Risk reduction or redistribution? Flood management in the Mekong region

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Abstract

Floods, benign and destructive, are an important feature of the landscape, livelihood and culture of the greater Mekong region. In the main valleys and plains rapid economic and social development over the past several decades has altered the use of land and water in ways that profoundly affect vulnerability of households, firms and regional economies to flood events. Disaster risk reduction measures usually involve structural interventions in the form of walls, channel modification, diversions and storage dams. Institutional measures are designed to reduce risks to certain subsets of the population or places, like central business districts. The thesis explored in-depth this paper is that current flood management policies and practices in the Mekong region, often claimed to be about reducing risks, are often more about shifting risks onto already vulnerable and disadvantaged groups.

Keywords: floods, politics, Mekong region, risk, disaster management, Vietnam, Thailand, Cambodia, vulnerability

1 Introduction

Floods, benign and destructive, are an important feature of the landscape, livelihood and culture of the greater Mekong region. In the Red River in northern Vietnam a major system of dykes has been built over millennia to protect farmer's fields and now cities. The delta of the Mekong river in Vietnam and Tonle Sap Lake in Cambodia are dominated by a monsoon-driven seasonal flood pulse. The Ping-Chao-Phraya in Thailand and the Salween and Irrawaddy in Myanmar and the Mekong in Laos PDR and Thailand, are home to both inter-montane valleys with long histories of cultivation and settlement as well as steep mountain tributaries. Across these larger, and many other smaller, river basins of the Mekong region, monsoonal rains swathe the country in green every wet season. Most people who live in flood-prone areas have some capacity for coping with and even benefiting from normal floods.

In the main valleys, coastal plains and deltas rapid economic and social development over the past several decades has altered the use of land and water in ways that profoundly affect vulnerability of households, firms and regional economies to flood events (Lebel & Sinh 2007). Livelihoods that were once dependent on seasonal flooding of rice paddies and fisheries in streams and flood plains now depend on careful control of water levels in irrigation systems or walls and canals to keep floodwaters away from business districts and market places (Manuta et al. 2006; Takeuchi 2001).

In mountain areas the changes to land-use and livelihoods have usually been less dramatic. Nevertheless, in some locations loss of forest cover, poorly made roads and other factors have increased erosion, landslide risks, and delivery of sediments to streams (Sidle *et al.* 2006). Climate change related increases in frequency of intense rainfall events could substantially increase risks from flash floods and landslides underlying the need for constructive engagement between climate adaptation and disaster risk management communities (Thomalla *et al.* 2006).

Floods vary hugely in their attributes. Onsets may be slow and long in duration, or extremely rapid and short-lived with associated debris flows. In most places it is the unusual floods – timing, magnitude or location – that are the most devastating.

The benefits of river floods for maintaining ecological important to services like in-stream fisheries or productive wetlands and floodplains (Folke 2003) are dismissed as irrelevant. Disaster risk reduction measures usually involve structural interventions in the form of walls, channel modification, diversions and storage dams. Indeed the capacity to control floods is often a key part of the rationale for water infrastructure projects supported by the public. Institutional measures in form of insurance or compensation schemes are likewise designed to control and reduce risks to certain subsets of the population or places, like central business districts (Lebel et al. 2006d; Manuta et al. 2006). But a management logic based narrowly on control measures to avoid disturbances, because it handles uncertain or unknowable risks poorly (Berkes 2007) may ultimately end up increasing vulnerabilities (Dixit 2003; White et al. 2001).

The thesis explored in-depth this paper is that current flood management policies and practices in the Mekong region, often claimed to be about reducing risks, are often more about shifting risks onto already vulnerable and disadvantaged groups. In an earlier review we identified common variants of the risk management discourse for floods and disasters and how they have shaped flood policies and practices across the Mekong region (Lebel & Sinh 2007). In this chapter we draw on our own field research in Thailand and Vietnam and reviews of related work by others in these and neighbouring countries to explore the social mechanisms involved in redistributing risks.

The rest of this chapter is organized as follows. First we briefly review our use of key risk-related terms. Second we survey examples of floods and flood risk reduction practices across different geographical zones. Third we summarize our findings around an initial classification of social mechanisms for redistributing risk.

2 Risks

In this paper we are interested in the risk to groups of people from floods. We define **risk** as the odds or chance that a flood event, or change to a flood regime, will have a significant adverse impact on a particular individual or group. The risk of being adversely impacted is a function of the interactions among the severity of the flood or regime change, opportunities for exposure and vulnerability (Figure 1). Impacts include death, harm, losses or damage.

An **involuntary risk** is one that is not freely chosen by the bearer in contrast to the sort of risks people make when they choose goods and services in a market. Involuntary risks and burdens are often allocated by institutions which can be studied to see how they handle issues of social justice (Ahrens & Rudolph 2006; Elster 1992). Risks may be external or *manufactured*, that is, arising from the process of development itself (Giddens 1999). Particular risks may be well understood, uncertain or unknowable in complex social-ecological systems (Adger & Vincent 2005; Berkes 2007).

