources (see Tables 6 and 7) to assemble this record. There is no exhaustive list to work through-it just needs a full list to be prepared in consultation with informed parties after an actual loss event, or in preparing a simulated event for study. The outcome should be a database of everything likely to be affected by the actual or simulated event.

The table in step 2 is a good place to start preparing a list of people, assets and activities at risk. Typical content would be:

STEP 6 CHECKLIST:

- Draw up a list of what has been (or could be) affected under three headings of 'people', 'assets' and 'activities', including environmental assets, within the area.
- Identify sources for all the actual or intended information.
- Identify how all the information is going to be collected, for example, surveys, census data, reports on the event etc.

Step 7: Identify the types of losses

In this step, the information derived in steps 5 and 6 is used to separate losses into categories, generally described as direct or indirect losses, and tangible/intangible. This helps define where the major loss components will be likely to arise and what measurement techniques will be needed. Measurement techniques will depend on the approach selected in step 4. The Guidelines identify many typical loss areas to be considered, especially in the intangible category. Intangibles are often ignored, yet are frequently identified as the most significant losses by the people affected.

The information can be sorted using a table with headings like this:

Usually bought and sold for money?	Direct loss (eg damage from contact with flood water)	Indirect loss (eg no contact with flood water, consequential damage)
Yes-tangible losses		
No-intangible losses*		

* Direct and indirect intangible losses are usually treated as one category.

The steps required in identifying types of loss would be:

STEP 7 CHECKLIST:

- Identify likely losses from the hazard event.
- Prepare a table categorising the losses as direct, indirect and intangible.
- Pay special attention to intangibles.

Step 8: Measure the losses from all sources

This is where the counting of losses starts. Elsewhere in these Guidelines there is detailed information on ways of addressing loss measurement in the 'survey', 'synthetic' and 'averaging' approaches to loss assessment, when looking at direct, indirect and intangible losses. There are tables in step 8 showing typical loss categories with suggested estimation principles for each one, along with the kinds of sources of data needed in each loss category for averaging or synthetic assessment methods.

Rather than grouping all losses by each category of loss (direct, indirect and intangible), it may be more practical to collate them by 'loss sectors', and determine indirect, direct and intangible losses for each sector at a time. For a typical flooding event, loss sectors like these could be used to separate the items into study areas:

- residential (including memorabilia and ill health),
- vehicles and boats,
- commercial (including tourism and hospitality),
- industrial,
- infrastructure,
- cultural heritage,
- environmental, and
- other.

So the steps to be followed in assessing loss by sector would be:

STEP 8 CHECKLIST:

- ➢ Identify and record what the main loss sectors are in the event being studied.
- ➢ Begin by assessing direct losses in the first sector, applying the method selected as most appropriate for use in this sector to derive losses.
- ➢ Continue with an assessment of indirect losses in the same sector, and include estimates from the Guidelines that represent the identified losses.
- ➢ Identify and document the intangible losses in that sector, and where possible quantify these using procedures set out in the Guidelines.
- ➢ Work through all the loss sectors, writing accompanying text to record specific actions and interpretations made from the 'survey', 'synthetic' or 'averaging' approach used to derive the dollar values and the equivalent for intangibles.
- ➢ The result should be a well documented and explained set of assessed losses for further review.

Step 9: Decide whether to count 'actual' or 'potential' losses in the assessment

When data is collected by 'synthetic' or 'averaging' approaches, this is generally part of work to estimate the losses that could occur in a hypothetical hazard event. This is a common approach, because it is rare to experience a real version of something that can normally only be done 'on paper'— like considering the likely outcome of a major storm surge. So you will get 'potential' losses as the outcome of such a study.

In contrast, loss assessments carried out after a real disaster, normally record all of the losses as 'actual' ones. 'Actual' losses already take into account all kinds of measures that people take to minimise the damage wherever possible, such as heeding warnings, moving cattle and valuable items to high ground etc.

