Adaptation to climate change and social justice: challenges for flood and disaster management in Thailand

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USER Working Paper WP-2007-12

Prepared for, and now under review, as a chapter of a book edited by Fulco Ludwig, Pavel Kabat et al. on Climate Change Adaptation in the Water Sector.

Version : ClimateFloodsJustice071211.doc

1 Introduction

The world has been committed to a changed climate and much of the burdens will fall on the poor in developing countries (IPCC 2007a, 2007b). For a decade or more the seriousness of the challenge has remained on the fringe of the evolving international climate change regime. The threats of disaster from more frequent and intense cyclones, heavy rainfall events, sea-level rise, and warmer temperatures with adverse effects on crops, ecosystems and human health have largely been used to motivate action on emissions. The emerging regime remains focussed on supporting a transition towards stabilizing greenhouse gas concentrations in the atmosphere, at levels which, it is hoped, will prevent dangerous interference with the climate system (Schellnhuber et al. 2006).

Under the current climate change regime a commitment to provide assistance for adaptation has been made. Initial mechanisms to distribute funds have been established. But, as no mandatory levels on contributions were agreed to what funds are available remains negligible relative to impacts and needs (Paavola & Adger 2006; Parks & Roberts 2006). Improving financial assistance to developing countries from the developed countries which caused climate change in the first place is a core social justice issue in international climate politics (Adger 2001; Adger et al. 2005a; Thomas & Twyman 2005). International assistance with adaptation is crucial for least development countries and where most attention has focused so far.

Within newly industrializing economies like Thailand the absolute resource and capacity constraints to adaptation are less. But the question of winners and losers arises just the same: for whom, and how, is adaptation to be pursued? Issues of justice arise with respect to allocation of resources, burdens and risks (Kates 2000; Thomas & Twyman 2005). In this paper we focus on the case of floods in Thailand.

Over the past thirty years the number and impacts of flood disasters has continued to increase across Asia even as abilities to monitor, warn and describe have vastly improved (ABI 2005; Dutta & Herath 2004; Few 2003; White et al. 2001). In Thailand this in part reflects growth in the absolute numbers of people living in flood-prone areas and the higher values of infrastructure at

risk (Nicholls et al. 2007). Thus, as Bangkok, and other regional centres like Chiang Mai or Hat Yai, expanded new settlements increasingly moved into lower-lying flood-plains.

Better early warning systems and improved emergency response capacities have helped reduce losses of life, but with more property, crops and livestock at risk, insurance and other compensation schemes under-developed, managing flood disaster risks remains a serious challenge. For those beyond the edges of rural modernization and urban economic prosperity the risks from floods or adverse changes to flood regimes have often not being reduced as new involuntary risks are re-distributed towards them as wealthier inhabitants protect themselves with infrastructure, insurance and compensation (Lebel & Sinh 2007).

The central concern of this paper is on issues of social justice in how floods are managed now, and might be in the future, given changes in flood regimes resulting from climate change and adaptation policies. Our main argument is that there are serious limitations in how floods and changes to flood regimes are being handled today and that these could easily be made worse by both inaction and misguided adaptation policies.

2 Climate change and flood regimes

In Thailand, with its' monsoonal climate, floods are normal part of the seasonal cycle and seen as beneficial to some ecosystems and livelihoods by some stakeholders. Floods are most likely to become disasters when they are unusual in timing or severity. Individual flood events pose risks and may contribute to disasters, but in the medium and long-term, it is changes to flood regimes that re-define what is unusual and normal, which pose the most important challenges to institutional development and adaptation. A flood regime is a historically experienced pattern of variability in onsets, durations, extents and frequencies. Here we highlight five kinds of changes to flood regimes to which climate change may contribute (Table 1).

In some basins long-term trends in rainfall may have also altered flood regimes, but untangling the contributions of different factors is difficult. For example, total annual inflows from the Upper Ping River into Bhumipol dam has declined (Sharma et al. 2007) by about 0.47% yr^{-1} over the last almost 50 years (Lebel et al. 2007a). At the same time irrigation areas have greatly expanded, forests have been converted to orchards, croplands and human settlements and rainfall at the main Chiang Mai station has declined about 0.28% or 3.3mm yr^{-1} (Lebel et al. 2007a).

Global warming is likely to cause additional changes to flood regimes and affect different kinds of floods in different ways (Table 1). Regional assessments in the latest IPCC reports (IPCC 2007b) suggest likely increases in wet season precipitation (June-August) and decreases in dry season (December-February). Where drying trends are being experienced or anticipated, reducing flood peak-heights or durations can be very important to wetlands, fisheries and agricultural ecosystems. More intense rainfall events, for example associated with more intense cyclones, increase flood peak-heights and durations causing damage to property and posing risks to life in flood plains (Table 1). They also increase risks of flash floods and landslides in mountain areas. Sea-level rise exacerbating flood risks in low-lying deltas. Finally, warmer temperatures may interact with flood patterns to alter exposure to water-borne diseases and thus alter risks of flood-related disasters.

Altered flood regimes do not translate linearly into altered risks of flood and flood-related disasters. Modest changes in a flood regime may not have much impact until a threshold is reached after which the impacts become large. Changes in flood regimes may interact with other processes of change, for example, riparian land-uses, styles of building construction or water withdrawals, which reduce or exacerbate the physical risks of disasters unfolding. Changes in flood regimes may interact with agricultural decision-making in complex ways as farmers try to adapt to changing risks of shortage or excess at different times of the year and in so doing alter run-off, ground water recharge and return flows to rivers from their fields.

Implied rather than explicit in Table 1 is variation in how quickly waters rise and fall, how long they last, and what sediments, debris and other pollutants or disease risks they carry with them. Changes in water quality can be as important as quantity to the risks a flood poses to humans. Faster flows and flows with debris cause a lot more damage and loss of life. Contamination of drinking water supplies is often critical factor in disease outbreaks after flooding.

Table 1. Summary of how different types of floods may be affected by climate change and the consequences for vulnerability.

