



STABILISATION OF CLIMATE CHANGE IN THE HIMALAYAS

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Introduction

1. The Himalayan ranges stretch across a length of 2500 Kms and averages a width of 300 Kms. It has fourteen of the tallest peaks in the world including Mount Everest that soar to a height of over 8 Kms. It stands in the path of the moisture bearing currents from the South and the freezing cold air from the North and has a vital meteorological influence not only on the weather patterns of South Asia but on the entire global climate. The Himalayan ranges are also a treasure trove of biodiversity including hundreds of precious medicinal plants and herbs. These are vital for the production of several formulations in the Allopathic, Ayurvedic, Chinese and Tibetan systems of medicine.
2. Three of the major river systems of South Asia, namely the Indus, Ganges and the Brahmaputra originate from the Himalayas. 500 million people inhabiting the plains of North India, Nepal, Pakistan and Bangladesh depend directly from these waters that flow down from the mountains. Considerable areas of the Indus and Brahmaputra river basins also fall within Chinese territory. The Salween, Yangtze, Irrawady and Mekong are some of the important Chinese rivers that originate in the Himalayas. It has been estimated that 1400 cu Km of freshwater are locked up in the Himalayan glaciers that act as the fountain –head of South Asia.
3. The mass of ice and snow in the Himalayas is the third largest in the world after the Greenland and Antarctic ice sheets. The vitally important role of the Himalayas in sustaining the lives and livelihood of millions of people is obvious. It is therefore a matter of deep concern to the entire global community and to the people of south Asia in particular that the Himalayan environment is under serious threat due to the effects of climate change and global warming. Climate change has already taken a heavy toll of the Himalayas. Lester Brown of the World Watch Institute,

USA says that due to the effects of global warming the pattern of precipitation in the Himalayas and the regions contiguous to the Himalayas will undergo a more drastic change in the years to come. The increase in temperature will reduce the amount of snowfall and therefore the snow fed rivers of China and the Indian subcontinent will have less water flow in the summer months when the snow melts. However, since the quantum of water in the atmosphere is constant, the reduced snowfall will convert to excessive rainfall during the monsoons. The rivers will have reduced water in the summer months and the flooding of these rivers during monsoons will be more intense. We are perhaps already witness to a cycle of more pronounced drought and floods in the region. Another alarming trend is the shrinking of the glaciers due to the rise in temperatures. The Gangotri glacier that is the source of the Ganges has receded by 600 meters in the past 40 years. There has been a marked increase in the rate since 1971 and the glacier has been shrinking by 30 meters per year. Surveys based on satellite images and ground investigations by ISRO's Space Application Centre (SAC) Ahmedabad [India] have established that in Himachal Pradesh state of India, alone, the glaciers have reduced from 2,077 km² to 1,628 km² – an overall deglaciation of 21 % in four decades. According to SAC as many as 127 glaciers of less than 1sq Km size have lost 38 per cent of their geographical area since 1962. The larger glaciers, which are progressively getting fragmented, have receded by as much as 12 per cent.

It is predicted that at this rate, many of the Himalayan glaciers will be severely degraded in the decades to come and most of the snow fed Himalayan rivers including the Ganges will become seasonal rivers.

4. It is evident that if the trend of reduced snowfall, increased precipitation and shrinking of the Himalayan glaciers continues, the result would be catastrophic for several millions of people in South Asia South East Asia and China. Food productivity of the entire region would be severely affected due to the cycle of droughts and floods. Due to the failure of agricultural crops there would be mass migrations to the cities and towns from rural areas, placing tremendous pressure on the infrastructure of these population centers. It has been estimated that during this century, the accelerated ice melts in the Himalayas flowing into the seas will cause sea levels to rise by 1 meter. Such a rise in sea levels would destroy fifty percent of the rice fields of Bangladesh. It would also result in millions of 'climate refugees' fleeing from the low-lying areas in India, China, Bangladesh, Indonesia, and Vietnam.

5. The mountains and valleys of the Himalayan region are home to 100 million people that include several indigenous communities whose livelihoods and culture are closely linked to the mountain eco-system. They face an uncertain future in the face of the climate change. Increased temperatures will have a drastic impact on their water and food security and on horticulture that is a major source of income to large sections of the Himalayan population. They will become increasingly dependent on food imports and will be more vulnerable to flooding and Glacial Lake Outburst floods.

