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

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To the reader

This publication is part of the “*Flood Management Tools Series*” being compiled by the Associated Programme on Flood Management. The “*Risk Sharing in Flood Management*” Tool 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 sharing costs and risks in flood management 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: “*Risk Sharing in Flood Management*”.

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EXECUTIVE SUMMARY

- 1 Integrated Flood Management (IFM) aims to minimize loss of life from flooding while maximizing the net benefits derived from floodplains. With IFM, the management of flood risks is based on a judicious combination of measures that address risk reduction, retention and transfer through a strategic mix of structural and non-structural measures for preparedness, response and recovery. Decisions have to be made on how to share the cost of taking risk placed on society among governments (central, regional and local governments), interested parties (such as private companies), communities and individuals. This tool is primarily aimed at flood managers and in particular those that are involved in formulating flood management strategies and policies. It attempts to provide rapid access to information on risk sharing mechanisms as part of the overall flood management strategy.
- 2 Flood risks are essentially the costs of taking risk: the sum total of the cost of risk reduction, costs of managing the residual risks and the flood losses that finally materialize. There are three strategies for risk management: risk reduction, risk retention and, as a last resort, risk transfer. Risk reduction includes activities that contribute towards diminishing the probability of potential losses. Flood risk due to events greater in magnitude than the design floods of mitigation measures also comprises the efforts required to reduce the residual risks. At the same time, risk transfer works if a project shares its risk with another party, such as an insurance provider, by getting insurance policies that cover various kinds of risk that can be insured. However, risk retention has even broader implications because every time a policy calls for a deductible, it retains some of the risk. An efficient solution requires a combination of all three strategies for risk management.
- 3 Risk reduction is the first step in the risk management process. With the IFM approach, flood risks can be reduced through structural or non-structural measures – either through decrease of flood magnitudes or through reduction of exposure of economic activities. For example, non-structural flood management measures such as flood proofing, flood forecasting and warning, and disaster prevention, preparedness and response mechanisms, and land use regulations have narrow environmental effects and should be favorably examined as viable options. At the same time, risk reduction can be achieved by reducing the vulnerability of those exposed to floods. A judicious combination of these tactics is generally the answer. An equitable mechanism for sharing the costs of risk reduction is based on providing basic protection against a minimum level of flooding, addressing vulnerability and accelerating wealth generation. The federal government, as the chief development agent in a welfare state, should generally be able to bear this cost. The costs of protection against higher floods can be distributed between the state and municipal authorities since they benefit direct revenue from economic activities. For any protection above basic minimum, the cost of risk reduction should be shared through various financial instruments.
- 4 Since protection against all floods is neither financially viable nor environmentally sustainable, residual risks are always present. Emergency preparedness plans, early warnings and disaster response actions are undertaken to keep materialized risk to a minimum. Individuals also bear responsibility to reduce their own vulnerability and implement proofing measures such as

retro-fitting. Physical diversion of flood risks by diverting floodwaters to less vulnerable areas is also an important option for flood risk management.

5 Even with all these measures in place, flooding results in losses due to direct damage to properties and indirect damage such as interruption of economic activities. Some materialized losses are absorbed by the element as retained risks. Depending on the capacity and vulnerability of the elements at risk, such retained risk may impact the recovery from flood and may turn it into a disaster. In order to share the cost of recovery, some of the materialized risk is transferred through insurance as the last step in a systematic risk management process. Insurance thus protects capital, enhances solvency, allows recovery, and if designed carefully, has the potential to encourage risk reduction behavior. Small scale floods are predictable, making risk reduction methods most suitable for dealing with them. On the other hand, low-probability high-consequence events easily have higher impacts, and recovery from those events may hamper a national economy or destroy the insurance market. Insurance instruments are most suitable for middle levels of risk, due to medium-probability medium-consequence events. Reinsurers play crucial role in low-frequency high-impact events.

6 Recently, non-traditional financial mechanisms have been developed for the facilitation and support of recovery from flood events. Index-based insurance, catastrophe bonds and micro-insurance are examples of such financing instruments. Some of those mechanisms have almost exclusively been employed in developed countries. It is important that a developing country perspective be brought into the financial risk sharing debate. A discussion of these financial mechanisms can contribute to relieving pressure on public finances with respect to development activities and governmental services, particularly in developing countries.

introduction

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1 INTRODUCTION

- 7 Floodplains provide excellent livelihood opportunities for habitation, agriculture and commerce. Where these floodplains have been protected from frequent flooding, they have developed into throbbing economic centres. The Integrated Flood Management (IFM) approach aims to maximize the net benefits from floodplains and at the same time reduce loss of life, flood vulnerability, and risks. The concept recognizes the importance of flood plains and the increasing development demands they face, while simultaneously recognizing the disruptive nature of floods. IFM aims at a fundamental re-orientation of social perception of floods from *“need to control”* to *“need to manage”*. It integrates structural and non-structural measures, land and water management, ecosystem preservation and development needs, and short- and long-term mitigation measures.
- 8 Agriculture continues to be an important source of livelihood in most developing countries. Due to exposure to frequent flooding, the poor and marginal farmers that occupy flood plains tend to adopt low-risk strategies, such as, for instance, devoting most of their land to crop varieties that promise more reliable yet lower yields. The uncertainty posed by flooding prevents these poor farmers from making higher risk, higher return investments, resulting in economically inefficient use of natural resources, further increasing their vulnerability. In the event of a low-frequency high-impact flood event, they often lose their productive assets and are pushed into a downward spiral of poverty.
- 9 Living harmoniously with floods is an important strategic option in IFM, which provides a suitable framework for flood risk management. Integrated flood management is based on the proactive strategy of risk management through a three-pronged attack on reduction of risks by reducing magnitudes, vulnerability and the exposure of the economic activities. It also involves addressing issues at all three phases of the risk management cycle: preparedness, response, and recovery and reconditioning. IFM seeks to set up a transparent mechanism for sharing the cost society must pay for taking risks due to flooding. Under such a mechanism, the interplay between floods, the development process and poverty must be understood. A population may be poor because it is regularly exposed to flooding, or it might be exposed to flooding because it is poor and occupies the most vulnerable land (WMO, 2009).



- 10 Accordingly, IFM is based on the following principles:
- Adopting a basin approach to flood management;
 - Bringing a multi-disciplinary approach to flood management;
 - Addressing climate variability and change; and
 - Enabling community participation in decision-making.
- 11 Traditionally, in the larger public interest, governments use public funds to provide the finances required to manage risks. Flood defenses are built according to a pre-defined “design flood” in order to reduce risk. Society must deal with the residual risks of flooding that exceeds the design flood. For decades, the financing of relief and recovery efforts after flood disasters in developing countries has relied on the diversion of funds from domestic budgets and financing from international donors. Such reactive approaches are often poorly targeted, inefficient and insufficient. Moreover, they provide no incentives for proactive risk reduction measures such as improved urban planning and higher construction standards.
- 12 With growing populations that put extra pressure on limited natural resources, particularly in the flood plains, the increasing frequency and intensity of flooding due to climate change, and the adverse impacts of flooding and greater flood losses on the development process, flood management practitioners and policy makers, particularly those in developing countries, have to judiciously allocate their limited resources. They must pay special attention to ensuring the distribution of the costs of flood risk management measures across society.
- 13 It is of prime importance to devise an approach to risk sharing that is economically efficient, corresponds to the shared principles of equitable treatment and fairness towards various groups in society, and encourages and strengthens solidarity. It is therefore necessary to take a comprehensive and transparent approach to distributing risks posed by flooding across the stakeholder spectrum, which includes various layers of the government, the private sector including the insurance industry, individual users and residents of areas prone to flooding. Risk must be apportioned according to the capacity and capability of the stakeholders but must also be able to meet societal goals for well-being and sustainable development.
- 14 Sharing of the financial cost¹ of taking risk can be addressed through a number of measures such as appropriate allocation of the cost of risk reduction measures, sharing the financial cost of disaster relief, and risk transfer mechanisms. This tool for “Risk Sharing in Flood Management” discusses various mechanisms for sharing risks. Some of the approaches, such as traditional claims-based insurance solutions, have been deployed for a long time with varying degrees of success. Others have only recently been developed or adapted into flood management. These approaches draw on lessons learned from managing risks due to other natural hazards and are at varying stages of product development. As a result, doubts about their acceptability in the market remain. Furthermore, some mechanisms have almost exclusively been employed in developed countries.

¹ Generally, the term “*financial*” can be used in connection with individuals while the term “*economy*” is connected to the wealth system as a whole. This document uses “*financial*” mostly when individual or multiplied individual risk or mechanism is emphasized.

- 15 The following Tool is primarily written for flood managers and in particular those that are involved in formulating flood management strategies and policies. It is presumed that these flood managers primarily have engineering backgrounds and are not fully conversant with financial jargon. This tool is an attempt to provide rapid access to information on risk sharing mechanisms as part of an overall flood management strategy.
- 16 The Tool defines risk sharing as the allocation of costs of taking risks, encompassing bearing the financial and other costs of flood risk management, and explains the shared responsibility of each stakeholder within the relevant physical, technical, economic and political contexts. It highlights the mechanisms for spreading the financial burden for flood management based on the principles of efficiency and fairness, that is, incorporating equity in flood risk management with economic effectiveness. It provides an overview of flood insurance and other forms of transferring flood risks and deals with the inter-relationship between flood insurance, building resilience and reducing risks in affected communities, and takes a brief look at alternative methods of sharing financial risks from floods, such as government-issued calamity and reconstructions bonds, and internal and external solidarity funds.



2 INTEGRATED FLOOD MANAGEMENT AND FLOOD RISKS

¹⁷ Risk is both a scientific and a social concept. Furthermore, it is not only a physical phenomenon but also a culture alone, conceptualized as the dangers that societies define as troublesome (Rees, 2002). Therefore, besides incorporating a solid physical science and technology base, risk must be studied and understood in a societal context. The physical flood event does not create a risk of loss or a disaster by itself. It is human activity that generates the risk of disaster. At the same time, it is not only the hydrological uncertainty that generates risk but also the political, economic and social uncertainty that add to the risk. Risk has the potential to be accentuated with engineering modification of the physical environment. A dyke, for example, could reduce exposure to a certain hazard magnitude event, but at the same time increase vulnerability of the properties behind it by providing a false sense of security. Under these circumstances, it is important to appropriately understand flood risks in order to understand their effective management.

2.1 Understanding flood risks

¹⁸ The dictionary defines risk in many ways, but some elements such as chance and loss are common to all definitions. Mathematically, it is expressed as the product of:

“The chance (or probability) of an event occurring and the impact (or consequence) associated with that event”

(UK Defra/Environment Agency, 2003).



Box 1 — Definition of risk

Risk consists of the combination of the probability of an event and its negative consequences.

Under natural conditions, flood risk is mathematically defined as follows:

$$\text{Risk (probable loss)} = \text{probability} * \text{consequence}$$
$$p [H] = v [D] * s [H,D]$$

where

- p [H] = probability of occurrence of the hazard;
- v [D] = value of the elements at risk, which is a function of the development in the exposed areas, the land use and the probability of presence (exposure); and
- s [H,D] = the susceptibility of the elements at risk, which is a function of the magnitude of the hazard as well as the socio-economic construct of the exposed elements (vulnerability).