Types of floods	Anticipated impact of climate change on flood regime	Other factors affecting flood regime	Affected and vulnerable groups	How adaptation could exacerbate social justice issues
Flash	Higher frequency of intense rainfall events in urban areas	Increased run-off from impervious services with urban development	Informal settlements near canals and drains	Eviction, no support for settlement
Landslides & floods	Higher frequency of intense rainfall events in mountain areas increase risks of landslides and flash floods	Altered hazard risks from land-use changes	Upland farmers and people living in rural towns near river banks	Relocation or restrictions on agricultural land-use that make more vulnerable to food shortages
River bank overflow	More prolonged rainfall episodes from more intense cyclones-depressions increasing bank overflow	Large-scale reductions upstream in tree-cover for agriculture and urban development Irrigation schemes Structural failures – dams and embankments	Human settlements, industry, infrastructure and agriculture	Diversion of water into farmers fields to protect cities without compensation claiming "acts of nature"
Coastal floods	Increased risk of coastal flooding from sea-level rise	Land subsidence from groundwater pumping	Coastal farming and fisher communities	Embankments to protect hotels & valuable property that causes erosion and flood risks in surrounds
Seasonal floodplain inundation	Reduced flood heights and duration from decreased inland rainfall	Diversions, withdrawals and flood plain protection measures	Lowland farming communities Fishers and harvesters of products from wetland ecosystems	Draining and filling of wetlands as "flood-prone areas"

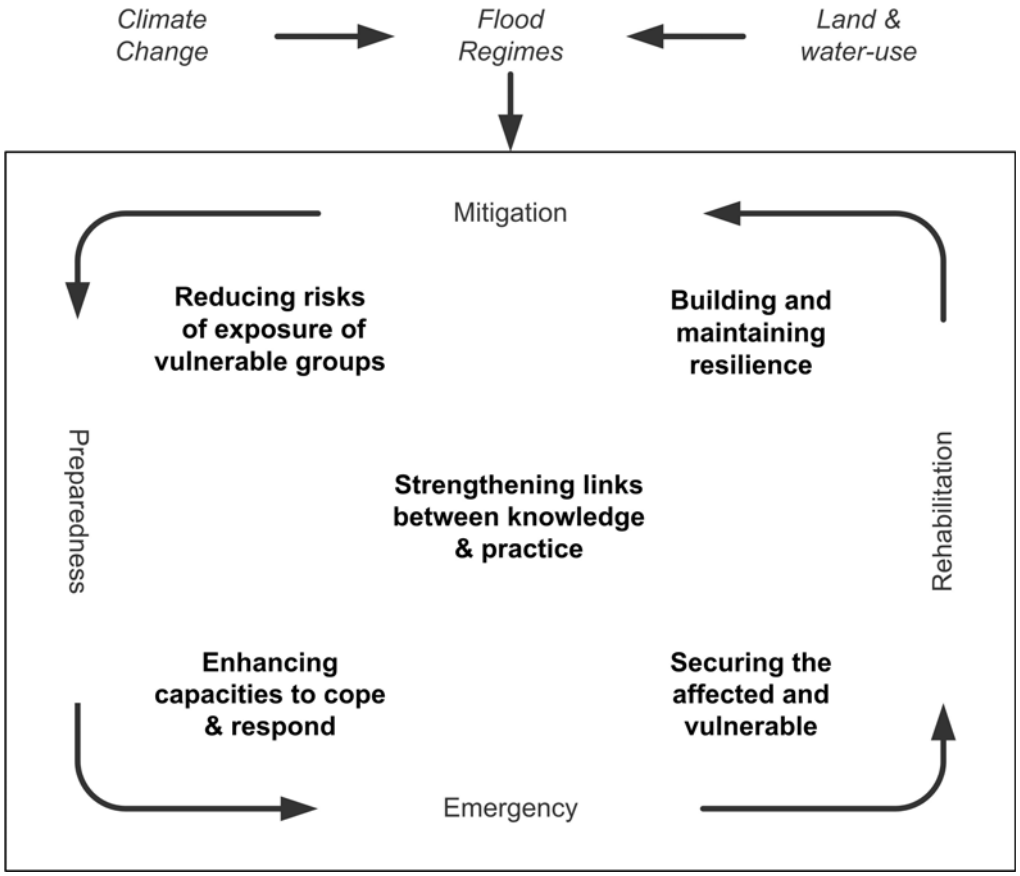
Changes in flood regimes may also interact with other social factors affecting risk, like access to resources, levels of convertible assets and wealth. A change to a more benign flood regime, for example, may reduce the implications of an increase in social vulnerability. Conversely, a more adverse flood regime may not increase overall risks if it coincides with a decrease in social vulnerability, for example, arising from economic development. This latter compensatory effect is difficult to measure precisely but can be expected to be important in Thailand with its history and prospects of further significant economic growth.

The likely impacts of climate change on flood regimes in Thailand (Table 1) are not known with much precision for specific locations. Regional differences across Thailand can be expected given current differences in climate: from dry and highly seasonal conditions in Northeast and Northern Thailand to the less strongly seasonal moist tropics of the Southern peninsula. Projections of future rainfall patterns are very uncertain and current modelling efforts do not yet provide much reliable information at the level of individual basins although this an area of active research (e.g. Richey et al. 2007; Sharma et al. 2007). Table 1 provides a set of five types of changes that need to be considered in adaptation. The large uncertainties have consequences for how challenges are articulated in particular places and basins and what make for appropriate and strategic responses.

3 Challenges

Government, business and civil society are beginning to respond to the challenges posed by climate change (Lebel 2007; OEPP 2000). For flood and disaster management the governance challenges can be conveniently grouped in relation to the conventional disaster cycle (see: Lebel et al. 2006b) as follows: reducing risks of exposure, enhancing capacities, securing the affected, maintaining resilience and strengthening links (Figure 1).

Figure 1 Adaptation to changing flood regimes as a consequence of climate change and other factors poses multiple challenges for fair and effective flood and disaster management.



The rest of this paper will deal with each of these in turn. Each section begins by describing the challenge, then proceeds to review how it is currently handled and how it is being or could be dealt with under future climate. Each section ends with a brief reflection on the key elements of a strategic response.

