CLIMATE CHANGE IN NEPAL – SHALL WE WAIT UNTIL BITTER CONSEQUENCES?

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Abstract

Although Nepal does not emit much of green house gas as compared to developed and industrialized economies, it has been facing several consequences of climate changes. Such changes are raising temperatures in the country's sky too. Exploitation of natural resources associated with growing population has led to increasing pollution, declining water quality, land degradation and other environmental problems. Within such circumstances climate change represents an additional stress which has multiple consequences such as extreme climate events including flood, draughts, heat wave, cold stream, melting of Himalayan glaciers and so forth. Due to such events agricultural productivity is suffering from severe losses and attainment of food security is under tremendous threats. The signs of such changes already felt may become more prominent over next couple of decades. If this time is not utilized properly it may be too late to avoid many foreseen bitter consequences.

Introduction

Human interactions with the natural environment have grown tremendously in the recent centuries. Environmentally significant greenhouse gases are changing due to both natural and human factors and contributing to global warming. The Earth's average surface temperature has risen by about 0.74 degrees Celsius in the past 100 years and it could even rise by up to 5 degrees Celsius by 2080 if the emissions of such gases are not decisively reduced says the report of Intergovernmental Panel on Climate Change (IPCC 2007). Most scientists believe that much of this global temperature increase is due to the burning of fossil fuels in vehicles, for heating, and for the production of electricity which when burned release carbon dioxide (C02) into the atmosphere (Brehm 2003). Likewise, nitrous oxide, and methane (CH4) are also naturally formed trace gases produced by the burning of fossil fuels, released by living and dead biomass. Among such gases, CO2 accounts for the greatest proportion of emissions as compare to methane which is released due to decay of organic matter, including waste dumps and also through deforestation while fulfilling the requirement of food and fuel for ever expanding population. Economic growth, intensification of agricultural activities and changes in land use are also equally responsible for present global warming which ultimately changes climate.

Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity (IPCC, 2007). The changes are attributed directly or indirectly to human activity which alters the composition of the global atmosphere and that is in addition to natural climate variability. Climate changes are more due to external forces and less due to natural internal processes such as emission of volcanic gases, changes in ocean circulation, and fluctuations in solar output and so forth. Over the last couple of years, it has been more frequently noted extreme weather events such as a very hazy winter and hotter summer months including heat waves which are attributed to climatic change. Change in climate affects earth ecosystems in number of ways such as; receding of Himalayan glaciers

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due to melting of ice; alteration in agriculture system; rainfall patterns including worse draughts; and water supplies (in terms of water stress and flash floods); contaminations in soil and water bodies; settlement patterns; loss of biodiversity causing extinctions of species; human health and so forth.

Objectives

In the face of existing scenario of climate change reviewed in the preceding section, this paper has been prepared mainly to examine consequences of climate changes in the agriculture and the livelihoods. The specific objectives of the paper are of two folds. The first objective is to create awareness among the readers regarding the recent atmospheric changes and the second one is to communicate this message right from the grassroots level institutions to the policy makers who has to address the issues.

Climate change in Nepalese context

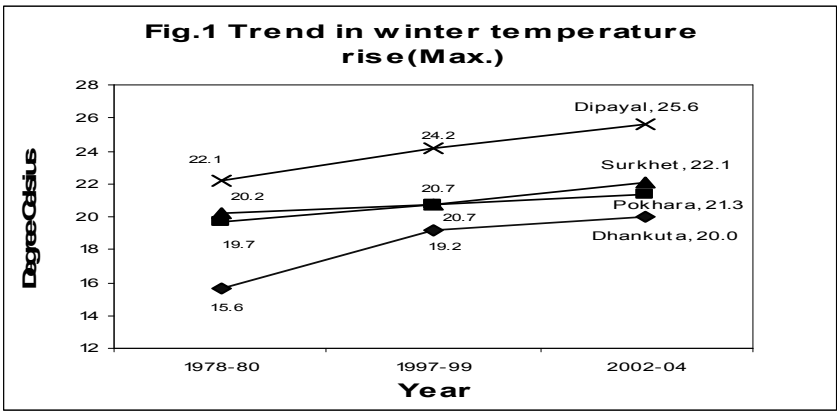
Nepal is a mountainous country with great geographical and climatic diversity. The geographical setting of the country ranges from nearly sea-leveled lowland found in Southern Terai Plain (between 152m to 610 m. above sea level) to large amount of snow covered Himalayas (between 4877m to 8848m. above sea level) including the highest peak of the world. The total snow area was estimated at about 506 thousand hectares in 1986; however, the recent data is not available. Water and forest are the major natural resources of the country, while water is the most important one which accounts for about 2.27 percent of the world water resources. The major sources of the water are glaciers, snowmelts from Himalayas, rainfall and ground water. The country's water resources have high potentialities for irrigation and hydropower and possibly the export of drinking water in future. The great rivers of the country such as Koshi, Gandaki and Karnali get major water supply from the snow and glaciers (CBS, 2005). Because of the varieties of topography, the country experiences tropical hot monsoon (in lowland Terai Plain) to alpine tundra (in High Mountain and High Himalayan regions) types of climate. In these two regions the average annual temperature is reported to be greater than 20 degrees Celsius and less than 10 degrees Celsius respectively. Monsoon normally arrives over eastern Nepal during the month of mid-June and last up to September. About 93 percent of total annual precipitation occurs during the monsoon season. In the recent years, Nepal is witnessing continuous disturbances in its ecology due to climate change resulting floods, severe landslides, soil erosion and so on. Climate change is also responsible for erratic weather patterns such as the thick haze that covers many parts of the southern plains of the country during winter seasons which destroys crops and livelihoods. Some of the major consequences are detailed in the succeeding sections of the paper

