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# POSITIONING ADAPTATION IN THE CLIMATE CHANGE DEBATE

**Climate change adaptation as a means for reducing vulnerability to climate change and building resilience in developing countries is steadily climbing the international agenda. While adaptation is acknowledged by some as a necessary complement to mitigation, others have expressed reservations about promoting it as a policy goal. Still others, increasingly so in developing countries, are even suggesting adaptation as an alternative to climate mitigation. Underpinning these views is the lack of a consensual understanding of what constitutes adaptation. This Alert provides an overview of adaptation and what it means, examining the position of adaptation in the climate change debate and the different perspectives on it.**

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**The NTS Alert Team**
Mely Caballero-Anthony, Sadhavi Sharma.

- Consortium of NTS Studies in Asia
- Centre for NTS Studies

## Introduction

Since the late 1980s, the world's policymakers and scientists have devoted considerable resources to research and policymaking related to climate change. The international response, largely guided by the International Panel on Climate Change (IPCC), globally considered a leading authority on the issue, has been firmly focused on climate change mitigation. Mitigation refers to prevention of future climate impacts on society through the limitation of Green House Gas (GHG) emissions, held primarily responsible for global warming. Emissions reduction then is at the centre of climate change negotiations. Whilst nations continue to battle it out in the international arena over specific quotas and caps on emissions, adaptation is a term that has steadily climbed the climate change agenda. Domestic and international policymakers now discuss response alternatives in terms of mitigation *and* adaptation. In 2001, three funds were created to support the facilitation of vulnerability assessment and adaptation. The IPCC has a working group devoted to the assessment of 'vulnerabilities, risks and adaptation' as part of its much influential Climate Change Assessment Reports. The recently drafted Copenhagen Accord – the outcome of the high profile Copenhagen Climate Change Conference in December 2009 – recognises the need for enhanced action and international cooperation on adaptation, especially aimed at building resilience in the least developed countries. The developed countries are also required to provide 'adequate, predictable and sustainable financial resources, technology and capacity-building to support the implementation of adaptation action in developing countries'. But while there seems to be a widespread acknowledgement of a need for adaptation, there is no coherent global programme for the same. Is adaptation a transformation of systems, does it essentially require anticipatory planning coupled with new technology, or can it be seen as an extension of current development measures? Is it a coping mechanism or one aimed at resolving potential problems? Do community-based reactive measures count as adaptation, and indeed, do these have the potential to resolve some of the effects of climate change? These questions require not just an understanding of terms associated with adaptation but also a political framing of what constitutes adaptation, which this Alert aims to do.

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## Conceptualising Adaptation

Smithers and Smits (1997) track the origin of the concept of adaptation to evolutionary ecology, wherein adaptation means the continued viability of a species, changes that allow an organism to survive and reproduce in the environment they inhabit. In the social sciences, the same context has been applied in the context of human relations with their environment. That is, social and economic systems, and individuals within them can and do adapt to changing environmental circumstances. According to the authors, an important distinction, however, is that 'humans possess the ability to plan and "manage" adaptation'. Unlike the responses of biological systems, which are entirely reactive, 'the responses of human systems are both reactive and proactive, incorporating environmental perception and risk evaluation as important elements of adaptation strategies'. Moreover, historically, human beings have transformed the environment around them by way of civilisation, agriculture, converting naturally available materials into resources to suit their built environment and needs.

Adaptation itself and related terms are not defined in the Kyoto Protocol or by the UNFCCC. However, both the UNFCCC and the IPCC have in the past few years placed vulnerability and adaptation on the climate change agenda. Adaptation means to adjust, change or modify to fit a new situation. In the context of climate change, adaptation is discussed in terms of vulnerabilities, adaptive capacities, resilience and many such terms that are socially determined and can inform decisions on implementation, expectations, responses as well as funding on a policy level. Many key adaptation terms and concepts are defined by the IPCC in its Third Assessment Report, and several other variations of the definition exist in the growing body of literature on the subject.

### Terms and definitions

The IPCC defines adaptation as 'adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderate harm or exploit beneficial opportunities'. The propensity of socio-economic systems to adapt is influenced by certain system characteristics that have been called 'determinants of adaptation'. These include terms such as 'sensitivity', 'vulnerability', 'resilience', 'susceptibility' and 'adaptive capacity', among others (see Table 1 below).

