



Adapting to Climate Change

By Louis Lebel

The impact of climate change on Asia will be far-reaching and significant, and vary depending on where you live.

Climate scientist Louis Lebel dissects the best available assessments and outlines the scenarios. One thing is sure, though: the poor and politically disenfranchised will suffer the most, especially in rural areas, he argues.

WITH GLOBAL WARMING AN accepted reality, the region is finally coming to grips with its impact in Asia. The depth of the damage caused by warming will depend greatly on the emerging responses of business, government and civil society. Their policies and actions could substantially reduce — or further exacerbate — the disruption to society, especially to disadvantaged groups.

Global warming is not going to be suddenly stopped or reversed by either voluntary or mandatory actions. At best, initiatives on multiple fronts — international agreements, networks of urban planners, responsible corporate leaders and civil society groups — when combined with higher fuel prices, might finally begin reducing the growth of greenhouse gas emissions and move the world towards stabilization of greenhouse gases in the atmosphere. At worst, dangerous thresholds in the earth's climate system risk being exceeded with catastrophic impacts to follow.

A lot is known about recent climate changes at specific locations in Asia.¹ The evidence for warming and related trends is overwhelming. Glaciers are retreating and snow-cover decreasing. Annual mean temperatures across South, East and Southeast Asia have increased 0.1-0.3 °C per decade in the last half century. There are more hot days and warm nights. Intense rainfall events and floods have increased in many locations.

Regardless of what is done now, global mean temperatures will continue to rise for a century or more. Forecasting the weather years in advance is impossible; but we can say something,

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statistically, about future climate. Global mean temperature will likely rise as much as 1-2 °C above 1990 levels during the next century, and possibly more. Some of the uncertainty is due to limits in our understanding of clouds, aerosols and ocean mixing. Some is due to differences in assumptions that can be made about future fossil fuel use and greenhouse gas emissions.

In the future the weather will still vary by day, season and among years; but over the arch of time statistical distributions of means, ranges and extremes will shift. Exactly how much depends on where you live. Local climate is affected by many factors. As cities covered with concrete and bitumen have grown in size they have gotten hotter. Air pollution from industry and land fires can alter regional rainfall and block sunlight. Global warming adds another layer. Across Asia, temperatures, rainfall patterns, the frequency of extreme events and the timing of the seasons are already changing and will continue to do so with substantial impacts on agriculture, ecosystems, water and human settlements (See Table 1 on page 23).

DISTRIBUTION OF BURDENS AND RISKS

Although the warming of the earth is a global phenomenon, its impact will not be experienced equally everywhere or by everyone.

Vulnerabilities vary hugely across different social groups, with the poor bearing a disproportionate share of the hardship. We know this by studying how extreme climate events and climate-related disasters now impact mothers,

small fishers, poor farming households and children. We know from experience that when wells nearby go dry from over use, women have to walk further to find water.

The influence of development policies that make people vulnerable in the first place also varies hugely. We know from studying and helping the disenfranchised — especially minorities and migrants — that mainstream development often bypasses these groups because they have little political influence and few opportunities to organize. People without citizenship, or otherwise discriminated against, often do not have access to public services or social safety nets that are crucial in coping with challenges to health or livelihood.

The impact of climate change is already visible where large populations of the rural poor live. Thus, in the past few decades Bangladesh has been struck by a series of devastating cyclones causing flooding that has killed thousands. Disaster management initiatives have saved many lives, but the combined vulnerability of a risky location, marginalization and poverty remains huge.

Despite widespread improvements in well-being — decades of economic growth have reduced poverty, improved health and expanded educational opportunities for vast numbers of people — the negative effects of climate change will be distributed very unequally as a result of entrenched unfairness in how societies have developed.

There are four crucial challenges posed by climate change in Asia: growing enough food,

1 Many of the key scientific findings discussed in this essay are based on the Fourth Assessment Report documents of the Inter-governmental Panel on Climate Change (IPCC). These are available online at: <http://www.ipcc.ch/>

2 There are several good studies of the potential impacts of climate change on crops in Asia. This example comes from: Naylor, R.L., D.S. Battisti, D.J. Vimont, W.P. Falcon, and M.B. Burke (2007). Assessing risks of climate variability and climate change for Indonesian rice agriculture. *PNAS* 104(19): 7752-7757.

maintaining ecosystems, managing water and coping with rising sea levels. We will deal with each in turn.