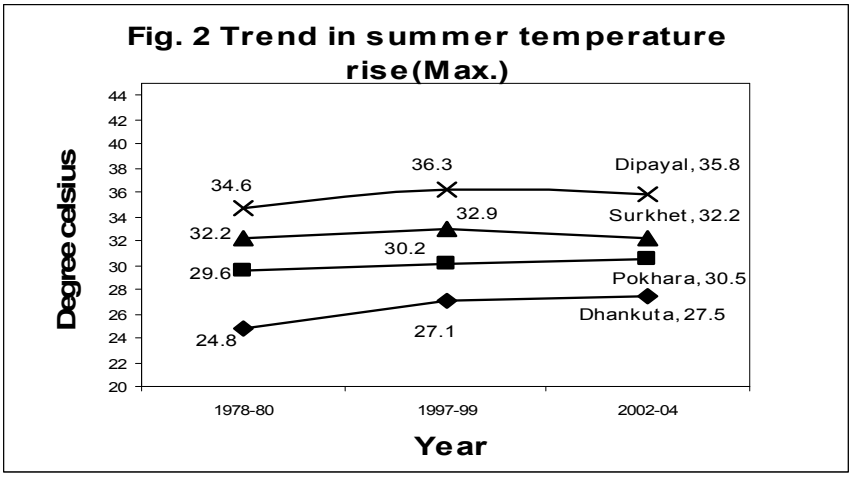
Rise in Temperature

The share of Nepal in the global emission of greenhouse gases is negligible. Estimate shows that Per Capita CO_2 emissions in the country are estimated at 0.13 t [World Bank, 2004]. While the country does not emit much greenhouse gases, it has to face the consequences of global warming. Such warming is raising temperatures in the Nepalese sky. Based on the available information it was reported that the average temperature in Nepal is rising by 0.5 degrees Celsius per decade (Dhakal, 2003). However, the country lacks comprehensive report on temperature rise and climate changes. At this juncture, simple analysis was done to capture recent trends in temperature rise in the country. Temperature records of the country for last 25 years were obtained from published documents. These analyses are presented in following Figures. While, analyzing trends three years moving averages of the recorded temperature data of Dhankuta, Pokhara, Surkhet and Dipayal were computed for the years