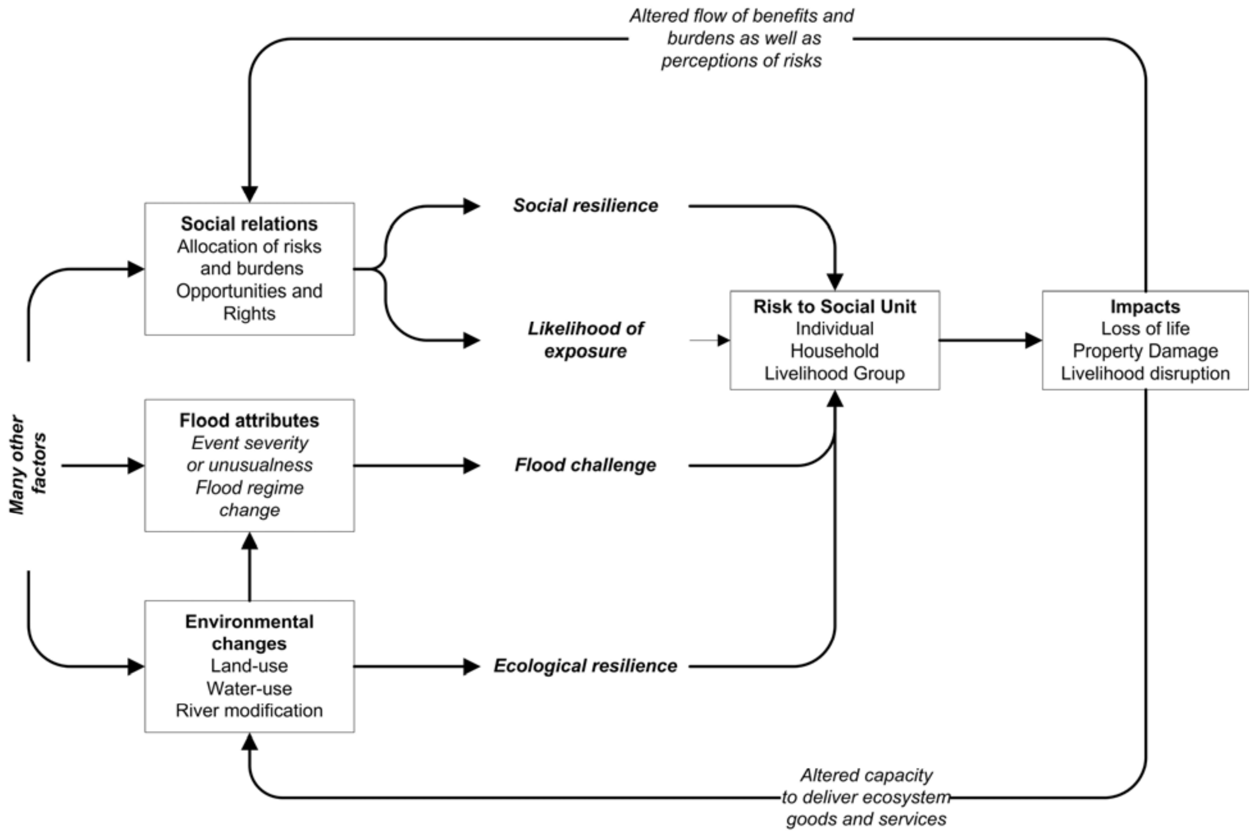
Defining the threshold of a **significant adverse impact** in a useful way for assessment and management can be difficult. It could be done in comparison to magnitude of impacts of other well understood factors or welfare criteria used in compensation or assistance programs. In this paper we restrict our analysis to qualitative interpretation as our interest is in identifying causal chains and clusters or mechanisms.

A **redistribution of risks** is said to occur when interventions have the effect of reducing risks for one group while increasing them for another. Shifts in risk may be produced by physical changes as well as institutional or individual behavioral changes. Redistributions could arise from changes in exposure, social resilience, ecological resilience or flood attributes (Figure 1).

Vulnerability with respect to flooding has many meanings (Green 2004; McEntire 2005). In this paper the **vulnerability** of an individual or group to a flood of a particular type or, a flood regime, is defined as the susceptibility to adverse impact should that such an event occur or the flood regime change. The **resilience** of an individual or group is a measure of its capacity to cope, recover, adapt or otherwise persist in response to the changes and challenges it faces

(Carpenter et al. 2001; Gunderson 2000). Exposure, vulnerability and resilience to floods are shaped by the social, economic and ecological circumstances of everyday living, including power relations (Blaikie et al. 1994; Few 2003; Turner et al. 2003).