Distinctions are made on the basis of whether responses are structural (technological) or behavioural, whether they are reactive or anticipatory – that is, before or after the extreme event has taken place, or whether they are intended to buffer and sustain current activities and how things are done, or do they seek to transform or facilitate change to new types and patterns of activities (Smit and Smithers, 2000). This contrasts with actions that are readily available and implemented within existing structures and institutions with major technological innovations and transformations.

While the IPCC definition is the most widely acceptable, Smit et al. (2000) point out several other definitions found in the climate change literature, some of which are as below:

- Adaptation to climate is the process through which people reduce the adverse effects of climate on their health and well-being, and take advantage of the opportunities that their climatic environment provides (Burton 1992, quoted in Smit et al. 2000).
- Adaptation involves adjustments to enhance the viability of social and economic activities and to reduce their vulnerability to climate, including its current variability and extreme events as well as longer-term climate change (Smit 1993, quoted in Smit et al. 2000).
- The term adaptation means any adjustment, whether passive, reactive or anticipatory, that is proposed as a means for ameliorating the anticipated adverse consequences associated with climate change (Stakhiv 1993, quoted in Smit et al. 2000).
- Adaptation to climate change includes all adjustments in behaviour or economic structure that reduce the vulnerability of society to changes in the climate system (Smith et al. 1996, quoted in Smit et al. 2000).
- Adaptability refers to the degree to which adjustments are possible in practices, processes or structures of systems to projected or actual changes of climate. Adaptation can be spontaneous or planned, and can be carried out in response to or in anticipation of change in conditions (Watson et al. 1996, quoted in Smit et al. 2000).

Essentially, the definitions of adaptation put forth by various authors imply an adjustment – in structures, economic and social systems – to respond to climatic stimuli. Although there are differences in the interpretation, scope and application of adaptation measures, the consensus is that adaptation measures should aim to reduce vulnerability, both present and future, to climate change. Adaptation measures then are a function of not merely physical climatic disturbances but also the level of social and economic development in a region, its geographical location, existing level of capabilities and social organisation in a particular society. These factors help to determine the region, society or group's vulnerability and adaptive capacity.

*Table 1: Related terms, their significance and meaning in relation to adaptation*

| **Related terms, their significance and meaning in relation to adaptation** | | |
|---|---|---|
| **Terms that describe system characteristics relevant for adaptation** | **Definitions given by Smit et al. (2000)** | **Most recent definitions adopted by the IPCC** |
| **Sensitivity** | degree to which a system is affected by, or responsive to, climate stimuli | the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. |
| **Vulnerability** | degree to which a system is susceptible to injury, damage or harm | degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. [It] is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. |
| **Adaptive capacity** | the potential or capability of a system to adapt to (to alter to better suit) climatic stimuli | the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences. |

Source: UNFCCC (2006)

- **Reactive and anticipatory adaptation**: Other factors that are used to classify different kinds of adaptation are time frame, suddenness of the event, kind of intervention – that is, whether it is autonomous or not, frequency of the events that require adaptive measures. Researchers make a distinction between **reactionary adaptation** and **anticipatory adaptation**. Reactionary adaptation depends often on the existing levels of social organisation, social resilience and networking in a particular community, governance systems and efficiencies. It is usually an unplanned reaction to an extreme event or present changes.

  Anticipatory adaptation requires research and assessment of climatic conditions to inform the resulting plan or strategy. It follows a planned intervention based on expectations and predictions of changes in the future. It takes place before impacts of climate change are observed. Some examples of anticipatory and reactive adaptation measures, both at an individual and society levels are outlined in Table 2.