GROWING ENOUGH FOOD

Climate has a profound impact on what crops can be grown where. Not surprisingly some of the worst effects are expected in the agricultural sector of developing countries. In Asia it will often be harder to grow food.

In the tropics, one of the key concerns is that temperatures are already near the upper threshold for rice to remain fertile. Even small local increases in temperature (1-2 °C) in hot countries will result in substantial declines in crop productivity that will threaten food security. In contrast, modest warming may be beneficial to developed-country agriculture in temperate regions by expanding growing seasons.

What will happen to rainfall is much less certain and likely to vary by location. Changes to the prevailing monsoons will be very significant given their importance to livelihoods and food security. Every few years an El Niño — or Southern Oscillation (ENSO) event — for example, delays rainfall resulting in much less rice being planted in Indonesia and elevating the risks of a rice deficit. Climate change is predicted to increase the risk of delays as long as a month or more in the onset of the monsoon from 9-18 percent today to 30-40 percent by 2050.² Adaptation strategies are needed that might include improving drought-tolerance, water harvesting and storage methods, and seasonal early warning systems.

The semi-arid regions over Central Asia and the Indian subcontinent are particularly vulnerable to environmental changes. Under global warming recent drought trends are expected to continue and worsen. Changes in land cover interact with climate. Vast areas have been degrad-

ed by human activities and some are now subject to desertification. These land surface changes, in turn, influence the intensity of the summer monsoon and are a source of major dust storms that affect large parts of China and East Asia.

More extreme precipitation events would also increase the likelihood of crop losses. Much harder to analyse are possible impacts on pests, weeds and diseases, but various studies suggest reasons for concern, especially when consideration is given to the projected demand for food crops over the next 50 years.

The burdens of coping with extreme rainfall events, changed flood regimes and unprecedented droughts will often fall on the very groups that now work the hardest to grow and catch food to eat and market. These are the same groups that already suffer substantially from the current variability in climate and distorted trade agreements driven by very powerful countries. Strengthening their capacity to adapt is crucial, requiring long-term strategic public investment in education and health, as well as private capital and skills to develop a commercially viable agricultural sector. Otherwise, the very high dependence on agriculture for survival raises the spectre of mass migration in response to climate-induced crop failures.

MAINTAINING ECOSYSTEMS

The impact on natural ecosystems depends a lot on rates of change in climate relative to the ability of different organisms to adjust their life cycles or distributions. Highly mobile animals or trees with good dispersal may be able to shift ranges in timely ways, whereas other populations may be doomed to extinction without costly and difficult interventions. Some plants may be able to adjust their flowering times to cope with modest shifts in climate. But it should be underlined that climate is only one of many threats to eco-

3 Reports from the assessment are available online at:
<http://www.millenniumassessment.org/>

systems. Many larger animals now have highly restricted and fragmented habitats as a result of deforestation and urbanization. Opportunities for dispersal may no longer exist. Thus it is not surprising that scientists have documented how climate change is already having a significant impact on biodiversity. Temperature changes of 1.5-2.0 °C could place 20-30 percent of plant and animal species at risk of extinction.

The Millennium Ecosystem Assessment recently documented the stress human activity has placed on ecosystems that are important to human well-being.³ Climate change is a key stressor. Tropical glaciers, coral reefs, mangroves and biodiversity hot-spots, many of which occur in Asia, are very sensitive to climate change.

Some of the impact on terrestrial ecosystems is likely to be indirect and complex. Changes in the frequency and intensity of disturbances like fires, for example, can have major implications for the structure of plant and animal communities. Emissions from fires may also modify the regional climate by adding particles to the atmosphere that reflect or absorb heat or influence how rain drops form.

In high mountains, small shifts in temperature or rainfall can greatly affect ecosystem functions like decomposition, primary production and soil nutrient cycling. But efforts to link and expand protected areas to conserve the biodiversity of remote uplands may inadvertently create conflicts with people who farm, graze or otherwise depend on those landscapes. Conservation, use and management of ecosystems must be negotiated in ways that respect the rights of local residents. Community support is crucial in these efforts.

