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## IMPACT OF CLIMATE CHANGE ON ECONOMY OF NEPAL : A STUDY

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### ABSTRACT

*This paper attempts to highlight the impact of climate change on economy of Nepal. The results indicate that climate change is a future threat for the country. Poverty, unemployment, load shading, crime, forest fire, diseases, migration, internal displacement, urban slum, flood etc. will be increase in future for global warming. Biodiversity and economic balance will be disturbed. Food production, electricity supply, basic infrastructure will be badly affected. Development activities in water resources, as well as sectors such as agriculture, and health could clearly be affected by climate change as well as current climate variability. Climate change is likely to affect human health, either directly related to the physiological effects of heat and cold, or indirectly, for example, through the spread of vector-borne pathogens. Fluctuation of climate variables influences the spread of infectious disease. Incidences of fresh flood or glacial lake outburst flood will be increase. Government will need more fund for disaster management purpose. Thus the paper suggested that government should take proper steps for mitigating the effects of climate change on the economy.*

Keywords: Climate change, Global warming, Natural calamities, & Disaster management

### Introduction

There is now widespread consensus that the Earth is warming at an unprecedented rate and it is likely to accelerate in the decades to come. Change in the amount of energy emitted by the Sun is a prime candidate as a cause of climate variability. Global climate change has attracted much

scientific and public attention in recent years, as a result of fears that human's economic activities are leading to an uncontrolled increase in Greenhouse Gas emission and concentration in the Earth's atmosphere leading to a global rise in the Earth's temperature due to the radioactive properties of these gases.

Nepal is a landlocked, mountainous country located in the Himalayas between India and China in South Asia. Nepal faces the consequences of global warming because of the geographical and climatic conditions, high dependence on natural resources and lack of resources to cope with the changing climate. Nepal is one of the ten most vulnerable developing countries because of its geography, poor physical infrastructure and the low level of development of its social sector. High altitude and latitude regions are likely to experience a higher rate of temperature rise compared to other regions. The objective of this paper is to study the impact of climate changes on economy of Nepal.

## **Materials and Methods**

### **(a) Study area description**

This study was conducted in the country found in the South Asia called Nepal. It is a landlocked, mountainous country located between India and Tibet. It is situated to the south of the Himalaya Region. Nepal measures about 880 kilometers along its Himalayan axis by 150 to 250 kilometers across. It has an area of 147,516 km<sup>2</sup>. Forming south-to-north transects, Nepal can be divided into three belts: Terai, Pahad and Himal. In the other direction, it is divided into three major river systems, east to west: Koshi, Gandaki/Narayani and Karnali, all tributaries of the Ganges river.

### **(b) Design and approach**

This study is descriptive in its design and has utilized both qualitative and quantitative approaches. Secondary data were used in this study. The secondary data are collected from various govt. reports, report of international agencies, research papers, published or unpublished thesis's, articles etc.

