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PHNOM PENH PLAN

GMS DEVELOPMENT DIALOGUE
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GMS: CLIMATE MAKERS OR CLIMATE TAKERS?

Understanding and Responding to the Challenges of Climate Change

BACKGROUND PAPER*

Introduction

There is now a scientific consensus that climate change is an inevitable phenomenon with far-reaching consequences on a global scale. While climate change is an environmental issue, its effects are forecast to be pervasive --- affecting not only natural systems, but people's health, safety, and livelihoods as well. It threatens to affect the gains from development, especially of developing countries, including the GMS.

The impact of climate change is predicted to take many forms. The rise in average temperatures will translate in sea level rise, warmer ocean temperatures, and increased water acidity. The Asia-Pacific region is likely to experience more hazardous typhoons and droughts which could put the major river basins at risk of flooding. Coastal cities, especially those along the river deltas will face multiple risks from storm surge, river flooding and typhoon damage.

GMS' Contribution to Climate Change

While the historical build-up of greenhouse gases (GHG) is a result of emissions from the OECD countries, there is evidence that developing countries are now the fastest source of new emissions. For example, emissions from the PRC are already roughly equal to the United States. These two countries are now the largest emitters.[1]

The Intergovernmental Panel on Climate Change (IPCC) estimates global emissions of Green House Gases (GHG) in 2004 to be around 49 Gigatonnes (Gt) CO_2-equivalent, of which carbon dioxide accounted for about 37.5 Gt, and the remainder was comprised of other GHG such as methane. Of the global GHG emissions, energy supply accounted for about 26%, industry 19%, gases released from land-use change and forestry 17%, agriculture 14%, transport 13%, residential, commercial and service sectors 8% and waste 3% (1.37 Gt)[2]. With world population in the same year estimated to be around

* This Background Paper is based on an internal report by Alastair Fraser on "The Potential Impacts of Global Warming and Climate Change in the Greater Mekong Subregion", prepared under the auspices of the GMS Environment Operations Center (EOC), Bangkok, Thailand. December 2007. Unless otherwise cited, the data presented in this Background Paper is drawn from this report.

[1] ADB 2008. Climate Change and the Asian Development Bank.

[2] Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz,et.al. (eds)], Cambridge University Press,

6.373 billion, the average total annual per capita emissions was around 7.7 tonnes, of which fossil fuels account for about 4.3 tonnes.

The GMS is a significant contributor in absolute terms to total global emissions of GHG, and a large contributor relative to its share of the world population. Combining the emissions from combustion of fossil fuels (~0.4 Gt) with that emitted from the use of biomass fuel (0.035 Gt) and that from forest destruction and degradation (1.73 Gt), total GHG emissions from the GMS would amount to 2.16 Gt annually or 8.6 tonnes per caput. This is higher than the global average without taking account of emissions of other GHG, and suggests that the contribution to the emissions from forestry from the GMS is at least 20% of the global total from only about 2.5% of the global forest area, and is likely to be higher if all biomass is accounted for. The GMS, with 3.9% of the world's population, appears to be contributing around 4.5% of the annual emissions of CO_2.

Physical Consequences of Climate Change

Climate change analysts estimate that GMS countries will see an average of 3 to 4 degree changes in temperatures. This rise in temperature is expected to result in significant physical changes: (i) an increase in the frequency of extreme weather events, (ii) rising sea levels, and (iii) changes in hydrological systems affecting both, the pattern of discharge, and the temperature and chemistry of water. These changes are likely to affect biological (including human) systems with changes in the (iv) distribution of agro-ecological zones, (v) changes in the distribution of disease vectors. The GMS is particularly susceptible to these changes because of its relatively small land-mass, long coastline exposed to storms generated at sea and the presence of major rivers and high-mountains that are particularly snow-fed.

Frequency of extreme weather events. Although there is still a lack of scientific evidence on the impact of rising temperatures on extreme river flows in the GMS, the subregion has in recent years experienced regular storms and floods, that have been attributed to loss of forest cover in upper river basins. A study of the Sesan and Srepok river basins that rise in the Central Highlands of Viet Nam[3] and feed into the Mekong River in Cambodia did not detect a strong correlation between loss of forest cover and frequency or intensity of flooding. This was partly because of the limited time series data available for comparison. However, it did show clearly that flooding was associated with extreme rainfall events, with those occurring late in the season having a far bigger impact than those early in the rainy season.

