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CLIMAITE CHANGE AND ENVIRONMETAL PROBLEM IN WORLD-A STUDY OF BIGGEST SUNDARBAN

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ABSTRUCT:

Climate is one of the more complex physical systems in nature, its behavior being fundamentally non-linear and chaotic. In assessing the potential risks from climate change and the costs of averting it, researchers and policymakers encounter pervasive uncertainty. Sceptics demand to get rid of the inherent uncertainties, and some experts, on the other end, keep sending out messages of catastrophic scenarios hoping that this will increase people's awareness of the danger we face. The recent admission of a mistake in IPCC's Climate change 2007 report (promptly broadcast by all the major media groups and newspapers from Jan. 20th 2010 onwards) made by the head of the Intergovernmental Panel on Climate Change—that Himalayan glaciers could melt away by 2035 (the IPCC claim of 2035 is wrong by over 300 years.)—has already brought a damage to the IPCC's reputation that is likely to be considerable. But in this paper, perhaps risking being provocative and paradoxical, instead of looking for the right answers to what we think are inevitable uncertainties, we intend to search for new questions that may lead to a new way of thinking and may bring about new lifestyles and behaviour for citizens and firms.

BACKGROUND OF THE STUDY:

The single human activity that is most likely to have a large impact on the climate is the burning of "fossil fuels" such as coal, oil and gas. These fuels contain carbon. Burning them liberates carbon dioxide gas in the atmosphere. Since the early 1800s, when people began burning large amounts of coal and oil, the amount of carbon dioxide in the earth's atmosphere has increased by nearly 30%, and average global temperature appears to have risen between 1° and 2°F. This increment of temperature is keenly related to the basic property of the gas. Carbon dioxide gas traps solar heat in the atmosphere, partly in the same way as glass traps solar heat in a sunroom or a greenhouse. For this reason, carbon dioxide is sometimes called a "greenhouse gas." As more carbon dioxide is added to the atmosphere, solar heat faces more trouble in getting out. The result is that, if everything else remains unchanged, the average temperature of the atmosphere would increase. As people burn more fossil fuels for energy they add more carbon dioxide to the atmosphere. This creates a blanket of carbon dioxide over the Earth's surface, which allows the short waves of the sun to penetrate the Earth's atmosphere, but prevents the long wave radiations (emitted from the Earth's surface) to get out. If this activity continues for a long period of time, the average temperature of the atmosphere will almost certainly rise. This is commonly referred to as global warming. Global warming is thus the increase in the average temperature of the Earth's near-surface air and oceans in recent decades and its projected continuation. The term "global warming" is a sub-set of the universal set climate change, which

also encompasses another sub-set namely "global cooling." The United Nations Framework Convention on Climate Change (UNFCCC) uses the term "climate change" for human-induced changes and "climate variability" for other changes. Climate change is therefore any long-term significant change in the "average weather" that a given region experiences and involves changes in the variability or average state of the atmosphere over durations ranging from decades to millions of years. The roots of these changes can be related to several dynamic processes on Earth, external forces including variations in sunlight intensity, and more recently by human activities.

OBJECTIVES:

#. Measuring emissions and evaluating the carbon footprint.

#. Identifying the most attractive opportunities for energy and materials reductions.

#. Engaging in an educational scheme to show how those efforts interplay and affect other corporate objectives (one of the biggest challenges is to change the way that people work).

METHODOLOGY:

The intuitive approach to costing adaptation involves comparing a future world without climate change with a future world with climate change. The difference between these two worlds entails a series of actions to adapt to the new world conditions. And the costs of these additional actions are the costs of adapting to climate change. With that in mind, the study took the following four steps:

• Picking a baseline. For the timeframe, the world in 2050 was chosen, not beyond (forecasting climate change and its economic impacts becomes even more uncertain beyond this period). Development baselines were crafted for each sector, essentially establishing a growth path in the absence of climate change that determines sector-level performance indicators (such as stock of infrastructure assets, level of nutrition, and water supply availability). The baselines used a consistent set of GDP and population forecasts for 2010–50.

• Choosing climate projections. Two climate scenarios were chosen to capture as large as possible a range of model predictions. Although model predictions do not diverge much in projected temperatures increases by 2050, precipitation changes vary substantially across models. For this reason, model extremes were captured by using the two model scenarios that yielded extremes of dry and wet climate projections. Catastrophic events were not captured, however.