6. As regards the direct implications for the forests in the Himalayan region, mitigation strategies are vital in order to ensure that the forests themselves do not get degraded and destroyed due to climate change. One example is the destruction of thousands of acres of Pine forests in Canada due to invasion of the Pine Beetle. This could hit 25percent of the trees in British Columbia and in interior areas like Quesnel, 80 percent of the trees could be unsalvageable within five to ten years. The Pine Beetle was able to spread to these areas due to the increase in temperatures caused by Climate Change. The dead and rotting pine will in turn fuel increased global warming in the area.

7. Specific to the Himalayas, we have evidence of changes in the tree species. In the middle altitudes of the Himalayas, Chir Pine is taking over Oak dominated forests. The Himalayan Subtropical Pine Forests are the largest in the Indo-Pacific region. They stretch throughout most of the 3,000-km length of this the world's youngest and highest mountain range. Some scientists believe that climate change and human disturbance are causing the lower-elevation oak forests to be gradually degraded and invaded by the drought-resistant Chir pine (*Pinus roxburghii*), the dominant species in these subtropical pine forests. Degradation of natural forests due to invasive species and other climate associated factors will accelerate climate change and the rise in temperatures will in turn result in further degradation of the forest eco-systems. In this context it is very important to take urgent measures to check the trend of rising temperatures in the Himalayas.

8. The rise in temperatures will adversely affect the biodiversity of the Himalayan region, which is a treasure trove of herbs and plants that are essential for numerous types of preparations in the Allopathic, Ayurvedic, Tibetan and Chinese systems of medicine. The impacts of climate change are going to be more pronounced for the highly sensitive sub-alpine and alpine species like *Saussurea* spp. Analyses of tree-ring samples of *Taxus baccata*, *Abies pindrow* and *Abies spectabilis* from various forest stands have provided valuable information on the plant growth and climate relationship. As regards the riverine ecology, the degradation of biodiversity will be felt

not only in the Himalayan region, but along the entire course of the rivers and upto the estuaries where they drain out into the oceans. It has been predicted that climate change would impact glacier melt as well as precipitation levels resulting in changes in the river regime, which in turn would impact inhabiting aquatic biodiversity and river dependent livelihoods. In the context of invasive species, they could destroy several kinds of medicinal plants in the Himalayas as well as various forms of aquatic life in the Himalayan river systems.

9. It does not require a Nostradamus to predict the impending doom that is awaiting a region already battling with crippling poverty and over population. **It is also vital to realize that we do not have the luxury of time. The clock is ticking away and we must act now before it is too late.** A problem of this magnitude has to be tackled in its totality. A two-pronged strategy is essential. Firstly, we have to be prepared for the consequences of climate change. This would involve adaptive measures such as planning for disaster management at the national level, changing cropping patterns, implementing water conservation measures, tackling the problem of pollution of rivers, etc. The second aspect of the strategy would be to try to stabilize the climate to the extent possible so that the impacts of climate change are minimized. This concept paper deals with the second aspect, i.e. stabilization of climate with reference to the Himalayas.

CLIMATE STABILIZATION OF THE HIMALAYAN REGION

1. Like any other eco-system, the Himalayas will be adversely influenced by emission of green house gases in any part of the world. **However, it is crucial to understand that there would be a considerable influence from the emissions of certain green house gases and aerosols from within the Himalayan ranges and the contiguous areas. The local emissions create a Regional climate impact that combines with the overall global warming to further accentuate the temperature rise.** Being a snow covered mountain eco-region, the Himalayas and other such eco-regions such as the Alps are particularly vulnerable due to the 'trapping' effect of the valleys. The Green House Gases with a shorter life span will also remain in the atmosphere for longer periods in cold climates. In this context, it is relevant to note that the rapid melting of ice caps in the Arctic is influenced not only by Global warming but also due to regional emissions mainly from Eurasia and oil and off-shore oil exploitation. Heavy shipping traffic with large concentrations of Nitrogen

Oxide emissions is another cause for the Arctic Haze that compounds the overall effect of Global warming. Closer home, the Siachen Glacier is another case in point. According to a recent study by the WWF, the past two decades has seen a rapid melting of the glacier and it is amongst the fastest melting glaciers in the world. It was precisely two decades ago that the Siachen Glacier dispute flared up between India and Pakistan, leading to massive troop deployment in the area by both countries. The study states that the Siachen Glacier has been melting alarmingly more due to military activity of India and Pakistan than due to global warming.

