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Thailand's Country Study on Climate Change 1990: Mitigation, Climate Scenarios, Vulnerability and Adaptation[1]. Edited by Kansri Boonpragob, and prepared by the Thailand Environment Institute for the Office of Environment Policy and Planning, Ministry of Science, Technology and Environment. 1999.

There may be no current scientific issue as controversial as climate change. It has been described as potentially the greatest global environmental challenge facing mankind and it is not difficult to imagine the dramatic impact and consequences it could bring for life on planet earth. Indeed, there is no shortage of those ever ready to paint doomsday scenarios of a world in which global warming and rising sea levels would bring apocalyptic change.

The principal greenhouse gases (GHGs), carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), occur naturally in the atmosphere in small quantities. In fact our world would not be habitable without the warmth they provide by absorbing outgoing long-wave radiation. Unfortunately many human activities, particularly the combustion of fossil fuels and deforestation, are injecting substantial quantities of these GHGs into the atmosphere, thereby raising the temperature of the earth. This warming may lead to climate change with an as yet uncertain but possibly serious impact on society.

Growing concern worldwide over changes in climate that could be ascribed to human activities led the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to establish in 1988 an Intergovernmental Panel on Climate Change (IPCC). The Panel was assigned the none too easy task of assessing scientific information on climate change and formulating realistic response strategies for the future management of this issue. Nearly 400 scientists participated in the preparation of the widely acclaimed first IPCC report, issued in 1990 and updated in 1992, which formed a crucial input to the Rio de Janeiro 'Earth Summit' that year. The UN Framework Convention on Climate Change (UNFCCC) was agreed at that meeting and has subsequently been ratified by more than 170 States, including Thailand. One of the commitments to the Convention is to develop, periodically update and publish national inventories of greenhouse gas emissions and sinks, as well as measures to facilitate adequate adaptation to climate change. The publication under review forms part of Thailand's response to that commitment.

The report is divided into 13 main sections, individually numbered but totalling some 300 pages; there are 97 tables and 96 figures. These bare facts are a measure of the seriousness of Thailand's approach to its commitment under the Framework Convention. This country study is in fact the third of a three-volume response and deals with greenhouse gas mitigation options, climate change scenarios, vulnerability and adaptation. The reader may recall that the ultimate objective of the Convention *"is to stabilize greenhouse gas concentrations in the atmosphere at levels that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, ensure that food production is not threatened, and enable economic development to proceed in a sustainable manner."*

[1]The country study covers the years of the early 1990s. Later decisions made at global meetings in Kyoto and The Hague are not taken into account in this review.

GHG Mitigation Options

This volume goes into considerable detail on the greenhouse gas mitigation options open to Thailand in the energy and forestry sectors, with a briefer examination of those relevant to rice cultivation, livestock, and the waste sector. Of the three most significant GHGs, CO_2 accounts for 73 percent of emissions, CH_4 25 percent, and N_2O 2 percent. The importance of reducing CO_2 emissions is emphasized by the expectation that 1994 energy sector figures are forecast to rise more than sixfold by 2030. The study reviews the options in each of the power, industrial and transport sectors and their predicted effect in reducing emissions. In the power sector, for example, changes in management policy, increased use of natural gas, and the adoption of a combined-cycle technology could together bring about a reduction of 33.3 percent by 2030. Similar projections in the other two sectors lead to a national scenario in which emissions are reduced by 28.6 percent for the whole energy sector. It is also made clear that the study is not intended to be an exact forecast but rather a comparison of different options in order to help policy makers in developing a national strategy for reducing carbon dioxide emissions. The government could use regulations, fiscal incentives, information, and research and development to achieve its aim.

Forest protection and reforestation were identified as the two main mitigation options in the forest sector. Here again, a combination of these two activities is advocated as the best solution. No figures are offered for the options that will be applied to rice cultivation in Thailand. Water management, the use of nitrate or sulfate fertilizers, and high-yield rice, together with methane production inhibitors are considered to be important factors in reducing GHG emissions. This part of the country study ends with a brief look at livestock and the waste sector. For the former mitigation strategies should emphasize a reduction of methane from enteric fermentation in ruminants; the rapidly increasing production of methane from waste landfill sites is a source of concern requiring both short- and long-term mitigation measures.

Climate Change

Before the industrial revolution (1750–1800) the quantity of GHGs in the atmosphere was relatively constant with CO_2 amounts of about 270 ppm. Industrialization, population increases, and developments in agriculture had raised that figure to about 356 ppm by 1990 (IPCC, 1990) with a growth rate of 1.8 ppmv per year. The earth is becoming warmer at a faster rate than ever. The IPCC (1990, 1994) has looked at climate change scenarios assuming a doubling of carbon dioxide levels ($2xCO_2$) and concluded that:

- Global mean temperature will increase at a rate of about 0.3°C per decade (with an uncertainty range of 0.2 to 0.5°C per decade).
- Doubling carbon dioxide levels may raise the global mean temperature by 1.5–3.5°C, and this may occur by the year 2075.
- A global mean sea level rise of about 6 cm per decade over the next century (with an uncertainty range of 3–10 cm per decade), with a predicted rise of about 20 cm by 2030 and 56 cm by the end of the century. This will be due to the thermal expansion of sea water and the melting of the polar icecaps.
- Changes in seasonal climate patterns could occur, affecting the survival and regeneration of species and leading to changes in natural ecosystems.

These are potentially dramatic changes. How would they affect Thailand? The study under review tackles this problem with a detailed consideration of the likely effects on the climate of Thailand.