3.1 Reducing risks of exposure

The challenge of reducing risks of exposure (Figure 1) has traditionally been framed as a technical activity for engineering, water and disaster management experts. Land-use planning and hazard mapping emphasizes hazard characteristics and familiar measures rather than efforts to understand differences in risks of exposure. Broader public engagement, when it occurred was not sought, but forced upon responsible agencies after the event by affected peoples with political clout and money.

Flood protection measures to protect central business districts may redistribute risks and burdens to neighbouring urban areas or surrounding rural locations (Lebel et al. 2007b). In October 2006, for example, the Thai government diverted flood waters to agricultural fields upstream to protect key parts of Bangkok. Sena District in Ayutthaya Province took some of the initial diversions after His Majesty the King allowed the Royal Irrigation Department (RID) to flood some of his own land to protect Bangkok (Anon 2006a). Many other areas were subsequently flooded with promises of

compensation be made for the service provided farmers followed RID planting and harvesting instructions (Anon 2006b). The RID also argued need for a law to give them authority to flood areas c during high-water periods (Anon 2006b). Despite a long history of similar events (cf. Manuta et al. 2006), inadequate prior consultation with farmers and absence of a proper institutional mechanisms for compensation, meant serious conflict ensued with substantial hardship to farming communities.

The Department of Disaster Prevention and Mitigation (DDPM) was established in October 2002 as " *the principal government agency to carry out the task and responsibility on disaster prevention and mitigation so as to remain in Thailand as the inhabitable and safe country*" (DDPM 2006). It replaced the earlier Civil Defense Division but remains within the Ministry of Interior. It is organized through a hierarchy comprising a national committee a system of 12 regional centres and then local Civil Defense Committees as part of normal bureaucratic structure (province, district, local). DDPM (2006) ranks disaster risk from flood as the highest priority for Thailand. The DDPM does not mention Climate change in its annual report of 2006.

Thailand has more than 16 million people or 26% of its population living in the low elevation coastal zone (< 10m) or 9th overall by population exposed (McGranahan et al. 2007). Low-lying areas of Bangkok, in particular, face flood challenges from both upstream and seaward (ABI 2005; Dutta et al. 2005; Dutta & Tingsanchali 2003; Nicholls et al. 2007). Land-subsidence from ground-water withdrawals in Bangkok (Gupta & Babel 2005) will magnify what otherwise should be relatively modest sea-level rises due to global warming (Table 1). In the unlikely event of much larger rises in sea-level challenges for coastal areas from flooding could become catastrophic. Scientists seriously discuss the risks of ice sheets of Antarctica and Greenland melting, but acknowledge the complex feedbacks and amplifying effects make prediction difficult. Nobody wants such catastrophes to happen, few want to contemplate the consequences, but some of us must do so (Schellnhuber et al. 2006). Scenario-based analysis and long-term contingency planning are necessary to strategic development of adaptation policies.

Massive infrastructure projects have been proposed to protect Bangkok from flooding. One recent example launched by disaster experts and politicians was a proposal to build an 80km long wall 300m offshore and 3m higher than moderate sea-level to protect Bangkok and two surrounding provinces (Wipatayotin 2007). Proponents claimed such a wall would allow mangroves to grow inside and slow down coastal erosion. Needless to say impacts on other people, ecosystems and cost-effectiveness of all such mega-projects need carefully scrutiny as the side-effects may be larger than risks they are proposed to address.

Alternatives should be considered, in both moderate and more extreme scenarios, including simply making more space for water, as in for example, restoring multi-functional seasonal wetlands, and directing settlements further away from the low-lying coastal areas. Major shifts in land-use are not going to be easy to achieve, but probably essential (McGranahan et al. 2007; Nicholls et al. 2007). Such shifts will need high quality public information, opportunities to debate and negotiate acceptable levels of risk, and forward-looking infrastructure investments to support movement of built-up areas across the landscape.

Reducing risks of exposure requires engagement with, and strong representation of, groups likely to be highly affected or especially vulnerable. Those at most risk should be given opportunities to participate in reshaping and reducing the risks to which they are to be exposed. Scenario-based approaches can be helpful in handling uncertainties. Informed deliberation is critical to avoid inappropriate over-reaction, for example, unnecessary re-locations, as well as premature dismissals of risks. Fairly allocating scarce resources, and conversely, burdens and involuntary risks, will often be more of a governance and administrative than engineering challenge.

3.2 Enhancing capacities to cope and respond

Capacities to cope with and otherwise respond to floods (Figure 1) and potential disasters can be enhanced or eroded by regulations and practices of state agencies (Manuta et al. 2006).

Local adaptation to changing flood regime arising from urbanization of former irrigated agricultural areas is underway already. It is enhanced by diversification. Lower income households across rural-urban gradients in Thailand often maintain diversified livelihood and income sources

(Rigg 2006). This diversity reflects historical responsiveness to opportunities and demands which can be drawn on in face of all kinds of challenges, including, crop losses due to flooding.

Government agencies are beginning to recognize the importance of local community organizations and networks in preparedness and emergency response. But acknowledging and working with others should not become an excuse to off-load public responsibilities. Decentralization reforms in Thailand have helped make local government more accountable to their constituencies on scales relevant to flood early warning and defense systems. But it also raises issues of capacity where responsibilities are transferred without matching financial resources, needed equipment or building of relevant capacities.

Overall it is not clear that the creation of dedicated, centralized, agencies for disasters has really helped build response capacities. One reason is the persistence of bureaucratic competition and fragmentation. With a huge mandates, small resources, and reluctant support from the line agencies that still hold the real expertise "disaster" agencies are still finding their place in flood management. Local government, central agency branches and community initiatives often appear to be more important (Garden 2007; Manuta et al. 2006).

Effective disaster preparedness and early warning systems requires high quality two-way communication between those at risk and those with expertise and resources that can help. On the ground field-work suggests redundancy of such channels is beneficial, for instance, when local radio stations are able to step in when formal administrative system is on holidays or adversely by flood itself (Garden 2007).