*Table 2: Types of human systems' adaptation to climate change*

| **Types of human systems' adaptation to climate change** | | |
|---|---|---|
| **Sector** | **Reactive** | **Anticipatory** |
| **Private** | Moving home | Changing architecture of buildings |
| | Changing insurance premiums | Buying hazard insurance |
| | Buying air-conditioning systems | Devising new customer |

| | | |
|---|---|---|
| | | products |
| **Public** | Offering compensation or subsidies | Installing early warning systems |
| | Enforcing building codes | Establishing new building codes |
| | Beach nourishment | Constructing dykes |

Source: UNFCCC (2006)

- **Time frame:** A climate event could be a short-term sudden hazard or a slow long-term change in patterns. Depending on the duration, climate change could be seen as a phenomenon in itself, such as a long-term climate change or a broader phenomenon within which climatic conditions and sudden shocks such as floods, tornados and/or other climate-related events such as droughts occur. Burton (1997) argues that for developing countries it makes sense to focus on current problems that affect the economy rather than on uncertain changes that will only be manifested at some point in the distant future. For this purpose, greater investment of resources and planning are advocated for dealing with extreme weather rather than studying longer-term changes. Long-term assessments of climate impacts can help societies adapt to the changing climate – be it warmer or wetter – by way of changing agricultural practices, investing in new technologies, and building new planning systems.

Adaptation can also be categorised as measures and strategies that contribute either to:

- **Building adaptive capacity** – To build adaptive capacity would require adequate information – research, data collecting and monitoring of climate variables such as temperature, rainfall, sea level rise, wind speeds, mapping of hurricanes and typhoons etc. Networking with local, regional and global networks are important not just for climate data and analysis but also for awareness raising. Supportive social structures such as medical, health and social networks such as civil society organisations, and supportive governance (regulations, legislations and guidance) are needed as a foundation for delivering adaptation actions; or
- **Delivering adaptation actions** – Actions that help to reduce vulnerability to climate risks, such as efficient drainage systems, flood defences, and disaster management service.

Adaptation responses can be drawn from a range of such categories. Targeted measures directed at building adaptive capacity are considered key in developing a response strategy. Many organisations have begun the process of building adaptive capacity through understanding the nature of the issue and risks, identifying and engaging the community/players, and assessing the situation (risks and thresholds) and likely adaptive responses.

Adaptation practices can also be differentiated along different dimensions, as given by Adger et al. (2007: 720): by spatial scale (local, regional, national); by sector (water resources, agriculture, tourism, public health); by type of action (physical, technological, investment, market); by actor (national or local government, international donors, private sector, NGOs, local communities, individuals); by climatic zones (dryland, floodplains, mountains, Arctic, etc); by levels of development of the system in which adaptation measures are implemented; or by a combination of these.

Many of these classifications are not mutually exclusive and often overlap. A combination of different factors has to be taken into consideration while drawing an adaptation strategy, but adaptation is primarily considered in terms of a region or group's level of vulnerability and susceptibility to climate risks.

## Climate risks, vulnerabilities and adaptation

The discussion on climate change adaptation follows from that of risk and vulnerabilities, and vulnerabilities assessments are considered fundamental not only in adaptation planning but also in climate negotiations, and international funding. There is a global acknowledgment of developing countries, small developing states and island nations being at a greater risk to climate change events, especially natural disasters and sudden events in the short and longer term. This *differential* vulnerability is an important aspect of adaptation plans and strategies. Climatic changes could result in different stresses in different regions, the scale, frequency, and impact of which may also not be uniform. Indeed, in some parts of the world, changes in temperature could lead to more favourable and beneficial conditions. Adaptation measures, both in the short and the long term would require a systematic assessment of the possible risks and degrees of vulnerabilities in order to formulate a response or adaptation strategy. But vulnerability and risk also depend on a combination of factors and are not simply determined by environmental changes.

The IPCC explains risk as the 'extent to which climate change may damage or harm a system', adding that vulnerability 'depends not only on a system's sensitivity, but also on its ability to adapt to new climatic conditions'. That is, vulnerability is highest where there is 'the greatest sensitivity to climate change and the least adaptability. But unlike the IPCC, other commentators see vulnerability not as a function of adaptive capacities or the level of adaptation in a particular region, but instead the relationship is reversed. That is, the ability of a region, society or people to adapt is determined by their level of risk and vulnerability. From both cases, however, it is clear that adaptation measures and vulnerability assessments are closely related and interdependent.