Rising sea levels. According to the IPCC 4th Assessment, many coastal regions are already experiencing the effects of relative (local) sea-level rise, as a result of combination of factors including climate changes[4]. Such a rise in sea level, not only increases the risk of coastal erosion and chronic flooding in coastal areas, but it also increases the impact of storm-induced surges. Major GMS cities like Bangkok, Ho Chi Minh City, Ha Noi and Yangon are seriously at risk from such surges; additionally, the east coast of Viet Nam from Thanh Hoa south to Nha Trang frequently experiences

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Cambridge, United Kingdom and New York, NY, USA. Emissions from agriculture and forestry however have a high error margin, and about a half is estimated to be gases other than CO_2 such as methane emitted from agriculture, while forestry is entirely CO_2 from burning and decomposition.

[3] Fraser A.I. and N. Jewell, 2002, Forest cover and river system hydrology, ADB internal report.

[4] Global sea level has been rising at a rate of about 1.7 to 1.8 mm/yr over the last century, with an increased rate of about 3 mm/yr during the last decade[4].

tropical storms. Similarly, the west coast of Myanmar and Thailand, from the border with Bangladesh, south to the border with Malaysia, which has recently experienced the consequences of the *tsunami* in 2005 is also at risk from surges associated with tropical storms in the Indian Ocean and the Bay of Bengal. The most recent devastation of such a storm surge can be seen in the aftermath of the very severe cyclonic storm Nargis, which made landfall in Myanmar on 2 May 2008. There are concerns about the impacts of climate change on coral reefs as a result of increasing acidity of the sea, combined with greater storm intensity and raised sea surface temperatures.

Changes in hydrological systems. Climate change is likely to affect rainfall patterns and therefore have an impact on run-off, lake levels, groundwater, floods and droughts, and water quality. There is paucity of scientific evidence on the impacts of hydrological changes in the GMS. At the global scale, however, there is evidence of a broadly coherent pattern of change in annual river runoffs, with some regions experiencing an increase at higher latitudes and a decrease in parts of West Africa, southern Europe and southern Latin America.[5] There is abundant evidence of an earlier occurrence of spring peak river flows and an increase in winter base flows in basins with important seasonal snow cover in North America and northern Eurasia, resulting from local and regional climate warming in these areas. As regards flooding, there is no evidence of a globally widespread change except for an apparent increase in the frequency of 'large' floods across much of the globe from the analysis of data from large river basins.

Distribution of agro-ecological zones. Apart from direct impact on the growth of crops, adaptive responses of plants and wildlife have also been observed resulting from the timing and length of the growing seasons. These adaptive responses may be beneficial in some cases or detrimental in others. Of greatest concern however, is the impact on food security. It will mean that crops will tend to fail or become un-commercial where conditions are currently marginal for their production, while the conditions where they can be grown successfully may develop in other areas that have become marginal for other crops.

Distribution of human disease vectors. The evidence for changes in disease distribution, prevalence, or severity due to climate change is still rather inconclusive, but there is sufficient reason for caution and vigilance. Changes in temperature, precipitation and/or humidity affects environments for water-and vector-borne diseases and create conditions for disease outbreaks. The risk of water-borne diseases from bacteria is linked to flooding, which is expected to emerge as an important issue in the future. The main impact will be felt in the agriculture sector which will be evident in the potential loss of production in the event of disease infestation or decline in yields due to decrease in minimum nighttime or increase in maximum daytime temperatures.