Coastal and marine ecosystems are also sensitive to temperature increases, with coral bleaching just one of the most well-known examples. As many people depend on fisheries for their livelihoods, climate change is a relevant concern but it

Provided impacts are not too severe and widespread, freer and fairer trade of agricultural products could help reduce vulnerabilities to climate change. Distorted trade driven bilaterally by very powerful countries, on the other hand, could exacerbate the impacts of climate change by reducing the competitiveness of vulnerable people.

is overshadowed at times by other worries, such as land-based pollution and over-fishing.

The impact of climate change thus will often come as an added insult to ecosystems already under stress. Unfortunately diverse and resilient ecosystems are also a key component of the adaptive capacity of societies — so much so that according to the Millennium Ecosystem Assessment, “degradation of ecosystem services poses a significant barrier to achievement of the Millennium Development Goals.”

MANAGING WATER

The challenges of managing water vary dramatically across Asia. In some places the issue is one of scarcity, in others excess. In some countries there is both too much and too little water, each year.

Temperature increases are most pronounced at high elevations. As the “water tower” of the world the Himalayas have a huge influence on rainfall, the monsoon, and storage of the water and ice that sustain a large fraction of humanity. The Himalayas and Tibetan plateau are getting warmer. As the source of many of the great rivers

4 A particular insightful study of the challenges for flood protection with modern development is: Takeuchi, K. (2001). *Increasing vulnerability to extreme floods and societal needs of hydrological forecasting*. Hydrological Sciences Journal 46(6): 869-881.

of Asia this is a very serious concern to societies downstream. Scientific studies suggest that rivers will swell for a few decades as glaciers and snow packs melt, but eventually those flows will slow to a trickle.

Run-off may increase in some wet tropical areas, but it is likely to decrease by 10-30 percent in the dry tropics, areas that are already water stressed. Many large river basins, where freshwater availability is already constrained by population and consumption growth, will be further reduced by changes in climate.

Water scarcity is a major threat to agriculture. Proponents of large-scale water storage and diversion projects will find it tempting to add climate change considerations to the expected benefits. But adequately demonstrating such benefits and then weighing them against other costs of regulating river flows - the impact on aquatic ecosystems, wetlands and fisheries - is confounded by other effects of climate change. The scope to expand irrigation is often limited; much greater attention needs to be given to improving the productivity of rain-fed agriculture upon which most of the region's poor depend.

Climate change is expected, overall, to result in more serious floods, but exactly how flood regimes will change in particular basins depends more on regional factors and how these interact with water use changes within a basin. The flood plains of major rivers like the Ganges-Brahmaputra, Mekong and Yangtze are critical, as are cyclone-prone coastal regions around the Bay of Bengal and the South China Sea.

Rapidly urbanizing areas are already struggling to handle increased flood damage from changing run-off patterns and flood-plain modification. Much of the cost in wealthier countries, like Japan or Korea, are related to maintaining and repairing flood protection infrastructure as cities expand further into vulnerable locations.⁴

In developing countries with more modest resources, adaptation will have to rely more on "living with" changes in flood regimes.

Many mountain areas are already vulnerable to intense rainfall events that can cause flash-floods and landslides. Increases in the frequency of extreme rainfall can make effective flood disaster prevention and management more difficult. Early warning systems and hazard mapping are difficult but may be the only option available.

The prospect of additional risks from climate change makes the need for forward-looking actions greater than ever before. But interventions in the name of staving off the inevitable, such as protective barriers and diversions built to protect capital cities from rising waters, may end up shifting risk onto the poor, who are already vulnerable. New approaches are needed to more fairly and equitably address current and future challenges posed by changing flood patterns, including the anticipated impact of a changing climate.

LIVING BY THE SEA

Much of the population of Asia lives in low-lying coastal areas. Many of these regions are already prone to storm surges, cyclones, river floods and tsunamis. Degradation of coastal ecosystems has made some communities even more vulnerable than they would be otherwise.

Coastal areas of Bangladesh, Vietnam and the Philippines are already impacted frequently by cyclones. Global warming raises ocean temperatures and rates of evaporation, two factors that could increase the intensity and frequency of cyclones or change their paths.