19 Accordingly, flood risks are defined as the expected losses from given flood events, in a given area, over a specified period.

20 Flood risk can also be assessed through a Source-Pathway-Receptor-Consequence (SPRC) model, which accounts for (Floodsite, 2005):

- The nature and probability of the hazard (the source);
- The degree of exposure of the receptor to the hazard (the pathway);
- The susceptibility of the receptor to the hazard; and
- The value of receptor, or the element at risk (the consequence).

21 The susceptibility of the receptor depends on its sensitivity –the damage caused by an event of a given magnitude, and adaptive capacity – the ability of a system to moderate potential damages, take advantage of opportunities, or cope with the consequences. The value and susceptibility of the receptor are combined to represent vulnerability.

22 Often, exposure is also included as a factor that determines vulnerability. In this publication, however, a clear distinction between exposure and the vulnerability is maintained while defining flood risks. It helps to analyze flood risks, allowing for a clear distinction between strategies that can be adopted to modify pathways through engineering means and those that require consideration of social issues that address vulnerability (WMO, 2006a). To follow an integrated approach to flood management, it is beneficial to define and understand the construct of flood risks, which consists of the following, also represented in **Figure 1**:

- The magnitude of the flood hazard expressed in terms of frequency and severity (depths of inundation and related velocities and duration);
- The exposure of the elements to flooding; and
- The vulnerability of the elements at risk.

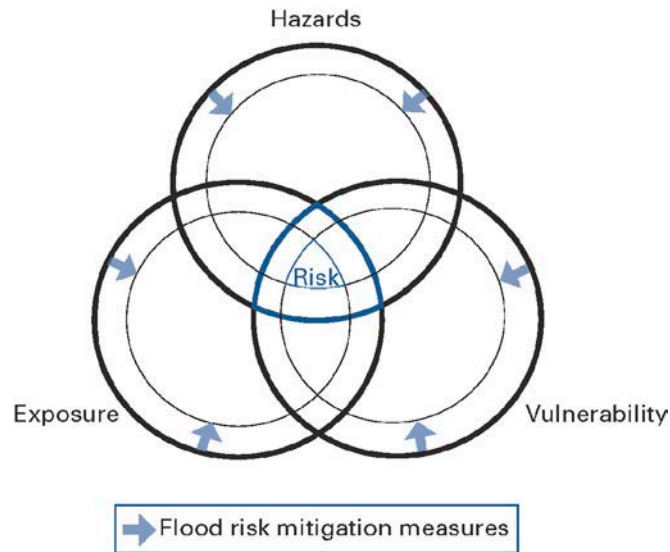


Figure 1 — Concept of flood risk and its reduction

23 Engineering of flood protection measures is based on the acceptable threshold for which structures are designed to provide protection and reduce risks. Linked to this is the uncertainty of the reliability of hydraulic structures designed for such events; safety of the exposed population and assets remains dependent on a protection that can fail. Even if flood probability and risk are reduced to extremely low levels through high levels of protection, residual flood risks always remain. Efforts are always made to reduce these residual risks. Flood loss occurs when these residual risks materialize.

- 24 Integrated flood management manages these risks through the application of risk management principles such as:
- Adopting a best mix of strategies;
 - Reducing vulnerability, exposure and risks;
 - Managing the water cycle as a whole by considering all floods, including both extremes;
 - Ensuring a participatory approach;
 - Integrating land and water management, as both have impacts on flood magnitudes and flood risks;
 - Adopting integrated hazard management approaches (including risks due to all related hazards such as landslides, mudflows, avalanches, storm surges), and creating synergies.

25 Risk management calls for identification, analysis, assessment, control, avoidance, minimization, or elimination of unacceptable risks through policies, procedures, and practices. There are three strategies for risk management: risk reduction, risk retention and, as a last resort, risk transfer. Some ways of managing risk fall into multiple categories. **Figure 2** illustrates this concept.

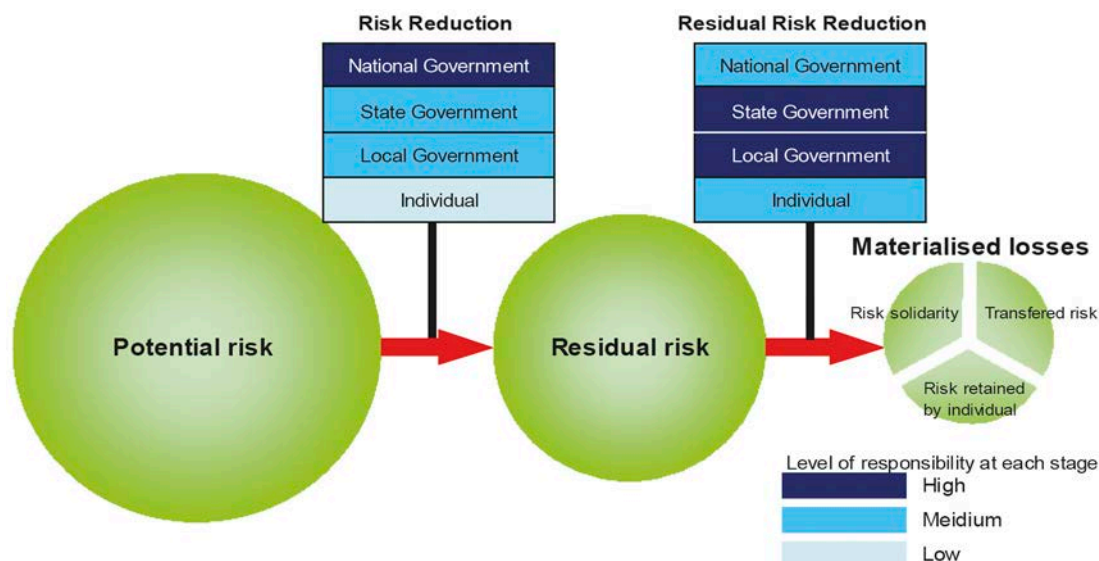


Figure 2 — Managing Flood Risks

26 Risk reduction, also known as loss prevention, includes activities that contribute towards diminishing the probability of potential losses. However, it is recognised that no degree of protection is insurmountable. There is always the possibility of residual risks – a flood event greater in magnitude than the design flood used to create the protection.

27 It should, however, be recognized that there are indirect costs of taking risks, such as losses or damage to the environment (degradation and loss of environmental services, among others) as well as psychological and cultural costs, which cannot be quantified. The cost of risk taking is illustrated in **Figure 3**.



Figure 3 — Cost of taking flood risks

2.2 Managing flood risks

28 Flood plains provide tremendous benefit to the socio-economic development of a society. For this reason, they have long been the preferred place for human settlements. At the same time, flood plains are also subjected to the risks posed by intermittent flooding, which is the price of deriving the benefits. Society has continued to make use of flood prone areas where the perceived benefits from living in an endangered area exceed the disadvantages associated with the risk. Such benefits have to outnumber the costs created by the flood risks. In order to maximize the net benefits from the flood plains, flood risks to economic and social activities have to be reduced to a minimum, and residual risks must be managed.

29 For cost-benefit analysis of any flood management measure, estimation of potential losses has to be made for the lifetime of a particular measure. To calculate this, flood loss data must be converted into “potential average annual losses” (WMO, 2007).

30 Risk management, therefore, includes the efforts made to reduce residual risks. Such efforts involve the use of flood sensitive land and spatial planning, early warning, flood proofing as well as evacuation and preparation for disaster relief (WMO, 2008; 2012). Finally, with all these efforts in place, flooding results in losses arising out of damage to properties and the interruption of economic activities. Such losses have the potential to increase the vulnerability of the population that is directly or indirectly affected by them. The materialised losses that are absorbed by the element at risk are also called retained risks. In order to help recovery of the affected areas and populations, some of the materialised risk is transferred, which entails passing a part of the materialised risk to the public at large through the national exchequer, or spreading it internationally through aid agencies. Another financial mechanism for risk transfer is to transfer the risk to another economic agent for an exchange price, called a premium.

31 Typically, an efficient solution requires a combination of all the three strategies. Each of the strategies deployed has a cost and corresponding benefits. It is possible to determine an optimal combination of strategies based on a cost–benefit analysis (WMO, 2007).

32 In practical terms, in situations where flood management measures have been taken, flood risks should be treated as the costs of taking risk. These costs include the costs of risk reduction and of managing the residual risks as well as the flood losses that finally materialize.

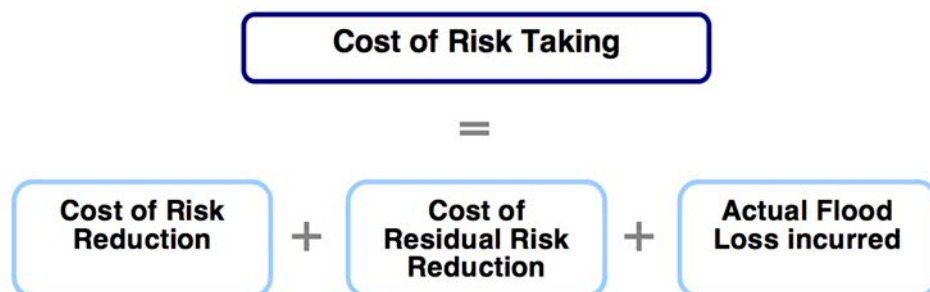


Figure 4 — Cost components of risk taking considered as the flood risk of measures



3 SHARING THE COSTS OF RISK TAKING

³³ Decisions to manage risks depend on how the risks are shared among various administrative entities and whether transferring of risks in time or in space is a viable option. Broadly, there are five competing sets of risk decision principles that should be considered with respect to risk sharing in the water-related hazards sector: precautionary vs reactive, uniform vs subsidiary, individual choice (market) vs paternalism, professionally determined vs political bargaining, and risk generator vs risk bearer vs taxpayer (Rees, 2002).

³⁴ The paradigm shift from engineering-centred flood control practices to integrated flood management practices in many countries across the globe is resulting in corresponding shifts in governance arrangements for flood management. The most notable of these are decentralization of responsibility, increased participation of stakeholders in decision-making and the increasing influence of the private sector. Climate change as a driving force behind increasing flood risks and the call for application of the “polluter pays principle”² add another angle to the debate. This change has led to questions concerning the appropriate division of responsibility between the state and its citizens and the ‘fitness for purpose’ of the current appraisal, prioritization and decision-making processes. Integrated flood management through stakeholders’ involvement in the decision-making process calls for new cooperative arrangements between the state (and among various tiers of government therein), private companies, civil society and individuals.

³⁵ All those within a basin, region or a country have a either a direct stake in the flood risk management system because of their exposure to flood risk, or an indirect stake. Those within the basin contribute to flood risks in flood prone areas through various economic activities. However, the infrastructure (roads and railways) and economic activities on flood plains facilitate economic development even beyond the basin. By virtue of their status as taxpayers, people outside flood prone areas have a stake in how expenditure decisions on flood loss mitigation

² According to the recommendation of Organization of Economic Cooperation and Development (OECD) in 1972, the “Polluter-Pays Principle” is a principle to be used for allocating costs of pollution prevention and control measures to encourage rational use of scarce environmental resources and to avoid distortions in international trade and investment. This principle means that the polluter should bear the expense of carrying out the above mentioned measures decided by public authorities to ensure that the environment is in an acceptable state (OECD 1972).



and relief expenditure are taken. In an urban context, populations located in upstream areas as well as those in downstream low-lying areas derive benefits from the timely evacuation of rain waters through the construction of storm drainage systems. Basin solidarity can be one of the ways to account for and compensate downstream residents for upstream watershed changes that alter flood characteristics.