Flash floods in mountains are particular hard to address with centralized and remotely managed early warning systems. People at risk need to be able to recognize warning signs of high risk, for example, intense prolonged rainfall, stream and river quality indicators, and take precautions during such periods. Radar can provide generic warnings about likelihoods of intense rainfall events over broad areas but such information still will often be inadequate alone for local disaster management. Tourists may be at higher risk because of unfamiliarity with speed at which floods in mountain streams can rise. There have been several fatalities of visitors to national parks in Thailand in recent years after intense rainfall events.

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 (Garden 2007). Early warning systems are in place and are reasonably effective at providing adequate time for residents to prepare for river-bank overflow events due to high rainfall further upstream (Junkhiwaw et al. 2004). But, as in Bangkok 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 (Manuta et al. 2006). Doing so increases water depths, velocities and inundation times in other adjacent areas. Conflicts often ensue among different quarters of the city as flood waters arrive (Garden 2007) and different local agencies attempt to secure their areas. The redistribution of risks among rural and urban, and among wealthy and poor within urban areas, is central theme of flood politics in the Mekong region (Lebel & Sinh 2007).

Politicians increasingly view flood disasters as opportunities and have been instrumental in making the bureaucracy more responsive to public inputs. A series of floods which affected Chiang Mai in 2005, resulted in political responses at multiple levels, but with little real action (Garden 2007). The mid-2007 municipal elections were notable for a campaign in which many posters pictured candidates standing waste-deep in flood waters. In Municipal Chiang Mai traditional weir-based irrigation systems known as Muang-fai distribute flood waters through what were rice fields but are know, in part, built up suburbs and commercial districts. Many citizens of Chiang Mai want these irrigation structures near the city removed and river allowed to adjust to natural levels, but there are also calls for high walls to block peak heights.

This tension underlines the special problem monsoonal areas of Thailand face with current and future climate. A recurrent annual challenge in operating water infrastructure upstream from Chiang Mai city is to balance objective of maximizing storage for dry season irrigation and domestic consumption needs versus allowing sufficient storage volume to capture late wet season

rainfall. Let depressions or cyclones can pose major risk to urban flooding at a time when river levels are normally already high (Lebel & Garden 2006).

Even higher wet season peaks or reduced seasonal inundation of flood plains in the dry season (Table 1) under climate change could make operational decisions for dam and canal infrastructure management much tougher than they already are. History in Thailand suggests more powerful actors can be expected to mobilize private or public resources to protect themselves, for example, by rising the heights of the soil on which they make their buildings in flood plains (e.g. Hara et al. 2007), regardless of the side-effects resulting water flows have on others (Lebel et al. 2007b).

Strengthening capacities to cope would benefit from better land-use and drainage planning as well as construction codes that could make homes of the poor, often situated near canals, safer (Auffrey 2002). In the monsoonal climate, sound construction, reducing speed of flood waters, and providing early warning so people can move their belongings to higher ground, may be more plausible and effective response then overly ambitious attempts at preventing flood waters from ever entering areas with human settlement, or worse, supporting calls for eviction from high risk locations without providing alternative options for safe low-income housing.

People living in flood-prone areas often have diverse strategies for coping with adverse impacts of floods. When roads are flooded they use boats and elevated walkways to cross between buildings and get their children to school. Without ducking responsibilities for improving welfare and reducing risks of disaster, it also seems important to provide adequate space for people to draw on their own capacities, networks and strategies to cope and respond to floods (Few 2003; Thomas & Twyman 2005). Disaster management institutions should enhance and support opportunities for self-organized and –determined responses.

3.3 Securing the affected

Despite widespread improvements in well-being – decades of economic growth across Asia have reduced poverty and improved health and education of many people – the impacts of climate variability and extremes are distributed very unequally. Disaster policies, programs and practices have not secured the most highly affected and vulnerable groups (Figure 1) from flood disasters. Spatial coverage of relief operations can be limited, and of rehabilitation programs even more so.

Difficulties often start from failing to acknowledge the large social differences in the impacts of floods and disasters. 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). Women died more than men in almost every country affected by the Indian ocean Tsunami (Oxfam 2005). If flood waters contaminate shallow drinking wells it is women that will have to walk further (Crow & Sultana 2002). If floods cause crop losses or food shortages the extra burdens and sacrifices are usually borne disproportionately by women (Denton 2002).

Complex procedures for compensation can multiply vulnerabilities that began as social differences. Communities of ethnic minority upland farmers or coastal fishers struggled to get equivalent levels of support in recovering from disasters and often need to appeal through non-state channels to mobilize resources (Manuta et al. 2006).

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 (Manuta et al. 2006).

Although the Tsunami has nothing to do with climate change risks per se, being by far the largest disaster to strike Thailand, the challenges it posed to social and ecological resilience of coastal communities and the institutional responses it triggered are insightful for understanding disaster governance and its current limitations. 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. 2006a; Manuta et al. 2005). The importance, but difficulties inherent in, financing and integrating rehabilitation of marginalized groups, not just foreign-income earning tourist destinations, into normal development once the relief-enthusiasm has waned are noteworthy.

Securing the most affected and vulnerable people have not been a priority of national or local governments, although decentralization reforms has improved the accountability of local politicians and associated bureaucrats to particular jurisdictions.

Emergency relief efforts following floods and disasters under current and future climate may not need to be any different. But in rehabilitation there may be opportunities to take into account extreme events as evidence of changing flood regimes and respond more pro-actively on development for affected and vulnerable people. As reducing risks of disaster become part of normal considerations in development alternative approaches will be needed.

3.4 Building and maintaining resilience

Reducing risks from floods does not just depend on proximate actions before and after floods. Ultimately some of the more profound impacts could came from building and maintain the resilience of highly vulnerable groups (Figure 1). This could involve for example, expanding livelihood opportunities or restoring ecosystems upon which they depend for food, shelter and income (Table 1).

