



Government of Nepal

Ministry of Science Technology and Environment, (MoSTE)



Proceeding of Workshop

On

INTEGRATING CLIMATE CHANGE CONCEPTS INTO THE SCIENCE CURRICULUM FOR SECONDARY LEVEL EDUCATION

8 - 9 November 2012
Hotel Himalaya, Lalitpur

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PREFECE

The workshop on " Integrating Concepts into Climate Change Curriculum in Science for Secondary Level (Grades IX & X) Education, Nepal" was held on 8-9 November 2012 at Hotel Himalaya, Lalitpur. The workshop was jointly organized by the Ministry of Environment, Science and Technology (MoEST) and Curriculum Development Centre, Ministry of Education. The workshop is one of the activities planned under "Mainstreaming Climate Change Risk Management in Development Project" which is being implemented by the Climate Change Division, MoEST. The workshop was vigorously attended by over 50 participants including Curriculum Officers, Textbook Writers, Teachers, Professors, Environment Specialists, and concerned Officers from MoEST, MoE and CDC.

The opening session of the workshop as chaired by Mr. Keshav Bhattarai, Secretary of MoEST and Mr. Suresh Man Shrestha Secretary of MoE was the chief guest. Mr. Arjun Thapa, Under Secretary, MoEST and NPM to the project welcomed the participants and briefly highlighted the objective of the workshop.

The technical session of the day one of the workshop was chaired and moderated by Professor Dr. Kedar Rijal. In the technical session, six papers were presented by the resources persons followed by floor discussion. Participants provided their feedback, comments and suggestions on the presentations during the floor discussion. The genuine comments/ suggestions received from the floor discussion have been incorporated in the recommendation of the workshop.

It is sincerely hoped that the recommendations/suggestions brought-up by the workshop will be used as a strong basis for integrating climate change content into the curriculum in science for secondary level education in Nepal.

FOREWORDS

"Mainstreaming climate change risk management in development" is one of the five components of Nepal's Pilot Program for Climate Resilience (PPCR). The Ministry of Environment, Science and Technology (MoEST) is implementing the project as an executing agency with technical and financial support from ADB.

Development and application of knowledge management tools for climate change is one of the three outputs expected by the implementation of the project. In order to achieve this output, five specific activities have been identified as basic inputs into strengthening the knowledge services of key knowledge partners, namely the MoEST, major research universities, District Development Committees and their local development partners.

The main objective intended of this output is to strengthen the country's system for generating, managing, and sharing knowledge as an input to make Nepal climate resilient. In achieving this objective, updating educational curriculum on climate change and resilience is one of the activities to be implemented. This activity is a follow-up to the Report prepared by Consultants to MoEST on "*Recommendations for Academic Curricula on Climate Change and Environmental Management*". The Report found that environmental sciences covered key points on environmental management, climate and weather, but climate change concepts needed to be further strengthened.

The workshop has, therefore, been planned to collect feedback, constructive suggestions & backstopping on the basis of intensive interaction among the concerned experts, school teachers, teacher educators & other concerned stakeholders with a view to integrate Concepts into Climate Change Curriculum in Science for Secondary Level (Grades IX & X) Education, Nepal. I hope the workshop has been a strong basis in the process of updating curriculum and to integrate climate change concepts into the curriculum in science for secondary level education (*Grade 9 and 10*).

I would like to thank Surya Man Shrestha, Secretary, Ministry of Education for his participation as chief guest and expressing encouraging few words in the workshop. I would also like to thank paper presenters, facilitators, participants from different schools, colleges, universities, concerned officers from MoEST and TA Team who contributed directly or indirectly for making the workshop a success.

Keshav Bhattarai
Secretary, MoEST

ACRONYM

ADB - Asian Development Bank

CC - Climate Change

CCMD - Climate Change Management Division

CCPRF - Climate Change Program Results Framework

CDC - Curriculum Development Centre

COs- Curriculum Officers

ICEM - International Centre for Environment Management

IUCN - International Union for Conservation of Nature

KU - Kathmandu University

MoEST - Ministry of Environment, Science and Technology

NCCSP - National Climate Change Support Program

NPD - National Project Director

NPM - National Project Manager

PPCR -Pilot Program for Climate Resilience

TA - Technical Assistance

TU - Tribhuwan University

TWG - Technical Working Group

TWs-Textbook Writers

CHAPTER I: INTRODUCTION

Background

Mainstreaming climate change risk management in development is one of the five components of Nepal's Pilot Program for Climate Resilience (PPCR). The Ministry of Environment, Science and Technology (MoEST) is the executing agency which implements 'Mainstreaming Climate Change Risk Management in Development Project' with financial support of ADB.

Development and application of knowledge management tools for climate change is one of the three outputs expected by the implementation of the project. In order to achieve this output, seven five activities have been identified as basic inputs into strengthening the knowledge services of key knowledge partners, namely the MoEST, major research universities, District Development Committees and their local development partners.

The main objective intended of this output is to strengthen the country's system for generating, managing, and sharing knowledge as an input to make Nepal climate resilient. In achieving the above objective, updating educational curriculum on climate change and resilience is one of the activities to be implemented. This activity is a follow-up to the Report prepared by Consultants to MoEST on *Recommendations for Academic Curricula on Climate Change and Environmental Management*. The Report found that environmental sciences covered key points on environmental management, climate and weather, but climate change concepts needed to be further strengthened.