The regional emissions and pressures in and around the Himalayas contribute to a regional climate impact on the Himalayas. This compounds the effect of global climate change. These regional emissions and pressures can be categorized as under:

A. The Asian Brown Haze

The Asian Brown Haze is caused mainly by domestic wood and coal fires and vehicle exhaust fumes. Certain mega-city hotspots such as Delhi, Beijing, Dhaka etc have been identified that contribute significantly to the Black Carbon in the Asian Brown Haze. The Asian Brown Haze is causing a regional heating effect that is accelerating the glacier melt in the Himalayas. In fact it is estimated that the heating effect of the brown haze is the same as that of the global warming due to Green House Gases. ***In a sense, the Himalayan region is perhaps being subjected to a 'Double Whammy' due to the combined effect of overall Global warming coupled with the impact of the Brown Haze.*** Black Carbon is an important component of the Haze and reduction in Black Carbon emissions should be given top priority. ***According to an IGSD/INECE report, the impact of Black Carbon on melting snow-pack and glaciers in the Himalayas may be equal to that of CO₂.*** In the context of the Brown Haze, aerosols play an important role. In the overall scenario of Global Climate Change, certain types of aerosols produce a heating effect whereas others have an overall cooling effect. However, in the case of the Brown Haze over the Himalayas, all the aerosols combine to form the haze and the net result is a regional warming effect. Hence in the Himalayan region, the effort must be towards reducing emission of all types of aerosols.

A. Concentration of Green House Gases at the source of emissions

While the effect of Carbon Dioxide emissions has a more global effect, there is sufficient scientific evidence to prove that other non-CO₂ gases and aerosols have a more pronounced effect on the climate in the immediate vicinity of the emissions. This is borne out by a study carried out on the concentration of Nitrous oxide in Eastern China. It was found that while most of the Nitrous Oxide concentrations were due to local emissions, about 30 to 40 percent of the Carbon Monoxide concentrations over the region were also a result of local emissions.

B. Urban Heat Islands

The phenomenon of Urban Heat Islands is well known. Both the core Himalayan region as well as the contiguous areas have a number of large cities and townships that form Urban Heat Islands. The UHI effect can be viewed as a balloon of higher temperature formed over the urban areas. This balloon of higher temperature is shifted to the adjoining non-urban areas due to wind factors and hence cause a higher temperature in these contiguous areas outside the cities/towns. The effect could be more intense in mountainous regions due to the 'trapping' effect of valleys. This is indicated in the high levels of pollution in the Khatmandu Valley. Levels of air pollution in Khatmandu are one of the highest in Asia, although the number of vehicles is far less than cities such as Mumbai and Delhi. UHI effect can extend to a range of upto 2.4 times the size of the city, beyond the city limits. Hence increased urbanization in the Himalayan region could create a number of climatic 'hotspots' that could contribute to the overall regional temperature rise if further unplanned expansion of these cities is not curbed and if efforts are not made to mitigate the UHI effect of these cities.

C. Pressures of Tourists and Pilgrims

Tourists and Pilgrims form a large floating population in the Himalayas. They are concentrated more in the cities and popular tourist and pilgrimage destinations. They exert a more direct 'point' influence and contribute to the Urban Heat Island effect in the cities such as Srinagar and Khatmandu. This effect is also pronounced in site-specific pilgrimage destinations such as the Gangotri Glacier that is the source of the Ganges River. It is feared that the

rapid retreat of the Gangotri Glacier will adversely affect water flow in the Ganges during the summer months.

D. Military presence in the Himalayas

There is a large and permanent military presence in the Himalayan region. The overall emissions are a result of both the troop deployment and also due to the movement of maintenance and administrative convoys that result in heavy movement of truck transport. Apart from the overall regional impact of the Army deployment, there are also ‘spot’ impacts as in the case of the Siachen Glacier. The Nubra River originates from the Siachen Glacier and is a source of the Indus River that caters for 75% of the irrigation requirements of Pakistan. The Siachen has been found to be amongst the fastest melting glaciers in the world following massive troop deployment in the area about twenty five years ago. ***It is emphasized that this paper does not attempt to make a case for demilitarization of the Himalayan region, since troop deployment is linked to security concerns and national policies of the concerned countries. However it is pointed out that there is ample scope for the respective countries to take practical steps to see that there is considerable reduction in the emissions caused by army deployment and administrative convoys.***

2. Cost Benefit Analysis

It is beyond the scope of this paper to present a detailed cost-benefit analysis of reducing emissions [principally black carbon and non-CO2 Green House Gases] in the Himalayas. However, available information point towards huge savings by way of improved health conditions, [especially of women], and savings in the energy sector. Other benefits include the avoidance of disasters caused by climate change, such as bursting of glacial lakes due to increased levels of glacial melt. Huge benefits would also accrue by preventing climate-induced drought/floods in the lower regions such as the Indo-Gangetic plains, Southern China and Bangladesh. Regional strategies for mitigation of Climate Change in the Himalayas and adjoining regions will address key issues such as food productivity and water security for large parts of South Asia, South East Asia and China. If computed in real time economic benefits as compared to the costs, the indicators will certainly favor strategies for reduction of emissions in the region. . A recent review of the economics of climate change by the Government of the UK states that, if no action is taken now, the overall cost and risks of climate change could be equivalent to the loss of 5% of global gross domestic product (GDP) each year. If a

wider range of risks and impacts is considered, the estimated damage could reach as high as 20% of global GDP.