The examination is based on the use of General Circulation Models (GCMs), mathematical models that simulate the major components of the climate system. The models are sophisticated and require super-computers for processing. GCMs are potentially powerful tools for the study of climate changes that may result from increased concentrations of GHGs in the atmosphere and help to identify the sensitivity of sectors to climate change. GCMs are somewhat controversial because of different sources of climate data and levels of CO_2 used as a baseline. Commonly, several different GCMs will be used in order to find which best duplicates the magnitude and pattern of the locally observed climate. In the present study six were used with 30-year (1951–1980) mean annual precipitation and temperature data representing the main climatic regions of Thailand.

It was found that the United Kingdom Meteorological Office high resolution (UK89) GCM was the most suitable; the Goddard Institute of Space Studies (GISS) model might be acceptable as an alternative. In running the doubled CO_2 scenario the UK Meteorological Office 1987 low resolution model was also used. The UK89 model simulated potential temperature increases ranging from about 2.5–3.5°C throughout the country, the highest increase being 3.5°C in the East and Northeast, with about 3.0°C in the West and Central areas. The South had the lowest increase at 2.5°C. The precipitation scenario under $2xCO_2$ gave the Northeast the lowest increase, ranging from no change to less than 20 percent above the baseline value. North, West and Central districts may be exposed to an increase of 20 percent, whilst the lower South could expect an increase of about 40 percent.

The GISS and UKMO 87 models also showed increases in mean monthly temperature (2.2–6.0°C) but precipitation levels varied from no change to low in northern areas and higher in the South. The need for further study of the combined effects of temperature and precipitation changes on the water balance and moisture regime was stressed.

The same three models were used in the study to characterize potential changes of forest cover in Thailand, based on the Holdridge Life Zone classification. This classification is a climate–vegetation model widely used to examine the global distribution of terrestrial vegetation by relating annual precipitation and biotemperature to ecosystem characteristics. Whilst again underscoring the need for caution in interpreting trends, all three models suggest that tropical life zones will replace subtropical life zones. The major distinction between these two zones depends on the critical temperature line at 24°C in the Holdridge classification. This change therefore reflects the higher temperatures predicted by all three models.

The annual precipitation in some northern and northeastern areas is expected to remain in the 2,000–4,000 mm range but drier conditions could result as the temperature increase would lead to an increase in evapotranspiration. Small parts of the Central West and Southwest could find that climate change results in a wetter habitat. This section discusses several adaptation options such as reforestation with drought and heat resistant species, selecting priority conservation areas, and the establishment of gene banks and culture collections.

The impact of climate change is perhaps nowhere more potentially catastrophic than in agriculture and especially, for the security of food production. The 20 percent of Thailand's 20 million hectares of agricultural land that is irrigated is highly dependent

upon man-made water resources. The most fertile rice growing areas are the lowlands near river deltas where the balance of fresh and salt water and sea level rise play crucial roles. The study paints a gloomy picture of the effect of sea level rise if no counter measures are taken. The propagation of salt water up the Chao Phya, Mae Klong, Tachin and Bangpakong rivers could extend 40 km into the central plains, devastating rice and orchard crops. It could damage Bangkok's water supply and the groundwater used by industry would become saline. Other coastal areas could face similar problems.

The impact upon rice production appears to be largely dependent on the management of water resources and the type of the rice culture. A case study in the watershed area of the Sri Nakarin dam from model runs suggests that doubling CO_2 could result in a water shortage in 10–15 years. A change in management practices by reducing the irrigated area and electricity production would be called for. When taken in conjunction with a study in the Chao Phya river basin a picture emerges of severe floods in the rainy season but droughts in the dry season. In irrigated areas a less than 10 percent fall in yield could be expected.

This section of the study gave this reviewer the feeling that the accent was mostly on improving current water resources management, with the expectation that it would also serve as a buffer against severe climate events. No doubt continued studies and planning could produce a clearer assessment of climate change on agriculture in Thailand. The export of rice is likely to remain an important contributor to the national budget for many years to come.

Some comments have already been made on the impact of sea level rise. To those should be added that better monitoring of changes in sea level calls for a much improved network of tide gauges and the compilation of long-term records. With a coastline of 3,000 km Thailand must keep a very close watch on developments if it is to avoid the disasters inherent in this aspect of climate change. The country study deals in some detail with possible counter measures for coastal areas. It rightly draws attention to the fact that there is no government agency directly responsible for action to mitigate the impact of climate change. Whilst at present there may be no need for a new agency, strengthened cooperation and coordination is essential. A committee on climate change impact vulnerability and adaptation is recommended to propose both short- and long-term action.

Surprisingly, there is no more than a bare mention of the Thai Meteorological Department (TMD) as one of the government organizations furnishing data for the report. Surely, in matters of climate change, it should be playing a strong and forceful role at both national and international levels. This reviewer believes that the TMD should now assume its full responsibilities, perhaps as the lead agency for the coordination of future research into this vitally important question.

Despite the large amount of information in this publication it is not without some sense of frustration that one reaches the end. It is reassuring in indicating Thailand's awareness of the implications of climate change but worrying in that the mechanisms and resources (both human and financial) available at governmental level may not suffice for what is, undoubtedly, a massive task. Perhaps we should take comfort from the fact that dramatic change is not for tomorrow, even though there is much that should be done now. The past few years have demonstrated conclusively that global warming continues but how that will translate into a changed climate with all its socio-economic impacts remains highly uncertain. That is an enigma likely to be with us for many a long year.

The publication is well produced and the editors are to be congratulated on their success in bringing together and consolidating the views and thoughts of so many contributors on this most important topic. A little more care in proof reading would have reduced the number of errors.

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Bangkok
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