Much of the costs in wealthier countries like Japan are related to maintaining and repairing flood protection infrastructure as cities expand further into vulnerable locations (Takeuchi 2001). In Thailand there is a history of assuming large-scale water infrastructure, as dams to store and canals or tunnels to transfer water among basins, as the best solution to problems of both excess and shortage. Changing climate and flood regimes imply a careful rethink of this approach. Infrastructure which is proposed needs to be assessed with respect to future environmental conditions and resource demands not just short-term political opportunities. Large dams that displace people but are never more than half-full don't help; nor do walls and diversions that just temporarily displace risks in space or time. It may be possible to greatly reduce vulnerabilities by paying much more attention to those factors which enhance social and ecological resilience.

For many livelihoods and sectors, rare but large risks, might be better handled with insurance or catastrophe bonds, than hard to maintain and expensive infrastructure which might lead to unreasonable risk-taking behavior. One problem is that investing and living in coastal cities could become much riskier with changes in sea-levels or increases in intensity of cyclones and storms (McGranahan et al. 2007; Nicholls et al. 2007) re-insurers will become reluctant to help local insurance companies in vulnerable locations without costly and complex state guarantees. These may be beyond the capacity of developing country governments and need international assistance. Innovative financing to help countries adapt to climate change induced flood disasters will be needed (ABI 2005; Bouwer et al. 2007).

The emphasis on physical interventions also fails to recognize the important contributions made by ecosystem to reducing vulnerabilities to floods. Complex ecosystems apart from providing short-term protection to floods are often capable of substantial and surprising levels of self-organized recovery in response to disturbances (Berkes 2007; McCully 2007). Rather than assuming the need for direct human intervention ecological resilience might be managed to reduce long-term risks to people. Unfortunately, over-exploitation and extensive degradation of coastal ecosystems has reduced their resilience making communities more vulnerable than they would be otherwise (Adger et al. 2005b).

The wetlands in the delta of the Chao Phraya river has been transformed by five decades of interventions with water infrastructure including embankments, dams, irrigation and drainage canals (Haruyama 1993). Local rainfall in the lower central plains is prevented from draining naturally by roads and irrigation infrastructure also increasing risks of deeper and longer flooding in flood-prone areas further inland in Suphanburi and Angthong provinces (Haruyama 1993). Within the city flood waters tend to collect in low-lying eastern parts of the city for prolonged periods (Dutta & Tingsanchali 2003). Bangkok's canal system which had supported a lifestyle that

fitted the monsoonal pulse has been neglected in the furious pursuit of roads (Ross et al. 2000). The loss of resilience has been compounded by groundwater extraction. Land subsidence in Bangkok metropolitan area increases the risk of floods in urban areas (Babel et al. 2006). Deep well groundwater extraction has resulted in compaction of sand and clay layers. Observed subsidence of 0.5m-1.0m have been measured in some areas. More recent suggest land subsidence still occurs but at reduced rates in the heavily built critical zones of the city where rates are now around 1cm/year. Higher subsidence rates are now observed in more coastal areas increasing risk of seawater flooding. Similar impacts from groundwater extraction on land subsidence and subsequent flood risks have been measured for Manila where, ironically, even more attention is given to risks from sea-level rises induced by climate change (Rodolfo & Siringan 2006).

In Thailand with more modest resources and technical capacities adaptation many areas will have to rely much more on "living with changes in flood regimes". Fortunately there is already a lot of local expertise within the region on how to do this well, and, which in some locations with proper support, may be a better outcome for local livelihoods then interventions that prevent flooding.

In the Songkram River wetlands, for example, the majority of residence view flood events as positive: they are times when catch more fish, have higher incomes and more food to eat (Blake & Pitakthepsombut 2006; Friend 2007). More extreme floods can, however, damage paddy rice crops and effect drinking water supplies. Overall the expectation is that droughts would have more adverse impacts than floods, but that there is substantial resilience to changing climate in the society, especially with on-going expansion of livelihood options on- and off-site (MWBP 2005).

Internationally, it is increasingly recognized that disaster management needs to shift from a focus on hazards to a broader vision that includes addressing vulnerability and resilience (ISDR 2005). This shift is helpful to addressing underlying vulnerabilities to changes in flood regimes and climate.

One of the less direct but potentially most profound responses for highly vulnerable groups to the challenges posed by climate change is to restore and protect seasonal flood plains, mangroves and wetland ecosystems, allowing compatible uses. In making more space for water and nature key the risks posed to less flood-tolerant infrastructure elsewhere can also be lessened.

3.5 Strengthening links between knowledge and practice

It may not be easy to tell if flood regimes are changing because of climate change until well after it has happened. Flood regimes and the risks they pose to particular social groups, in any case, are affected by multiple factors (Table 1). Planning will invariably take place in the presence of significant knowledge uncertainties. But a better understanding of how floods impact different groups and how flood and disaster management systems performed through a disaster cycle is extremely valuable to efforts of reducing risks of disaster (Figure 1).

Comprehensive evaluations of flood and disaster management systems through full disaster cycle are rare except following events that cause major losses of life. Most responsible agencies view such assessments as a threat, fearing culpability, rather than an opportunity to learn how to do their job better (Manuta et al. 2006). Better data on disasters is crucial (Bouwer et al. 2007).

Understanding of causes of floods and flood regime changes is also important to taking appropriate remedial actions. Unfortunately, much policy on floods appears to have been made with little reference to evidence-based reasoning. It is common practice in Thailand, for example, to blame all floods on land-use changes in the mountains (Forsyth 1998; Walker 2003) without paying any attention to amount or intensity of rainfall. The impacts of changes in land-use on watershed hydrology in the mountains with complex landscapes, when studied carefully, are complex and more uncertain than often claimed (Bruijnzeel 2004; Richey et al. 2007; Sidle et al. 2006).