36 Principles of cost allocation need to be set up. Based on the above considerations, the costs of taking flood risks have to be distributed not only among those occupying the flood plains and drawing direct benefits, but also among those who derive indirect benefits. For the purposes of equity and fairness, these costs should also be allocated in a transparent manner. Risk sharing is one of the aspects of risk management that deals with the way the cost of risk is distributed among several stakeholders: the federal, state and local governments and the flood effected individuals (Galloway, 1994).

37 Risk sharing includes sharing:

- The costs for risk reduction;
- The costs of residual risk reduction;
- The materialized risk, i.e. the losses or consequences.

3.1 Sharing costs of flood risk reduction

38 The first step in risk management is risk reduction. Within the integrated flood management approach, potential flood risk can be reduced either through decreasing flood magnitudes (that is, by creation of retention basins), decreasing exposure of economic activities, decreasing vulnerability, or a judicious combination of the three. It entails a variety of measures that require financial resources, the availability of which consequently determines which of the possible options can be executed.

Building a culture of prevention is not easy. While the costs of prevention have to be paid in the present, its benefits lie in a distant future. Moreover, the benefits are not tangible; they are the disasters that did NOT happen.

Kofi Annan, 1999

39 Since flood risks are a construct of flood hazards, exposure of economic activities and vulnerability of the society affected by floods, it is crucial that options to reduce each of these components are fully explored when attempting to reduce overall flood risks.

40 Exposure is the measure of the population and assets that would be directly exposed to a flood in absence of flood protection. The level of exposure does not necessarily translate into impact. The link between exposure and the residual risk of impact depends on flood protection measures. Exposed populations and assets should thus be distinguished from populations and assets at risk even in the presence of protection. Exposure, however, is a useful metric because it provides the basic information required to assess the need for flood protections.

41 Another approach is to increase society's resilience in the face of adverse impacts. Reducing vulnerability plays a key role in dealing with residual risks and in strategies for living with

floods. Vulnerability to flood hazards can be reduced by a certain extent through measures that promote resilience, adaptation and flood risk reduction. A detailed discussion on vulnerability characteristics and the measures that may be useful in dealing with them may be found in the Associated Programme on Flood Management (APFM) publication *Social Aspects and Stakeholders Involvement in Integrated Flood Management* (WMO, 2006a). Reducing vulnerability also requires disaster analysis in order to learn lessons and integrate corrective measures into prevention and preparedness plans.

42 This still leaves residual risks caused by extreme flood events. Those events either exceed the design flood level or the level societies would have experienced under natural climate variability. Some efforts have been made to prevent further adverse impacts, recondition important infrastructure and document these events. The reduction of vulnerability through preparedness (such as the use of early warning systems) is essential to achieve development goals.

43 Below is a non-exhaustive list of options for reducing each of the three factors contributing to flood risks. Actual actions taken will depend on the conditions of risk and the social, economic and physical setting in question.

44 Many view the government as responsible for protecting the public, and thus for bearing the cost of flood risks as well. Traditionally, governments take primary responsibility for protecting the public from floods in all its aspects. Due to competition from other societal needs, and because the resources come from public funds, governments are often concerned about the fiscal implications of taking full responsibility for the entire cost of flood risks. They thus seek measures to share the costs of risk between the various tiers of government (federal, state and local), as well as households and businesses.

Table 1 — Options for reducing flood risks³

Reduce Hazard	Reduce Exposure	Reduce Vulnerability
<ul style="list-style-type: none"> • Retaining water where it falls (increasing infiltration, rooftop storing) • Retention basins (natural wet lands or depressions, man-made basins such as school playgrounds, household underground tanks) • Dams and reservoirs • Diversion channel • Land use management (house building codes in urban areas, infrastructure construction practices, appropriate spatial planning) 	<ul style="list-style-type: none"> • Structural measures on the river (dykes, river training work such as flood walls, raised infrastructures such as roads and railways) • Structural and non-structural measures / actions by individuals (flood proofing) • Land use regulations • Flood emergency measures (flood warning and evacuation) 	<ul style="list-style-type: none"> • Physical: by improving infrastructure, well-being, occupational opportunities and living environment • Constitutional: by facilitating equal participation opportunities, education and awareness, providing adequate skills and social support systems • Motivational: by building awareness and facilitating self-organisation

45 To what extent risk can be shared by the poor who generally (and particularly in developing countries) occupy risk prone areas is arguable. A transfer of burden to an already vulnerable population cannot be justified through an argument for efficiency and loss reduction. Such a transfer invokes fundamental questions about equity and social solidarity in the provision of relief to victims of catastrophic floods. This includes questions about how much those in non-risk areas and the general tax-paying public contribute to preventing losses and compensating

³ The APFM Tool Series addresses many of those options and aspects of reduction of flood risk in detail; accessible through http://www.floodmanagement.info/ifm_tools.htm



victims in vulnerable communities, and to what extent the burden should be borne by those who are located in high-risk areas. These issues are deeply rooted in societal values and the socio-economic and political environment in a given flood situation.

⁴⁶ A mechanism for sharing the costs of risk reduction could be developed where the federal government provides a basic level of protection against a minimum level of flooding while the costs of protection against higher floods would be distributed between state and local authorities. Projects funded by the federal government places responsibility on all taxpayers; this is appropriate where there are countrywide benefits in terms of national security, protection of infrastructure and generation of livelihoods. According to Ingram, crises create consent, and should be used creatively and effectively to alter the contemporary allocation of responsibilities among federal, state and local entities (Ingram, 1988).

⁴⁷ State and local authorities benefit from activities that provide them with direct revenue and should therefore, in principle, bear the costs of risk reduction for any protection above the basic minimum. They can also use various financial instruments, such as market bonds, which can increase the state's ability to fund large projects in the short-term. Bonds are an appropriate tool to be used when the asset produced will provide long-term benefits. Bonds could be backed by the authority's General Fund and/or another funding source such as user fees.

⁴⁸ In the United States of America, the *Galloway Report* (produced by the U.S. Interagency Flood Plain Management Review Committee, established after the Midwest Floods of 1993) recommended introducing cost sharing provisions for State and local participation in recovery, response and mitigation activities (Galloway, 1994). The report stated that all those who support the risk, either directly or indirectly, must share in the management and costs of reducing that risk. To use an example, the federal/state cost-share, originally set at 75/25, was adjusted to 90/10 for major disasters (Hurricane Andrew, the Midwest flooding, and the Northridge earthquake). These changes in cost-share percentages have two significant potential consequences: they raise the expectation of similar treatment for future disasters, and they lose sight of the fundamental purpose behind cost sharing, which is to increase local involvement, responsibility, and accountability. Flood losses actually incurred by individuals and communities can be shared by putting in place a flood insurance program that obtains its support from those who are protected. Disaster support for those in the floodplain is contingent upon participation in these self-help mitigation programs. However, this system is applicable only in those socio-economic environments where the entire population has the means to participate in the self-help mitigation program. To do otherwise, would be to run the risk of widening the gap between the rich and poor strata of the population: whereas the poorer sections may not have the means to contribute and therefore would not benefit from disaster relief activities, the richer sections would receive recovery assistance from the program they contributed to.

⁴⁹ In Japan, the **River Law** (enacted in 1896, totally revised in 1964, last amended in 1997) has played an important role in forming policy for flood management. The River Law assigns the costs related to river administration to the central government for class A rivers, and to prefectural government for class B rivers. However, upon government ordinance, a prefecture government may in principle undertake half of the administration cost for a major part of the class A river within the named prefecture. At the same time, the central government can also

provide subsidies of up to half of the cost for designated major works on class B rivers⁴. In times of flooding, the responsibility for flood response and action taken to mitigate the impact of floods lies mainly with the local government⁵. It is the responsibility of the State to take emergency measures in the event of a large-scale disaster. In the case of extreme floods, the federal government provides special financial support to local governments (Cabinet Office, Government of Japan, 2011). The overall management of all natural disasters is based on another law that clarifies the responsibility of the State, local governments and the public.

50 In Switzerland, the role of the federal government is largely limited to the provision of financial, scientific and technical support, with cantons and communes taking on the principal duties of emergency management (WMO, 2006b). The federal government is responsible only for tasks that are explicitly in the Constitution. The Federal Law assigns responsibility for flood control to the cantons, which in turn can assign this task to municipalities or even to riparian landowners. This means that the role of the Federal Government is limited to providing financial support and, as required, technical and scientific support. It has to be noted that financial support can be provided only if projects fulfill the objectives as defined in the Law (chapter 1 of the Swiss law). Subsidies from the federal government cover, on average, 30% of the total costs. Their size depends on the financial power of the canton and/or of the municipality concerned. The maximum amount is 45%, which may exceptionally be raised to 65% for restitution after flood disasters. The remaining costs are distributed between the canton (frequently 30%) and its municipalities. Whereas the cantons are the executing agencies, technical knowledge will always be supplied by the canton even if the municipalities are responsible. The initiative for protection projects must come from municipalities.

51 Sometimes part of the costs can be transferred to individuals through direct taxes. For example, the Netherlands water boards fully fund all operations, including flood protection, from a levy and tax based on the size of the stakeholders' property. Another example is the house bank approach of Dutch Water Bank, which borrows long term capital from international markets at fine rates, and acts as the "house bank" to the water boards (GWP, 2008). Individual initiative for reducing flood risks may also be encouraged through economic incentives. The State can thus increasingly – but not exclusively – rely on user fees and/or assessments, an application of the "beneficiary pays" principle. Additional fees or assessments may be used for operations and maintenance, for direct capital outlay, or to pay off bonds. In such cases, it is important to transparently assess the proportionate benefits to each stakeholder faction. However, the incentive issue is somewhat irrelevant in poor areas, particularly in developing countries and informal settlements composed of environmental or economic migrants.

3.2 Sharing the cost of residual risk reduction

52 Residual risks will always be present because it is impossible to provide protection against floods of all magnitudes. They tend to increase with time, since economic activities and construction of structural measures in protected areas increase with time. This is one of the

⁴ River Law in Japan (in Japanese), Articles 59-62: Japan Government, Ministry of Internal Affairs and Communications. law.e-gov.go.jp/htmldata/S39/S39H0167.html

⁵ Flood Fighting Law in Japan (in Japanese), Articles 41-44. Japan Government, Ministry of Internal Affairs and Communications. law.e-gov.go.jp/htmldata/S24/S24H0193.html



reasons why flood damages continue to rise despite substantial investments in flood control measures. Climate change will also result in increased residual risks due to greater uncertainty about magnitude and frequency of flood events.