Thus, the workshop of this nature has been organized to collect feedback, constructive suggestions & backstopping on the basis of intensive interaction among the concerned experts, school teachers, teacher educators & other concerned stakeholders. The underling aim of the workshop was to integrate climate change concepts into the curriculum accordingly.

Objective

The overall objective of the workshop is to integrate climate change concepts into the curriculum in science for secondary level education (*Grade 9 and 10*)

This objective was expected to be achieved by:

- 1) Presenting the findings of the Academic Curriculum Review ADB TA 7173) to Curriculum Officers (COs) and Textbook Writers (TWs)

- 2) Identifying and recommending appropriate contents on climate change which is to be incorporated into the curriculum
- 3) Providing relevant background information and reference sources on climate change to the COs and TWs, and putting them in contact with key experts on the topic
- 4) Holding working sessions to identify how CC concepts can be appropriately introduced to Curriculum in Compulsory Science & Optional Environmental Science for Grade 9 and 10 in the revised curriculums to be disseminated in 2013

Output of the workshop

The ultimate output expected from the workshop was that the climate change concepts are integrated into the curriculum in science for secondary level education (*Grade 9 and 10*)

Methodology

Resource persons have presented key information on climate change to the Curriculum Officers, text book writers and concerned workshop participants. The TA Consultants provided them with Reference Materials. The workshop agenda were developed based on the following method:

1. The first morning was devoted to presentations by resource persons. After the presentations there was floor discussion followed by comments and queries on the papers presented.
2. After the floor discussion, the participants were divided into groups based on the themes/issues and assigned them the group tasks. These themes/issues were based on the steps used by the CDC to analyze and incorporate new topics into the curriculum.
3. In the morning of the 2nd day of the workshop, the groups worked on the issue-based tasks.
4. In the second part of day 2, the group presented their recommendations/suggestions on CC Curriculum, and agreed on the step by step process to incorporate CC components into science curriculum.

Participants

The key participants of the workshop were:

- Concerned officials of MOEST
- Concerned officials of MoE
- Curriculum development Officers (CDC)
- Textbook Writer

- School Teachers
- Teacher Educators & University Personnel
- Climate change resource persons from universities, international organizations and other institutes

Papers presented in the workshop

1. Climate Change Impacts and Adaptation in Nepal and its Importance in Educational Curriculum
2. Review of the Findings of Academic Curricula on Climate Change and Environmental Management (TA 7173) with respect to Updating Curriculum of Climate Science in Secondary level Education.
3. Existing Climate Change (CC) Contents in the Science Curricula of Secondary (9 and 10 Grade) Level Education
4. How new topics are addressed in secondary science curriculum: sharing the experience of integrating disaster risk management in educational curriculum
5. The process of updating /incorporating CC Curriculum in the Secondary level education
6. Experience sharing on climate change teaching material development.

Reference Materials made available

- Findings of Academic Curricula on Climate Change and Environmental Management (TA 7173) with respect to Updating Curriculum of Climate Science in Secondary level Education
- Climate Change and Training Manual: An Easy Guide for Teachers (Amita Thapa, Climate Change Network Nepal)
- Training Manual – Climate Change and the Environment prepared by Nepal Administrative Staff College

List of Resource Persons

S. N.	Name	Presentation Topic	Areas of expertise	Organization	Address
1	Mr. Batu Krishna Uprety	Review of the Findings of Academic Curricula on Climate Change and Environmental Management (TA 7173) with respect to Updating Curriculum of Climate Science in Secondary level Education.	Environment/Clim ate Change Specialist	Independent	Tel: 479359/483787E-mail: upretybk@wlink.com.np
2	Dr. B.K. Ranjit, Deputy Director	Existing Climate Change (CC) Contents in the Science Curricula of Secondary (9 and 10 Grade) Level Education	Curriculum Development Specialist	CDC	Cell: 9741013198 Email: sabalranjit@hotmail.com
3	Parbat Dhungana Professor	The process of updating /incorporating CC Curriculum in the Secondary level education	Climate Change / Environment Teacher Training	F. of Education, KU	Cell: 9841440646 Email: parbat@kusoed.edu.np
4	Anu Adhikari Rakshaya Shaya CC Program Officers – CC	Climate Change Impacts and Adaptation in Nepal and its Importance Educational Curriculum	Climate Change Education/ Communication	IUCN	Tel: 5528781 anu.adhikari@iucn.org

5	Kedar Rijal Madan Koirala	How new topics are addressed in secondary curriculum: sharing the experience of integrating disaster risk management in educational curriculum	Climate Change & Environment	F. of Environmental Sciences, TU	Tel: 4332147 KR 9841372943 MK 4108681 (R), M: 9841259938 E: krijal@cdes.edu.np ; madankoirala@gmail.com
6	Amita Thapa Magar CCNN Program Officer	Experience sharing on climate change teaching material development	Climate Change Education/ Communication Specialist	Clean Energy Network	Cell: 9841926860 Email: amita@cen.org.np

CHAPTER II: ADDRESSES AND PAPER PRESENTATIONS

Addresses

Mr. Keshav Bhattarai, Secretary, MoEST chaired the opening session where Mr. Suresh Man Shrestha, Secretary, Ministry of Education was the Chief Guest. Their brief opening remarks, as chair person and chief guest respectively, are given here.