Figure 1. A conceptual model for risks from floods with an emphasis on how social and ecological resilience and relations affect risks. Risk is a result of interactions between the flood challenge, the likelihood of exposure and social vulnerability or resilience of the unit of interest.



Risks are also dependent on circumstances and location. To handle the complex of many other factors (Figure 1) which affect social relations, environmental changes and flood attributes we group our observations that follow about floods and risks according to broad geographical settings: in the city, fields, mountains, coast and rivers.

3 Floods

3.1 In the city

Some of the best examples of re-distribution of risks come from efforts to protect major cities (Lebel & Sinh 2007). Flood protection measures to protect the central business district of Bangkok, for example, frequently result in prolonged flooding of surrounding suburbs and districts or farmlands further upstream.

In October 2006, for example, the Thai government diverted flood waters to agricultural fields upstream to protect key parts of Bangkok. A lack of preparedness meant there was inadequate prior consultation with farmers and the institutional mechanisms for compensation were not in place. As a result serious conflict ensued with substantial hardship to farming communities (Lebel & Sinh 2007).

There are also some difficult flood management issues within the greater Bangkok metropolitan area. Additional information about risks could be used to support negotiation over and decisions among parts of the city in handling annual flood risks. For example, a survey of residents experiences of flooding in two low-lying largely residential districts in eastern Bangkok were used to develop loss functions based on floodwater depth and inundation period (Dutta & Tingsanchali 2003).

The Vietnamese government has an even more challenging task of protecting the rapidly urbanizing region around Hanoi given the huge seasonal differences in the water levels of the Red River (Lebel & Sinh 2007). A series of major dykes as high as 15-metres, it should be noted, has been developed in the Red River region over centuries with the result that water levels are now regularly much higher than places where people live and farm. We will explore in some detail this example as it illustrates some of strategies and issues that arise in addressing risk redistribution.

The policy to protect the capital Hanoi from large floods by retaining water in the upper regions and diverting excess flood waters into neighbouring areas has been in place since after the historic high flood of 1971. When introduced, such central decisions, it was then understood, must be followed at local levels. Today, local government and society in flood diversion and retention areas have more power in the decision-making process. Decisions to divert excess flood waters into neighbouring areas, nevertheless, remains a sensitive political issue (Lebel & Sinh 2007).

In 1999, under increasing political pressure to protect Hanoi as a result of concerns with unpredictable flood heights, the Government of Vietnam issued the "*Regulation for Flood Diversion and Flood Retard in Red River System*"(Socialist Republic of Vietnam 1999a, 1999b). This includes, as a last resort, emergency response actions for when flood level of the Red River in Hanoi reaches 13.4 metres. These would involve upstream diversion of flood discharges to primarily the provinces of Ha Tay, Vinh Phuc, Phu Tho, Ha Nam, and Nam Dinh. Diversions into the Day River are decided by the Prime Minister. It is estimated that as many as 675, 000 people would be affected by such diversions (Xuan 2006). The Government of Vietnam believes can reduce risks of such actions through completing construction of the Son La Dam and afforestation works in upstream areas of the Red River (Xuan 2006) .

Negotiation of compensation is not well documented but appears to be largely a technical exercise involving scientists in the field and the Provincial People's Committee (PPC) of the potentially affected provinces (DDMFSC 1999). Thus, a study of public participation documented discussions in the community followed by decisions made in the PPCs. The issues covered were usually local land-use planning and infrastructure development (Neefjes 2004). These are elements of the flood waters diversion and retention compensation scheme, which often represent the interests of the local elites, but not the compensation package itself. The local residents did not think they had meaningful voice over local budget issues so they totally did not have interest, except when it came to their contribution to provide matching or counter funds (Poverty Task Force 2003).

Government policy provides support for evacuation and living during emergencies, support in recovery such as exemptions for children's school tuition fees and agriculture tax in following year (Socialist Republic of Vietnam 1999a). The affected province also receive investments in infrastructure and economic development (Ministry of Agriculture and Rural Development 2001). In these ways some of the risks re-distributed by infrastructure and operational decisions on flood water management are re-dressed.

Education and awareness programs in rural areas harness traditions of sharing risk deeply rooted in local norms. Local residents accept bearing the consequences of diverted flood waters in recognition of damage and loss of life that would occur behind dykes. In these flood-prone receiving areas many have developed coping strategies. Local government, for example, issues instructions on ways to reduce losses in case of flood waters diversion and retention by using rice varieties that required shorter time to mature; or harvested their crops earlier than necessary.

At the same time awareness raising programs in urban areas are somewhat misleading, over-selling the capacity to 'control' floods and the ease of solutions. They usually emphasize structural measures which are primarily of interest to local elites in urban areas of towns and do not mention the social and environmental impacts on the diversion and retention affected areas.

Moreover, because embankments may fail in large floods, management ends up being crisis driven (Fox 2003). Embankments create vicious circles in which flood-plain protect lead to more building and investment behind them, but also greater risk of larger losses in a larger flood event. Flood management needs to take a much broader and more integrated approach.