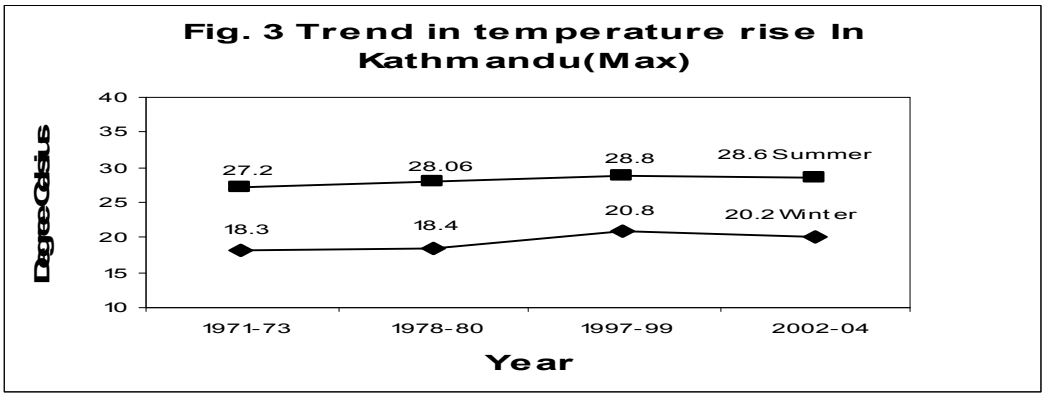
1978-80, 1997-99 and 2002-04. These places represent hills from east to far west regions of the country. The winter temperature mentioned in the figures is average maximum and minimum mean temperature of the months December, January and February. Similarly, for computing summer temperature, average maximum as well as minimum mean temperature of the months May, June and July was taken. The analyzed results of the year 2004-05 are compared with the year 1978-80. As depicted in the Figures-1 and 2 the temperature in all four places are generally seen in rising trend compared to the year 1978-80 in the recent years. In winter the mercury has found to be risen more than 2 degrees Celsius in all four places within the reference period of 25 years (Figure-1). Likewise, during summer the increase in the temperature is computed to be more than 1 degree Celsius in all three places (except Surkhet) over the years 1978-80(Figure-2). As shown by the figures, rise in the temperature (more than 4 degrees Celsius in winter and about 3 degrees Celsius in summer) in Dhankuta is much alarming which needs detailed investigation in future.

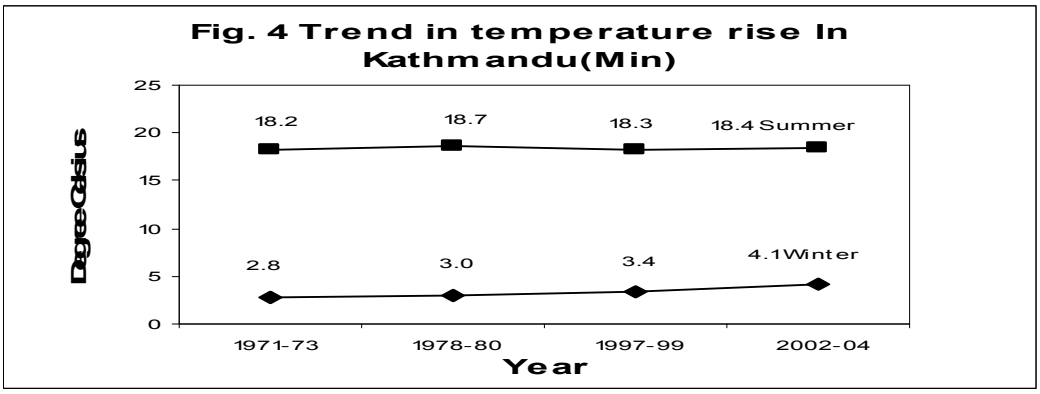
Trend in temperature rise in the capital city of Kathmandu was computed (based on three years moving averages) separately to assess the impact of human activities and urbanization on climate change. Present population density in Kathmandu district is more than 2739 sq.km which is growing at the rate of about 5 percent annually. Analysis of temperature data is presented in Figure-3 and 4.The Figures show increasing trend in temperature rise in the district but, interestingly, the change does not seem matched with increased human activities resulted from tremendous population growth and rapid urbanization.





As depicted by graphs maximum mean temperature during summer and winter season raised (Figure-3) by more than 1 and about 2 degree Celsius respectively during the period of 1971-73 to 2002-04. Rise in minimum temperature during summer was found very negligible while the rise in winter was nearly 2 degree Celsius. From the above analysis it is interesting to note that both maximum and minimum temperature during winter and maximum temperature during summer in Kathmandu is in increasing trend which indicates that this district will no more enjoys pleasant climate that it used to have about 35-40 years back.





This could be resulted due to human induced climate change. Similar trends are seen in southern Terai plains. In these regions extreme temperatures including heat wave and cold stream are witnessed frequently during summer and winter season respectively. Loss of human lives due to cold stream was reported to be 30 and 48 in numbers (CBS, 2006) in the year 2004 and 2005 respectively.