Opening remarks by Mr. Keshav Bhattarai, Secretary, MoEST

Chief Guest, Mr. Suresh Man Shrestha, Secretary, Ministry of Education, Mr. Khagaraj Baral, Executive Director, Curriculum Development Centre, participants who are here in this morning, ladies and gentlemen,

I am pleased to express my few words in this workshop on “*Integrating Climate Change Concepts into Secondary Level Science Curriculum*”, which brought together climate change experts, curriculum specialists, textbook writers and teachers to discuss about how to improve the teaching of climate science and climate change topics in secondary school in science courses. I am happy to say that the workshop is very well participated by experts and professionals concerned with academic curriculum, environment and climate science and I hope that the recommendations made by the workshop will be a strong basis for updating contents on climate change science in to the secondary level education in Nepal.

No doubt, among other, climate change is a critical issue for Nepal’s development. We, therefore, need to start educating students on the facts about climate change and prepare them to deal with its impacts on society in the future.

The workshop is being organized under the ' Mainstreaming Climate Change Risk Management in Development Project' which is part of Nepal’s Pilot Program for Climate Resilience, MoEST is working with a number of government departments to ensure that the challenges posed by climate change are addressed through multiple efforts across key development sectors, including education.

Opening remarks by Mr. Suresh Man Shrestha, Secretary, Ministry of Education

Mr. Chairman, Mr. Khagaraj Baral, Executive Director, Curriculum Development Centre, participants, ladies and gentlemen,

First of all I would like to thank organizers of the workshop for giving me an opportunity to express my quick view point regarding “*Integrating Climate Change Concepts into Secondary Level Science Curriculum*”. I would like to let you know that academic curriculum revision has its own special process and provisions based on which the curricula of different academic levels are revised and updated.

Almost every day people representing some institutions, organizations or projects come to me with requests to address their issues into the academic curricula of different levels. Despite our desire, every issues cannot be fitted into the curriculum because academic curriculum has its own standards, criteria and limitations. However, we need to prioritise based on the nation's need and importance of the issue/subject. Nevertheless, I do realise that climate change adoption is an important issue that need to be addressed in time and incorporation of climate change concepts and adoptions practices into the educational curricula is one of the crucial area to start with.

Welcome Address, Workshop Objective and Highlights of the Project By Arjun Thapa, Under-Secretary and NPM

Honorable Chairman, Chief Guest, respected participants and colleagues,

I would like to welcome you all in this workshop on “Integrating Concepts into Climate Change Curriculum in Science for Secondary Level (Grades IX & X) Education, Nepal”. Specially I would like to express my warm welcome to Mr. Keshav Bhattarai, Secretary, MoEST for kindly chairing the session, Mr. Suresh Man Shrestha, Secretary, MoE as chief guest and Khagaraj Baral, ED-CDC as guest whose presence here has inspired all of us organizers and participants in the workshop. Mr. Chairman, let me briefly highlight the objective of the workshop.

This two days workshop is one of the planned activities under output two of 'Mainstreaming climate change risk management in development project' which is being implemented by MoEST in partnership with other concerned national and local stakeholders. 'Development and application of knowledge management tools for climate change' is output 2 of the 3 outputs anticipated by the implementation of the project.

The main purpose of this output is to strengthen the country's system for generating, managing, and sharing knowledge as an input to make Nepal climate resilient. In achieving the above objective, updating educational curriculum on climate science and resilience is one of the activities to be implemented. This activity is also a follow-up to the Report prepared by Consultants to MoEST on *Recommendations for Academic Curricula on Climate Change and Environmental Management*. The Report found that environmental sciences covered key points on environmental management, climate and weather, but climate change concepts needed to be strengthened.

The expected output from this workshop is that climate change concepts are integrated into the curriculum in science for secondary level education (*Grade 9 and 10*)

Mr. Chairman, with this, please allows me to highlight quickly about the project "Nepal: Mainstreaming climate change risk management in development".

Mainstreaming climate change risk management in development is one of the five components of Nepal's Pilot Program for Climate Resilience (PPCR). The Ministry of Environment, Science and Technology (MoEST) is the executing agency which implements 'Mainstreaming Climate Change Risk Management in Development Project' with financial support of ADB.

This project has been effective since 1 March 2012 and administered by ADB. The project aims to safeguard the government's infrastructure development projects, policies and programs against the impacts of climate change. Component 3 is the most advanced of the five components. The project has three outputs: (1) climate change risks are integrated into Nepal's development planning and implementation of development projects, (2) knowledge management tools for climate change are developed and applied, and (3) outputs and lessons from the SPCR and other adaptation programs are managed for results and incorporated into Nepal's climate change programming. MoEST is the EA for this component.

ADB has contracted the International Centre for Environment Management (ICEM) and local partners METCON Consultants and APTEC Consultancy to provide technical assistance for project implementation. The consultants were mobilized in June 2012.

Project management: MoEST's Climate Change Management Division (CCMD) is responsible for the implementation of the TA. The present management arrangement includes Ms. Meena Khanal (Joint Secretary) as the National Project Director (NPD) and two NPMs; Mr. Arjun Thapa, Under Secretary and Akhanda Sharma, Under Secretary. Ms Khanal will be retiring in November 2012 and a new NPD will be appointed after her retirement.

The following key project management progress has been achieved to date:

- TA office space and facilities at MoEST established including purchasing of TA equipment;
- A series of project briefings and discussions have been conducted with key government staff including NPD, NPMs, Chief of CCMD; Director Generals and focal persons and counterpart staff of participating government line departments;
- Under the chairmanship of the Secretary of MoEST, a Steering Committee for the project was established. MoEST convened the first meeting of the Steering Committee on 23 July, 2012; and
- The Inception report was submitted for government and ADB review in September 2012 and the TA team is currently facilitating the collation of comments from the various sector agencies.