Flood management in Chiang Mai city northern Thailand needs to take into account risks from overflow from the Ping river which runs through the centre of town as well as flash flooding from run-off from the adjacent mountain, Doi Suthep (Lebel & Garden 2006). Encroachment on floodplains and river banks has seen the main wet season channel of the river narrow substantially as it passes through built-up areas. The expansion of housing estates built on raised soils in the surrounding flood plain further disrupts drainage (Lebel et al. 2007). Canals important for dry season irrigation become conduits for, or diversions of, flood waters depending on flood heights, management and interaction with ad hoc actions taken by firms, communities and government with temporary barriers. There is strong pressure to manage the main channel and various canals or flood barriers to reduce the risks of floods in the central business and tourism district, but doing so increases water depths, velocities and inundation times in other adjacent areas (Lebel & Garden 2006). Various agencies have their own separate plans for Chiang Mai (Manuta et al. 2006).

Insurance for buildings and property, provided premiums are set reasonably and system allowed to function properly, can also work as disincentive to excessive risk-taking by investors in flood prone areas (Fox 2003). Flood insurance is still uncommon in the Mekong region and largely restricted to major urban centres. The regulation and structure of the industry is under-going substantial changes globally which may affect insurance options in the Mekong reigon. Rare but very high pay-out flood disaster events may be better covered as a result of trends in reinsurance which allow small insurance firms to assume greater risk than size of its own assets would otherwise allow. On the other hand, evidence for, and concerns about further, climate change induced to risks of intense cyclones and rainfall events, combined with rising costs of disasters (White et al. 2001) are leading to re-assessment of the insurability of disaster hazards .

Reinsurance transfers some of the risk from smaller insurance companies to the larger re-insurer firm. A related mechanism is so-called catastrophe bonds by which insurance companies shift some of the risk they have (of going broke after a big payout) by shifting some of the risk on to investors which of course benefit if catastrophe does not occur. Such a risk transfers are not directly examples of risk redistribution in the sense used in this paper as it does not necessarily make any other group worse off (at higher risk). Indeed reinsurance may be an important way to counter risk redistribution resulting from selective access to insurance. On the other hand, the fact that a handful of large reinsurance companies dominate the industry should be of concern as it creates potential for shifting certain risks towards less powerful groups and nations.

The issue of competing flood management objectives in urbanizing regions in monsoon Asia is a recurrent one because these commercial and service centres grew up literally from agricultural trading towns and ports in the middle of rice-fields. Flood management issues in the city and in the fields (or on the coast, where these are deltas), as a consequence, are forever intertwined.

3.2 In the fields

Rice is usually thought of as a land-use tolerant, even dependent on floods. Until recently most rice planted in Sena and neighboring districts of Ayutthaya Province in Thailand was of deep-water varieties that “float” and thus highly flood tolerant. In the mid-90s the Ministry of Agriculture has introduced higher-yielding varieties that require careful control of water depths, but which can yield 3-4 crops a year. Irrigation infrastructure is used to create an artificial flood regime without the seasonal peak flood.

The Chaojed Bangyeechon Irrigation Project covers around 434km^2 of Sena and neighbouring districts. The closure of the Klong Kanomjeen water gate in Sena, for example, prevents flooding of the irrigated area but increases flood depth and duration in the constricted flood plain outside it, including market and residential areas (Manuta et al. 2006). The development of industrial estate and manufacturing industry within the irrigation zone adds pressure on the Royal Irrigation Department to prevent seasonal peak floods from entering the irrigation area.

Sena Municipality, on the other hand, has no flood prevention plan. In recent floods the main measures taken are to provide sand bags and temporary bridge structures to access the flooded market area (Manuta et al. 2006). A new project is building a wall along the river to protect the government offices, bus station and main market. No compensation was provided to residents in Sena Municipality as a result of longer duration of floods produced by flood control measures to protect the irrigation district.

In a real sense this population has "lived with floods" for a long time, and have many practical coping strategies to deal with the extended flood period each year, such as, removable shelving to lift perishables and household goods above the high water-level. Farm households outside the irrigated area are usually on stilts and not seriously affected by seasonal flooding, although transport may be inconvenient (Manuta et al. 2006).

The Mekong Delta of Vietnam is under-going similar transition to that in the Chao Phraya basin in Thailand with respect to how floods are viewed and handled. There is now a mix of flood-tolerant and flood-averse livelihoods and settlements strewn across the landscape. The concept of 'living with floods' (Lebel & Sinh 2007) is pursued but tempered by recognition of need, for example, for children to be able to attend school and that modern agricultural and commercial activities are no longer all flood-tolerant. Changes in lifestyles and aspirations as well as migration in of people less familiar with seasonal flood pulse have produced new unanticipated new risks, for example, for death by drowning for children.