Melting Glacial Lakes

The glaciers of the Himalayas are the renewable storehouse of fresh water which serves as the perennial source of the several rivers in the country. On average, air temperatures in the Himalayas are 1°C higher now than in the 1970s, rising by 0.06 °C per year (Shrestha et al, 1999).With such rising temperatures, many big glaciers have been melting rapidly resulting to even lake bursts in the country.When such glaciers are exposed to warmer temperature the rate of melt and pond growth can be very rapid leading to a discharge of huge volumes

(millions of cubic meters) of water. Many glaciers are in this condition in the country. Many investigations have reported that as a result of the melting of the glacier, many lakes have grown six-fold. The United Nations Environment Program (UNEP) too had warned five years ago that 20 big glacial lakes in the country are at risk of floods from glacial lake bursts, which could trigger huge loss of life and property through out the country. An inventory carried out by International Center for Integrated Mountain Development (ICIMOD) and UNEP has shown that there are 26 potential dangerous glacial lakes in Nepal. One of the most alarming results of climate change can be seen in the Tsho Rolpa glacial lake which is known as the most dangerous glacial lake in Nepal. It is situated at an elevation of 4,580 meters above sea level at the source of the Rolwaling River in the Tama Koshi basin, north of the capital Kathmandu which has swollen containing nearly 100 million cubic meters of water. It was reported that if it burst, the Tsho Rolpa could affect life and property as far away as 100 kilometers downstream. According to UNEP, the water level of the lake needs to be brought down by at least 20 meters to ensure safety. Recently in 2003, the Kawari glacier lake, situated in the foothills of the Annapurna II mountain, burst, destroying property worth US $100,000. Five people were killed and dozens rendered homeless. Glacial lake bursts on smaller scales have been frequently reported in the past [Dhakal, 2003].

Flood and Draughts

Causes of floods in the country are often triggered by rapid melting of snow and ice in high mountain regions including torrential rainfall / cloudbursts in the middle mountains and foothills during the monsoon season between June and September. In the recent years some rainfall records have indicated increasing trend in hazardous rainfall events in the country which is due to potential impacts of climate change in the country. In July 1993, Nepal experienced the worst natural disaster in record. Two days of torrential rainfall in central Nepal triggered disastrous landslides, and caused major flooding in main streams and the Terai plains. About 28,000 people in the mountain areas and 42,000 people in the lowlands were affected. About 160 people in the highlands and over 1000 people in the lowlands were killed due to flood and landslides.

During recent 2-3 years onward the country is experiencing severe impacts of draughts and other adverse weather conditions. In 2005-06 farmers from mid and far-western hills and mountains experienced dry winter which affected their subsistence winter crops. This situation was repeatedly experienced during the year 2006-07. Overall rainfall during summer monsoon of the year was about 16 percent below the normal which reduced cultivation area of paddy in the country. As a result, total paddy production declined by about 13 percent as compared to previous year and about 21 percent below the forecasted production for the year 2006-07. The draught situation was more severe in eastern Terai where production of paddy was reportedly declined by about 30 percent. In addition to draughts, mid and far-western regions experienced flood, hailstones and crop diseases which caused serious production losses (ABPSD, MOAC, 2006). Every year, the number of people dying in floods and landslides is in increasing trends. In the years 2000 to 2005 more than 1314 people died of floods and landslides across the country (CBS 2006).

Social Impacts

Consequences of climate change for the society vary by geographical location and remoteness. These effects will be more negative to communities who are living in hills, mountains and river flood plains. Poor communities are more vulnerable as they have less capacity to cope with disaster and are more dependent on natural resources such as land, water, forest, pastures and food supply for their livelihood. Moreover, women are the most

vulnerable group and bear much of the consequences. Because in rural areas women are very close to nature and environment as they gather fuelwood, fodder and manage local water supply. The climate change affects health of millions of people especially the poor, the elders and the city dwellers through increased deaths, disease and due to heat waves, floods, storms, fires and droughts. City dwellers are especially affected due to acute water shortages. Impact of climate change could also be on migratory pattern, as people have tendencies to migrate in more climatically suitable areas. As a result, such invasion by nonnative people could distort tradition and culture of native people of that particular location and available natural resources of that area will be in further stress.

Climate change and farming systems

Climate changes as a result of increases in greenhouse gases include various specific effects on farming systems of the country. Higher surface temperatures, precipitation, hailstones, draughts, landslides, floods, soil erosion may affect various elements of farming systems especially in subsistence agriculture. Every year landslides, water and wind erode considerable amount of top soil from agricultural land. In the hills soil erosion is estimated at about 24 million m^3 and about 1.7 mm depletion of productive soil every year. These climatic changes have numerous implications for agriculture production. Many are rather obvious such as covering farmland with huge water, forcing shifts to other virgin areas and encroachment of forest land. As consequences, farmland retreat ultimately; frequent storm would cause crop damage; and changes in precipitation would reduce productivity of land. Effects such as changes in natural plant propagation rates and plant disease patterns are also possible. Other impacts of climate change on farming systems are changes in water resources available for irrigation; longer growing season in frost-affected areas which affect upland farmers; desertification of productive agriculture land due to flood, draughts and soil erosion; risks of monoculture instead of diversified agricultural production due to extreme weather events, pests and diseases [Bennet, 1991]. In the country about 64 percent of cultivated areas are fully dependent on monsoon rainfall. Crop productivity is also vulnerable to change in nature, time and duration of monsoon rainfall. In drier areas, climate change is expected to lead to salinisation and desertification of agricultural land. Productivity of many crops could be decreased due to heat stress, longer dry seasons, uncertain rainfall and degradation of land, with adverse consequences on food security.