Output 1 will involve developing and documenting sector-specific knowledge and case analysis, incorporating climate change risk management into sector guidelines, revising manuals and standards; training and sharing knowledge on climate change risk management, reviewing sector policies, developing a data support infrastructure for the implementation of climate change risk management, preparing detailed concept notes for climate change related projects, and establishing an overall climate change risk management system. A number of agencies will be actively involved in Output 1 including Department of Water Supply and Sewerage, Department of Roads, Department of Urban Development and Building Construction, Department of Irrigation, Department of Water-Induced Disaster Prevention, Department of Hydrology and Meteorology, Ministry of Federal Affairs and Local Development, Department of Local Infrastructure Development and Agricultural Roads.

To date the following key progress has been made toward achievement of Output 1:

- Key stakeholders have been consulted and their issues and concerns regarding the TA have been noted;
- TA national team, MoEST staff and government focal persons and counterparts have been orientated to the ICEM Climate Change Vulnerability Assessment and Adaptation Planning methodology;
- A list of case study sites has been prepared; and

- National TA team members are currently preparing sector institutional analysis and initial baseline information for the case study sites.

Output 2 will involve: (i) implementing district level climate change training programs; (ii) updating educational curriculum on climate science and resilience; (iii) establishing a small grants research fund; (iv) documenting traditional/indigenous adaptation practices; (v) establishing a knowledge management information system which will gather, store and help to produce knowledge products (vi) developing a communications strategy, and (vii) supporting the development of knowledge products and services. The Ministry of Education and four national universities will be involved in Output 2.

To date the following key progress has been made toward Output 2:

- Process for working with the Curriculum Development Committee on integrating climate change into secondary curriculum has been clarified;
- Role of National Climate Change Knowledge Management Centre has been clarified and proposed in the Inception Report;
- ToRs for Service Providers and Individual Consultants for District Training, Grant Management, Indigenous Research, Curriculum Review and Knowledge Management System have been prepared;
- Tribhuvan University and Kathamndu University have identified representatives from Environmental Sciences to work with MoEST. The appointments from Pubaranchal and Pokhara Universities are in progress;
- The draft Communication and Knowledge Management Strategy has been completed and submitted for government and ADB review.

Output 3 aims to monitor climate change programs in Nepal through a single reporting framework that creates a platform for shared learning and harmonized reporting.

The key progress to date under Output 3 is the development of MoEST's Climate Change Program Results Framework (CCPRF) which encompasses the PPCR components as well as three additional climate change projects under MoEST's portfolio - National Climate Change Support Program (NCCSP), with support from DFID; Community-based flood risk and GLOF risk reduction programme, with support from UNDP; Ecosystem's based adaptation Programme, with support from UNDP. The framework comprises of two components:

- 1) **CCPRF Coordination Committee (CCPRF CC):** The purpose of this committee is to bring together Project Directors or nominated senior representation from the Steering Committees of the eight projects under the CCPRF in order to: (i) share progress, (ii) facilitate coordination and the sharing of information and data, (iii) avoid duplication in activities, (iv) evaluate progress and performance, and (v) document lessons learned.
- 2) **CCPRF Technical Working Group (TWG):** In order to support the CCPRF a technical working group will be established, comprised of the M&E specialists from each of the eight CCPRF projects and where possible NPMs. The group will have primary responsibility for designing and overseeing the implementation of a coordinated results management framework for MoEST.

Paper presentations

Climate Change Impacts and Adaptation in Nepal and its importance in education curricula

Anu Adhikari, Racchya Shah, and Sony Baral

IUCN Nepal

1. Introduction

Climate change can be felt in the short term through natural hazards such as flood, landslide, and drought and in long term through gradual degradation of the environment brought about by change in temperature and rainfall patterns. The adverse effects of these events are already felt in all over Nepal in sector like agriculture and food security, forest and biodiversity, ecosystem, water, health, settlement, migration patterns, energy, transport etc. Since majority of our population are poor and dependent for their livelihood on natural resources already threaten by climate change this has to become national priority. Tackling climate change impact has to be our national priority.

What constitute climate and weather?

Climate: Climate describes the average or typical conditions of temperature, relative humidity, cloudiness, precipitation, wind speed and direction and other meteorological factors that prevail globally or regionally for extended periods.

The Intergovernmental Panel on Climate Change (IPCC) glossary defines Climate Change as: Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. The climate of a location is affected by its latitude, terrain, altitude, ice or snow cover, as well as nearby water bodies and their currents.

Weather: Weather describes the hourly or daily conditions that people experience each day. The term Weather describes the state of the air at a particular place and time – whether it is warm or cold, wet or dry, and how cloudy or windy it is, for example. In simple words, Weather is the day-to-day conditions of a particular place. Weather is a set of all the phenomena occurring in a given atmosphere at a given time.

Weather refers to current activity, and not long-term atmospheric activities. All the Earth's weather takes place in the lowest part of the atmosphere, which is called the troposphere. This extends upwards from ground level to about 8km at the poles and about 16km at the equator.

Although in layman terms these are used as interchangeably but there is conceptual difference between these two terms; “Climate is what we expect, Weather is what we get”

Climate Change

Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), which defines ‘climate change’ as: ‘a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods’. (UNFCCC Article 1 Para 2).