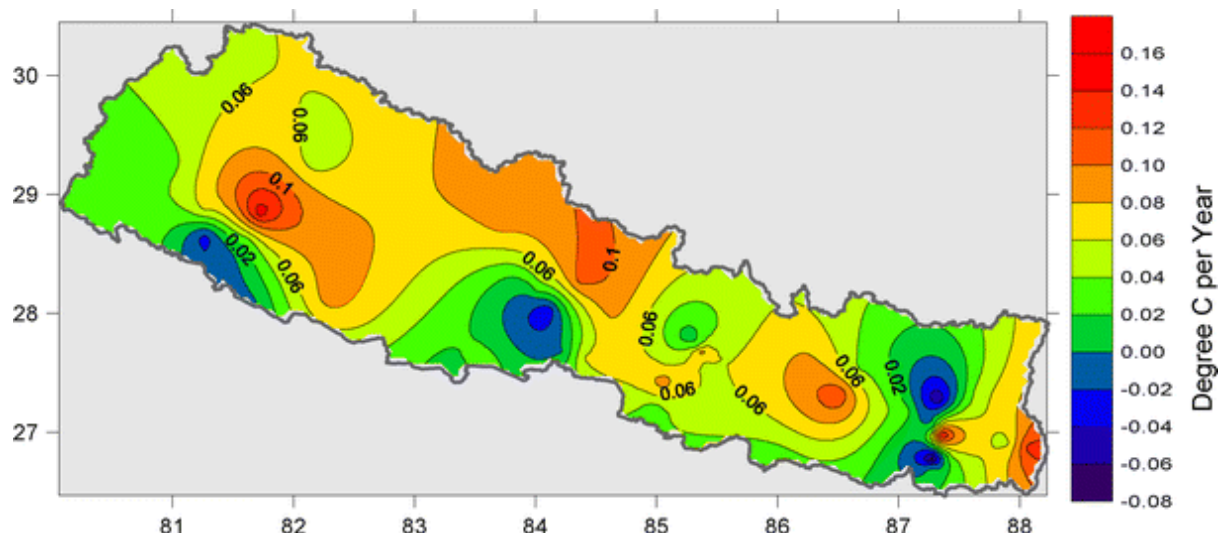
### **(c) Method of analysis**

To reveal the global warming practices in general and the impact on economy in particular, different methods of quantitative and qualitative analysis comprising of descriptive analysis, content and text analysis were performed.

## **Results and Discussion**

The Climate Change Risk Atlas 2010 ranked Nepal as the 4th most vulnerable country worldwide (out of 170 countries). More than 4,000 people died in Nepal over the last ten years in climate induced disasters, which caused economic losses of USD 5.34 billion. Every year more than one million people are directly impacted by climate-induced disasters such as drought, landslides and floods in the mid- and far-west Nepal. Over the last few years, it has been experienced the occurrence of frequent and intense floods, droughts and extremes throughout the country.

Effects of global warming encompass all vital systems of Nepal economy. Human health, agriculture, forest, water resources and biodiversity are suffering at different scales depending on local conditions. The country is susceptible to disasters, including flash flood, Glacial Lake Outburst Floods (GLOF) and melting snow in the mountains and droughts and inundation in the Terai. The changing of climate is shown in the below diagram.



In Nepal, contribution of agriculture, industry and service sector in Gross domestic product are 27 percent, 13.5 percent and 59.5 percent respectively. Climate change will affect all the sectors. Fruits, vegetables, rice and wheat are the main crops. Climate change will badly affect the agricultural production. The low land Terai region produces an agricultural surplus, and part of which supplies the food deficit hill areas. When cultivation in Terai region will affected by unfavourable climate than entire country will be affected. Readymade garments, fruits and vegetables are the main exporting items of Nepal and all of these are very much climate sensitive. In service sector, tourism is the main source of income and employment opportunity for the Nepali people. Due to climate change number of tourist in Nepal is decreasing and in future it will decrease more. So earning from tourism will decrease and dependence on external aid and foreign remittance will increase. Therefore, climate change will be adversely affect the economy. The long-term climate risk index (CRI) of 10 countries most affected from 1999 to 2018 is shown in table no. 1.

**Table 1: The Long-Term Climate Risk Index (CRI): The 10 countries most affected from 1999 to 2018 (annual averages)**

CRI 1999-2018 (1998-2017)	Country	CRI Score	Death toll	Deaths per 100000 inhabitants	Total losses in million US \$PPP	Loses per unit GDP in %	Number of events (total 1999-2018)
1 (1)	Puerto Rico	6.67	149.90	4.09	4 567.06	3.76	25
2 (3)	Myanmar	10.33	7 052.40	14.29	1 630.06	0.83	55
3 (4)	Haiti	13.83	274.15	2.81	388.93	2.38	78
4 (5)	Philippines	17.67	869.80	0.96	3 118.68	0.57	317
5 (8)	Pakistan	28.83	499.45	0.30	3 792.52	0.53	152
6 (9)	Vietnam	29.83	285.80	0.33	2 018.77	0.47	226
7 (7)	Bangladesh	30.00	577.45	0.39	1 686.33	0.41	191
8 (13)	Thailand	31.00	140.00	0.21	7 764.06	0.87	147
9 (11)	Nepal	31.50	228.00	0.87	225.86	0.40	180
10 (10)	Dominica	32.33	3.35	4.72	133.02	20.80	8

Source: Eckstein, D., Künzel, V., Schäfer, L., &Winges, M. (2020). Global Climate Risk Index 2020, p.9.