• Predicting impacts. An analysis was done to predict what the world would look like under the new climate conditions. This meant translating the impacts of changes in climate on the various economic activities (agriculture, fisheries), on people's behavior (consumption, health), on

environmental conditions (water availability, oceans, forests), and on physical capital (infrastructure).

The research work prepared in three stages which are as follows –

Pre-field work:

This stage includes - i) collection of districts map ii) collection of secondary information from district handbook, census report, others books and journals etc. iii) preparation of questionnaire statistical schedule for collection of primary data which are closely related with the research work.

Field work:

By questionnaire schedule primary data will be collected from the study area. Observation schedule also help to collect the information.

Post field work:

Collected data will be classified in a master table and various cartographic and statistical techniques will be made in support of the theoretical discussion.

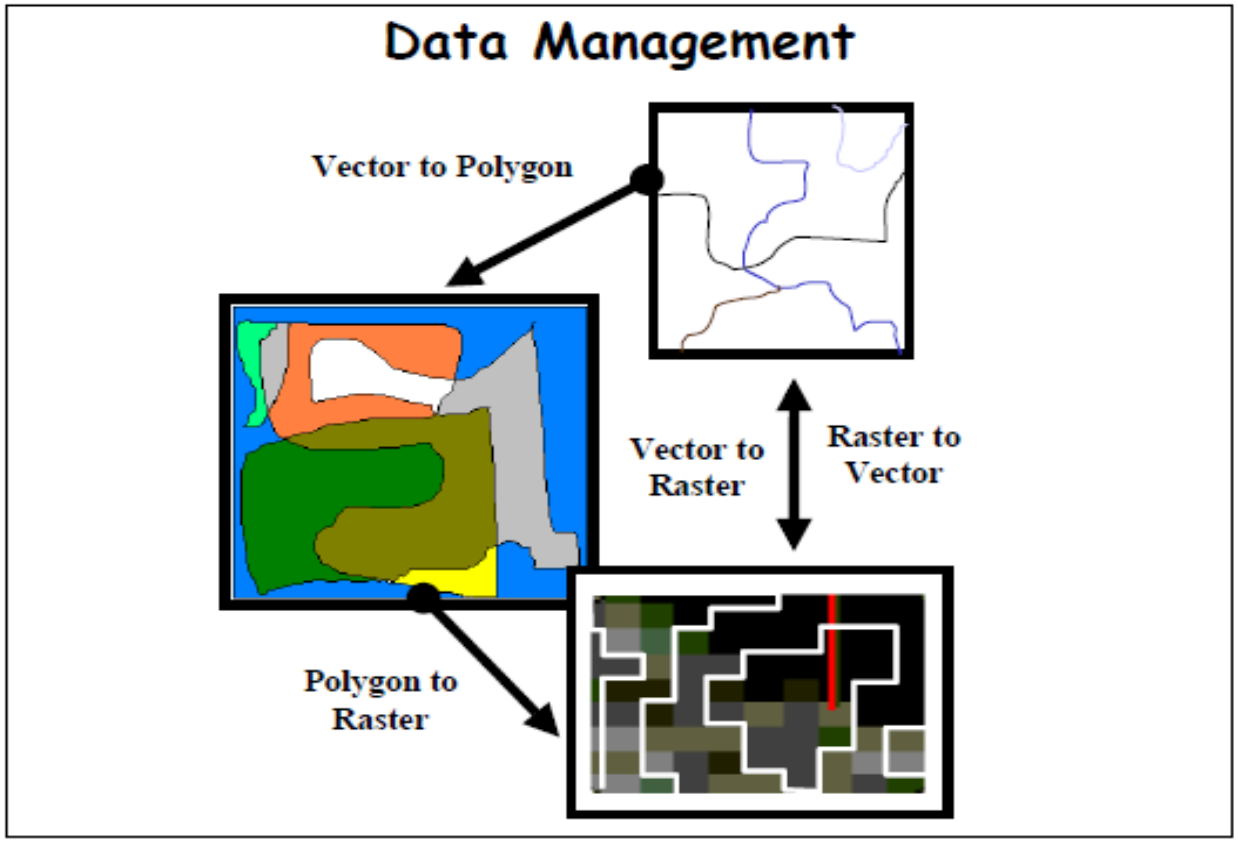

Fig-1: A Model of Research Methodology

RESULTS:

Climate change impacts on the Sundarbans

The potential impacts of climate change on the Sundarbans will only be superimposed on the baseline stresses discussed above that are already posing a critical threat to the ecosystem. Following from the scenarios outlined in Section 3, climate change is expected to have a significant effect on the flow regimes of the major rivers in Bangladesh, including the Ganges. Since the viability of the Sundarbans rests on the hydrology of the Ganges and its tributaries which supply the fresh water influx, climate change is expected to have significant impact on the Sundarbans. In addition to the altered hydrology, sea level rise will also have adverse impacts on the forest, directly through enhanced inundation and indirectly by enhancing saline intrusion in river systems.

Fig-2:Map of Biggest (India and Bangladesh) Sundarban

The climate change scenarios reviewed in Section 3.2 indicate that there is general agreement across climate models on increased precipitation during the monsoon season. Greater rainfall runoff would provide increased freshwater discharge in all the major distributaries of the Ganges supplying freshwater to the Sundarbans – the Gorai, the Modhumati and Bhairab system on the Bangladesh side and the Hoogly on the Indian side. Generally, increased flow regime in the distributaries of the Ganges would push the saline front outward towards the sea. Such a changed freshwater dominated hydrological condition during the monsoon in the absence of countervailing influences would help freshwater loving species such as the Sundari, especially in the mesohaline and polyhaline regions. Simultaneously however, a rise in sea level would also occur under climate change which would cause increased backwater effect in the major distributaries of the Ganges and tend to push the saline front further inland. The final location of the saline front during the monsoon will therefore be the result of two opposing effects: enhanced freshwater flows and enhanced backwater effect, and is hard to predict precisely. The backwater effect would also reduce the discharge of freshwater flow from the northern reaches of

the tributaries of the Ganges resulting in a relatively prolonged inundation of the forest land. Increased rainfall intensity – which is also anticipated in the region - would caused enhanced erosion upstream and result in increased availability of sediments, particularly along the Ganges and its distributaries. The latter effect in combination with prolonged flooding episodes would increase the rate of sedimentation/siltation in the back swamps and creeks inside the forest area. Such a change would be relatively more pronounced in the Bangladesh side of the forest and may slightly offset permanent inundation of the forest floor due to continued increase in sea level rise. The effects of climate change on the Sundarbans would be considerably more critical during the dry season that extends from November to April. Climate models predict a decrease in precipitation during this period which might further reduce freshwater flows, which will encourage enhanced withdrawals upstream for irrigation. This reduction in freshwater inflows into the Sundarbans could be exacerbated by increased evapo-transpiration losses and water use on account of rising winter temperatures. Reduced freshwater flows coupled with sea-level rise would consequently further enhance the dry season salinity levels in the Sundarbans.

Fig-3: A General View of Sundarban

The reduction in freshwater flows would only deteriorate with time and the lowest water levels would be expected in March. As a response to reduced flow regime the salinity front would penetrate inland both inside the forest areas and in the entire south-western areas of the country. Similar ingress of salinity is also expected on the Indian side of the Sundarbans. The effect of sea level rise on salinity ingress is modelled here using the salinity model of the Institute of Water Management (IWM), Bangladesh. Considering about 23 cm of SLR, isohaline lines penetrate inland, as shown in Figure 9 Significant penetration has been indicated for the threshold salinity of 1 ppt or higher for the rivers supplying freshwater in the western and central parts of the Sundarbans: Betna, upper Bhairab and Kobadak.

Salinity Ingress in the Sundarbans Under 23 cm Sea Level Rise:

If an increased sea level rise of 44 cm is considered a relatively higher penetration is expected to occur along the western parts of the GDA for the isohaline limits of 1, 5 and 10 ppt. It must however be mentioned that the model offers results of low confidence due to its limitation of using a fixed salinity boundary along the downstream of rivers. The modelling results are indicative, and actual salinity ingress would be compounded but when model results are superimposed on the possibility of reduction of surface flows during the peak low flow period, one may have an understanding of the extent of salinity ingress along the rivers in the Sundarbans. As a consequence of salinity penetration in the Sundarbans, majority of the mesohaline areas will be transformed into polyhaline areas, while oligohaline areas would be reduced to only a small pocket along the lower-Baleswar river in the eastern part of the forest. Such a finding closely supports earlier studies (Ahmed et al., 1998).