The Vietnamese government has responded with flood kindergartens (Dang 2003). These proved helpful in dealing with relatively high flood levels in October 2002. Floods continued to be viewed positively by many farmers because of their impacts on fisheries, renewal of soil fertility, leaching effects in acid sulphate soils, killing rats and insects and providing freshwater.

The "*living with the flood*" policy has had mixed results in the Mekong Delta (Dinh 2003). Support to poor households to elevate their house foundations in 90's failed to provide adequate protection in the devastating 2000 floods. After this Government of Vietnam promoted resettlement of people in flood-prone areas in protected residential clusters without giving up rhetoric of "living with the flood". Many poor households did not want to move into the residential clusters because they were not confident of their capacity to back loans. In one sense it was a shift from a flood to debt-repayment risk. Moreover clusters have insufficient water and sanitation systems, poor public facilities or employment opportunities (Dinh 2003).

On-going study in Binh Dinh Province (Bui Viet Hien & Nguyen Thi Phuong Vinh, in prep.) suggests that poor land-use planning and weak social protection measures are reducing social resilience to floods.

Dai Huu Village, Cat Nhon Commune is one of the lowest-lying areas of Phu Cat District in Binh Dinh Province. The wetlands are highly suited to traditional water-rice planting practices. Peak season floods are prolonged in the commune typically lasting three months (from September to November). During which few productive activities can be carried out because for many years the government has pursued a mono-crop strategy. Farmers are only allowed to grow rice in their land slots; they are not allowed to turn to aquaculture or plant jute in flood season.

To make matters worse the summer-autumn crop appears to have become increasingly vulnerable to floods following the central Government's recommendation for all flood prone areas to shift to two-crops with a higher yielding hybrid rather than conventional three. But no job creation measures were made. With surplus labour most young people migrate to larger cities leaving behind children and middle age and old people at home to do most of the farm work. Although some are able to return to help with harvest, the most vulnerable people – women, children and the elderly – now face the flood season alone.

Similar observations, but with more disastrous consequences, have been reported from coastal areas of Myanmar in the Irrawaddy, Yangon and Pegu divisions where multiple cropping, difficult because of high flood risks, was nevertheless imposed on villages (Thawnghmung 2003).

Seasonality is an underlying feature of monsoon Asia, with periods of both too much as well as too little water. One final way flood management can redistribute risks is among groups who use floodplain areas or parts of catchment for different purposes in different seasons. Across the region multi-purpose dams upstream from irrigation areas are managed against the risks of over-flow or failure late in the wet season versus efforts to try to end the rainy season with as much water stored as possible to supply to irrigation schemes later in the dry season. As concerns with excessive flooding, for example, in flood-sensitive irrigation areas or urban centres, increases the pressure on operating existing infrastructure in ways that minimizes wet season storage rises. The result is a shifting of risks in time: from floods in the wet, to shortages in the dry.

3.3 In the mountains

Flash floods in mountain regions are a distinct set of challenges from those experienced downstream. Flash flood and landslides after intense rainfall events are sporadic and have highly localized impacts. In these situations post-event factors result in some groups bearing larger risks than others *without their necessarily being a shift in risks.*

In 2004 in Ban Mapota, Om Koi District, Chiang Mai province high flood waters and associated debris from landslips destroyed fields and houses (Manuta et al. 2006). Emergency relief by helicopter was provided but very little assistance was provided in recovery stage to a very vulnerable group. Language differences, unfamiliarity and unrealistic bureaucratic procedures that insist reports of damage to dwellings must be made within 3 days for compensation to be considered discriminate strongly against ethnic minorities living in remote areas. The insistence that compensation only be given to households possessing citizenship cards is particularly unfair given that it is the state's failure to adequately provide them in the first place and services to remote areas that created such vulnerabilities in the first place.

Serious landslides following heavy rains in Lai Chau Province in northern Vietnam in 1994 and 1996 were followed by efforts to map landslide hazard risks (Lee & Nguyen 2005). Understanding conditions under which landslides are more likely to occur is critical (Sidle et al. 2006) as well as terrain and other factors which increase likelihood of debris flows or landslide dams disrupting river flows (Yumuang 2006). Such information, however, requires significant research effort to collect and in most mountainous areas of the Mekong Region has not yet been made available in forms accessible to local governments or people living in the areas to take into account in their planning.

Roads are also important to the impacts of sustained or intense rainfall events in mountain areas. They can act as conduits for rapid erosion and delivery of sediments and debris to upper tributary streams (Sidle et al. 2006; Ziegler et al. 2004; Ziegler et al. 2001). Debris trapped under bridges may also create temporary dams that cause diversions or fast-rising waters when they break.

The role of dams in flood management is complex, sometimes helping, but at other times appearing to exacerbate risks because of behaviours they encourage and the lack of effective response when capacities are exceeded.