*A coastal house in Indonesia on makeshift stilts*

Source: Curt Carnemark/ World Bank. Available at

The IPCC, in its Second Assessment Report, defines vulnerability as 'the extent to which climate change may

damage or harm a system'. It adds that vulnerability <http://www.flickr.com/photos/worldbank/>
'depends not only on a system's sensitivity, but also on its ability to adapt to new climatic conditions' (Watson et al. 1996: 23). The report argues that the vulnerability of a region depends to a great extent on its wealth, and that poverty limits its ability or capacity to adapt. Thus vulnerability depends not so much on climatic stresses alone, but more so, on the level of economic development and institutions in a particular country. Indeed, many argue that a study of adaptation should begin with the study of social and economic vulnerability. According to Adger et al. (2007) 'vulnerability to climate change refers to the propensity of human and ecological systems to suffer harm and their ability to respond to stresses imposed as a result of climate change effects'. Such effects include impacts on the health system, agriculture, and pressures on infrastructure in some countries.

Another idea closely related to vulnerability and adaptation is that of differentiation. It means that the impacts of climate change will be unevenly distributed around the world and within regions. Again, apart from geographical and ecological differences, this is owing to the difference in the distribution of resources and wealth around the world. The experience of climate stresses and the ability to adapt is likely to differ even within regions, social groups, countries and economic sectors. Blaikie et al. (1994) argue that those households and groups that have higher incomes, greater resources and social networks will display greater resilience despite being more vulnerable to absolute losses.

The IPCC also recognises that developing countries are most susceptible or vulnerable to climate change, and least equipped to adapt. Their situation is compounded by the existing lack of resources and low levels of economic development. Developing countries have a limited technological prowess, lack of wealth, resources, education and in some cases, institutional capacities. Many of the factors noted by the IPCC and by adaptation literature point to conditions that are not new or indeed created by climate change, but tend to make these societies and groups more vulnerable to climate change. Marginalised, subsistence farmers, and livelihood groups who depend on primary resources are particularly vulnerable to climate change. For instance, in Asia poor rice farmers could be particularly affected by changes in rainfall and water availability. Recognition of the underlying factors that determine vulnerabilities and adaptive capacities of societies thus can be important in informing climate agendas and adaptation strategies.

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## Adaptation vis-à-vis Mitigation

While there is growing advocacy and support for adaptation, the world's efforts are still primarily focused on mitigation, and adaptation is recognised as a necessary complement to mitigation efforts. A serious adaptation strategy requires greater research on the different climatic perturbations in the short and long term, research and investment in technology and economic systems, all of which have not been forthcoming so far. Although specific scientific insights would be useful in mapping and predicting possible climatic stresses, the degree and scale of these changes, the frequency of related events, the possible *solutions* to these changes, investment into research and innovation, and the place adaptation is accorded in a climate change strategy as well as the types of adaptation adopted will have to be politically and socially determined. In this context, it is useful to understand adaptation vis-à-vis mitigation.

### Adaptation and mitigation – a win-win situation?

Many decision-makers at an international level think both mitigation and adaptation are important in reducing risks attached to climate change. This view sees mitigation as central to climate change policy. Where the consequences are seen as unavoidable, adaptation is advocated to deal with it. According to this stance, the extent and scope of regional climate change impacts depend on the degree of mitigation, and the scale of adaptation efforts required could be lower if aggressive mitigation is undertaken. Adaptation is, however, also acknowledged as inevitable in certain cases, as even if no more GHGs were to be released in the atmosphere, existing concentrations in the atmosphere could still potentially cause climatic events that would require adaptation. For instance, according to some climate researchers, irrespective of the success of mitigation efforts, there will still be some degree of unavoidable climate change, owing to the GHGs already persisting in the atmosphere, as well as the building warming of oceans (IIED, 2003). This will result in temperatures and sea-level continuing to increase for several decades (and in the case of sea level rise, perhaps several centuries) regardless of any present-day emissions reductions. Proponents of mitigation also point to certain barriers to implementing adaptation, such as the inability of natural systems to cope due to technological, social, cultural, and financial or economic constraints.

Advocates of a mitigation complemented by an adaptation approach see it as a win-win situation as a focus on mitigation is seen as an essential preventive measure that will reduce the need for adaptation, applying the latter only where absolutely essential, thus appearing more cost-effective. However, the costs of mitigation itself, in terms of caps on development are not factored in here. As seen above, the factors determining adaptation possibilities and capacities are social and economic rather than simply environmental. Societies that are less developed have heightened vulnerabilities to the effects of climate change as manifested in health and agricultural systems, and reduced capacities to respond to natural disasters or sudden events, as well as limited adaptability because of reduced access to resources. This presents a situation where societies adhering to strict mitigation measures in terms of emissions reductions, would face economic consequences of the same, resulting in limited capacities to adapt in turn.