The above table shown that Nepal is more vulnerable country as per Climate Risk Index. The Climate Risk Index indicates a level of exposure and vulnerability to extreme events, which countries should understand as warnings in order to be prepared for more frequent and/or more severe events in the future. The Global Climate Risk Index developed by Germanwatch analyses quantified

impacts of extreme weather events. The major hazards of ecological zones of Nepal shown in the below table.

**Table 2: Ecological Zone with Major Hazards**

Ecological zone	Altitude (masl)	Climate	Average temp.	Major hazards
Tarai	60-200	Humid tropical	> 25 <sup>0</sup> C	Floods; Cold waves; Earthquakes; Epidemics
Siwalik	200-1500	Moist subtropical	25 <sup>0</sup> C	Landslides; Floods
Middle Hills	1000-1500	Temperate	20 <sup>0</sup> C	Earthquakes; Thunderstorms; Hailstone
High Hills	2200-4000	Cool to sub-alpine	10-15 <sup>0</sup> C	Landslides; Floods
Himalaya	4000-8848	Alpine to arctic	< 0 to 5 <sup>0</sup> C	Glacial lake outburst floods; Epidemics

Source: Gautam, D., Kathayat, R. & Yadav. R. (2008). Impact of climate change on students, schools and neighbourhoods: A sociological study from Matehiya and Bageshwori VDCs of Banke, Mid-Western Nepal. Kathmandu, Nepal: ActionAid Nepal.

The above table expression that the plain to mountain, all areas are affecting for climate change. Tarai is the plain area and situated in southern part of country. This area is affecting by flood during rainy season for excess rainfall. Hilly areas are affected by landslides, flood, and thunderstorms. Himalaya mountain areas incidences of glacier melting and glacial lake outburst floods are increasing day-by-day. The impact of climate change on water resources is likely to affect agricultural systems and food security. This is especially critical in a least developed country like Nepal where a high percentage of the population is dependent on agriculture for its livelihoods. The anticipated climate change impacts in Nepal economy shown in the below table.

**Table 3. Anticipated Climate Change Impacts in Nepal**

Temperature	<ul style="list-style-type: none"> <li>➤ Significant rise in temperature:                             <ul style="list-style-type: none"> <li>● 0.5 to 2.0 °C by 2030</li> <li>● 1.3 to 3.8<sup>0</sup>C by 2060</li> <li>● 1.8 to 5.8 °C by 2080</li> </ul> </li> <li>➤ Increase in the number of days and nights considered hot by current climate standards</li> <li>➤ Highest temperature increases during the months of June to August and at higher elevations</li> </ul>
Precipitation	<ul style="list-style-type: none"> <li>➤ Wide range of mean annual precipitation changes:                             <ul style="list-style-type: none"> <li>● -34 to +22% by the 2030s</li> <li>● -36 to +67% by the 2060s</li> <li>● -43 to +80% by the 2090s</li> </ul> </li> <li>➤ Increase in monsoon rainfall towards the end of the century:                             <ul style="list-style-type: none"> <li>● -14 to 40% by the 2030s</li> <li>● -40 to +143% by the 2060s</li> <li>● -52 to +135% by the 2090s</li> </ul> </li> </ul>
Runoff	<ul style="list-style-type: none"> <li>➤ Higher downstream flows in the short term, but lower downstream flows in the long term due to retreating glaciers and snowmelt and ice-melt.</li> <li>➤ Shift from snow to rain in winter months.</li> <li>➤ Increased extreme events, including floods, droughts and GLOFs.</li> </ul>

Source: Figures for anticipated changes in temperature and precipitation (NCVST 2009; McSweeney et al. 2008); figures for runoff (Bates et al. 2008; Eriksson et al. 2009).