High intensity cyclonic storm surge, induced by a general rise in sea surface temperature, is also likely to have compounding effect on salinity intrusion along the coastal areas of Bangladesh, including the Sundarbans. A simple frequency distribution of all observed cyclonic activities in the Bengal delta suggests that these events usually occur twice per annum: in late May and in early November (Haider et al., 1991). Cyclones are usually formed in a complex process where the sea surface water temperature is exceeded beyond the threshold value of 27oC. Since climate change will cause an increase in mean sea surface temperature, it may be expected that the excess heat energy will be dissipated in the form of increasing number of high intensity cyclones. Unfortunately, such high intensity cyclones are often associated with high storm surges. It may be argued that intensity of storm surges is likely to be increased under climate change scenarios, particularly in the later part of the 21st century. Cyclonic storms would cause severe damages to the forest, its inhabitants and resources. A high intensity event in 1986 devastated the Sundarbans, drowned thousands of its magnificent animals including the threatened species, the Bengal Tiger.

The wind associated with that particular cyclone also devastated vegetation of a large part of the forest. Influenced by climate change, high intensity storm surges would inundate high levees and back swamps that do not get submerged with saline water and thereby would be affected by salinity. According to a number of studies available on the Sundarbans (Karim, 1994; Siddiqi, 1994), complex forest processes such as the natural regeneration of vegetation and forest succession also depend on salinity regime. Considering that the salinity regime inside the forest will significantly change as a consequence of climate change, it has been argued that increased salinity would have discernable adverse impacts on forest regeneration and succession (Ahmed et al., 1998). For example, the freshwater loving Sundari is projected to decline or disappear entirely under climate change. Areas with best quality standing timber predominated would be replaced by inferior quality tree or shrub species.

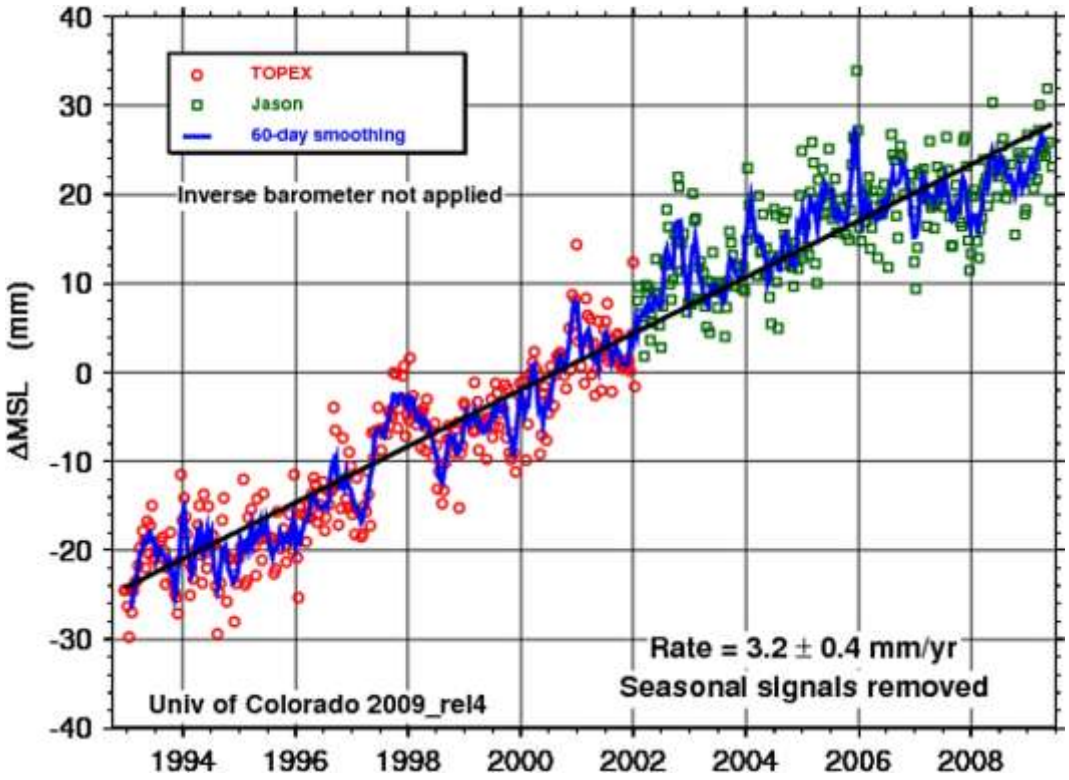

Fig-4: Change of Mean Sea Level
(Source: University of Colorado,2009)