3. The Time factor and the Regional perspective

- A. In addressing the issue of climate change concerns for the Himalayan Region, the consideration of the Time Factor is vital. At the Bali Conference on Climate Change, UNSW climatologists lead a consortium of more than 200 leading climate scientists who have warned the United Nations Climate Conference of the need to act immediately to cut greenhouse gas emissions, with a window of 10-15 years for global emissions to peak and decline, and a goal of at least a 50 percent reduction by 2050. ***However, it is to be understood that from the regional perspective of the Himalayan Ecology, we may not have so much time. The effects of global warming are more pronounced on snow covered mountain eco-systems. Moreover, the Himalayan region will witness increased population pressures in the coming decade. This is all the more reason that emission reduction strategies must worked out and put into execution mode at the earliest in order to meet the increased ecological stress that will occur in the near future.*** Concentrated efforts must be made to drastically reduce aerosol and non-CO2 emissions within the next five years, primarily to cut down on the formation of the Brown Haze over the Himalayas. If this is not done, the ecological damage to the Himalayas and especially the Himalayan Glaciers may be irreversible.
- B. Reduction of emissions in the Himalayan region must be recognized as a Race against time. Hence there is no time to be lost in carrying out further exhaustive research and analytical studies. Findings of credible research studies already carried out need to be taken into account. The stress should be on identifying and categorizing the principal sources of aerosol, Black Carbon and non- CO2 emissions. This will need to be followed by working out strategies for achieving required scale of reduction for these emissions within a mutually agreed time-frame.

THE WAY AHEAD

1. Mitigation of Climate Change in the Himalayas will be of mutual benefit to the Himalayan nations. It will also directly impact the other

non-Himalayan regions that depend on the Rivers that originate in the Himalayas.

2. The Five Himalayan countries, together with certain other global agencies should form an organization to formulate and execute a joint strategy for mitigation of climate change in the Himalayan region. *Such an organization could be modeled along the lines of the existing Arctic Union.* The main aim would be to cooperate on a regional basis to reduce emissions within and around the Himalayan region, with emphasis on Black Coal and non-CO2 emissions.

3. Advantages of Regional Cooperation on the Himalayas

A joint strategy by the five countries will have tremendous advantages. It will ensure that there is an integrated, time-bound approach to tackling the issue with the active involvement of other concerned International Agencies.

3. Frame work for a joint strategy

A joint strategy for emission reduction in the Himalayan region could be based on the following parameters:-

[a] Identifying the extent of the zone requiring intervention. This would include the Himalayan ranges and contiguous areas. Broadly, the Himalayan Ranges would be the core zone and the contiguous areas would be the outer zone. Initially, the outer zone could be for a radius of fifty Kms from the core zone. The outer zone could then be increased periodically till a maximum laid-down radius is covered under the action-plan.

[b] An analysis of the interventions required in the core zone and the outer zone in order to reduce emissions and mitigate climate change and to stabilize the effects of global warming to the extent possible.

[c] The countries concerned will then have to sign an agreement on the various interventions and the time frame within which these will be implemented.

[d] The process will need to be facilitated by UN and other organizations such as UNFCCC, IPCC, IUCN, FAO, UNEP, UNESCAP, ICIMOD, etc. These organizations should also be involved in organizing the required funding mechanisms.

5. Recommended interventions

Certain measures that could be considered are enumerated below. Some of these will have to be applied more stringently and on priority in the core zone as compared to the outer zone.

[a] Industries

Certain types of industries will have to be banned and phased out. Alternatively, they should be permitted only on introduction of upgraded technology that will sufficiently minimize emissions. They will also require financial assistance to incorporate cleaner technologies. There is good scope for reducing BC emissions by improved technology for thousands of brick kilns in the region. Nepal and Bhutan may need financial support for installing cleaner technologies. An international funding mechanism will be required for this purpose.