53 Emergency preparedness plans, early warnings and disaster response actions must be undertaken in order to mitigate the adverse impacts of residual risks arising from overtopping of hydraulic flood protection structures and keep materialised risk to a minimum. Information is required not only to assess residual risk, but also to evaluate the flood risk in each area and the reliability of structural flood protection measures. Land-use planning and zoning regulations such as building codes can help local authorities limit development in vulnerable areas. Safety and preservation of life is the top priority in emergency preparedness. Similarly, it is necessary to take into consideration the consequences of materialized risks in terms of time and location, such as the risks from overtopping/breach of flood protection measures. In this case, population and properties at risk need to be assessed in advance and incorporated into disaster preparedness plans. Early warning of impending failure/overtopping would require close monitoring of the conditions that are likely to generate such a situation. Many of these parameters, particularly hydro-climatic, are monitored at the basin level and beyond. Federal authorities have the responsibility to provide these at the national level.

54 Rescuing victims and providing assistance in case of need can be best addressed by community-based authorities, since they are the first to respond in emergency situations. Local authorities have to share in this responsibility by investing in preparedness, executing regular evacuation drills and organising rescue and relief operations. They, along with State authorities, are responsible for promulgating and implementing land use plans in protected areas, including building codes and flood proofing measures.

55 Individuals bear responsibility to reduce their own vulnerability through implementation of flood proofing measures such as retro-fitting (WMO, 2012). Communities have the potential to handle response planning and emergency management, and should therefore be effectively mobilised and have appropriate institutional support.

3.3 Physical transfer of residual flood risks

56 When feasible, physically transferring flood risks can be an important option in flood risk management. This is based on the premise that protection objectives for protected areas are set differently depending on the nature of land use. Where human lives or a high level of material damage is at stake, protection levels will be higher than they may be in areas used for farming or forestry. Thus some areas may be flooded often, others seldom and a few others, as far as possible, never. Protection objectives must therefore be defined in relation to land use.

57 Traditionally, levels of protection were set without regard to the vulnerability of the land to be protected. The risk-based approach (USACE, 1996), however, seeks to define optimal flood protection through an economic evaluation of damages, including consideration of various uncertainties. In this approach, a number of alternative solutions are evaluated in order to determine their expected economic net benefit (benefit minus the cost). In certain cases, the risk-based approach is undertaken by fixing and factoring in different design thresholds for embankments providing protection to urban areas and those providing protection to rural

areas. Furthermore, cities in wealthier countries have higher protection levels than those in the developing world. Physically transferring risk, by methods such as diversion of flood waters to less vulnerable areas, can also help manage the overall flood risk. It is, however, not only the monetary value of assets that should shape that choice: equity issues between urban/rural, rich/poor neighbours, and appropriate compensation through negotiations need to be factored in as well.

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Figure 5 illustrates a fictitious river basin segment: a hypothetical situation where an upstream agricultural/rural area can be used to divert and temporarily store flood waters in order to prevent overtopping/breaching of the embankments downstream, thus protecting the urban areas with dense population and economic activities. By diverting water into agricultural areas, very high potential losses in urban areas can be avoided. This may result in actual agricultural damages that are higher than the potential agricultural damages calculated before the flood event. Such an arrangement would require additional compensation in agricultural/rural areas over and above the actual agricultural damages materialised. Such compensation must be agreed upon in advance, at the disaster preparedness planning stage, through a transparent process involving all affected parties and the insurance companies. The real-time operation of such a mechanism would require close monitoring and a clearly established decision-making process supported by early warnings. The feasibility of such an arrangement would also depend on geo-physical characteristics. Similar arrangements include the retention of rain water in natural or man-made depressions.

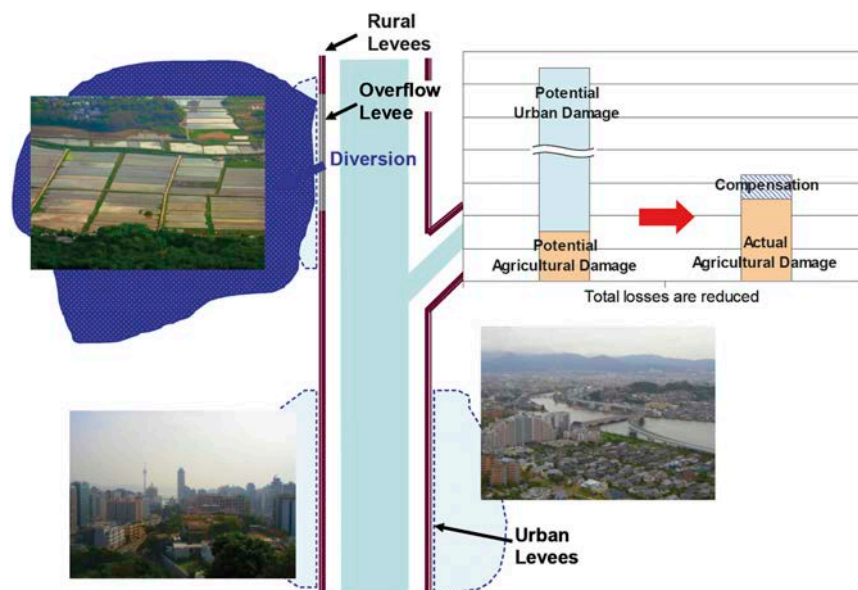


Figure 5 — Physical risk transfer by diversion of flood water to agricultural lands

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However, such a mechanism requires extensive consultations and negotiations with all stakeholders, particularly the affected communities. All such measures should be based on an understandable, transparent, and comprehensive weighing of interests. A compromise satisfactory to all parties involved must be arrived at through a participatory approach to communication and discussion. Landowners and farmers directly affected by such diversion should be closely involved in the planning of measures as well as the search for a financial compensation (risk transfer) mechanism that is closely linked to the physical risk transfer. To the extent that individual interests are compatible with general welfare, a spirit of “give and take” should be promoted. Furthermore, legal frameworks should be in place to facilitate such transfers.



4 FINANCIAL RISK SHARING INSTRUMENTS

4.1 Materialised risk and disaster relief

⁶⁰ Flooding results in disasters if the people at risk are unable to cope with the consequences of retaining materialized risks. Those most exposed to and affected by natural hazards are the poor in developing countries, who are usually the occupants of the most susceptible areas. Either due to their vulnerability and consequent limited political power, or due to reasons of convenience for making a living when floods are not occurring (such as ease of access to working areas and river water), they live with a high risk of flooding. Furthermore, materialized risk for the poor and vulnerable segments of the population often adds to their vulnerability. In order to recover from flood events, they may have no choice other than to resort to sale of personal assets and loans, likely pushing them into a downward spiral of vulnerability and poverty. This is often seen as a primary cause for what has been called the “*poverty trap*”. There are different views on who should bear the losses in such situations.

⁶¹ The poor and vulnerable have limited or no access to insurance and financial services. In most cases they have to manage and compensate for flood losses on their own. The lack of financial compensation can slow recovery. Sometimes government assistance for the survivors of a disaster may be dependent on the whim of a politician, who may be influenced by many other issues and not always entirely objective.

⁶² Sharing the materialised risk includes formal and informal responses to expected losses, such as self-insurance, precautionary savings in financial or other assets, social networks and formal insurance. Public disaster relief systems (emergency subsistence and soft loans, for example) are often set up to cater to victims of natural disasters. Another resort is to transfer the materialized risk over time through insurance, which is a post-event compensatory mechanism available at a given cost. The adverse impacts of retaining risk can be avoided through reliance on savings, loans from friends and family members, or the selling of assets. Governments



provide disaster aid, often from development budgets, in order to prevent flood events from turning into disasters.

⁶³ Such disaster aid is rooted in the concept of social solidarity with the flood victims, which is a valued public virtue that promotes a humanitarian and equitable society. Taxpayers' solidarity with flood victims is not necessarily typical only of a socialistic political setup, but is also diffused in market driven economies⁶. It holds strong appeal for those who see assistance to disaster victims as promoting a humanitarian and stable society, even if it encourages risk-taking behavior. However, due to resource constraints when development budgets are diverted for relief and rehabilitation, particularly in developing countries, development programs are heavily impacted, often resulting in loss of GDP growth.

4.2 Sharing materialised risk through risk transfer

⁶⁴ Transferring risk through insurance is the last step in a systematic risk management process. It protects capital, enhances solvency, allows for recovery, and, if designed carefully, has the potential to encourage risk reduction. At the same time, while risk transfer can be very beneficial, it does not actually reduce the total risk – it just moves the risk either in time or by transferring it to other entities. However, problems in setting up risk-transfer schemes remain where:

- There is a large concentration of risk: When there are many policies at risk from the same event.
- Ownership is difficult to establish: When establishing ownership of assets lost is non-trivial, concerning, for example, fisheries, ecosystems or water supply.
- Damages are difficult to quantify: When it is difficult to assess the financial value of damage to livelihoods and cultural capital, thus making risk-transfer mechanisms problematic.

⁶⁵ Before reaching a decision as to which risks can be cost-effectively transferred, it is essential that activities are thoroughly organized in order to reduce risks as far as economically possible. This involves planning to eliminate avoidable risks and designing resilience into systems and assets.

⁶⁶ Small-scale floods happen fairly often. Without appropriate management, these flood risks inhibit optimal utilization of flood plain resources. If losses occur frequently, the rationale for an insurance system becomes questionable. Moreover, small events are predictable, and risk reduction methods are most suitable for dealing with such risks. Frequent risks require other strategies for mitigation and management (USAID, 2006). The cost of mitigation increases dramatically as the magnitude of a flood event increases, making those methods economically unviable.

⁶⁷ Insurance instruments are most suitable for middle layers risks. In case of low-probability high consequence events, the insurance market often fails. In such events, particularly in situations

⁶ In Hungary, where a transition from socialist to market economy has been experienced, floods and loss sharing was discussed in terms of public-private insurance system, which changed from an original situation of 100% full compensation by the government (Linnerooth-Bayer and Vari 2003) to a public-private system with significant cross-subsidization from persons living in low-risk areas to persons living in high-risk areas, making it possible for poor persons in high-risk areas to afford flood cover.

where the risk is concentrated in relatively small areas (such as densely populated cities, protected with levees), requires government, donors and other international institutions to provide re-insurance. This is known as catastrophe insurance. Here the cover is often based on individual private insurance policies and the state involvement is only for reinsurance and/or catastrophe situations. **Figure 6** depicts the potential applicability of each of the instruments depending on the losses or magnitude of floods or losses from the floods.