The IPCC Fourth Assessment report clearly indicates that anthropogenic activities have accelerated the process of global climate change. Increasing GHG emissions has contributed to the increase in the atmospheric temperature, resulting in location-specific impacts.

How the Climate System Works?

Climate is a complex and interactive system constituting a delicate balance of different elements. It consists of atmosphere, land surface, snow and ice, oceans and other water bodies. These components interact with one another and with aspects of the earth's biosphere to determine not only the day-to-day weather, but also the long-term averages that we refer to as 'climate'.

Various external factors influence the internal dynamics of the Climate Systems and these include natural phenomena such as volcanic eruptions and solar radiations, as well as human-induced changes in atmospheric composition. The entire climate system gets the power and energy from the Sun. The radiation balance of the Earth may get modified by three fundamental ways:

- by changing the incoming solar radiation;
- by changing the fraction of solar radiation that is reflected (called ‘albedo’); and
- by altering the long wave radiation from Earth back towards space

Climate, in turn, responds directly to such changes, as well as indirectly, through a variety of feedback mechanisms.

Carbon Cycle: Carbon is the fourth most abundant element in the universe and is essential for life. Every organism needs carbon either for structure or energy. The carbon cycle is the set of biogeochemical processes by which carbon undergoes chemical reactions, changes form, and moves through different reservoirs on earth including living organism.

Geological component of the carbon cycle is driven by plate tectonics and include processes like volcanic eruptions. Biological component is driven by respiration and photosynthesis by living organism. Human influences carbon cycle primarily through burning large amount of fossil fuel-coal, oil and natural gas. Another factor is deforestation, cut or burned forest as they can no longer store carbon which will be released in atmosphere.

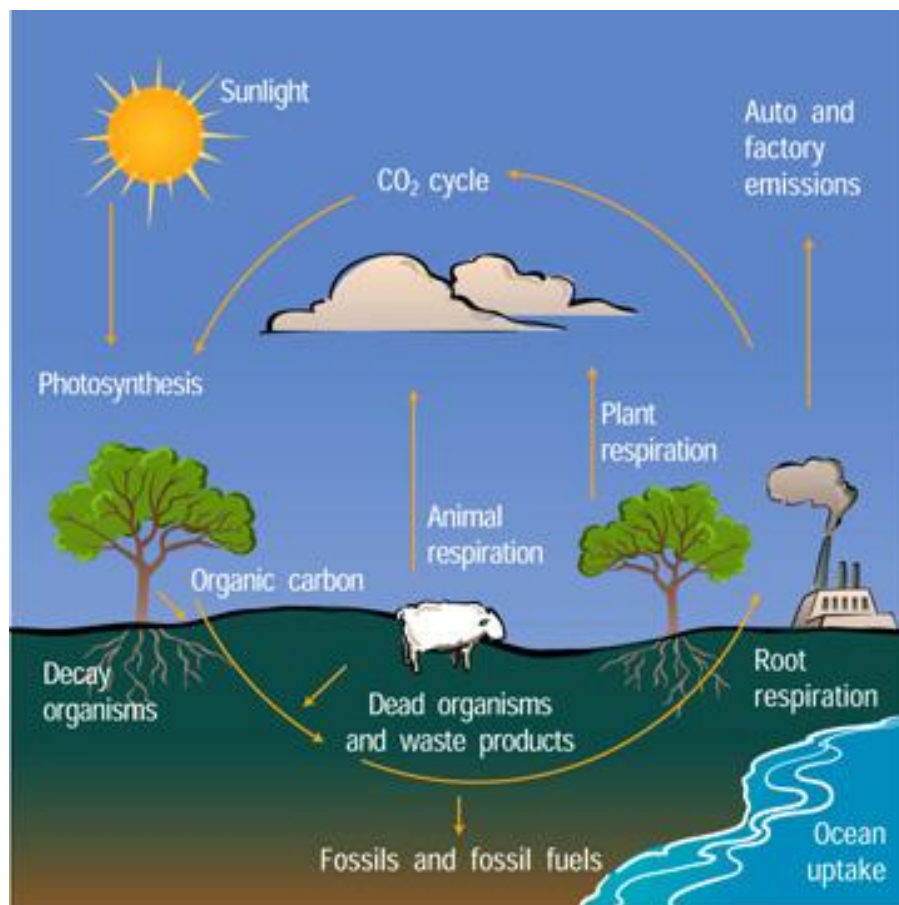


Figure 1: Carbon cycle

Global Warming: Global Warming refers to an average increase in the Earth's temperature, which in turn causes changes in climate patterns. Projection from the UN climate change body, the apex scientific body on climate change, the IPCC says that global surface temperature will probably rise a further 1.1 to 6.4⁰ Celsius during 21st century. Similarly, Nepal surface temperature has increased at the rate of 0.06 0 Celsius during 1977 to 1994.

A change in the net energy available to the global atmosphere system is called 'radiative forcing'; it can be natural or anthropogenic. The radiative forcing can be positive means it will warm and negative means it will cool the climate system. A warmer Earth may lead to changes in rainfall patterns, a rise in sea level, and a wide range of impacts on flora and fauna and humans.

The rapid rate of urbanization has led to increased fossil fuel burnings and ultimately leading to increased CO₂ emission. The action of carbon dioxide and other greenhouse gases in trapping infrared radiation is called the greenhouse effect. The greenhouse effect is naturally occurring phenomenon that blankets the earth and warms it, maintaining the temperature that living things need to survive.