[b] Automobiles

Automobiles in both the core zone and the outer zone should convert to environment friendly fuel. As far as the Govt of India is concerned, priority for converting to CNG or LPG should be given to Jammu, Dehradun, Srinagar, Shimla and Manali rather than Delhi or Mumbai. All the countries concerned maintain a very large military presence in the core zone. Thousands of Army trucks move within the core zone every day. Therefore environment friendly fuel for these vehicles is essential. However, in view of logistical considerations, this may not be practical in the near time. Hence the Himalayan countries must ensure that military vehicles plying in the Himalayan region conform to required emission norms. Adequate mass transport facilities such as buses should be provided for tourists and pilgrims. Use of individual vehicles by tourists and pilgrims could be discouraged through imposition of toll tax and declaration of 'no car zones'. Convenient car parking facilities should be provided at base areas.

[c] Road Construction activity

There is constant road construction and maintenance activity in the Himalayan region. This is on a large scale and it is necessary for the supply and maintenance of the troops deployed in the Himalayas. The obsolete road construction methods require burning large quantities of coal tar. This contributes substantially to the Green House gas and Black coal aerosol emissions in the Himalayas. Hence there is an urgent need to introduce cleaner technologies for road construction and repair in the Himalayas.

[d] Demography

Demographic pressure always translates to greater levels of human activity. Concentrations of populations should be avoided. The Governments should encourage of well-planned satellite townships in the Himalayan region, rather than increased growth of cities such as Khatmandu, Jammu and Shimla.

[e] Aforestation

An intensive aforestation programme by the countries will be of vital importance. Efforts must be made of regain the glory of the original Himalayan and sub Himalayan forests. While stringent law enforcement will be required to curb timber smuggling, alternatives should be provided to rural populace that depends primarily on wood for fuel. A well thought out plan should also be prepared and executed to protect the interests of the large number of people in the core area who make a livelihood though the manufacture of furniture, sports goods etc. The establishment of trans boundary National Parks could be considered. This would be a useful initiative by neighbouring countries to improve the management of forests along border areas. Ecological Territorial Army Battalions comprising of ex-servicemen will be able to play a very important role in aforestation of the Himalayas in India. **The proposed Trans Himalayan Development Authority proposed by the state Government in of Himachal Pradesh in India is an important step towards improved management of the Himalayan forests. The idea in its existing form could be enhanced to incorporate all the forests in the Himalayan region within India and in the other countries.**

[f] Improved technologies in domestic fuel consumption

There is good scope for improving technologies for domestic fuel consumption requirements, such as cooking. The National Programme on Improved Cookstoves [NPIC] in Himachal Pradesh, the Western Himalayan Indian State is a good example. Such initiatives will have dual benefits of emission reduction combined with improved health of women.

[h] Land use practices

Burning of huge Agriculture residue such as paddy in the North Indian State of Punjab and in parts of could have a direct influence on the Brown Cloud over the Himalayas. Burning of agriculture residue is also a common practice in some of the Himalayan states. The fires from the fields frequently spread to the Himalayan foothills causing forest fires. These issues need to be addressed in the areas close to the Himalayas. There is considerable stress on the Himalayan landscape due to pressures of over-grazing. Slash and burn cultivation in Eastern Himalayas must also be taken into account. _

[i] The Cities for Climate Protection Campaign [CCP] sponsored by ICLEI [International Council for Environmental Initiatives] would be of relevance for the cities in and around the Himalayan Region.

[j] Mega- City hot spots There will be a need to concurrently reduce Black Carbon emissions in some of the identified mega-city hot spots that are closer to the Himalayas. These could be Delhi, Kolkotta, Dhaka and Karachi.

CONCLUSION

1. There is sufficient evidence to indicate that regional emissions of Non- CO2 GHGs, aerosols and Black Carbon are a key factor in the rise of temperatures in the Himalayan region. Reducing these emissions will result in mitigating the overall effect of climate change in the Himalayas. A massive aforestation programme across the Himalayan Region will also be essential. In turn, this could check the trend of reduced snowfall and rapid glacier retreat.

2. This could best be achieved by forming an alliance of the five Himalayan Countries, along the lines of the existing Arctic Union. International agencies will need to facilitate the process.

3. The concept for cutting down on regional emissions, combined with efforts to improve the forest cover could herald a new dimension to dealing with Climate Change. It is for consideration that the idea could be applied to other similar eco-regions such as the Alps.

4. International agreements such as the Kyoto Protocol and the Bali Declaration call for achieving desired level of reduction in emissions by 2050. The Himalayas and other similar eco-regions may not have that much time. Hence there is an urgent need for the Himalayan Nations to formulate and execute a joint strategy for the Himalayas before it is too late.

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