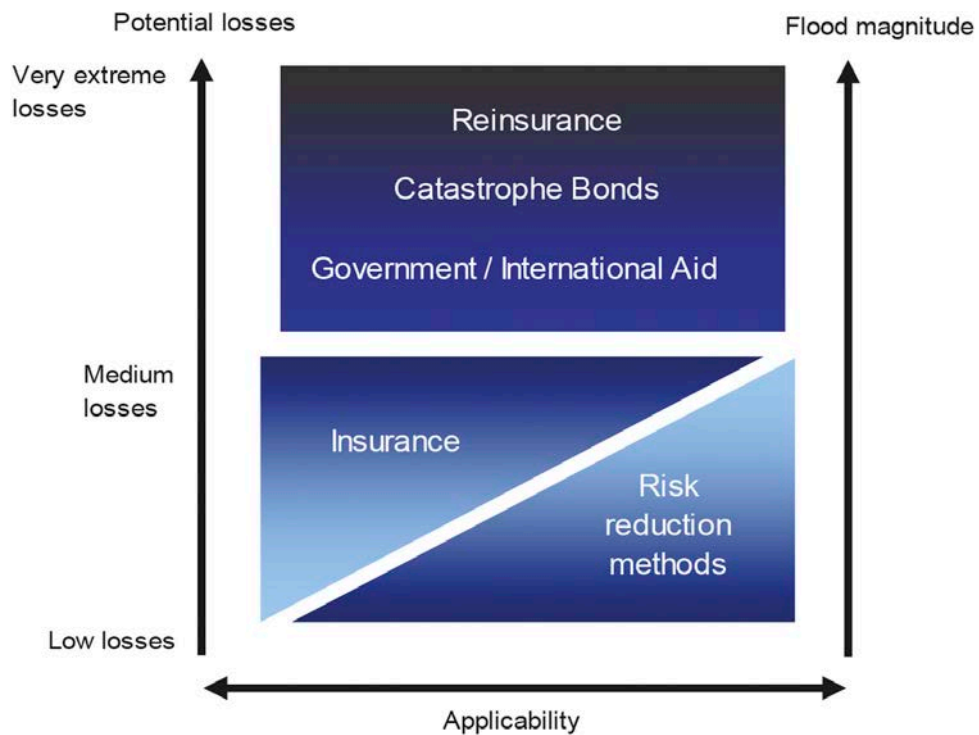


Figure 6 — Applicability of insurance based on flood magnitude and losses (MCII, 2008)

⁶⁸ Existing levels of insurance vary in range from informal arrangements for assistance with family, friends and neighbours, to community schemes like micro-insurance and mutual insurance based on affinity groups such as communities and trades, to formal insurance, where funds are collected by a profit-making third party, to reinsurance, which accepts risks that are too severe for smaller schemes or operators to retain. These are briefly discussed in the below sections.

4.3 Traditional flood insurance

⁶⁹ Insurance can work only for risks that are insurable. The main principles of insurability are: risks have to be quantifiable, occur randomly and be many in number so that variations in claims are smoothed out. From the client's side, the premiums have to be affordable and the contract has to perform reliably. These issues sometimes prevent insurers covering losses due to flooding, pollution, farming and gradual deterioration of assets. Key insurance principles that determine the insurability of a risk and how they are applied in case of flood risks are given in **Box 2** (Swiss Re, 1998).



Box 2 — Insurance Principles and Floods

Key insurance principles that decide the insurability of a particular hazard in a given situation are mutuality, need, assessability, randomness, economic viability and similarity of threat:

Mutuality: A large number of people who are at risk must combine to form a risk community.

In case of flooding, the mutuality requirement is not met when frequently affected risks are the only ones insured. This is one of the major reasons why insurance cover against flooding is not widespread.

Need: When the particular event occurs, it must place the insured in a condition of financial need.

Assessability: The expected loss burden must be assessable.

While it is feasible to assess losses due to small scale floods that occur fairly often, it is not possible to do the same for the statistics for catastrophic flood losses since their probability of occurrence is small. The assumptions in risk assessment in such cases are laden with a high level of uncertainty.

Randomness: The time at which the insured event occurs must not be predictable and the occurrence itself must be independent of the will of the insured.

Economic viability: The community organised by the insured persons must be able to cover its future, loss related financial needs on a planned basis.

Economic viability is threatened when flood protection measures fail, including the economic viability of the region. A once in a century event may overtax the local risk-carrier financially. Re-insurance is generally resorted to in such cases.

Similarity of threat: The insured community must be exposed to the same threat, and the occurrence of the anticipated event must give rise to the need for funds in the same way for all concerned.

Similarity of threat of flooding is present only to a limited degree since flooding is comprised of various types of occurrences, such as storm surges, flash floods and dike failure.

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Many countries have some form of flood insurance cover (see **Table 2**)⁷. These insurance systems differ widely between countries in their treatment of risks. These different approaches can be categorized under the “option” system and the “bundle” system (Chricton, 2008). Under the “option” system, insurers extend their policy to include flood on payment of an additional premium; as this is the case, with a very low take up, in Belgium, Germany, Australia, and Italy, for example. Under the “bundle” system, cover for flooding is bundled with other hazards, such as fires, storms, and earthquakes. This system is in use in Britain, Japan, Israel, Portugal, and Spain, for example. With the bundle system, insurers charge differential rates based on intensity of risk.

⁷ Paper dealing with examples of insurance schemes in different countries, contribution from Japanese Institute of Construction Engineering including (JICE, 2003) and (Yoshioka et al., 2002).

Table 2 — Various national flood insurance schemes and approaches

China	Particular focus is on the study of flood insurance systems in other countries.
France	There is a nationally legalized natural disaster insurance system called "CATNAT." Insurance rates: - Uniform rates relative to original insurance rates, regardless of such factors as the objects insured and locality. - Insurance rates rose from the initial rate of 5.5% to 9.0% as disasters increased. The current rate is 12.0%.
Germany	- Floods are considered a natural hazard, which is not covered by ordinary insurance contracts. In the erstwhile German Democratic Republic household insurances covered flood damages. There is still a number of these old contracts in place which provide insurance protection. The same applies for old contracts in Baden-Württemberg. - There are a number of insurers that offer flood insurance. The insurer, however, assesses the risks, on a single case basis.
Japan	Private comprehensive insurance: - Insurance against natural disasters exists in the form of comprehensive insurance offered by private insurance companies and the basic contract of special fire insurance. - The national government is not involved in the administration of the insurance. Insurance rates: - Insurance rates for flood damage are uniform throughout the country, regardless of flood risk levels.
Netherlands	At present, there is no flood insurance system under which flood coverage is provided by insurance companies. The government and insurance companies, however, are discussing the introduction of a flood insurance system, because of pressure on the government to provide compensation as an insurer of last resort.
United Kingdom	Private insurance companies cover flood risks for households and companies in the United Kingdom. The government does not offer compensation in case flood damage occurs. Accepting insurers to accumulate tax-exempted funds encourages capital growth by the insurance industry. Coverage against flood damage is usually included in building or home contents insurance, implying that it is bundled with other risks.
United States	Flood insurance system: - There is a national government-run flood insurance system. - The flood insurance system is closely linked with land use regulation, and settlement in floodplain areas is strictly restricted. - In the case that a community participates in the flood insurance system, it is mandatory for flood hazard areas without levee protection to be insured, whereas it is not for areas with levee protection (either 1/100 or 1/200). Areas surrounded by levees must also be insured as it can be flooded both from landside and riverside. - Congressional Budget Office estimates that multiple year discretionary outlays for National Flood Insurance Program and the appropriation of authorized amount are appropriated to state and local communities. Insurance rates: - As per the flood insurance rate table prepared by the Federal Insurance Administration (FIA) Rates depend on the size of the family living in the building, the size of the building, whether the building has a basement, etc.
India	The National Flood Insurance Program (NFIP) was introduced by Indian national Congress Insurance companies sell flood insurance through the National Flood Insurance Program. Farmers are covered under schemes of the government. Activities of the government include provision of shelter, food supplies, clearing of debris and vocational training. There is also compensation from the Prime Minister's National Relief Fund to those killed in natural disasters whenever they occur.
Pakistan	Currently all disaster management institutes in the country are being coordinated under National Disaster Management Authority (NDMA), established in 2006. Federal Flood Commission (FFC) is the central/federal body authorized to review and approve all the flood protection schemes in the country. As a fundamentally an agrarian society, Pakistan expands crop, livestock and other agrarian insurance schemes.

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Evidence suggests that those at risk tend to conceptually ignore the probability of the most extreme and infrequent loss events, but insurers need to load their premiums considerably to allow for those events. This creates a gap between what buyers are willing to pay and what sellers are willing to accept for protection against very infrequent but catastrophic losses. If the cost of the premium is relatively high, consumers will not insure. The high cost may be a



signal from the private market that the risk is very high (unsustainable), or that there is great uncertainty, or that the scale of operations is too small, or that alternative risk management options exist.

72 Traditionally, insurance against floods have been limited to urban properties. Due to their high price, these policies have not been very popular and have never played a significant role in developing countries. The private market will seek to segment customers, eliminating cross-subsidies. However, this may be contrary to public policy in terms of ensuring solidarity between those who are seriously at risk and those who are barely at risk. This situation can be improved by raising risk awareness and promoting solidarity through a cooperative approach. The readiness for solidarity also depends on a public understanding of the availability of less risky alternatives.

73 Where the primary interest is in reducing vulnerability, and poverty reduction and agriculture play key roles, there is a need to expand the application of flood insurance from property to agriculture. The experience of managing agricultural risk shows that the insurance model utilized in developed countries is not always a good model for developing countries (World Bank, 2005). Mandatory insurance policies are viewed as a tax. However, they can be acceptable if made conditional on assistance to low income groups.

4.4 Reinsurance

74 Natural catastrophes tend to be rare but very large events have the capacity to adversely impact the profitability of the insurance company. Investors prefer a lower volatility in order to enable steady payments of dividends, because erratic profits depress their share values. For that reason, insurance companies often resort to reinsurance. Through participation of international institutions such as World Bank⁸ or reinsurers, some of the risk is transferred outside the country.

75 Reinsurance is the insurance of the insurance companies. Whenever the insurer cannot or does not want to take the entire risk, and wants to reduce the likelihood of having to pay a large obligation as the result of an insurance claim, the insurer resorts to reinsurance, thereby protecting itself from the losses incurred by catastrophe. This is a mechanism of whereby insurers transfer a portion of the risk portfolio to other parties. The reinsurance company receives pieces of a larger potential obligation in exchange for some of the money the original insurers received to accept the obligation.

76 The functions of re-insurance are to reduce volatility, minimize taxes, underinvestment incentive, costs of insolvency and real service advantages as the traditional hedge for primary insurer (Lewis & Murdock, 1996). Reinsurers specialize in low-frequency high-impact events. Because capital reserves are limited, the reinsurer has to levy a significant uncertainty margin to cope with short-term fluctuations in occurrence and severity of catastrophes; this can be a multiple of the long-term risk premium.

⁸ Turkish Catastrophe Insurance Pool (TCIP)

77 Very extreme events may exceed the funds available, particularly in the early years when a surplus has not been accumulated or a sufficient volume of business has not yet been established. The excess amount may need to be guaranteed, perhaps through contingent loans from government and/or donors. The Mongolian Index-based Livestock Insurance Pilot, for example, has such an arrangement with the World Bank (World Bank, 2005). A possible role for government, donors or other sources of financing is to provide resources for addressing low-probability, high-consequence events.

78 Risk-based premiums are generally opposed in poor regions. Insurance may be an option, but only by circumventing the commercial insurers via non-profit mutual arrangements. If insurers are limited in their ability to introduce appropriate risk-related variations in, for example, deductibles or premium loadings, insurance can lead to a less risk-averse culture. It is therefore vital that insurance is complemented with a risk management framework (such as land development, building design, and construction standards) to avoid such moral hazard. The private sector can support this process as a partner: the insurance industry of the United Kingdom, for example, actively engages with policymakers on flood defence funding, land zoning and construction standards. In the United States, insurers help to fund the technical training of publicly paid building inspectors, and Australian insurers assisted Fiji in setting standards for cyclone-resistant buildings (Dlugolecki, 2001).

79 Involving the insurers in the development and execution of strategies like IFM has the potential to enhance flood resilience, reduce the magnitude of losses, and thus help increase insurers' willingness to establish, maintain and expand a presence in developing countries.