Effects on Key Sectors

*Life, property, and assets (physical and social infrastructure)***.** Extreme weather events associated with climate change pose great threat to human settlements and societies in terms of damage to life, property and assets including modern infrastructure such as transport and energy. For instance, a 1m sea level rise will affect some major GMS investments in energy and transport, particularly in the Mekong delta and along the

[5] Milly, P.C.D., K.A. Dunne and A.V. Vecchia, 2005: Global pattern of trends in stream flow and water availability in a changing climate. *Nature*, **438**, 347-350.

coastal areas**.** Assets and population in countries like Thailand, and Viet Nam are increasingly located in costal areas in cities like Bangkok and Ho Chi Minh City. In Viet Nam alone, based on estimates, a 1m sea level rise is likely to displace 22 million people.

Agriculture and Food Security. The impact of climate change on agriculture and food security is of paramount concern. The agriculture sector can experience damage to crops due to sea level rise and saline water intrusion, extreme temperature and drought events, flooding, wind and soil erosion. Climate change can also impinge on the distribution of agro-ecological zones, threaten growth and productivity of agricultural crops and affect the distribution of pests and diseases. Some crops will be marginal to grow because of changes in climate, while others may benefit from warmer climate and may expand. The rise in sea level temperatures will have consequences on the marine environment, including marine flora and fauna, affecting the supply of seafood. The effects of these changes will have far-reaching consequences not only on agricultural productivity, but also on the livelihoods of fishing and coastal communities, and those in the rural areas.

As a mitigation response to climate change, one commodity that will gain in importance is biofuels. In some areas in the GMS where the soil and climatic conditions are suitable for oil producing plants, there is already a tendency to crop oil-producing plants, which could have an impact on food security.

Energy. The energy sector may be at risk from the threat of severe storms and extreme weather; the impacts may be direct on the generation of hydro-electricity and through damage to power distribution systems. The GMS countries collectively (including Yunnan Province adjusted pro-rata to PRC population) produce about 10% of their energy from hydro-power so that any disruption will be significant. Reduced rainfall, shorter rainfall season and more variable rainfall with longer dry spells could impact significantly on power generation.

Tourism. Tourism is another sector that could be affected, but to a lesser extent. Tourism that is dependent on sea and sand may be affected by both the loss of beaches and damage to tourist infrastructure. Changes in the distribution of agro-ecological zones could also impact tourism to the extent that they could affect the most attractive habitats and their species.

Geographical Distribution of Risks

The physical consequences of climate change imply that areas with certain specific characteristics are likely to be more severely affected. The GMS coastline is at risk from the consequences of rising sea levels and extreme weather events. Except for Lao PDR and Yunnan Province in PRC, all GMS countries have coastlines that are likely to experience negative impact of changes. The IPCC 4th Assessment identifies four river valleys in the GMS --- the Red, Mekong, Chao Phraya and Salween Rivers that are susceptible to increased flooding. Low lying areas along the course of these major rivers are at risk of greater flooding as a result both of changes in rainfall patterns and the frequency of extreme weather events.

All GMS countries also have uplands that are likely to experience a wide range of changes. These upland areas will be susceptible to changes in rainfall patterns and

extreme weather events that will increase the risk of erosion and landslides. On the positive side however, a modest increase in temperature could increase yields and extend the range within some crops could be cultivated in these areas. However, suitability of soils and steep slopes at higher elevations will remain a limiting factor.

The impact of climate change will affect different groups in society differently. The risks can be divided into (i) those that will involve gradual changes over the long-term (e.g., the impact on crop production of rising temperatures); and (ii) those that may occur suddenly and with increasing frequency (e.g., extreme weather events). The former would require interventions to promote awareness and education so that the affected groups are prepared when the impacts occur; the latter would require more practical measures such as modifying and/or strengthening physical structures to withstand extreme weather events.

Rural populations, especially those dependent on agriculture and forestry for their livelihoods are most vulnerable. Because of low population density in these areas, investment in mitigation measures would be less cost-efficient in terms of the population size served. While the trend is to invest heavily in areas with massive infrastructure and high population density that are prevalent in urban areas, the focus on the rural areas should revolve around the concept of self-help.

Mitigation and Adaptation Measures: A Call to Action

While the impacts of climate change are likely to happen in decades, the long gestation of many critical response measures compels immediate action. Measures taken now will only begin to take full effect at some time in the future. Interventions to deal with the consequences of climate change can be considered in three categories: (i) those aimed at reducing emissions; (ii) those aimed at mitigating the consequences of further global warming and climate change; and (iii) those aimed at helping sectors or communities to adapt to expected changed circumstances brought about by climate change.