The above table shown that temperature, rainfall, glacier melting, flood will increase in future. Climate change can affect water supply by its impact on rainfall, glacier melting and increase in temperature. Snow and glaciers have an important role to play in the water availability as they contribute to the dry season river flow. All of the glaciers have been found to be retreating at a higher rate than other parts of the world. The river flow in the glacier-fed rivers is projected to increase until the year 2030 or 2040 followed by a gradual decrease. The likely impact of climate change in key sectors of Nepalese economy are shown in the below table.

**Table4: Likely Impact of Climate Change in Key Sectors (Ministry of Environment, 2010b).**

Sector	Likely impacts of Climate Change
Agriculture and food security	<ul style="list-style-type: none"> <li>➤ Declining crop and livestock production.</li> <li>➤ Major impact on subsistence farming, which is more vulnerable to erratic monsoon rains and floods.</li> <li>➤ Decline in the production of winter and spring crops because of temperature and precipitation anomalies.</li> <li>➤ Decline in rice yields, with serious implication of food security for a large section of the population, particularly in the western region.</li> <li>➤ Loss of local and traditional crop varieties, leading to negative impacts on food and nutrition security.</li> </ul>
Water resources and energy	<ul style="list-style-type: none"> <li>➤ Water stress will negatively impact agricultural productivity, human health, nutrition security, and sanitation facilities.</li> <li>➤ Excess water, such as during heavy precipitation and flooding events, will damage infrastructure, human settlements, and crops.</li> <li>➤ Changes in river flow will impact micro-hydro projects, disrupt the power generation system, and decrease the system's efficiency, leading to largescale power shortages and blackouts, given that 90% of the country's electricity is derived from hydropower.</li> <li>➤ Solar power systems will be affected by heavy precipitation, prolonged cloudy days, heavy snowfall, and hailstorms.</li> <li>➤ Increased incidence of forest fires will lead to loss of forest resources and biodiversity, and result in a fuelwood crisis.</li> </ul>
Forests and biodiversity	<ul style="list-style-type: none"> <li>➤ Temperature and rainfall variability have resulted in shifts in agro-ecological regions.</li> <li>➤ Higher incidences of pests and diseases have been reported.</li> <li>➤ Emergence of alien and invasive species is increasing, leading to habitat loss and the loss of biodiversity in many regions.</li> <li>➤ Increasing occurrence of forest fires has caused damage to critical habitats and affected human settlements.</li> <li>➤ Changes in flowering and fruiting timings of many horticultural crops have been observed.</li> <li>➤ Decline in the provision of ecosystem services by vital ecosystems such as wetlands and forests.</li> </ul>
Public health	<ul style="list-style-type: none"> <li>➤ Nepal's already poor health care infrastructure makes it more vulnerable to climate change.</li> <li>➤ Greater risk of outbreaks of vector-borne diseases such as malaria, Kala azar, and Japanese encephalitis.</li> <li>➤ High incidence of water-borne diseases due to a lack of access to clean sources of water during disasters such as floods or droughts.</li> </ul>
Urban settlements and infrastructure	<ul style="list-style-type: none"> <li>➤ Key infrastructure, such as roads, water and sanitation, hospitals, schools, and public buildings, is at risk of being damaged by natural disasters such as landslides and floods.</li> <li>➤ Water and energy systems in urban areas are at greater risk.</li> <li>➤ Large influx of disaster-induced migrants displaced from rural areas will result in overcrowding in slums and informal settlements, leading to public health challenges.</li> </ul>

Source: Patra, J. and Terton, A. 2017. Review of current and planned adaptation action in Nepal. CARIIA Working Paper no. 20. International Development Research Centre, Ottawa, Canada and UK Aid, London, United Kingdom, p.11-12.

The above table illustrations that agriculture will be adversely effects for climate change which will increase the food insecurity. Nepal have limited areas for agricultural cultivation and increase of temperature, flood, water logging etc. will further blow on agricultural production. Excess water in river will destroy more paddy land and also affects the electricity production of hydro projects. For higher temperature incidences of forest fire will be increase and forest pattern will be change. Fruits production pattern will be change and incidences of pests and diseases will be increase. Climate change will adversely effect on health care infrastructure and physical infrastructure of the nation. Let discuss the impact of climate change in various dimensions:

### (1) Glacial Lakes Outburst Flooding

Mountain cryosphere's and ecosystems are highly sensitive to climate conditions. Development of industry, tourism and communication infrastructures has already put pressure on ecosystem. With the high sensitivity of snow cover to changes in temperature, a rise in temperature would result in earlier snow melt in spring.