4.5 Non-traditional financial mechanisms

80 Non-traditional financial mechanisms, together with insurance mechanisms, belong to a portfolio of financial mechanisms for the facilitation and support of recovery from flood events. Such non-insurance mechanisms can:

- Provide direct financing for reducing the flood risks, such as flood proofing;
- Serve communities that do not have insurance institutions, or an insurance culture;
- In some contexts offer a lower-cost alternative to insurance for providing post-disaster capital, especially for low-level risks;
- Share the materialised flood risks from the poor through national and international solidarity.

4.5.1 Index-based insurance

81 Recent years have shown an interesting development towards alternative index-based insurance risk transfer products. These products seek to handle risks which the conventional insurance industry has avoided or where it has failed to achieve appropriate market penetration. For example, captive or mutual insurance companies for corporate risks, weather derivatives for non-catastrophic climatic variability, and catastrophe bonds (cat bonds) (see **Section 5.5**).

82 Typical insurance schemes are indemnity based, that is, they are based on payment after the real verification of losses by an expert, subject to acceptance by the parties. An index-based risk transfer approach uses a proxy measurement to pay for significant economic loss. For



example, if it is known that extreme rainfall or extreme temperatures have a high correlation with agricultural production losses, then these measures can be used to proxy loss and make payments in case of loss of production. A variety of mechanisms used for payment of index-based insurance are described in **Box 3**. One noteworthy advantage of indexed insurance contracts is that claims management is greatly reduced, since there is no need to validate losses; they are determined by a simple objective measurement.

Box 3 — Index-based insurance contracts

Four mechanisms can be used to determine a payment from an index-based insurance contract:

- 1 **Parametric:** A scheme based on physical parameters that determine if the risk materialized. For hurricanes, the parameter is wind speed. If the parameter reaches the established threshold, this triggers a loss;
- 2 **Modelled losses:** Operate like the parametric scheme. In this scheme, a mathematical model is used with a set of parameters. The parameters are the inputs of the model. If the output of the model reaches a predetermined threshold, the financial scheme pays out;
- 3 **Parametric index:** Mid-way between the parametric and modelled losses mechanisms. It uses a number of observations of, for example, wind speed, at different locations, weighted to reflect the amount of business at risk in the vicinity of each location;
- 4 **Industry index:** An index built using sources from the insurance industry to predict the losses in the industry. Once the industry index reaches a certain threshold, it triggers a payment.

83 Such an approach helps to solve a variety of problems associated with the usual public sector response to catastrophic risk and credit constraints in developed countries, namely traditional forms of agricultural insurance and ad hoc disaster aid. However, experience with index-based insurance is largely limited to drought risk. There are only a few examples of their use with respect to flood risk.

4.5.2 Catastrophe bonds

84 An insurer faces a large cost after a catastrophic event. To reduce the expected costs of financial distress, the insurer hedges the risk. The insurer can obtain indemnity-based reinsurance, or it can issue a catastrophe bond (cat bond) with a parametric trigger such as the actual magnitude and location of an earthquake or hurricane (Doherty, 1997).

85 Cat bonds are a capital market-based alternative to reinsurance. A reinsurance contract's payoff is usually based on the realized loss (indemnity payment). In contrast, cat bonds usually have an index or a parametric trigger. In the first case, the payoff after the catastrophic event is based on an index of industry-wide losses; in the second, the payoff is determined by certain parameters. Thus, the payoff is largely, and in the case of a parametric trigger, completely, independent of the sponsor's realized loss.

86 Cat bonds are widely used in developed countries. They are projected to transfer insurance risk arising out of natural disasters such as earthquakes, hurricanes and floods to the capital markets. Cat bonds are risk-related securities that transfer a specified set of risks from a sponsor to the investors.

87 Cat bonds can be considered a type of asset, one that is acquired for a fixed period of three to five years by the investor, who bears the default risk in return for a regular interest payment. This is generally at rates higher than the market interest rates to cover the possibility of default

or loss of capital invested. Cat bonds act like reinsurance to remove the peaks or volatility of catastrophe risks. The principal obstacles to greater use of the capital markets are: the higher prices; the possibility of basis risk, because the bond is triggered by objective conditions, not actual losses to the insurer; unfamiliarity with the instrument; and regulatory limitations as a result of accounting rules.

⁸⁸ In the capital market, cat bonds are considered an investment opportunity that diversifies the risks away from the financial markets and into natural hazards. Cat bonds are not closely linked to the stock market or economic conditions and offer to investors a good diversification of investment risks. The key advantage of cat bonds is that they help transfer risks to a large group of investors.

4.5.3 Micro-insurance

⁸⁹ Micro-insurance is the financial arrangement used to protect low-income segments of society against specific hazards in exchange for regular premium payments proportionate to the likelihood and cost of the risk involved. It has evolved in conjunction with micro-credit and uses insurance as an economic instrument at the micro level of society. "Micro" does not refer to the size of the risk carrier (some are small or even informal, while others are very large companies), nor to the scope of the risks, which are by no means small to the households that experience them (Roth et al, 2007).

⁹⁰ In cases where the individual values insured are often small in relation to the insurance transaction cost, micro-insurance offers a potentially more suitable alternative. It can be delivered through a variety of channels, including small community-based channels, credit unions or other types of micro-finance institutions, as well as by enormous multi-national insurance companies etc. It is also useful in promoting the culture of risk reduction.

⁹¹ Micro-insurance has low premiums and low caps coverage and is synonymous with community-based financing arrangements. "Bundled" micro-insurance is provided to clients of micro-finance where insurance is linked to a loan. Communities are involved in important phases of the process such as package design and rationing of benefits.

⁹² The community is also involved in revenue collection, pooling, resources allocation and, frequently, service provision. Decisions in micro-insurance are made within each operational unit rather than far away, at the level of governments, companies, non-governmental organizations (NGOs) that offer operational support. This instrument is particularly beneficial in developing countries, but excluded sections of society in developed countries can also make use of this option. Micro-insurance schemes are currently operated through micro-finance institutions or community-based organization in Bangladesh, India, Malawi, Nepal, Pakistan and four Caribbean countries (ProVention/IIASA, 2006).

⁹³ Micro-insurance links multiple small units into larger structures, creating networks that enhance both insurance functions, through broader risk pools and support structures for improved governance (such as, training, data banks, research facilities, and access to re-insurance). It is conceived as an autonomous enterprise, independent of permanent external financial lifelines; its main objective is to pool both risks and resources of whole groups for the purpose of providing financial protection to all members against the financial consequences of mutually



determined risks. The essential role of the network is to enhance risk management by the members of the entire pool of micro insurance units over and above what each can do operating as a stand-alone entity.

4.5.4 Government financing instrument

⁹⁴ There are two principal types of mechanisms available to governments to fund the costs of recovery from flooding: hedging instruments and financing instruments (Doherty, 1997). Insurance and capital market-based securities are examples of such hedging instruments, where the financial risk of the losses from future disasters is borne by another party through ex ante risk transfer mechanisms. On the contrary, financing instruments are arrangements whereby the government sets aside funds prior to a disaster and taps its own funding sources after the event occurs. For example, the government may implicitly self-insure by setting aside money to finance some of the recovery needs following a disaster. Alternatively, the government can mobilize its own financing sources by using policy instruments such as imposing taxes, borrowing domestically or internationally, or diverting from the public budget. Alternatives for financing disaster response and rehabilitation include (Kunreuther and Linnerooth-Bayer, 1999):

- Catastrophe tax
- Catastrophe reserve fund
- Government debt instruments
- International loans
- Budget diversions

⁹⁵ These financing instruments have traditionally been used in emerging-economy countries to fund disaster recovery. However, these options may be politically difficult to implement (such as imposing a disaster tax) or economically undesirable (such as transferring funds from other budgetary commitments). Catastrophe risk financing refers to the combination of all methods used to pay for financial losses incurred during a disaster. Developing countries in the past focused on post-disaster aid and lending. It is clear, however, that such “ex-post” strategies are not efficient or sufficient. Risk financing now stresses “ex-ante” (before the disaster) measures such as risk transfer and sharing. While use of ex-ante risk financing methods is increasing, during most disasters in developing countries some degree of ex-post support will always be needed.



5 EXAMPLES OF SHARING FINANCIAL RISK

5.1 National Flood Insurance Plan (USA)

⁹⁶ In the US, according to the National Flood Insurance Act of 1968, the National Flood Insurance Program (**NFIP**) has enabled property owners in participating communities to purchase insurance as a protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damages (FEMA, 2002). It prohibits federal agencies from providing financial assistance for acquisition or construction of building and certain disaster assistance in the floodplain in any community that did not participate in the NFIP. The purchase of flood insurance was voluntary, but there have been several incentives to join the system. For instance, lending institutions could not make, increase, extend, or renew any loan secured by improved real estate located in a designated Special Flood Hazard Area (**SFHA**, the 100-year floodplain). It particularly relates to those communities that participate in the NFIP, unless the secured building and any personal property securing the loan were covered for the life of the loan by flood insurance.

⁹⁷ Another policy scheme motivating community based activities through economic incentives is flood insurance with a community-based rating system (FEMA, 2008). NFIP requires communities to maintain a minimum level of floodplain management for its residence to eligible to purchase flood insurance and established the Community Rating System (**CRS**), divided in 10 classes, to encourage communities to exceed the minimum requirements. For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; for example, a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount (Class 10 communities are not participating in the CRS and therefore receive no discount). The CRS classes for local communities are based on 18 creditable activities, organized under four categories; public information, mapping and regulations, flood damage reduction, and flood preparedness (Galloway, 2004). However, the program fell short of meeting



its goals in part because of its limited ability to guide development away from floodplains and the inability to restore beneficial floodplain functions once they have been impaired (AIR, 2006).

5.2 Crop insurance system (Pakistan)

⁹⁸ This scheme was established with the help of the Bank of Punjab and two national insurance companies in the hope that in the near future, other banks and insurance companies will also join it. The objective of the scheme is compensation of farming groups from crops loss caused by natural disaster. It states that if any natural disasters (such as floods or droughts) hit a region, it would be proclaimed a 'disaster area' and 50-70% payment, together with help in agricultural credit and freedom from local taxes, would be granted to impacted farmers. In this case, they have crop insurance under the latest agriculture insurance scheme. Moreover, the scheme also includes life insurance for one year with an additional claim. In order for farmers to avail of the crop insurance scheme, the bank charges an additional 2% of the loan on the top of an 8% mark-up amount on the loan. This insurance scheme, the first of its kind in the country, was thought to benefit 98% of farmers, particularly the poor ones. However, the recent studies showed that most of farmers were unable to take advantage of the scheme due to their adverse financial position. Only those farmers who were financially sound took advantage of the scheme after the floods destroyed their crops. In order to stabilize the situation, the government suggested that the agricultural package with the rate of mark-up on farm loans be made equal to industrial loans. At the same time, the State Bank of Pakistan (**SBP**) is forecasting that it will open 10 more branches (of which five would be opened in Punjab), with extensions to enlarge their presence in other regions as well, where they will offer analogous insurance schemes to farmers. In consultation with the tobacco growers it is meant to assist, the scheme will be extended in the Mardan region.