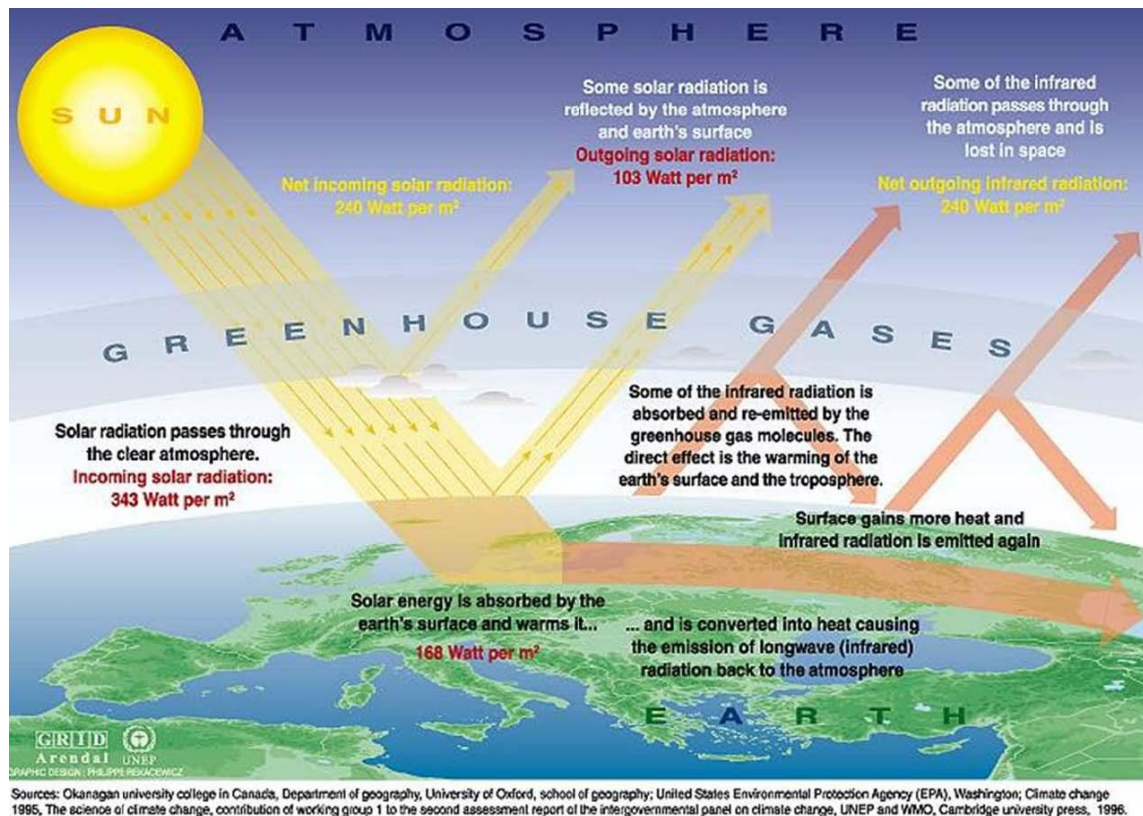


Figure 2: Greenhouse Gas Effect

Surprisingly, the atmosphere abundant gases (nitrogen, oxygen and argon) do not influence climate. Instead, it's the molecules of trace gases, especially water vapour, carbon dioxide, methane, nitrous oxide and ozone that strongly absorb infra-red radiation contained in sunlight, or emitted by land and water as they cool. The gases especially CO₂ acts like blanket and restrict the rate at which earth's surface can radiate heat to space. These water and trace gases keep earth about 54⁰F warmer than it would be without them. This retention of heat is called greenhouse effect and the gases that cause it are known as greenhouse gases.

In terms of GHG emissions, Nepal produces only 0.025% of global greenhouse gas emissions.¹ While most hydropower generation qualifies as a form of “clean” energy, Nepal is also promoting other forms of renewable energy, such as solar, wind, biofuels, and biomass.

Climate of Nepal

The greatest influence on Nepal's climate is the South Asian monsoons. The monsoons enter Nepal from the southeast, with precipitation beginning as it reaches the lower hills of the Churia range, which act as the first monsoon barrier. The high mountains of the Himalayan range act as a final barrier to the monsoon, creating a rain shadow to the north in the Himalayan Plateau. Monsoon rains are most abundant in the east and gradually decline as they move west; while winter rains are higher in the northwest, declining as they move southeast. The highest rainfall occurs in the central and mid-hills (around the Pokhara valley) and northeast and east of the Kathmandu valley. Average annual rainfall is approximately 1800 mm. Temperatures tends to increase from North to South. The highest temperatures are registered during the pre-monsoon period.

The Himalayan glaciers are another prominent feature of Nepal's climate. In addition to the effect of the high mountain range on the monsoon, the snow and ice of the glaciers act as natural water storage. Changes in the snow line and glacier melts could have very serious affects on high altitude ecosystems and downstream areas. The melting of glaciers has also led to numerous new and large lakes in Nepal. These glacial lakes form when glaciers melt and water is captured behind the glacier's terminal moraine (a natural dam of rubble and ice that forms at the tongue of a glacier.) As the pressure of the growing glacial lake increases, these natural dams can become unstable causing Glacial Lake Outburst Floods (GLOFs).

¹ Initial National Communication to the Conference of the Parties of the United Nations Framework Convention on Climate Change, 2004, Government of Nepal.