Dams can be a source of new risks because of sudden releases of stored water (Bakker 1999) or structural failures (Lebel & Sinh 2007). In March 2000, for example, the Se San River in Ratanakiri province of Cambodia rose sharply after an unannounced release from the Yali Falls hydropower dam killing several people and damaging property, crops and livestock (Saroeun & Stormer 2000). Planning for the dam within Vietnam had not included potential environmental and social impacts across the border in Cambodia (Badenoch 2001). Many of the world's most devastating dam failures have been in China. In August 1975, for example, two large dams on the Huai River, Shimantan and Banqiao, collapsed and the resulting floods killed as many as 230,000 people in Henan province alone. The catastrophe was kept hidden from the media and the public for decades (Bhattacharjee 2004; McCully 1998). Flood disasters are treated as national security issues and on this basis often kept secret in Myanmar/Burma, Lao PDR and China (Economy 2004; Seng 2004).

In mountain areas dams can also have direct immediate and longer-term impacts on risks of people who are displaced by their construction.

3.4 On the coast

Risks from floods in coastal areas come from both land and ocean-side events, for example, storm surges, unusually high tides and Tsunami waves.

Rush to control coastal land uses (and deter coastal resettlement) made small fisher households, whose livelihoods were already highly vulnerable from depleted coastal fisheries and competition with larger trawlers, at greater risk in the post-Tsunami recovery process (Lebel et al. 2006b; Manuta et al. 2005).

The Indian Ocean tsunami also had greater impacts on mortality of women than men in almost every country affected (Oxfam 2005). In societies in which women have low socio-economic status disasters are more likely to kill women than men, both directly and as a result of post-disaster circumstance (Blaikie *et al.* 1994; Neuymayer & Plumper 2007). These kinds of risk differences are not all the result of risk redistribution, but social relations in which women are disempowered are likely to be a common underlying cause.

Trade and investments link people in coastal areas to other parts of the world more strongly than ever, both increasing (e.g. through loss of mangroves) and reducing (e.g. through market commercialization and diversification) their vulnerabilities (Adger et al. 2005; Lebel et al. 2002). But interactions in development can be complex. Concurrent changes in property rights to coastal lands in Vietnam towards individual household and privatized arrangements, for example, led to reduced investments by local communities in coastal defenses which then became more vulnerable to flooding from storm surges (Adger 1999; Tri et al. 1998).

Lower flows in the annual cycle in the Mekong delta increase extent and severity of saline intrusions with impacts on agricultural productivity. Intrusion is worst when river flows are low and tide amplitudes are highest (Nguyen & Savenije 2006). Over half of the delta used to be affected. Sluice gates and dams built in the 80's and 90's to prevent saline intrusion have reduced the areas affected by salinity intrusions, but also had other impacts on environment and other land uses, for example, making waterways less suitable for shrimp aquaculture and rice farms on acid sulphate soils because of increasing acidity of canal waters (Tuong et al. 2003).

Some similar interactions have been observed in southern Thailand. In Pak Phanang basin, a new river channel was constructed and a large tidal dam was built to help protect rice farmers from high tides and force a greater separation in activities of shrimp and rice or orchard farmers. There had been a history of conflict over land and water uses in this area between shrimp farmers, rice-growers and orchard growers (Lebel et al. 2002). Reducing risks of saline intrusion for up-stream farmers increased risks of flooding in the main town of Pak Phanang further downstream as tidal surge could not travel naturally upstream. Closing the tidal dam separated brackish and fresher waters as expected altering the production risks for different types of farmers: benefiting some and disadvantaging others. Some shrimp farmers were observed to continue operations by trucking in sea-water they needed in early stages to acclimatize young shrimp to fresh water as they mature.

Flood control which reduces area inundated in the Mekong delta also has significant adverse impacts on groundwater resources: reducing area by 19% in 1993 reduced groundwater storage by 31% and by 44% in 1998 storage reduced storage by 42% (Kazama et al. 2007). Groundwater resources are particularly important for poor rural households who live away from main channels.

Risks of flooding in low-lying areas maybe exacerbated by the impacts of groundwater pumping on land subsidence (Rodolfo & Siringan 2006). While the benefits of pumping go to many the added risks are often born by communities in already flood-prone areas with the least capacity to invest in elevated buildings and other local flood protection measures. Such locations are prone both to river-bank overflow floods as well as storm-water runoff from downpours within urban areas (Parkinson 2003).

Embankments in the Mekong delta while reducing the occurrence of floods become more prone to catastrophic failure if, as is commonly observed, the combination of flood protection structures increase flow velocities in rivers and canals and bank erosion (Le et al. 2007). Construction of upstream dams in the Mekong catchment would exacerbate these processes by reducing delivery of sediments to the delta (Le et al. 2007). Measures to reduce risks in one location or against other factors may result in redistribution of risks to flooding further downstream. Flood forecasting models may help reduce some of the risks (Dutta et al. 2007).