5.3 CATNAT (France)

⁹⁹ The **CATNAT** ("catastrophe naturelle" in French, which means natural disaster) system in France promotes State involvement only for reinsurance and/or catastrophe situations (Crichton, 2008). The system, under which government acts as a reinsurer, has been running since 1982. A commission, comprised of representatives of the central government, decides whether a given occurrence is deemed a natural disaster, hence making claimants eligible for reimbursement (Jametti, 2006). Property insurance is almost compulsory among property owners while all insurance companies offering property insurance in a specific area are obliged to include protection against natural disasters. A publicly-owned reinsurance company, the Caisse Centrale de Réassurance, has been established to facilitate this process. Reinsurance is not compulsory but the State-offered reinsurance scheme is potentially attractive both because the reinsurance premiums are low and because it can offer unlimited cover.

¹⁰⁰ The system can reduce problems of adverse selection because property insurance is almost compulsory, but there is still the problem of moral hazard. Since January 2001, a sliding scale has been introduced so as to encourage loss prevention measures. This scale applies to those districts which do not yet have a prevention plan for foreseeable natural risks (Plan de Prévention des Risques, **PPR**). Recent flood events showed a need to the risk accumulation because it is going to rise as insurance penetration increases in areas prone to natural catastrophes. The

CATNAT system therefore, has to be modernized through increased flood risk assessment and mapping of areas at stake (Marcellis-Warin and Michel-Kerjan, 2001). The updates of the system will allow users and risk managers to more precisely evaluate flood risks on a global level.

5.4 Turkish catastrophic insurance pool

¹⁰¹ After the Marmara earthquake caused massive losses in terms of life and property on 17 August 1999, the Turkish government recognized the need for partnership between the public and the private insurance industry to transfer most of catastrophic risk to international reinsurance and capital markets and to encourage risk mitigation and safer construction practices. The Turkish Catastrophic Insurance Pool (TCIP) was established in accordance with the governmental decree on Compulsory Earthquake Insurance⁹.

¹⁰² The main objectives of the TCIP are to:

- Guarantee that all property tax-paying homes have affordable earthquake or flood insurance cover;
- Reduce citizens' dependence on the government to fund the reconstruction of private property after a devastating earthquake or flood;
- Reduce government's fiscal exposure to earthquakes or flood by transferring excess catastrophe risk to international reinsurance markets;
- Encourage physical risk mitigation and safer construction practices.

¹⁰³ The obligation of the government to extend credit and construct dwellings for the public in the event of an earthquake was abolished. The World Bank provided technical and financial assistance to TCIP. The compulsory scheme covers only residential buildings that fall within municipal boundaries. Industrial and commercial risks as well as residential buildings in local villages without establishing municipality can be insured on a voluntary basis. TCIP also transfers the responsibility for post disaster relief and recovery from the government to households in the risk zones. The pricing matrix used by the TCIP takes into account seismic risk (five risk areas) and construction type (four categories: steel, concrete, masonry, and other) (Yazici, 2003). As a result, the TCIP has facilitated the growth of the catastrophe insurance market in Turkey. It also relies on a strong communication strategy to ensure that residents are aware of earthquake or flood risk, mandatory insurance laws, and the programme's excellent claim-paying record. At its inception, TCIP had sufficient claims-paying reserves to withstand a once-in-100-years event. Since then, it has increased its reserves and strengthened its reinsurance capacity to sustain an earthquake with a return period of 350 years.

5.5 Cat bonds

¹⁰⁴ In April 2007, Europe's biggest insurer Allianz SE issued the first ever Blue Wings Ltd. cat bonds, worth 150 million USD, in order to provide cover against flood risks. They covered Allianz against severe losses from river floods in Britain and earthquakes in Canada and the United States of America, excluding California. The trigger for the flood component was a parametric

⁹ Governmental Decree Law No. 587 on Compulsory Earthquake Insurance (December 27, 1999).



index based on flood depths at more than 50 locations across Britain. At the time of launch, the Blue Wings scheme was over-subscribed, with high demand from investors including dedicated insurance-linked securities funds, hedge funds and money managers. Allianz has now called for an early redemption of its Blue Wings cat bonds. The bonds were repaid on January 10 2009, three years earlier than expected. Due to a revision by RMS of the catastrophe model that was based on the UK inland flood model on which the bonds were based, the instrument became uneconomic for Allianz. The original estimate of the risk was very high, but because the subsequent revision made it very low, using a complex and fairly expensive instrument like a catastrophe bond was no longer justifiable. Allianz regularly returned to capital markets by sponsoring a total of five cat bond transactions, with a total volume of approximately 850 million USD.

105 The current total volume of outstanding cat bonds in the market is estimated to be around 13 billion USD.

5.6 Micro-insurance (India)

106 Disaster micro-insurance can be divided into two categories: an extension of a micro-credit and micro-savings program, or a stand-alone insurance scheme (ProVention/IIASA, 2006). India features a large number of micro insurance programs partly because there is a provision stating that regulated insurers must increase their shares of low-income clients over time. Swayamkrushi of Andhra Pradesh, for example, provides bundled schemes as an extension of microcredit. It has been providing microfinance since 1997, and has added a compulsory life and property insurance in 2001. Offered independently and voluntarily, the Self-Employed Women's Association has been offering health, property, and life insurance with disaster-risk cover since 1992.

107 Along with these extension schemes, stand-alone programs for disaster micro-insurance can also be found in India. The Gujarat State Disaster Management Authority has established a compulsory group-based housing insurance scheme for those households that have been completely destroyed and rebuilt with government assistance. Deducted from the final instalment of housing assistance, the policy provides protection for 10 years for 14 types of natural and human-induced disasters. Under this agency, beneficiaries have successfully received grants for reconstruction and purchased a policy from the compulsory housing insurance scheme to protect their investments and prepare for future events.

108 Furthermore, some voluntary stand-alone micro-insurance schemes were initiated in India. The NGO All India Disaster Mitigation Institute (AIDMI) has been offering a disaster insurance program, called Afat Vimo, covering households and micro-businesses in the state of Gujarat (AIDMI, 2006). There is close collaboration between public insurers and AIDMI; premiums are kept low and affordable because of the pro-poor regulatory requirements. The Afat Vimoscheme provides life and non-life disaster insurance to low-income clients for losses incurred in the case of 19 eventualities, such as cyclones, lightning, landslides and earthquakes. The AIDMI also supports communities by providing relief, rehabilitation and development assistance to vulnerable communities. In 2003, the first index-based weather scheme in a developing country was launched in the Mahbubnagar district of Andhra Pradesh by the rural microfinance organization BASIX with technical assistance from the Commodity Risk Management Group

(CRMG) of the World Bank. After 2004, a number of other institutions began expanding the market for weather insurance in India (World Bank, 2005).

5.7 Catastrophe risk insurance facility (South-Eastern Europe)

¹⁰⁹ The Strategy of the Catastrophe Risk Insurance Facility was initiated in the countries of South East Europe in 2008. It monitors the prior examples of domestic and local catastrophe risk programs established with the direct technical and principal support from the World Bank – the Turkish Catastrophe Insurance Pool, the Romanian Catastrophe Insurance Pool and the Caribbean Catastrophe Risk Insurance Facility. Nevertheless, this facility has some new improvements. For example, the enlargement of compensation form disaster insurance products and parametric index-based weather risk protecting agreements; additional control of the facility; expands participation of government control in the program; and the transparency of the Facility to a broader scope of users, government agencies and other stakeholders depended to climate threat.

¹¹⁰ The strategy is proposed as a local reinsurance pool that will profit from nations of scale, county risk variation, and the state-of-the art risk controlling potentials that will subsequently convert into minor premium rates prices for climate threat and disaster insurance products in South Eastern Europe countries. Particularly, risk formation and development of catastrophe risk insurance products is time-limited and costly; different countries have fairly tiny markets with a small premium capacity and undiversified risks that styles them unattractive to reinsurers. By sharing the risks and funds through a superior area, an investment in insurance risk is more operational; disaster insurance products have a greater hypothetical market; the risks are spread, building the delivery of such products cheaper for users and more affordable to insurers. In the same time the insurance programs will be more straightforwardly promoted for the total reinsurance market. Finally, this facility reflects the trans-boundary original of greatest environmental catastrophes, which regularly affect bordering countries.

5.8 The Insurance Council's Residential flood insurance project (Australia)

¹¹¹ In the end of 2006, after the significant examination by the broad insurance industry in Australia on the subject of flood mitigation and management, the Insurance Council Board identified a methodology for the insurance industry to propose a flood insurance outline. Its objective was to clearly identify how to lead and make available for majority of the households in Australia residential insurance flood coverage. The insurance industry has also confirmed its obligation to cooperate in partnership with Governments to report about the problems of flood mitigation and management, stating that flood remains an important society matter that is going to increase in view of climate variability and change. The Insurance Council trusts that a partnership approach with Government and the overall insurance industry is necessary to highlight the needs in terms of increasing population awareness on flood risk and flood management. In order to decrease the confusion of users, the broad insurance industry works to improve a voluntary public meaning for domestic flood. It is predicted that different insurers would accept this meaning of flood on a voluntary basis; i.e. – insurers will continue permitted



to offer coverage to other meanings for flood, with consumers who will be capable to use the voluntary common meaning as an indication for assessment of the offered product. The key complication to succeeding better market accessibility of flood cover for the most of homes is the ability for insurers to realize and price the risk.

5.9 Index-based insurance in Malawi

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The economy in Malawi is affected by rainfall hazards, rising food insecurity. However, groundnut farmers can now get loans that are covered against nonpayment with an index-based climate result. It means they are able to have an agreement with a payoff determined by climate incidents, where a required drought or rainfall noted at an indicated weather station. Farmers accumulate an insurance payment if the index gets an evident degree of concrete costs. The pilot project prearranged by the National Smallholder Farmers Association proposes a packaged loan and index-based micro-insurance product to farmers. Therefore, the farmer gets into a loan contract with a higher interest rate that contains the climate insurance premium, which the bank and country finance foundation pay to the insurer, the Insurance Association of Malawi. In case of a drought (as measured by the rainfall index), the borrower pays only a portion of the credit due, where the rest is paid by the insurer straight to the bank. Without this insurance, banks hardly finance to high-risk, low-income farmers, who cannot get necessary loan to pay their needs. Additionally, because of the physical trigger, on the contrary, farmers will have an incentive to cut probable costs, like, diversifying their crops. There is also no need for costly individual claims-settling and practical costs that will lower the demand for farmers to sell their assets to recover after environmental catastrophe. However, there is one disadvantage of index insurance is 'basis risk,' which means that payouts may not be completely compared with losses. The World Bank has offered methodological support and guidance in developing this environmental insurance product. By decreasing loan repayments in the case of natural disaster the Malawi scheme indirectly protects farmers from loss of livelihood and food insecurity. To conclude, from the experience of the 2008 African floods demonstrates that index insurance scheme conserves resources and helps those most vulnerable to extreme floods better recover from traumatic events.



6 CONCLUSIONS

113 Integrated Flood Management (IFM) calls for a proactive strategy of risk management through a three-pronged attack on reduction of flood risks by reducing magnitudes, vulnerability and exposure of economic activities and human lives. In practical terms, flood risks should be treated as the costs of taking risk. These costs include the cost of risk reduction, costs of managing the residual risks and the flood losses that finally materialize.