An example from Southern Thailand illustrate some of the pitfalls of quick attribution. Major floods occurred in Hat Yai, southern Thailand, in 1988 and 2000. The floods 21-24 Nov 2000 killed 30 people and caused more than 220 million USD damage. In 1998 about 5.6%, and in 2000 about 22% of the municipal area was inundanted to depth of more than 2 metres. Some communities were submerged more than others. Tanavud and colleagues (2004) assert that vulnerability of Hat Yai to floods increased as a result of reduction in forest in the upstream of the Khlong U-Taphao basin between 1982 and 2002 from 20% to 11% of forest cover. Most of the land,

the authors note, was converted to rubber plantations. They argue that the conversion "*disturbed the finely tuned equilibrium of the natural ecosystems to such a degree that environmental stability was compromised*". Quick and simplistic attribution of floods in urban areas to events upstream in the watershed are a common in practice in Thailand (Lebel & Sinh 2007; Manuta et al. 2006); careful scrutiny of changes within urbanizing regions is much rarer.

Thailand's "Initial Communication" (OEPP 2000) under the United Nations Framework Convention on Climate Change (UNFCCC) makes few specific references to how it proposes to adapt to climate change impacts on floods. The standard line then and since has been that "*reforestation, afforestation, protection of conservation forests, land and water conservation also support the adaptation process*" (OEPP 2000: 69).

Since the mid-1990's climate change has been simply incorporated into existing environmental debates (Forsyth 2003) and policy in which re-forestation is prescribed as a solution to all environmental ills, real and imagined. The problem is that in practice this usually means focusing on restricting land-use in vulnerable mountain areas, relocation and other drastic policies that would make marginal people even more vulnerable while major factors affecting risks within floodplains are completely ignored.

Misleading attributions of recent individual flood events or disasters to climate change may also prevent learning because they also become an argument for blaming others – global warming – rather than examining those contributions to vulnerability and differences in risk which can be addressed locally. Poorly reasoned and unfair adaptation policies could increase risks for vulnerable groups (rightmost column, Table 1). This is the dark-side of adaptation.

Overall capacities for assessing vulnerability and adaptation options in Thailand are fairly limited, indeed so much so, that the Initial Communication to UNFCCC published in 2000 states" *the lack of comprehensive research in this area seriously limits the ability to make appropriate policy recommendations*" (OEPP 2000). A review carried out in 2007 suggests not much has changed since (Jesdapipat 2007). Public awareness, however, seems to be growing substantially with a lot more media coverage of climate change events and international issues in 2007 then earlier years.

Apart from informed expert and bureaucratic input public engagement in assessment processes is needed to help reduce policy- and interest-driven biases.

With changing flood regimes resulting from climate change the need for continuous monitoring, evaluation and learning will become even more important. Much can probably be gained with better linking existing local, practice and scientific-based knowledge.

4 Discussion and conclusions

National and local governments and special line agencies concerned with flood and disaster management in Thailand have struggled to cater for the interests and needs of the poor and other disadvantaged groups under current climate variability and recent flood regimes for many different kinds of floods (Table 1). Issues of social justice have been largely ignored, but should be made central to the pursuit of reducing risks of disasters.

Flood regimes and risks are already changing in Southeast Asia as a result of human activities. The prospects of additional risks from the impacts of climate change on flood regimes makes the needs for forward-looking actions greater than ever before. But interventions in the name of adaptation to climate change can create winners and losers (Table 1). They can shift the distribution of benefits or involuntary risks from one group to another. Adaptation may even exacerbate injustice, as when actions in the logic of protecting national assets and interests make some disadvantaged groups even more vulnerable than they were before.

There are four main reasons why climate change could significantly exacerbate existing unfairness and inequities corresponding to each of the major management challenges (Figure 1). First, risks of exposure vary hugely across different social groups despite profound improvements in average measures of well-being, health and economic development. Second, capacities to influence decision-making on behalf of, or by, vulnerable groups remains limited with the consequence that opportunities to enhance capacities to cope with and otherwise respond to floods are unnecessarily constrained. Third, ethnic minorities, migrants, women and other second-class citizens continue to

be at a disadvantage in relief and rehabilitation efforts as a result of discriminatory policies and practices that limit access to key resources and services. Fourth, some of the most vulnerable groups are dependent on seasonal floods for the maintenance of wetland and farming systems, but which excessive river regulation in name of flood protection and for other objectives makes less resilient. High risks of exposure, weak political influence, limited access, and neglected dependencies, together, spell disaster.

New approaches are needed to more fairly and equitably address current and future challenges posed by changing flood regimes including the anticipated impacts of a changing climate. The political and institutional dimensions of disaster management need to be acknowledged and become a foundation for improved disaster governance (Lebel et al. 2006b). Important guiding principles might include: putting the most vulnerable groups first (Paavola & Adger 2006); building social and ecological resilience (Berkes 2007; O'Brien et al. 2006), and what might be described as "*democratization*" of disaster management (Lebel & Sinh 2007).

From mitigation through to rehabilitation there is a need to empower and enable the affected and disadvantaged (Figure 1). They need places to articulate their needs and aspirations and space to build and develop their capacities. Access to, and control over, resources is needed not just top-down allocations to agencies acting on "their behalf". Informed, deliberative and collaborative approaches to major decisions about flood and disaster management hold promise. The links between knowledge and practice should be strengthened in both directions, recognizing the valuable contributions which local experience and understanding of conditions can make to reducing risks, while also making best use of science and technology to serve groups in greatest need. A focus on building and maintaining resilience of affected and vulnerable groups rather than managing floods as generic hazards could also help address current injustices.

Reducing the risk of disasters should be central to climate adaptation (Bouwer et al. 2007; Thomalla et al. 2006). Incorporating climate change adaptations into flood and disaster management should be seen as an opportunity to address inequities, insecurities and unfairness that have created large disparities in well-being, vulnerability and opportunity. But we should not wait for more catastrophic confirmations of climate change: there are many actions that would benefit disadvantaged and vulnerable groups now which don't need climate change or any other excuse as a justification.

Acknowledgements

The Asia-Pacific Network for Global Environmental Change Research and START supported initial case study work and regional meetings. Follow-up work has been supported by IFAD and Echel Eau through the Challenge Program for Water and Food (CPWF) for the M-POWER program (www.mpowernet.org) under project grant PN50.