Reducing emissions. Governments need to prepare plans for reducing net CO_2 emissions which can be done both by reducing the use of fossil fuels, reducing the rate of destruction of natural forest, by increasing the use of renewable energy including hydropower and biodiesel fuels and establishing plantations that will sequester additional CO_2. Such plans could be prepared on a sector by sector basis. For example, the transport sector could become carbon neutral if about 6 million hectares of bio-diesel crops were grown to meet about half the total annual fuel requirements of the transport sector.[6] Around 4 million ha of new plantations on land with steep slopes can be developed to have the dual function of sequestering the CO2 emitted from the fossil fuel component of the fuel mix, as well as protecting vulnerable soils from erosion.

[6] There is no data on the emissions of CO_2 by the transport sector, but data on the vehicle density for each country is available from which the total number of vehicles and hence the total distance traveled annually can be roughly estimated giving a total annual fuel consumption. Estimating this way suggests annual fuel consumption for all forms of transport at around 29 billion liters, (23 million tonnes) which would result in CO_2 emissions of around 82 million tonnes or 18% of total emissions in GMS. This is consistent with the global proportion of fossil fuel derived emissions from the transport sector of about 13%. This estimate would imply that the transport sector could become carbon neutral if about 6 million ha of bio-diesel crops were grown to meet about half the total annual fuel requirements and around 4 million ha of new plantations.

As the clearance of forests is a major source of CO_2 emissions in the subregion, the GMS can declare all remaining forests as protected areas to be managed sustainably so that harvest is compensated for by re-growth. The value of virgin, disturbed and good secondary natural forest for carbon sequestration, biodiversity and soil conservation can be increased by the creation of corridors to connect isolated tracts and by filling in bare or unstocked areas where there is a mosaic of forest among other land-uses. Conserving existing forest areas and extending them, especially on steep slopes that should not be used for agricultural purposes, will both limit further emissions of CO_2 from this source and will sequester some of the emissions from other sectors.

Mitigating the consequences. Because of the global nature of the problem of climate change, any measure adopted by GMS countries will not necessarily bring proportional benefits. Measures adopted by the GMS countries however, will strengthen their negotiating stance for reduced emissions by other countries in the international arena and will undoubtedly increase their level of preparedness.

Governments need to conduct detailed surveys of places and communities that have been identified as vulnerable to the consequences of climate change (i.e., coastal areas, low lying flood plains along the main rivers and mountainous areas with steep slopes) Without detailed surveys of these specific places it is impossible to say what mitigation measures will be needed and how much these will cost. Governments have a responsibility to conduct such surveys and prepare contingency plans to mitigate as far as possible serious risks to life and property.

Adaptation measures. Human societies always have, and will continue to adapt to changing conditions, but the rate at which adaptation will be needed and the direction of adaptation due to climate change is different from the past. The climate changes that can be expected as a result of global warming, though largely induced by mankind were not intended, and may turn out to be undesirable. This may require changes in lifestyle that a majority of humans seem reluctant to adopt. An important element in adaptation will be information that allows people to understand and recognize the dangers faced, their causes and the measures needed to avoid them or minimize their consequences.

Governments need to improve monitoring and reporting of information relative to climate change such as river flow and flood levels and wind speeds and increase the density of measurement stations in order to detect with greater certainty trends in frequency and intensity. Much of the evidence for climate change comes from Europe and the USA, because they have widespread monitoring stations and long records, while data for GMS is very limited. Lack of such data makes identification of the location and degree of risk extremely problematical and will delay adaptation.

Despite the lack of such information, it is already known where floods and devastating storms have occurred in the past, and national governments, if they have not done so already, should prepare and maintain maps of the affected areas, with relevant meteorological records and information on the degree and type of damage and the repair costs. As such a database is developed, it will provide invaluable information on measures required to minimize future damage and potential reduction in losses that can be expected from specific investments. It will also provide guidance for improving building codes and engineering standards to cope with increases in stresses in the future.