Nepal's climate is characterized by four distinct seasons: pre-monsoon (March-May), monsoon (June-September), post-monsoon (October-November) and winter (December-February). These seasons vary enormously in terms of temperature and precipitation, and the climate also differs greatly across Nepal's highly varied ecological belts (SPCR, 2010).

Temperature, Rainfall Pattern and Intensity: Various climate change vulnerability assessment show that Nepal is highly vulnerable to climate change. More than 1.9 million people are estimated to be highly vulnerable and another 10 million are exposed to increasing risks (MoEnv, 2010). Nepal is the 4th most vulnerable countries in the world from climate change vulnerability (Maplecroft, 2010)².

Temperature data collected from the mid 1970s from 49 stations in Nepal (Shrestha et al. 1999 and Shrestha and Aryal, 2011)³ indicate that average temperature between 1977 and 1994 increased at a rate of 0.06⁰ C per year. The rise of temperature was greater at the higher altitudes and increase in temperature was more pronounced during the cooler months (0.0-0.08⁰C per year from October-February, for all of Nepal) than for the warmer months (0.02-0.05⁰C per year for March-September). Studies also indicated that the observed warming is not uniform across the country and is more pronounced in high altitude regions compared to the Terai and Siwalik region (MoEnv, 2010).

Precipitation data for Nepal does not reveal any significant trends (Practical Action. 2009) ⁴. The inter annual variation of rainfall, particularly monsoon precipitation, is so large that observed trends are very uncertain and could be a part of natural cycles (MoEnv, 2010). Based on data from 1947 to 1993, Sharma et al. (2000)⁵ found that the precipitation trend in the Koshi Basin (eastern Nepal) shows an increasing trend while the eastern and central parts of Nepal face a negative trend of <700mm/decade. Annual average precipitation is decreasing at the rate of 9.8mm/decade (MoPE, 2004)⁶.

² Maplecroft (2010). Maplecroft: South Asia at risk from climate change, Scandinavia safest <http://maplecroft.com>)

³ Shrestha, a., Aryal, R. (2011). Climate change in nepal and its impact on Himalayan glaciers. Regional Environmental Change 11 (Aupplement 1): 65-77

Sharestha, A B., Wake, C.P., Mayewski, P.A., Dibb, J. E. (1999). Maximum temperature trends in the Himalayan and its vicinity: An analysis based on temperature records from Nepal for the period 1971-94. Journal co Climate 12: 2775-2787

⁴ Practical Action (2009). Temporal and Spatial variability of climate change over Nepal (1976-2005). Kathmandu. Nepal. Practical Action .

⁵ Sharma, K.P., Vorosmarty, C. J., Moore II B (2000). Sensitivity of the Himalayan hydrology to land use and climate change. In Climate Change 47, Kluwer Academic Publishers, Dordrecht, the Netherlands. pp 117-139.

⁶ MoPE (2004). Initial national communication to the conference of Parties of the United Nation framework convention on climate change: Kathmandu, Nepal: Ministry of Population and Environment.

Various studies have made climate change projections using different models with temperature and precipitation-related data recorded for different periods. An analysis of temperatures since 1962 shows significant variations between years. However, a progressive increase in maximum temperatures is evident and confirms both global and regional records. From 1977 to 1994, the mean annual temperature is estimated to have increased by 0.04 - 0.06°C annually. Studies also indicate that the observed warming trend is not uniform across the country⁷.

The OECD study on General Circulation Models (GCM) run with the SRES B2 scenario shows that the mean annual temperature is likely to increase by an average of 1.2°C by 2030, 1.7°C by 2050 and 3°C by 2100 compared to a pre-2000 baseline. In terms of spatial distribution these studies show higher increases in temperature over western and central Nepal compared to the east for the years 2030, 2060 and 2090, with highest increase in western Nepal. Warming has been more pronounced in high altitude regions and lower in the Churia-Terai region. This is consistent with the notable global trends of temperature increases at higher altitudes.

Precipitation projections show no change in the western Nepal and up to 5-10 percent increase in eastern Nepal during winter. During summer, precipitation is projected to increase for the whole country in the range of 15 to 20 percent. A RCM (Regional Circulation Model) projects both rise and fall in the mean annual precipitation with no clear trends. In terms of spatial distribution, a MoEnv study projected an increase in monsoon rainfall in eastern and central Nepal compared to western Nepal. Further, the projection indicated an increase in monsoon and post monsoon rainfall as well as increase in the intensity of rainfall and a decrease in winter precipitation (MoEnv, 2010)⁸.

Annual precipitation data shows a general decline in pre-monsoon precipitation in far-west and mid-western Nepal, with a few pockets of declining rainfall in the western, central, and eastern regions. In contrast, there is a general trend of increasing pre-monsoon precipitation in the rest of the country. In the rest of the country, monsoon precipitation has generally increased. Post-monsoon precipitation shows increasing trends in most of the mid-western and the southern parts of eastern, central and western Nepal. A general declining precipitation trend is observed in most of the far-western and northern parts of the western, central and eastern Nepal. Inter-annual variations in rainfall vary widely. Recent records in Nepal show increasing incidents of droughts and floods, hailstorms, landslides and crop disease⁹.