Low-lying coastal mega-cities, unlike smaller villages and towns, can often afford and have the political power to take actions against high tides and storm surges in the ocean. Thus a set of walls has been built along the Chao Phraya River in Bangkok which has protective functions not just against river bank over-flow floods from rainfall upstream. Discussions around making these walls higher if need be to address issue of climate change induced sea-level rise have begun. The walls, however, already increase flooding in other surrounding parts of the metropolitan area, effectively shifting risks to those not living in or near the more central parts of the city (Dutta et al. 2005).

Finally climate change poses new and shifting risks for agriculture within coastal areas. Sea-level rises due to climate change would greatly alter flooding patterns in the Mekong Delta in Vietnam through excessive flooding in tidally influenced areas and longer inundation times in more inland parts (Wassmann et al. 2004). The adverse impacts would effect all three cropping seasons as well as risks of embankment failure (Le et al. 2007).

3.5 In the lakes and rivers

Floods used to be and may still be beneficial for the aquatic and floodplain ecosystems and some users (Fox & Sneddon 2005). The issue of sediment delivery, inadequate or excessive, appears to be as important component of flood regime changes as water levels for ecological resilience. Suppression of natural flood disturbances through dams, diversions, land and water uses affect non-human life and biodiversity in aquatic ecosystems (Dudgeon 2000, 2005). Much of the opposition to dams in the Mekong region is derived from concerns of these impacts from a value of nature perspective or because of their impacts on natural resource dependent livelihoods. Risks in these cases arise more from changes to flood regimes rather than high floods.

The best studied example in the Mekong region is probably the flood pulse in Tonle Sap Lake, Cambodia. The annual flood pulse changes the size of inundated areas in Tonle Sap four-fold (Sakamoto et al. 2007) more or less in synchrony with changes in the Plain of Reeds in Vietnam and Cambodia and the Mekong delta (Tanaka et al. 2003). The lake is critical to fisheries production and food security in Cambodia (Kummu et al. 2006; Varis & Keskinen 2003) but the resilience and productivity of underlying ecosystem processes are still not that well understood (Lamberts 2006) . As a consequence some the major risks, for example, from land-use, fish-harvesting or dam construction remain uncertain.

Abnormally high floods combined with changes in land-use and lifestyles can cause loss of life and significant economic losses. Improved access to information is crucial to fair allocation of flood risks. In the Mekong region there has been some progress with respect to cooperative management of floods in the Mekong River. In November 2001 the governments of Cambodia, Laos, Thailand and Vietnam signed the Flood Management and Mitigation Agreement (Dosch & Hensengerth 2005). A follow-up agreement was signed between China and the Mekong River Commission in 2002, as a result of which China has provided Lower Mekong Basin countries with daily water level and 12-hourly rainfall information from the upper Mekong or Lancang River since April 2003 to help forecast floods (MRC 2003). The Greater Mekong Sub-Region (GMS) flagship program on "*Flood Control and Water Resources Management*", for example, was designed to compliment work by the Mekong River Commission. It focuses on land-use planning, structural measures, and flood preparedness (Krongkaew 2004).

Integrative approaches appear crucial to informing negotiations over basin development, water resources management and flood risks (Kummu et al. 2006) where these are understood to be risks from *changes to the natural flood regime*. At the same time more monitoring, better models and more control structures won't necessarily lead on their own to better or fairer flood management (Sarkkula et al. 2007): improvements to governance are also needed (Lebel & Sinh 2007; Sokhem & Sunada 2006).

4 Risk redistribution

4.1 Mechanisms

Our exploration of flood and disaster risk management practices in different geographical settings revealed several different ways that risks can be redistributed. Synthesizing and systematizing these observations we arrived at a preliminary list of the different classes of mechanisms through which risks from floods are redistributed (Table 1) and group them according to their primary routes of action (cf. Figure 1).

Table 1. Summary of mechanisms through which risks are redistributed

	Description	Likelihood of Exposure	Social Resilience	Ecological Resilience	Flood event or regime attributes
A	Introduction of flood protection infrastructure exposes non-target populations to higher risks	X			X
B	Patterns of settlement that reinforce social stratification leading certain social groups to live or work in places with greater exposure to floods.	X			
C	Emergency relief, disaster recovery, or compensation programs that reduce access to natural resources of one group of affected and disadvantaged people and re-allocate it to others		X		
D	Development policies that reduce flood-season land-use or crop choice or livelihood options which force activities to be under-taken at higher risk times than they otherwise would be		X		
E	Overly-centralized top-down flood management that reduces a community's capacities for understanding risks, responsibilities to take action and overall ability for self-organizing responses		X		
F	Flood protection measures which disrupt aquatic ecosystems upon which one group depends making indirectly more vulnerable to floods			X	X
G	Ways of identifying or re-defining risks that neglects real uncertainties and/or overlooks key impacts on one group but not others	X	X		
H	Efforts to protect urban or rural irrigated areas from flooding in wet season, by for example, releasing storage, increase risks of insufficient water for next dry season irrigation	X		X	
I	Construction of dams and reservoirs to protect downstream areas from floods that result in forced displacement of people from reservoir areas with inadequate compensation, alternative livelihood opportunities or safe places to live	X	X	X	X