### Mitigation – too late?

A divergence in policy priorities has existed between developed and developing countries since the 1997 Kyoto Protocol. This divergence centres on issues around emissions reduction. The main priority of the developed nations, and of the UNFCCC, has been mitigation. It is in recent times that the discussion has steered towards adaptation citing the greater vulnerability of less developed countries.

Increasingly, developing countries, especially small developing countries and island nations are expressing deep concerns about their vulnerability to and their low level of preparedness for climate change events. Given the urgency felt by these countries, there is a greater demand for support for adaptation measures. Adaptation, because of its immediacy, is seen as a better alternative for small developing countries, as the results of mitigation, it is argued, will only manifest itself after a considerably long time, which in the meanwhile puts these countries at greater risk to natural disasters, floods, hurricanes and typhoons and increased sea levels.

For instance, Indonesia, an archipelagic nation, is at risk from rising sea levels. According to the IPCC, the global average temperature must not rise by more than two degrees Celsius, but given continued emissions, the global temperature is expected to overshoot that limit set by the IPCC. Countries such as Indonesia, then, prefer to invest in developing an adaptation strategy, which includes disaster risk reduction.

Further, as pointed out by Martens et al. (2009), the success and practicality of mitigation initiatives is questionable. More stringent emissions control programmes represent an extremely inefficient approach, especially for developing countries, and could have enormous social consequences. According to the authors, the efficiency of such action is also 'highly debatable'. Economists argue for a proper assessment of alternatives to mitigation and a plan to develop more cost-effective technologies whilst investing in greater research towards completely understanding the scale and consequences of climate change, which presents much uncertainty. This is seen as a better option for developing countries whereby emissions can be reduced over a longer period of time and adaptation can be employed for more immediate risks.

This view of resorting to adaptation as a reactive and last-minute measure to climate change can be seen as fatalistic. It presents a doomsday scenario, and the impulse to adapt is driven by panic rather than rational proactive planning.

### Mitigation – a pointless ritual?

A greater support for adaptation as a more proactive alternative views that mitigation is a mere behaviour changing exercise, which has little potential for solving the problem of climate change. Roger Pielke (1998, 162) points out that the United Nations Climate Convention Framework 'implicitly favours mitigation responses' because of its definition of climate change, which emphasises only 'those climate impacts attributable to human-caused changes' in the atmosphere. Indeed, the stated goal of the convention is to reduce the concentration of GHGs in the atmosphere. However, there is very little likelihood that mitigation would successfully result in the proposed levels of emissions reductions. According to the IPCC, an estimated reduction of 60 to 80 per cent would be required to stabilise the level of GHGs at the current level in the atmosphere. But CO2 is an important factor in continued growth and maintenance of modern lifestyles, and despite ratification of the Kyoto Protocol, emissions in both developing and developed countries have gone up by 2.3 and 10 per cent respectively.

Further, according to some scientists, a reduction in GHGs may not necessarily mean arrested global warming and no climate change. Roger Pielke (1998) suggests that even if mitigation targets were to be achieved, according to IPCC projections climate change is inevitable, and also that changes in climate would occur independent of human causes. Adaptation is generally not favoured by the 'climate change community', according to Pielke, because countries do not want to appear as compromising on their stand on mitigation. Support for adaptation could give an impression 'that one was against mitigation activities and in a broader sense anti-environmental' (Pielke, 1998, 162).

Climate mitigation models also fail to consider or anticipate any major structural changes on the scale of the industrial revolution possible in human society (Snooks, 2009). Mitigation is then supported as a ritual for being seen as environmentally friendly as opposed to adaptation, perceived as 'an unacceptable, even politically incorrect idea' (Burton, 1994; Pielke 1998).

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## Perspectives on Adaptation

Many countries have national plans for how they can deal with climate change and address the problems associated with it. While there is a strong call for the reduction in GHGs and emissions, there are also concerns about what such measures entail and the costs to not just the developing countries, but also Western economies. Carbon emissions have gone up since the ratification of the Kyoto Protocol, making some believe that carbon reduction could well be an impractical goal. Besides, there are disagreements about the nature, time scale and severity of climate change as well as with regard to the proposed solutions. Here, the different perspectives on adaptation – what counts as a good adaptation measure, and what measures should society invest in or support, provide a good starting point for global action.