Due to snow and glacial melting, several glacial lakes are under tremendous risk of flooding of localities. The melting of glaciers leads to the formation and rapid expansion of glacial lakes whose banks are made of loose glacial debris and unstable remnant ice. Glacial lakes are often located at the base of mountains with hanging ice. While the lake at the base continues to fill up, ice blocks from the mountain slope above detach and plunge into the lake, creating waves that break the loose moraine dam, causing a sudden discharge of large volumes of water. Floods of this kind is known as Glacial lake outburst floods and have disastrous consequences for the population and for the biodiversity of the entire watershed. The damage caused by such glacial lake outburst floods in Nepal are shown in the below table.

**Table 5: Damage Caused by Glacial Lake Outburst Floods in Nepal**

Year	Glacial lake	Impacts and consequences	References
1977	DudhKoshi	Killed 3 people; destroyed bridges for 35 km downstream; construction materials of a hotel swept away.	Mool et. al. 2001, Bajracharya et. al. 2007, Ives 1986.
1981	The Zhang zhangbo	Closed the China- Nepal highway for 1 year; destroyed Friendship bridge; damage worth USD 3 million.	Mool et al. 2001, Bajracharya et al. 2007, WWF 2005
1991	Chilbung/ Chhubung lake	Damaged several houses in Beding village in Rolwalingvalle.	Mool et al. 2001
1995	Dig Tsho lake feeding DudhKoshi and BhoteKoshi	Destroyed almost completed Namche Small Hydro Project (\$1.5 million); damaged 14 bridges, 30 houses and trails; killed 5 people; collapsed roads.	WECS 1987, UNEP 2002, WWF 2005
1997	DudhKoshi	Destroyed mini hydroplants	Mool et al. 2001, Bajracharya et al. 2007.
1998	SabaiTsho lake	Washed away fields, killed 2 people, damaged trekking trails	Mool et al. 2001
2003	Kawari glacial lake	Killed 5 people, destroyed wealth worth \$100,000.	Dhakal 2003

Source: Chaudhary, P. & Arya, K. (2009). Global Warming in Nepal: Challenges and Policy Imperatives, Journal of Forest and Livelihood 8(1), p.8.

The above table demonstrations that the incidences of glacial lake outburst floods are increasing and it damaging the infrastructure and taking the life's of the peoples. Within the span of

two decades, three major glacial lake outburst floods events were experienced in the Khumbu. A damaging glacial lake outburst floods event in 1977 from the base of Mount Amadablam destroyed park facilities and a tourist lodge located along the riverbeds. It destroyed the Namche Hydropower Station, trails, bridges, and washed away cultivated land, houses, livestock and killing along its 90 km downstream impact zone. In the eastern Himalayan region, in general, more than 15 major glacial lake outburst floods events have been recorded since 1995. Recently, the International Centre for Integrated Mountain Development, with the support of the United Nations Environment Programme, released the results of an inventory of glaciers, glacial lakes, and glacial lake outburst floods in Nepal and Bhutan. The study mentioned 3,252 glaciers and 2,323 glacial lakes in Nepal among which twenty were potentially dangerous.

## **(2) Impact on Agriculture**

Nepal is considered one of the agriculture dominated countries and livelihood of the people is entirely dependent on agriculture. Most of the irrigable land is the Terai. Nepal has various types of agricultural zones like plains, hills, mid hills, high hills and mountain. Agricultural sectors: mainly crops, livestock's and horticulture largely depend on the given water sources in the country. Changes in climate and weather is major reason for change in moisture availability in the soil and supply of water.