Literature Cited

ABI. 2005. Financial risks of climate change. June 2005. Summary report. Association of British Insurers (ABI), London.

Adger, N. W. 2001. Scales of governance and environmental justice for adaptation and mitigation of climate change. J. Int. Dev. **13**:921-931.

Adger, N. W., N. W. Arnell, and E. L. Tompkins. 2005a. Successful adaptation to climate change across scales. Global Environmental Change **15**:77-86.

Adger, N. W., T. P. Hughes, C. Folke, S. R. Carpenter, and J. Rockstrom. 2005b. Social-ecological resilience to coastal disasters. Science **309**:1036-1939.

Anon. 2006a. King's move helps save capital. The Nation, Bangkok, 11 October 2006.

Anon. 2006b. Large areas 'needed for overflows'. The Nation, Bangkok, 12 October 2006.

Auffrey, C. 2002. The informal settlements of Chiang Mai: lessons of sustainability for other intermediate size cities. Pages 127-151 in M. Romanos, and C. Auffrey editors. Managing intermediate Size Cities: Sustainable Development in a Growth Region of Thailand. Kluwer Academic Publishers, London.

Babel, M. S., A. D. Gupta, and N. D. S. Domingo. 2006. Land Subsidence: A Consequence of Groundwater Over-Exploitation in Bangkok, Thailand. International Review for Environmental Strategies **6**:307-327.

Berkes, F. 2007. Understanding uncertainty and reducing vulnerability: lessons from resilience thinking. Natural Hazards **41**:283-295.

Blaikie, P., T. Cannon, I. Davis, and B. Wisner 1994. At risk: Natural hazards, people's vulnerability, and disaster. Routledge, London.

Blake, D. J. H., and R. Pitakthepsombut. 2006. The Songkhram River wetlands of Northeast Thailand and participatory resource research initiatives. MWBP working papers on livelihoods in Songkhram, Thailand. Mekong Wetlands Biodiversity Programme, Vientianne, Lao PDR.

Bouwer, L., R. Crompton, E. Faust, P. Hoppe, and R. A. Pielke Jr. 2007. Confronting disaster losses. Science **318**:753.

Bruijnzeel, L. A. 2004. Hydrological functions of tropical forests: not seeing the soil for the trees. Agriculture, Ecosystems and Environment **104**:185-228.

Crow, B., and F. Sultana. 2002. Gender, class, and access to water: three cases in a poor and crowded delta. Society and Natural Resources **15**:709-724.

DDPM. 2006. Thailand Country Report. Department of Disaster Prevention and Mitigation, Ministry of Interior, Thailand.

Denton, F. 2002. Climate change vulnerability, impacts, and adaptation: why does gender matter? Gender and Development **10**:10-20.

Dutta, D., M. S. Babel, and A. D. Gupta. 2005. An assessment of the socio-economic impacts of floods in large coastal areas. Asian Institute of Technology, Bangkok.

Dutta, D., and S. Herath. 2004. Trend of floods in Asia and flood risk management with integrated river basin approach. 2nd Asian Pacific Association of Hydrology and Water Resources and Conference.

Dutta, D., and T. Tingsanchali. 2003. Development of loss functions for urban flood risk analysis in Bangkok. International Symposium on New technologies for urban safety of mega cities in Asia. International Center for Urban Safety Engineering, University of Tokyo, Tokyo, Japan.

Few, R. 2003. Flooding, vulnerability and coping strategies: local responses to a global threat. Progress in Development Studies **3**:43-58.

Forsyth, T. 1998. Mountain myths revisited: integrating natural and social environmental science. Mountain Research and Development **18**:126-139.

Forsyth, T. 2003. Critical Political Ecology: The Politics of Environmental Science. Routledge, London.

Friend, R. 2007. Securing sustainable livelihoods through wise use of wetland resources: reflections on the experience of the Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP). Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme, Vientianne, Lao PDR.

Garden , P. 2007. The Chiang Mai floods of 2005. USER Working Paper WP-2007-19. Unit for Social and Environmental Research, Chiang Mai University, Chiang Mai.

Gupta, A. D., and M. S. Babel. 2005. Challenges for Sustainable Management of Groundwater Use in Bangkok, Thailand. International Journal of Water Resources Development **21**:453-464.

Hara, Y., D. Thaitakoo, and K. Takeuchi. 2007. Landform transformation on the urban fringe of Bangkok: the need to review land-use planning processes with consideration of the flow of fill materials to developing areas. Landscape and Urban Planning **10.1016/j.landurbplan.2007.06.009**.

Haruyama, S. 1993. Geomorphology of the central plain of Thailand and its relationship with recent flood conditions GeoJournal **31**:327-334.

IPCC 2007a. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC. Cambridge University Press, Cambridge, UK.

IPCC 2007b. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC. Cambridge University Press, Cambridge, UK.

ISDR. 2005. Hyogo framework for action 2005-2015. World Conference on Disaster Reduction. 18-22 January 2005. Kobe, Hyogo, Japan. International Strategy for Disaster Reduction.

Jesdapipat, S. 2007. Report on capacity building survey to address Thailand vulnerabilities, adaptation and resilience to climate risks. SEA START RC, Chulalongkorn University, Bangkok.

Junkhiwaw, S., W. Sivongs, T. Sukhapunnaphan, and N. Tangtham. 2004. Developing flood warning system for upland watersheds of the Chao Phraya basin. The Sixth International Study Conference on GEWEX in Asia and GAME, Kyoto, Japan.

Kates, R. W. 2000. Cautionary tales: adaptation and the global poor. Climate Change **45**:5-17.

Lebel, L. 2007. Adapting to climate change. Global Asia **2**:15-21.

Lebel, L., and P. Garden 2006. Bureaucrats, consultants and stakeholders: an emerging knowledge system for the upper Ping River Basin, northern Thailand. USER Working Paper WP-2006-11. Unit for Social and Environmental Research, Chiang Mai.

Lebel, L., P. Garden , N. Subsin, and S. Na Nan. 2007a. Averted crises, contested transitions: water management in the Upper Ping River Basin, northern Thailand. USER Working Paper WP-2007-15. Unit for Social and Environmental Research, Chiang Mai University, Chiang Mai.