This part of the loss assessment considers whether, and by how much, predicted or 'potential' losses should be trimmed back because of known preventive or protective actions that might be taken in a real event. However, the use of 'actual' losses raises a number of issues:

- It is difficult to determine the correct ratio between actual and potential loss (see Table 17 for estimates).
- Actual losses may discriminate against well prepared communities if the loss assessment is used to decide the worth of mitigation options.
- Actual losses may discriminate against poorer communities as they will typically have fewer assets and less economic activity to be damaged by a hazard.

- The difference between actual and potential losses will change a lot over time as people move and as other circumstances change.

So there are some hard issues to consider in making a loss assessment for a simulated disaster event where different community responses and lifestyles may prevail:

STEP 9 CHECKLIST:

➢ It is recommended that, wherever possible, potential losses should be used rather than actual losses.

Step 10: Calculate annual average damages if needed

Investment in disaster mitigation can be economically justified in terms of losses avoided in an average year, using an estimate of AAD. AAD is calculated by plotting loss estimates for a given hazard at a range of magnitudes, against the probability of occurrence of the hazard event.

So the steps to be followed in calculating annual average damages would be:

STEP 10 CHECKLIST:

➢ Make a table that lists a range of possible events for a given hazard, the annual occurrence probability of each event and a loss estimate for each event.

➢ Using a minimum of three distinctly different events, plot the loss estimates against their event occurrence probability.

➢ The shaded area under the curve is equal to AAD (see Figure 7) and can be obtained mathematically by integration.

Step 11: Assess benefits to the region of analysis

Economic assessment measures the net loss to the economy of the area of analysis. To obtain net loss, any benefits to the economy resulting from the disaster need to be subtracted from the assessed losses. 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. This step is only relevant for economic loss assessment.

So the steps to be followed in assessing benefits to the region of analysis would be:

STEP 11 CHECKLIST:

➢ For a post-disaster assessment, identify the major flow of funds into the region: Commonwealth funds (for example Natural Disaster Relief Arrangements), State or Territory disaster relief payments, and insurance estimates from the Insurance Council of Australia).

➢ For a hypothetical assessment, estimate the likely amount of NDRA funds using the results of a completed assessment. Include insurance estimates from the Insurance Council of Australia, if available, or make estimates through experience with similar events

Step 12: Collate and present the results of the loss assessment

Present the results of the loss assessment in a simple format, such as in Table 18. The table should include all of the assessed losses for each of the loss categories (direct, indirect and intangible) and a total of the benefits to the region of analysis. The benefits are deducted from the losses to give an estimation of the economic cost of the event (or net economic loss). A statement on the importance of intangibles should also be included to ensure they are not overlooked in mitigation proposals.

So the steps to be followed in collating and presenting results of the loss assessment would be:

STEP 12 CHECKLIST:

- ➢ Prepare a table that shows the net of the losses and benefits to the region of analysis and calculate net economic loss.
- ➢ Include a statement on the importance of the intangible losses.

For more information, please contact:

ASSOCIATED PROGRAMME
ON FLOOD MANAGEMENT

Associated Programme on Flood Management
c/o Climate and Water Department
World Meteorological Organization

tel	+41 (0) 22 730 83 58
fax	+41 (0) 22 730 80 43 apfm@wmo.int
email	www.floodmanagement.info

World
Meteorological
Organization
Weather • Climate • Water

World Meteorological Organization
Communications and Public Affairs Office
7 bis, Avenue de la Paix – P.O. Box 2300
CH-1211 Geneva 2 – Switzerland

tel	+41 (0) 22 730 83 14/15
fax	41 (0) 22 730 80 27
email	cpa@wmo.int
	www.wmo.int

Global Water
Partnership

GWP Global Secretariat
Linnégatan 87D - PO Box 24177
SE-104 51 Stockholm – Sweden

tél	+46 8 1213 86 00
fax	+46 8 1213 86 04
email	gwp@gwp.org
	www.gwp.org