Temperature, rainfall pattern and humidity have a changes the pattern of pests and diseases. Increase in temperature and CO<sub>2</sub> will lead to an increase in population of pests and severity of diseases in presence of host plant. It increases the rate of reproductive cycle of insect and pest. The increase in insect population leads to demand for more use of pesticide, which unknowingly causes lots of harm to ecosystem as well as human society. Reduction in the yield will make the farmers to alter their agricultural practices to adapt in the changing environment. With increasing temperature, more cases of flooding in low-lying areas will be high, declines in food production and increase in crop diseases. Increasing variability of precipitation patterns will have a significant effect on crop productivity. The impacts of less water during the dry months will be visualize more in near future.

Late snowfall or snowfall during spring affects the cropping schedule. Recently, such changes in the seasonal pattern have inhibited the farmers to sow crops like potato in prime time. Rapid melting of snow and as a result, of snow ice would cause huge amounts of debris and sediment delivery which may destroy their agricultural lands, forests and pastures. Winter snowfall is the main source of moisture supply and irrigation for agriculture during the cropping season. Less amount of snowfall in winter will affect the crop. Decline in snowfall in the winter is likely to reduce the availability of grasslands in the area during summer. This in turn is likely to result in downsized livestock numbers and may reduce production. The decrease in grazing livestock will lead to the reduction of manure supply for the farms as well as the grazing areas.

## **(3) Impact on Hydrology**

The hydrology of Nepal is primarily monsoon driven. Around 85 percent of rainfall occurs during the four monsoon months of June to September. The temporal variability of rainfall and runoff is very high, and the problem of excess water during the monsoon and water scarcity during the dry season affects all aspects of life in the country. Many studies have opined that the changes in temperature and rainfall alter the hydrological cycle and water resources. Anticipated changes in hydrological cycle and the depletion of water resources are some of the top environmental challenges that Nepal is going to face due to climate Change. This will effect on the electricity production.

Demand for air conditioning in the summer will increase due to higher temperature. So demand for electricity will increase, but supply of electricity from hydro-electricity plants will decrease due to climate change. Excess or shortage of water will affect the stable production of electricity of hydroelectricity projects.



#### **(4) Impact on Tourism**

Tourism is considered to be a highly climate-sensitive economic sector. Tourism is one of the sectors most likely to be affected by climate change. Wide-range of climate-induced environmental changes will have profound effects on tourism at the local and regional destination level. Climate change in mountain tourism focuses on reduced snow cover and its impact on the ski industry, which is not pertinent in the Himalayas. Trekking is the most popular tourism activity. Large number of international visitors participate in trekking through the natural and cultural landscapes of the Nepalese Himalayas. The prospect of climate change as a result of global warming has heightened concern over the ability of this region to maintain its natural beauty and, consequently, its tourism base. Looking at the most popular tourist activities in the country (mountaineering, trekking) it can be said that weather and climate are important parameters for these activities. The kind of climatic impacts a destination is experiencing will have an effect on the timing of certain activities and it influences participation rates

Parks in the mountains, particularly north-eastern Nepal, will experience more avalanches and glacial lake outburst floods, while the hills will face more landslides, debris flows and flash floods and the lowland Terai will see more flood-related hazards. Unreliable snow cover resulting from temperature rise is likely to lead to a loss in winter tourism. Water shortage, water quality problems, and more frequent and intense heat waves in southern Nepal could cause notable reductions in tourism. Temperature rise is likely to change summer destination preferences and outdoor activities. So revenue from tourism sector will be decrease, specially the foreign currencies.

#### **(5) Impact on Water Resources**

Mountain glaciers is the important source of freshwater for people. If glacier melting continues at its current pace, the winter snowfall will not be sufficient to replenish the amount of snow and ice lost through melting, leading to a deficit in water storage in the form of snow and ice. This could cause many rivers to run dry, inducing shortages of water for drinking, agricultural irrigation, and affecting fisheries and wildlife.

Temperature rise and changing rainfall patterns are expected to worsen the already acute water shortage problem. Changes in frequency and intensity of droughts and floods are projected, which could cause significant financial and human loss. Renewable water supply is expected to decline in certain areas and expand in others. Clean water supply may also decrease due to a warmer environment inducing lower water quality. The most critical impacts of climate change are related to its water resources and hydropower generation, stemming from glacier retreat, expansion of glacial lakes, and changes in seasonality and intensity of precipitation.