Lebel, L., S. Khrutmuang, and J. Manuta. 2006a. Tales from the margins: small fishers in post-Tsunami Thailand. Disaster Prevention and Management **15**:124-134.

Lebel, L., E. Nikitina, V. Kotov, and J. Manuta. 2006b. Assessing institutionalized capacities and practices to reduce the risks of flood disasters. Pages 359-379 in J. Birkmann, editor. Measuring Vulnerability to Natural Hazards: Towards Disaster Resilient Societies. United Nations University Press, Tokyo.

Lebel, L., B. Sinh, P. Garden, B. Hien, N. Subsin, L. Tuan, and N. Vinh. 2007b. Risk reduction or redistribution? Flood management in the Mekong region. USER Working Paper WP-2007-10. . Unit for Social and Environmental Research, Chiang Mai Unviersity, Chiang Mai.

Lebel, L., and B. T. Sinh. 2007. Politics of floods and disasters. Pages 37-54 in L. Lebel, J. Dore, R. Daniel, and Y. S. Koma, editors. Democratizing water governance in the Mekong region. Mekong Press, Chiang Mai.

Manuta, J., S. Khrutmuang, D. Huaisai, and L. Lebel. 2006. Institutionalized incapacities and practice in flood disaster management in Thailand. Science and Culture **72**:10-22.

Manuta, J., S. Khrutmuang, and L. Lebel. 2005. The politics of recovery: post-Asian Tsunami reconstruction in southern Thailand. Tropical Coasts **July**:30-39.

McCully, P. 2007. Before the deluge: coping with floods in a changing climate. IRN Dams, River and People Report 2007. International Rivers Network, Berkeley.

McGranahan, G., D. Balk, and B. Anderson. 2007. The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones. Environment & Urbanization **19**:17-37.

MWBP. 2005. Vulnerability assessment of climate risks in the lower Songkhram River Basin, Thailand. Mekong Wetlands Biodiversity COnservation and Sustainable Use Programme, Vientiane, Lao PDR.

Neuymayer, E., and T. Plumper. 2007. The gendered nature of natural disasters: the impact of catastrophic events on the gender gap in life expectancy, 1981-2002. London School of Economics and Political Science, London.

Nicholls, R. J., S. Hanson, C. Herweijer, N. Patmore, S. Hallegatte, J. Corfee-Morlot, J. Chateau, and R. Muir-Wood. 2007. Ranking of the world's cities most exposed to coastal flooding today and in the future. Organisation for Economic Co-operation and Development (OECD), Paris.

O'Brien, G., P. O'Keefe, J. Rose, and B. Wisner. 2006. Climate change and disaster management. Disasters **30**:64-80.

OEPP. 2000. Thailand's initial National Communication under the United Nations Framework Convention on Climate Change. Page 100. Office of Environmental Policy and Planning, Ministry of Science, Technology and Environment, Bangkok.

Oxfam. 2005. The tsunami's impact on women. Oxfam International.

Paavola, J., and N. W. Adger. 2006. Fair adaptation to climate change. Ecological Economics **56**:594-609.

Parks, B. C., and J. T. Roberts. 2006. Globalization, vulnerability to climate change, and perceived injustice. Society and Natural Resources **19**:337-355.

Richey, P. T., D. Thomas, S. Rodda, B. Campbell, and M. Logsdon. 2007. Effects of landuse change on the hydrologic regime of the Mae Chaem river basin, NW Thailand Journal of Hydrology **334**:215-230.

Rigg, J. 2006. Land, farming, livelihoods, and poverty: rethinking the links in the rural South. World Development **34**:180-202.
Rodolfo, K., and F. Siringan. 2006. Global sea-level rise is recognised, but flooding from anthropogenic land subsidence is ignored around northern Manila Bay, Philippines. Disasters **30**:118-139.
Ross, H., A. Poungsomlee, S. Punpuing, and K. Archavanitkul. 2000. Integrative analysis of city systems: Bangkk "Man and the Biosphere" programme study. Environment & Urbanization **12**:151-161.
Schellnhuber, H. J., W. Cramer, N. Nakicenovic, T. Wigley, and G. Yohe, editors. 2006. Avoiding dangerous climate change. Cambridge University Press, Cambridge, UK.
Sharma, D., A. D. Gupta, and M. S. Babel. 2007. Spatial disaggregation of bias-corrected GCM precipitation for improved hydrologic simulation: Ping River Basin, Thailand Hydrology and Earth System Sciences Discussions **4**:35-74.
Sidle, R., A. Ziegler, J. Negishi, A. R. Nik, R. Siew, and F. Turkelboom. 2006. Erosion processes in steep terrain - truth, myths and uncertainties related to forest management in Southeast Asia. Forest Ecology and Management **224**:199-225.
Takeuchi, K. 2001. Increasing vulnerability to extreme floods and societal needs of hydrological forecasting. Hydrological Sciences Journal **46**:869-881.
Tanavud, C., C. Yongchalermchai, A. Bennui, and O. Densreeserekul. 2004. Assessment of flood risk in Hat Yai municipality, Southern Thailand, using GIS. Journal of Natural Disaster Science **26**:1-14.
Thomalla, F., T. Downing, E. Spanger-Siegried, G. Han, and J. Rockstrom. 2006. Reducing hazard vulnerability: towards a common approach between disaster risk reduction and climate adaptation. Disasters **30**:39-48.
Thomas, D. S. G., and C. Twyman. 2005. Equity and justice in climate change adaptation amongst natural-resource-dependent societies. Global Enviromental Change **15**:115-124.
Walker, A. 2003. Agricultural transformation and the politics of hydrology in northern Thailand. Development and Change **34**:941-964.
White, G. F., R. W. Kates, and I. Burton. 2001. Knowing better and losing more: the use of knowledge in hazards management. Environmental Hazards **3**:81-92.
Wipatayotin, A. 2007. Group floats plan to keep rising sea out. Bangkok Post, Bangkok, Thailand, 25 November 2007.