The potential impacts of climate change on agriculture in the country are crucial because of its role in providing food and fiber to ever rising population. Of all human activities agriculture consumes the greatest amount of water accounting for about 96 percent of the total water use in the country. As reported by IPCC (2007), stress on water availability and shortages of food availability in Asia is likely to be exacerbated by climate change in coming decades. As per the projection of IPCC (2007) about 50 million additional people of the world are likely to be at danger of hunger by 2020 due to further climate change. Food insecurity and loss of livelihood are foreseen due to loss of cultivated land. The continuous draughts and adverse weather conditions has been affecting the food security situation in the country. For the year 2006-07 food grain shortage was estimated at about 190 thousand Mt. (UNWFP, 2007).

Policy regime

Most of the developing countries including Nepal are focusing their policies mainly on addressing the issues of ensuring food security and poverty reduction only. However, the government has been realizing the importance of environment conservation from the commencement of Sixth Five Year Plan (1980-85) which is seen in the incorporation of

environment and land use policies in the plan document. From Seventh Five Year Plan the government started considering environmental aspects in preparing development and construction programs. The country signed General Convention on "Biological Diversity and Climate Change" during Earth Summit in the year 1992. Environment Protection Act and Environment Protection Regulation were formulated in 1997 and 1998 respectively. Government of Nepal has been attempting to integrate environment conservation activities with development and gradually environmental factors with sectoral policies and programs. Almost all the sectoral policies are focusing on sustainable development issues. Although many of these provisions were made to address environmental and sustainable development issues, many of them were not implemented effectively due to lack of a single integrated policy, inter-sectoral coordination among implementing agencies and due to poor monitoring and supervision mechanism. Furthermore, despite many acts, systems and policies, many of them are not well adjusted to address today's issues of climate change. Now it is high time for the concerned to look after such matter.

Conclusions

In many countries particularly in the developing one there has been considerable expansion in the exploitation of natural resources which has resulted in increasing environmental degradation. In addition to this, change in climate has put additional stress to the livelihoods of the people in these countries including Nepal. As a result of shift in weather conditions these countries are exposed to many calamities such as flood, draughts, landslides, soil erosion, shift in farming practices coupled with decreased or stagnated crop productivities. Melting of Himalayan snowline due to increased temperatures could increase annual water discharge in short term but in the long run an acute shortage of water is foreseen. Water resources in the country play vital roles in irrigating farmland. Thus, water and agriculture are anticipated the most affected sectors in the country. The multiple stresses of climate change would disrupt the ecology of mountainous and hilly regions and would affect human population profoundly. Agriculture productivity would suffer severe losses and attainment of food security would be under tremendous threats. With further rise in temperature its impacts on human being will increase tremendously. The early sign of climate change already observed by us may become more prominent over couple of decades. If this time is not utilized properly it may be too late to avoid bitter end. Thus, it is inevitable that impacts resulting from global warming which is already unavoidable due to past emissions are to be addressed appropriately from now on.

Recommendations

The country, however, lacks substantial capacity to cope with challenges of extreme events caused by climate change due to underdeveloped economies and very little scientific and technical capabilities, the following simple measures could be supportive in reducing the impact of climate change.

- Promotion of public awareness and participation in disaster mitigation strategies.
- Formulation of strategies for precautionary risk management.
- Future emission trends will depend on population growth and development of economic and technological condition. Paying concern to the degree to which human activities are increasing and changing the climate is needed from now on.
- Appropriate strategies are to be developed to ensure environmental and ecological protection and conservation of natural resources while implementing programs for food security.

- Development of early warning, risk management system in agriculture and strategies for flood and drought management.
- Strategies for mitigation, technological development and research on climate science should combine policies with incentive based approaches, and actions at all levels from the individual citizen through to national governments and international organizations.
- Inclusion of adaptation measures in land-use planning and infrastructure design.
- Improvement in existing climate forecasting (temperature and rainfall) mechanism and introduction of crop forecasting system accordingly.
- Consideration of climate change in planning, designing and implementation of development activities.
- Adjustment in cropping calendar and crop rotation.
- Development and application of sustainable agricultural technologies.
- Priorities should be given to disaster preparedness activities.

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