#### **(6) Impact on Forests and Wildfires**

Global warming can contribute to increase in wildfire in several ways. Burning heat and lack of rainfall will create ideal conditions for major wildfires. In addition, longer warm seasons often translate into longer fire seasons. Warmer temperatures will promote outbreaks of insects that feed on trees, killing many of the hosts and creating large amounts of dry fuel for forest fires. If, as climate models predict, wildfires continue to increase in frequency and intensity, the amount of carbon dioxide released into the atmosphere from burning vegetation and soil organic matter could outstrip the amount absorbed by regrowing forests, strengthening the greenhouse effect and global warming and possibly leading to even more fires in a worsening cycle.

#### **(7) Impact on Human Health**

Changes in frequency and intensity of weather will serious threat to human health. These threats may either be direct, such as heat waves and flooding, or indirect, such as tick-borne diseases. Particularly vulnerable sections of the population are elderly people with limited access to health care services. Climate change is likely to affect human health, either directly related to the

physiological effects of heat and cold, or indirectly, for example, through the spread of vector-borne pathogens. The principal health effect of climate change is heat waves and other extreme weather events. They cause mortality and incapacitating diseases such as chronic respiratory and cardiovascular disorders. Fluctuation of climate variables influences the spread of infectious disease.

### **(8) Impact on Poverty and Unemployment**

As per Asian Development Bank report, 25.2 percent people in Nepal lives below the national poverty line in 2010. The proportion of employed population below \$1.90 purchasing power parity a day in 2010 is 15 percent. Despite a number of attempts from different sectors, poverty is still a rampant phenomenon and the country remains one of the poorest countries in the world. Accordingly, World Bank report, the average unemployment rate during 1991-2017 was 2.98 percent with a minimum of 1.8 percent in 1999 and a maximum of 4.5 percent in 1996. Global warming will negatively affect the poverty and unemployment. Natural calamities will be a common fact and so income of people will be unstable. As a result, poverty and unemployment will increase. As tourism and agricultural section will adversely affect by climate change, so it will increase the unemployment problem in the society.

### **(9) Impact on Internal Displacement and Migration**

Internally displaced person is someone who is forced to flee his or her home but who remains within his or her country's borders. They are often referred to as refugees, although they do not fall within the legal definitions of a refugee. When livelihoods of people are affected for global warming, people will migrate one place to another for better job opportunity. It will possible that for sharing jobs with local people and conflicts may arise

### **(10) Impact on Foreign Remittances and International Aids**

Nepal receives large amounts of donor aid, of the order of US\$ 350 million per year, or about. The largest donors, in terms of overall investments, are Japan, the Asian Development Bank, and the World Bank. foreign aid also accounts for the lion share of development investments in the country. The extent to which climate risks affect development activities in the country can be partially affects the total aid portfolio. Development activities in water resources, as well as sectors such as agriculture, and health could clearly be affected by climate change as well as current climate variability. So Government will be more depend of foreign remittances and aids for global warming effects

#### **Initiatives of Government**

Several initiatives are already underway to address these issues, but additional efforts are required, as outlined in the National Strategy for Disaster Risk Management, along with five priority actions:

- Ensuring that disaster risk reduction is a national and local priority with a strong institutional basis for implementation.
- Identifying, assessing, and monitoring disaster risks and strengthening early warning systems.
- Improving knowledge management for building a culture of safety and resilience.
- Reducing the underlying risk factors.
- Enhancing preparedness for effective responses

Nepal ratified the United Nations Framework Convention on Climate Change in May 1994 and signed the Kyoto Protocol in September 1995. The Government of Nepal identified the Ministry of Environment as the Designated National Authority as part of its commitment to the effective implementation of climate change policies. In 2008, the Government and the United Nations Development Programme began work on the preparation and implementation of the National

Adaptation Programme of Action. There are other national initiatives like the Pilot Programme on Climate Resilience and Reducing Emissions from Deforestation in Developing Countries. In Nepal the Ministry of Environment is the lead agency for the preparation of the National Adaptation Programme of Action as part of a team which also includes representatives of government agencies and civil societies.