The human system is naturally resilient and historically, human activities have adapted to a changing climate. A greater confidence in human ingenuity, resilience and adaptability follows from this view. But the understanding of adaptability itself ranges from advocating scale solutions such as new technology, building modern flood defences, transforming the food and agricultural systems, or investing in research on climate-resistant varieties of seeds, genetically modified crops to other measures such as behaviour and lifestyle changes, community-based strategies, local knowledge, traditional and autonomous measures. In certain instances, an adaptation project is not divorced from ongoing development projects; indeed, while some see this in terms of growth and improved infrastructure, others see adaptation in the context of sustainable development and small-scale measures. Here we examine some of these perspectives on adaptation.

### Adaptation as a community-based measure

There is relatively little research into Community-Based Adaptation (CBA), as these often take place autonomously and at a local level, as opposed to being part of a national or international strategy. This approach is based on the premise that small communities in poor countries are at the greatest risk of climate change, and have very little means to adapt. These communities, such as subsistence farmers and tribal communities are also most likely to depend directly on nature and primary resources because of their lack of access to development. Community-based adaptation projects seek to build the resilience and adaptive capacities of these communities whilst also recognising local knowledge and methods of adaptation. These communities can be seen as small-scale policy and adaptation 'laboratories' for knowledge on how adaptation can be achieved at a local level. Such projects are defined according to specific community needs and priorities, and are essentially seen as a 'bottom-up' approach to adaptation.

Local knowledge about techniques for water-harvesting, soil conservation, flood protection, stress-resistant local varieties and improved cutting practices in forestry are examples of community-based local adaptation, which relies on traditional knowledge, often divorced from conscious considerations of climate change as a global agenda. As a disaster risk management strategy in the Philippines, the UNFCCC points to an early warning system operational in some villages, where the community uses drums and horns to alert communities. Local elderly people are able to forecast cyclones and storms by observing abnormal behaviour of animals and by recognising particular types of clouds.

Community-based adaptation projects also tend to encourage a climate-resilient natural resource management plan for villages, and educating them in replanting strategies. The Asian Development Bank funds some such adaptation programmes in Asia – coastal and marine resources management adaptation projects in Indonesia, Malaysia and the Philippines, and water resource planning in Cambodia, among others.

As social and economic processes determine adaptive capacities, CBA aims to take into consideration the most marginalised and at-risk sections of societies in studying the conditions that constrain or enhance adaptive capacities. It recognises that small communities often do not have access to information and may be cut off from national agendas and the decision-making process. CBA projects promote participation, facilitate access to information, and educate communities about climate change and related terms. An example of awareness-raising and a participatory approach is the use of theatre, songs and poems. In the Philippines, with support from the Red Cross, the community has implemented an integrated disaster planning programme, which includes building seawalls, evacuation plans and land use plans.

Community based measures are said to enhance the resilience of communities, as in the case of natural hazards, often communities share responsibility and rely on social networks, especially in developing countries, where national response systems may not be in place in the event of natural disasters. Also, adaptive capacities are seen as heterogeneous within societies and localities. CBAs take into consideration the differentiation of vulnerability and adaptive capacity in terms of age, gender, income, and health.

### Role of technology

While many communities, especially farmers and coastal communities in poor countries, employ traditional practices of farming or building, and early warning systems against natural hazards such as floods or hurricanes, a planned approach to adaptation on the other hand involves research and technological innovation, which may be taken up by as a national adaptation strategy, by the private sector or international communities and donor bodies, or a combination of these.

*The Thames Barrier in London for flood/ surge protection*

Source: Andy Roberts, 2004. Available at Wikimedia Commons <http://commons.wikimedia.org/>

Technology can potentially play an important role in adapting to climate change. Efficient cooling systems, improved seeds, desalination technologies, and other engineering solutions represent some of the options that can increase coping abilities or eliminate certain stresses. Innovation, which refers to developing new strategies or technologies, is an important aspect of adaptation. These can include early warning systems, seasonal forecasting, flood defence systems such as major flood barges, and improved infrastructure.