Under such conditions vegetation canopy would become sparse and plant height would be reduced significantly. With such a dramatic series of anticipated changes in forest vegetation under climate change, the productivity of the forest would be severely constrained. Chaffey et al. (1985) demonstrated that, total merchantable wood volume per unit area of forest land decline with increasing soil and river salinity. Preliminary estimates suggested that, disappearance of oligohaline areas combined with decreasing mesohaline areas would result into over 50% loss of merchantable wood from the Sundarbans (Ahmed et al., 1998). Increase in salinity in the Indian side of the forest would have compounding effect to the existing poor productivity of the forest. Since the composition of vegetation has profound effect on distribution of forest fauna, a change in forest succession would in turn affect the long-term sustainability of the ecosystem. Considering the timeframe of such changes and the land-use patterns inland, it is highly unlikely that forest species would have sufficient time or room to migrate inland in response to these changes.

Adaptation options for the Sundarban:

The most useful adaptation aiming at saving the Sundarbans from sea-level rise induced submergence would be to modify the threats of permanent inundation. Since most part of the projected sea level rise would occur from tectonic subsidence, it would not be quite possible to stop the processes involved. However, efforts must be made to figure out ways to enhance sedimentation on the forest floor, by means of guided sedimentation techniques. If such

approaches appear to be technically feasible and economically viable at a pilot level, efforts must be made to undertake projects in order to save the forest. Controlled and guided sedimentation will have a balancing influence on subsidence process and could help delay permanent inundation of the forest floor. The second most important adaptation strategy will be to reduce the threats of increasing salinity, particularly during the low flow period.

Fig-5: Adaptation View of Sundarban

This may involve a range of physical adaptations to offset salinity ingress, including: (a) increasing freshwater flows from upstream areas; (b) resuscitation of existing river networks towards improving flow regime along the forest; and (c) artificial enhancement of existing river networks to facilitate freshwater flow regime along the rivers supplying freshwater to the western parts of the forest. For the sustenance of the forest in its natural state a previous study has recommended that about 240 cumec water should be allowed to flow through the Gorai river system, particularly during the critical dry period of April (Mirza, 1998). The actual amount of water flowing along the Gorai River in 1995-96 was about 52 cumec, which was far below that the recommended flow regime. The Gorai River is an important source of freshwater supply to the southwest region (SWR) of Bangladesh and is the only remaining major spill channel of the Ganges River flowing through the region where the Sundarbans is located at its southern most part. Dry season Gorai flows have been particularly affected by the building of the Farakka barrage on the Indian side.

The most visible impact has been in the form of bringing morphological changes along the Gorai — since 1988, the river has been completely disconnected from the Ganges during every lean season. As a result only the base flow of the Gorai river system, contributed predominantly by seepage, was able to reach the Sundarbans during the dry season. Following the signing of the Ganges Water Sharing Treaty (GWST) with India in 1996, the flow regime of the Ganges within Bangladesh has slightly improved. In order to increase the flow from its current level will require enhancing regional cooperation amongst coriparian countries to augment flow regime of the Ganges, and the creation of storage capacity within the Ganges basin on the Bangladesh side so that a sustained flow regime can be maintained in Gorai and other rivers throughout the lean season.

CONCLUSION:

In this paper, instead of looking for the right answers to the inevitable uncertainties that have to do with climate change, we search for new questions that may lead to a new way of thinking and may involve new lifestyles and behaviour. As paradoxical as it may seem, we suggest that the whole issue of global warming and climate change is not an ethical one. It is not in the ethical realm of right or wrong that a possibility for sustainable development and new lifestyles for adaptation will arise. We are not experiencing climate change because there is something wrong. Instead, there might be something unclear, or even not yet known, or missing. We are interested in those questions (we call them effective questions) that independently of whether climate change is true or not are able to shift people's habits and therefore behaviour in the direction of environmental responsibility. By no means do we intend to provide the ultimate questions. We only want to address the argument of becoming responsible to formulate questions that open up scenarios and lead to concrete actions.

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