There are two main climate change relevant policies. The first is the Climate Change policy which is general and limited to identifying the key responsible organisations and their roles in relation to climate change action. The second is National Adaptation Programme of Action (Ministry of Environment 2010) which develops a national adaptation programme framework, organisational mandates and identifies key adaptation needs.

With regard to the Convention on Biodiversity, Nepal's Biodiversity Strategy (2002) was prepared under the UNDP/GEF Biodiversity Conservation Project. It lists several climate related risks, including flooding and siltation, as threats to biodiversity conservation. Nepal also has a National Strategy for Sustainable Development under the name of the Sustainable Development Agenda for Nepal (SDAN). The SDAN lists Nepal's continuing vulnerability to climate change, natural disasters and environmental degradation (in that order) among the constraints facing Nepal's Sustainable Development. It also contains a separate section on climate change, which lists the potentially serious consequences for infrastructure, agriculture, drinking water, irrigation, hydropower, and biodiversity, and mentions the risk of Glacial lake outburst floods.

For climate change communication in Nepal, Ministry of Population and Environment guides other ministries and department. It is the main Centre of United Nations Framework Convention on Climate Change in Nepal. It has involved its Climate Change Management Division and Environment Division for prioritizing climate change activities. Multi-stakeholder Climate Change Initiatives Coordination Committee was formed as a key national forum for regular consultation of climate change policies, plans and projects by replacing Climate Change Network. Public awareness programmes were initiated by the government and non-government sector; and these activities were increased with time after 2006.

Pilot Programme for Climate Resilience had started in Nepal along with the National Adaptation Programme of Action. Local level adaptation projects by non-governmental organizations taking place in different regions of Nepal. Governmental institutions such as Alternative Energy Promotion Center and Reducing Emissions from Deforestation and Forest Degradation-Forestry and Climate Change Cell are working towards climate change communication and mitigation (Anup, 2018).

Nepal established a Natural Calamities Relief Act, in place in 1982, designed to develop and coordinate policies, planning and implementation of relief in response to natural disasters. Key natural disasters were characterised as earthquakes, fires, storms, floods, landslides, heavy rainfall, drought, famines and epidemics. A Central Disaster Relief Committee under the chairmanship of the Home Minister was established to guide the process of implementation and establish norms of assistance to disaster victims to be distributed through District Disaster Relief Committees.

### **Conclusion and Suggestions**

Climate change is becoming one of the major environmental issues. The temperature is rising in Nepal and it will continue to rise in the coming years partly due to climate change. There is evidence that climate change is already affecting the biodiversity and weakening the livelihood assets of poor and marginalised communities. Rapid change in climate threatens to reduce ecosystem biodiversity. Some existing species of plants and animals would be unable to adapt because they are not sufficiently mobile to migrate at the rate required for survive.

Increasing glacial lake outburst floods activities, erratic monsoons and wildfires, caused by periodic droughts, will affect biodiversity. Since tourism seasonality in the Himalayas is determined by the monsoon season, changes in the pattern of monsoons directly impact the flow of tourists and their activities. Vector and water-borne disease have been found to be increasing within country,

along with a strong identified relationship between these diseases and temperature and precipitation. It is mostly the poor and disadvantaged groups who suffer from these climate change consequences, but the health impacts will be experienced across all sectors and regions. Load shading, crime, internal displacement and various social crimes will increase because of climate change effects.

Readymade garments, fruits and vegetables are the main exporting items of Nepal and all of these are very much climate sensitive. In service sector, tourism is the main source of income and employment opportunity for the Nepali people. Due to climate change number of tourist is decreasing and in future it will decrease more. So earning from tourism will decrease and nation may be more depend on external aid and foreign remittance will increase.

As global warming is an international issue and it has no border, so all nations should work together for combating it. Nepal government can aware people about the probable demerits of global warming. Afforestation can be doing in the deforested areas. Government can prepare strong disaster management team. It is necessary to highlight climate change risks and adaptation measures in the government five-year plan and poverty reduction strategy. More research and studies are needed to fill the existing information and knowledge gap, and to identify key vulnerable areas, communities, and sector for integrated planning and implementation.

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