The likely change to mean sea-level as a result of global warming over the next century is typically estimated at between 0.1 to 0.9 m. But there is also a small chance of much larger rises. Scientists seriously discuss the risks of ice

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sheets in Antarctica and Greenland melting, but acknowledge that complex feedbacks and amplifying effects make prediction hard. Nobody wants such catastrophes to happen and few want to contemplate the consequences, but it is important to do so.⁵

Human modification of rivers and land is also increasing the vulnerability of coastal human settlements. Dams and other water infrastructure reduce sediment delivery to coastal deltas. Channel modifications that make rivers narrower and flows faster result in banks that erode more quickly. Embankments in the Mekong delta could become more vulnerable following construction of dams upstream. Reduced freshwater flows, on the other hand, may also allow more extensive intrusions of salt water from the coast. Sea-level rises due to climate change would greatly alter flooding patterns in the Mekong Delta through excessive flooding in tidal areas and longer inundation times inland. The adverse impacts would effect growing seasons and raise the risk of embankment failure.⁶

Ground water withdrawals around mega-cities like Bangkok and Manila are causing land

subsidence. Rises in sea-level may be minor or major factors relative to these local processes, but investing and living in coastal cities will be riskier with even modest changes in sea-levels or increases in storm intensity. Re-insurers may quickly become reluctant to help local insurance companies in vulnerable locations without costly and complex state guarantees that could be beyond the capacity of developing-country governments.

EMERGING RESPONSES

Across Asia, government, business and civil society are beginning to respond to these challenges. School children are asking questions, journalists are writing more stories, movies are being made and experts are being asked for explanations. Climate change is “in.”

Claiming that a particular policy, investment strategy or change in consumer behavior will help stop global warming or help society adapt is good copy. But like all ads — it pays to read the fine print. We need to ask:

Is the emerging response in Asia commensurate with the risks posed by climate change? Is it reducing the vulnerabilities of groups already

5 One of the most comprehensive recent efforts on the subject is: Schellnhuber, H.J., W. Cramer, N. Nakicenovic, T. Wigley, and G. Yohe, eds. (2006). *Avoiding dangerous climate change*. Cambridge University Press: Cambridge, UK. 392 pp.

6 Several studies have been made of the Mekong. A good recent one is: Le, T.V.H., H.N. Nguyen, E. Wolanski, T.C. Tran, and H. Shigeko (2007). *The combined impact on the flooding in Vietnam's Mekong River delta of local man-made structures, sea-level rise, and dams upstream in the river catchment*. *Estuarine, Coastal and Shelf Science* 71: 110-116.

at a disadvantage from current patterns of development? The short answers are no and no. My reasons for concern are:

First, adaptation based on assessment of easily measured costs tends to reflect threats to infrastructure and built environments rather than soils, fisheries and rural livelihood. Framing climate change as just another external hazard or security threat makes it easy to neglect the causes of social vulnerability within a society. Informed deliberation is critical to avoid inappropriate over-reactions and wishful dismissals.

Second, actions to protect valuable assets from flooding or rising sea-levels may be mostly about shifting risks onto less influential groups. Pro-poor investments in adaptive agriculture, disaster management or insurance for low-income urban and coastal areas are rare. Empowerment of the disadvantaged is the primary way to deal with the problems of neglect, and risk shifting.

Third, token promises by leaders without any follow-up distract attention from the need to mobilize and address risks posed by climate. The anticipated impact of climate change in Asia, as reviewed in this essay with respect to food, water, ecosystems and human settlements, are a significant challenge to economic and social development. Putting climate change on the agenda of regional gatherings is not the same as protecting the public or building the capacity of people to adapt. A wider range of response options is needed, with much greater public scrutiny.

Fourth, the distinct policy challenges of reducing the emissions that cause global warming should not always be linked directly to the related challenge of reducing the impact of and helping people adapt to climate change. We must not take away resources from vulnerable and disadvantaged peoples on the front lines of this crisis.

Reducing emissions quickly is vitally important to the magnitude of the climate change risk the world faces; but is not a substitute for the urgent need to act to reduce vulnerabilities.

The world is already faced with the reality of a changing climate. But developing countries should not forgo the right to develop even as they pursue global net emission reductions. Nor should highly vulnerable peoples be left to the mercy of climate change caused by the activities of others. The policy priorities are clear. What is needed is action.

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