114 It is impossible to avoid the contentious issue of how to share the burdens placed on society from floods between different stakeholders, especially in societies which are regularly affected by floods. First, in the public interest, governments provide, to the extent possible flood defenses to reduce or prevent the risk up to a certain design flood, ultimately from taxpayer resources. For the remaining residual risks, further public finances are utilized to a large extent, mainly for emergency response to reduce these residual risks. This involves early warning, evacuation and preparation for disaster relief and flood proofing. A decision should be made on how to share the cost of risk reduction among governments (central, regional and local governments), interested parties (such as private companies), communities and residents.

115 Second, physical transfer of flood risks is an important option for flood risk management. Physically transferring risk, for example through diversion of floodwaters to less vulnerable areas, can help. Third, with all these efforts in place, flooding results in losses due to damage to properties and interruption of economic activities. Some of the losses absorbed by the element at risk are retained risk.

116 Transferring risk through insurance is the last step in a systematic risk management. This can be addressed through sharing the financial risks associated with actual flood losses between the state and all other groups affected. Some key questions are whether the current (and in many cases ad-hoc and uncoordinated) approach to risk sharing corresponds with the shared principles of equitable treatment of various groups in society and whether changes to the current system would allow the solidarity principle to be strengthened. Here it is necessary to take a comprehensive approach to distributing risks posed by flooding across the stakeholder spectrum, which includes various layers of the government, private sector (such as the insurance



industry), and individual users and residents of areas vulnerable to flooding. In addition, flood management practitioners and policy makers should consider uncertainty stemming from climate change and how the cost of related flood risk reduction measures should be distributed across society. The following issues need to be addressed while sharing flood risks:

- Governments are traditionally responsible for protecting the public, so they have the major role in bearing the cost of flood risks, particularly on behalf of the poor. They seek measures to share the costs of risks between various tiers of governments (federal, state and local) and households and businesses.
- It is arguable as to what extent the risk can be shared by the poor tend to settle in risk prone areas. A transfer of burden to an already vulnerable population cannot be justified by argument of efficiency and loss reduction.
- Sharing financial flood risks can take place in various forms, be it through allocation of calamity or reconstructions funds in governmental budgets, internal and external solidarity funds, flood insurance, or catastrophic bonds. Governments can provide the financing in a number of ways that still provide incentives to domestic insurers to operate in an appropriate fashion.
- Often consumers have low risk awareness, particularly regarding low-frequency, high-impact events. Consumers do not usually willingly purchase insurance. The private market can play a useful role in raising awareness, since it has a profit motive to increase market penetration.
- Risk of uncertainty is increased due to poor availability of data, which results in the private market being less able, or even unable, to bear some of the risk. Hydro-meteorological, geographical, and economic data tends to be more readily available for developed countries than for developing countries. Climate change is likely to create new weather patterns, so new techniques would need to be developed to interpret historical data on floods and flood losses to derive meaningful insight into potential flood losses. There is need for more rigorous research and analysis to support flood risk assessments.
- In general, accessing and using data requires a fee. Efforts should be made to make climatological data a public good and its collection fully funded through public funds. Governments would have to reduce this uncertainty by investing more in hydro-meteorological and other data collection.
- Risk transfer requires the establishment of new mechanisms whereby flood risks to the vulnerable, caused by climate change, are spread more widely. In addition to humanitarian motives, there are strong socio-economic reasons for developed countries to participate in new insurance mechanisms.
- While developing river basin flood management plans, financial risk transfer mechanism should be considered in the broader context of flood risk management. Although a last resort in the risk management process, they should be considered as one of the management options from the beginning. This would require greater local participation at every stage of an insurance programme's design, implementation, and monitoring. Such participation of stakeholders at all levels remains a key challenge and yet is crucial to success. The development of the institutional framework necessary to link risk reduction and risk transfer together should be pursued.
- Donors need to invest in knowledge generation and in facilitating knowledge sharing and dialogue among all stakeholders involved, in order to start pilot projects and investigate the financial viability, potential and limits of these projects. Risk data collection and modelling

activities should be supported and brought into the public domain as “open” resources so that they can be applied in order to reduce the start-up costs for future projects.

- Some of the mechanisms listed above have almost exclusively been employed in developed countries. A developing country perspective needs to be brought into the financial risk sharing debate. A discussion of these financial mechanisms in developing countries can contribute to all stages of flood risk management and relieve constraints on the development process and governmental services. Finally, civil society should monitor the impact insurance schemes have on people with different levels of vulnerability.

GLOSSARY

Sources: ^(*) FEMA, 2008b, ^(*) III, 2009, ^(*) Swiss Re, 2009, ^(*) Munich Re, 2009, ^(*) HM Revenue & Customs, 2009, ^(*) Crosby, 1905

ADVERSE SELECTION: The tendency of those exposed to a higher risk to seek more insurance coverage than those at a lower risk. Insurers react either by charging higher premiums or not insuring at all, as in the case of floods (Flood insurance is provided by the federal government in the US but sold mostly through the private market.). In the case of natural disasters, such as earthquakes, adverse selection concentrates risk instead of spreading it. Insurance works best when risk is shared among large numbers of policyholders. ^(*)

BOND: A security that obligates the issuer to pay interest at specified intervals and to repay the principal amount of the loan at maturity. In insurance, a form of surety ship. Bonds of various types guarantee a payment or a reimbursement for financial losses resulting from dishonesty, failure to perform and other acts. ^(*)

CATASTROPHE BONDS: Risk-based securities that pay high interest rates and provide insurance companies with a form of reinsurance to pay losses from a catastrophe such as those caused by a major hurricane. They allow insurance risk to be sold to institutional investors in the form of bonds, thus spreading the risk. ^(*)

CLAIM: A formal request to an insurance company asking for a payment based on the terms of the insurance policy. Insurance claims are reviewed by the company for their validity and then paid out to the insured or requesting party (on behalf of the insured) once approved. ^(*)

CO-INSURANCE: An insurance, usually of large risks, by two or more direct insurers on a joint basis as a means of spreading the risk. The risk is shared between the insurer and the insured. ^(*)

COMMISSION: Fee paid to an agent or insurance salesperson as a percentage of the policy premium. The percentage varies widely depending on coverage, the insurer, and the marketing methods. ^(*)

COVER: Insurance and reinsurance protection based on a contractual agreement. ^(*)

DEDUCTIBLE: The amount of loss paid by the policyholder. Either a specified dollar amount, a percentage of the claim amount, or a specified amount of time that must elapse before benefits are paid. The bigger the deductible, the lower the premium charged for the same coverage. ^(*)

DERIVATIVES: Contracts that derive their value from an underlying financial asset, such as publicly traded securities and foreign currencies. Often used as a hedge against changes in value. ^(*)

DIVERSIFICATION: Risk reduction technique that limits the risk of accumulation by spreading an organisation's risks across different geographical locations as well as across different lines of business, in order to increase the number of mutually independent risks. ^(*)



ECONOMIC LOSS: Total financial loss resulting from the death or disability of a wage earner, or from the destruction of property. Includes the loss of earnings, medical expenses, funeral expenses, the cost of restoring or replacing property and legal expenses. It does not include noneconomic losses, such as pain caused by an injury. ^{(*)2}

EQUITY: In investments, the ownership interest of shareholders. In a corporation, stocks as opposed to bonds. ^{(*)2}

EXCLUSION: A provision in an insurance policy that eliminates coverage for certain risks, people, property classes, or locations. ^{(*)2}

FLOODPLAIN: Any land area susceptible to being inundated by flood waters from any source. ^{(*)1}

FLOOD PROOFING: Any combination of structural and nonstructural additions, changes, or adjustments to structures, which reduce or eliminate risk of flood damage to real estate or improved real property, water and sanitation facilities, or structures with their contents. ^{(*)1}

INCURRED LOSSES: Losses occurring within a fixed period, whether or not adjusted or paid during the same period. ^{(*)2}

INDEMNIFY: Provide financial compensation for losses. ^{(*)2}

INDEX: An indicator showing the changes to particular parameters and allowing comparisons, especially between values and prices, to be made. ^{(*)4}

INSOLVENCY: Insurer's inability to pay debts. ^{(*)2}

INSURANCE: A system to make large financial losses more affordable by pooling the risks of many individuals and business entities and transferring them to an insurance company or other large group in return for a premium. ^{(*)2}

INSURANCE POOL: A group of insurance companies that pool assets, enabling them to provide an amount of insurance substantially more than can be provided by individual companies to ensure large risks such as nuclear power stations. Pools may be formed voluntarily or mandated by the state to cover risks that can't obtain coverage in the voluntary market such as coastal properties subject to hurricanes. ^{(*)2}

LAW OF LARGE NUMBERS: The observed frequency of an event more nearly approaches the underlying probability of the population as the number of trials approaches infinity. ^{(*)5}

LIQUIDITY: The ability and speed with which a security can be converted into cash. ^{(*)2}

LOSS: A reduction in the quality or value of a property, or a legal liability. ^{(*)2}

MORAL HAZARD: The possibility that an insured party may take more risk-taking behaviors because of being insured. ^{(*)6}

OPERATING EXPENSES: The cost of maintaining a business's property, includes insurance, property taxes, utilities and rent, but excludes income tax, depreciation and other financing expenses. ^{(*)2}

OPTIONS: Contracts that allow, but do not oblige, the buying or selling of property or assets at a certain date at a set price. ^{(*)2}

PERIL: A specific risk or cause of loss covered by an insurance policy, such as a fire, windstorm, flood, or theft. A named-peril policy covers the policyholder only for the risks named in the policy in contrast to an all-risk policy, which covers all causes of loss except those specifically excluded. ^{(*)2}

POLICY: The entire written contract between the insured and the insurer. ^{(*)1} It includes:

- The printed policy form;
- The Application and Declarations Page;
- Any endorsement(s) that may be issued; and
- Any renewal certificate indicating that coverage has been instituted for a new policy and new policy term.

PREMIUM: Financial cost of obtaining an insurance cover, paid as a lump sum or in installments during the duration of the policy. A failure to pay premium when due automatically cancels the insurance policy which, upon payment of the outstanding amount within a certain period, may be restored. ^{(*)3}

REINSURANCE: Insurance for insurance companies which spreads the risk of the direct insurer includes various forms such as facultative, financial, non-proportional, proportional, quota-share, surplus and treaty reinsurance. ^{(*)3}

RETENTION: That part of the risk assumed which the (re)insurer does not (retro)cede. ^{(*)4}

RISK: Condition in which there is a possibility of loss; also used by insurance practitioners to indicate the property insured or the peril insured against. ^{(*)3}

SALVAGE: Damaged property an insurer takes over to reduce its loss after paying a claim. ^{(*)2}

SOLVENCY: Insurance companies' ability to pay the claims of policyholders. ^{(*)2}

VOLATILITY: Volatility designates the degree to which individual securities or whole markets fluctuate in value. Volatility is frequently quantified using statistical methods, e.g. by measuring the standard deviations of the relative price differences. ^{(*)4}

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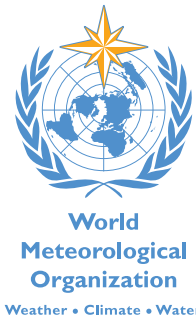
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