For agricultural systems, new technology can be developed for irrigation, climate-resistant varieties of crops and genetically modified seeds that are drought-prone. Some of the concerns with technology development are that of ownership and profit, costs, a political sanction for research and the lack of a larger international framework for developing new technologies. Moreover, the developing countries have limited access to such technologies and have repeatedly made demands for 'technology transfer'. However, a key point here is that for technology to be transferred, it has to be developed in the first place, which must require coherent international support for technology.

There is also increasing interest in geo-engineering, which refers to attempts to alter climate by physically interfering with the climate system. Geo-engineering can provide an effective and affordable way of cooling the planet and modifying climate. Britain's Royal Society, one of the most prestigious scientific bodies in the world, published a report in 2009 arguing that it was feasible to 'engineer the Earth' (*The Australian*, 2010). The Royal Society's Philosophical Transactions dealt with techniques such as cloud seeding. Other examples include using mirrors in space to deflect some of the sun's rays from the Earth, or building a 'space parasol' made up of an extremely fine aluminium mesh to keep the planet cool, increasing ocean alkalinity, and placing aerosols in the upper atmosphere.

### Adaptation as continued development

As already noted above, the level of development in a particular society is closely related to its adaptive capacity as well as its vulnerability to climate change. According to Warren Evans, the World Bank Environment Development Director, economic growth 'is the most powerful form of adaptation' (*Economic Times*, 30 September 2009). The World Bank report on the economic costs of adaptation states that majority of the adaptation costs would be on improved infrastructure, both as a preventive measure and to facilitate better response to natural disasters. The report further notes that in many instances adaptation and development are 'one and the same' (World Bank, 2008, 5). The report on economic costs of adaptation also estimates the maximum percentage of expenditure to be on infrastructure, especially in Southeast Asia. This is because of its greater vulnerability to natural disasters and the key role of infrastructure in the prevention of damage and response to extreme weather events.

Bad weather already causes damage, especially in less developed countries. Their weak infrastructure and limited capacity for prevention makes them more vulnerable than wealthy nations. Therefore adapting both landscape and settlement by way of better urban planning and infrastructure to handle climate change makes for positive development policy and an adaptive measure. Investing in better roads and telecommunications promise to speed the pace of evacuations and reduce vulnerability to climate change, and yet these are needed and recognised as important development objectives, regardless of emergencies. Development also makes economies less reliant on climate-sensitive sectors such as agriculture.

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## Conclusion

As seen in this Alert, adaptation is set to receive growing importance in the climate change debate. Developing countries, especially, be it from a fatalistic or a proactive point of view, recognise adaptation as a more practical and efficient alternative to mitigation. The literature and existing studies on adaptation also elucidate the fact that vulnerability to climate change as well as the ability to adapt is essentially related to the levels of economic development and access to resources generally. Related factors also include the health systems in a region,

governance and response systems, agricultural development and the level of technology. It is further evident from this that adaptation approaches and possibilities as well as its success are largely dependent on social and political factors, not simply ecological determinants. Projects, programmes, investments and technology transfer also would depend on social and political factors in the international arena, and an examination of existing adaptation capacities in particular regions. Additionally, human systems may adapt in order to pursue goals other than species survival – this could mean a further enhancement of life by way of accompanying development, or exploitation of possible and perceived opportunities such as a new system of agriculture or an energy revolution, presented by climate change. In order to understand the potential of adaptation in developing countries' development and climate policy, an overview of existing means and future ambitions is required. Part II of this Alert will look at some of the existing adaptation strategies in the region and the types of adaptation measures adopted at a national and local level in Southeast Asia.

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**About the Centre:**

The Centre for NTS Studies, based in the S. Rajaratnam School of International Studies, was inaugurated by the Association of Southeast Asian Nations (ASEAN) Secretary-General Dr Surin Pitsuwan in May 2008. The Centre maintains research in the fields of Climate Change, Energy Security, Health Security, as well as Internal and Cross Border Conflict. It produces policy-relevant analyses aimed at furthering awareness and building capacity to address NTS issues and challenges in the Asia Pacific region and beyond. The Centre also provides a platform for scholars and policymakers within and outside Asia to discuss and analyse NTS issues in the region.

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