Two straightforward ways (A, B) that reducing likelihood of exposure could lead to a redistribution of risks were observed. The first and most common mechanism were interventions with side-effects (A). Also important are situations where past patterns of settlement reinforce exposure of vulnerable populations to floods (B). Such mechanisms are obvious in riverside slum settlements of cities in the region, but may also occur for low and intermediate income classes.

Three other mixed mechanisms (G, H, I) involve both changes in exposure and other pathways. The first transfers risks and alters vulnerabilities because of the way risk itself is defined (G). The second by shifting risks in time affects different sub-groups (H). The third forces a group to bear burdens and risks on behalf of downstream populations without choice or fair compensation (I).

Several mechanisms have their effects through increasing social resilience of one group at the expense of others. One is primarily an issue of resource allocation (C) whereas the other two have more to do with opportunities for choice or self-determination (D, E). Differences in resource allocation may be by socio-economic class, but also with respect to age, gender or ethnicity. It is less clear for the latter two mechanisms how often there really is a risk redistribution as opposed to just situations where one group is disadvantaged and other's remain unaffected.

Finally, a third kind of mechanism is those which have their effects on distribution of risk primarily as a result of how they affect resilience of ecosystems upon which some depend (F)

4.2 Re-allocating risks

Most mechanisms in Table 1 have as an outcome accentuating existing risk differences among individuals or social groups. Could risks be allocated in different ways that don't re-distribute risks that further disadvantage vulnerable groups?

Risks are allocated by institutions in society, but for floods, many of these procedures and decisions are taken without deliberation or scrutiny of democratic processes (Lebel & Sinh 2007). Interventions, what ever combination of structural and institutional measures they involve, should be based on informed negotiation and deliberation with at risk and affected stakeholders. Public engagement is needed to not just allocate, but also to identify and define risks (Jasanoff 2003).

Risk redistribution may be considered a fair and reasonable outcome by all parties if there is adequate and timely distributed compensation. Agricultural lands of lower economic value or where there is a history of flood-adapted practices related to natural wetlands or deep-water rice, remain an important component of flood risk management strategies of many urban areas (Table 1, A). The point here is that losses of crops resulting from intervention to protect urban need to be compensated. Doing so in a sense re-levels the final risks borne by the two groups. Potential for insurance has not been realized in developing parts of Asia. Insurance for crops and livestock could help secure livelihoods (Fox 2003; Freeman et al. 2003).

Uncertainty in risks probably increases the value of including a diversity of views (Berkes 2007; Lebel et al. 2006a). At the same time governance characteristics like accountability and transparency are also likely to be important (Ahrens & Rudolph 2006; Lebel et al. 2006c).

Intentional redistribution of risks is more difficult when the specific risks in question are highly uncertain or unknowable because information asymmetries that can be a basis for discrimination disappear. Policy uncertainty with respect to floods is important in many of the places and situations we studied our reviewed. Who is responsible for risks is often unclear and as a consequence they go unmanaged until too late with the result usually being to the detriment of poor and disenfranchised. For example, if government is responsible for damage to buildings floods then it should budget for it, otherwise give private sector incentives to assume risk (provide insurance) (Freeman et al. 2003); instead what we observe is responses based on political incentives on a case by case basis.

This helps explain why some disasters are allowed to happen: governments act when forced or when there are sufficient political incentives to do so (de Waal 2006). In the Mekong region the constituency affected is paramount: when floods threaten key business interests there are responses, but when farmer and fisher livelihoods are of little interest in the absence of social mobilization which makes disaster visible and, therefore, politically salient. Re-defining floods as disasters and disasters as large-value property losses of firms rather than lives or small-value assets of households reinforces unfair risk allocations (Table 1, G).

Institutional capacities and governance processes more generally, are crucial to flood disaster risk reduction (Ahrens & Rudolph 2006; Lebel et al. 2006c).

5 Conclusions

The way floods and changes in flood regimes are experienced has changed tremendously with urban-industrial development across the greater Mekong region. Societies have gotten more confident in their technical capacities to protect areas from floods with infrastructure (even as it costs more and more). People are increasingly concerned with risks. Mitigation is increasingly described by state authorities in terms of managing risks but these are rarely negotiated. Instead flood management is still seen as a technical exercise of hazard mapping, finding optimal operational rules and formula for compensation. Issues of why some groups are much more vulnerable than others, or are placed at much higher risks are side-stepped. As a consequence disaster risk reduction can end up being about risk redistribution.

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