⁷ SPCR, 2011

⁸ MoEnv (2010). National Adaptation Programme of Action (NAPA). Kathmandu. Nepal: Ministry of Environment

⁹ SPCR, MoEST, 2011

2. Climate Change Impact

Nepal faces serious climate risks. It ranks fourth on a recently published list of country vulnerability that is based on the Climate Change Vulnerability Index, with poverty and adaptive capacity being some of the key determining factors in the ranking¹⁰. Nepal ranks 11th in the world in terms of vulnerability to earthquakes. Climate change is expected to intensify Nepal's already pronounced climate variability and increase the frequency of climate extremes such as droughts and floods.

Whilst the impacts on some sectors are likely to be more severe than on others, sectors that are particularly sensitive to climate change include agriculture, forestry, water and energy, health, urban and infrastructure, tourism, industry, and overall livelihoods and economy.

Agriculture and Food Security: World food production varies by several percent from year to year, largely as a result of weather conditions such as the El Niño phenomenon and inter-annual climatic variability in many regions. But agriculture in some regions is more sensitive to weather than in others. Typically, sensitivity to weather is greatest firstly in developing countries, where technological buffering to droughts and floods is less advanced, and secondly in those regions where the main physical factors affecting production (soils, terrain, and climate) are less suited to farming.

Agriculture is fundamental to the livelihoods of the rural population. Nepalese economy largely agrarian in characteristics and is rainfed. It contributes to about 35 percent of GDP and employs two thirds of the population.

Climate change is expected to affect agricultural productivity through three primary channels in Nepal: (i) rising temperatures, (ii) climate variability and related changes in the timing, intensity, and volume of rainfall, and (iii) rising carbon dioxide levels. Evidence suggests that the observed changes in temperatures and soil moisture are negatively affecting agriculture in many parts of Nepal.

The agriculture sector is not only among the most vulnerable sectors to the impacts of climate change. It is also directly responsible for 14 percent of global greenhouse gas emissions. In addition, the sector is a key driver of deforestation and land degradation, which account for an additional 17 percent of emissions.

¹⁰ www.maplecroft.com/about/news/ccvi/html. The *Climate Change Vulnerability Index* evaluates 42 social, economic and environmental factors to assess national vulnerabilities across three core areas. These include: exposure to climate-related natural disasters and sea-level rise; human sensitivity, in terms of population patterns, development, natural resources, agricultural dependency and conflicts; thirdly, the index assesses future vulnerability by considering the adaptive capacity of a country's government and infrastructure to combat climate change.

The effects of a changing climate on agriculture are already leaving poor people with even fewer assets, which they need to protect themselves from the shocks and stresses of change. The Terai region is prime agricultural belt along the entire southern region of the country, is most at risk from flooding. This could lead to inundation or depositing of sediments on agricultural land. Similarly, drought – both during winter and summer – is affecting crop production and animal husbandry. The winter drought assessment confirmed that production of the major winter crops – wheat and barley – decreased nationally in 2009 by 14.5% and 17.3 % respectively compared to previous years.¹¹

The 2008/2009 winter drought-one of the worst in the country's history-destroyed crops across Nepal, with wheat crops cut by 14% and barley production by 17% respectively. Some districts in the mid-west and far-western regions received less than 50% of average rainfall for November 2008 to February 2009, and their crop yield dropped by more than half. More than two million people were highly at risk of starving.¹² Only 26.5% of cultivable agricultural land in Nepal is irrigated.¹³ Of that irrigable land, even less has access to water supply all year round. As a result, agricultural production greatly depends on favourable weather conditions, mainly on the monsoon's timing and sufficiency. A late or erratic monsoon quickly translates into crop losses – and subsequently to food insecurity. Agriculture is also at risk of increased water scarcity due to growing demand from other sectors.

The ability of Nepal's agriculture sector to adapt to these changes is limited because of its already low productivity and high incidence of poverty, particularly amongst the rural population.¹⁴ Decline in rainfall from November to April adversely affects the winter and spring crops. The overall effect of rising or high food prices on the poor is therefore a function of location as well as prices. The urban poor are most affected by high prices for staples and vegetables in urban markets, while the rural poor – especially in remote, chronically food-insecure districts – are doubly impacted by high transport costs and grain prices. The following indicators suggest how climate change could be affecting agriculture,

- Nepal has experienced 12 warmest years in the period from 1975 to 2007
- Nepal experience late or early monsoon, high intense rainfall events, decreasing number of rainfall days leading to high runoff and lower recharge of ground recharge
- Extreme fog conditions especially in Terai

¹¹ Market Watch 14, 2009/WFP

¹² www.wfp.org/food-security/; posted on 31 May 2009

¹³ MoAC, 2010. Selected indicators of Nepalese Agriculture and Population

¹⁴ Climate Change and Agriculture Country Note-Nepal. This Country Note was produced by a World Bank team led by Animesh Shivastava, comprising Cristina Dengel, Jitendra Srivastava

- Rainfall in mid-June and mid-July shifted to mid-August and mid-September

The IPCC (1996) summarized research on the potential impacts of climate change for livestock and listed four possible effects: (1) changes in livestock feed grain availability and price; (2) direct effects of climate on animal health, growth, and reproduction; (3) impacts on pasture and forage crops; and (4) changes in distribution of disease and parasites.

Forest and Biodiversity: Nepal has a very high species diversity falling in the 25th position globally and the 11th position regionally although it covers only about 0.1 percent of the total earth surface (MoPE (a), 2000)¹⁵. Nepal's abundant biodiversity is because of extreme variations in geography and climate. Altogether 399 endemic flowering plant species and 160 animal species have been reported as endemic to Nepal. Forest occupies about 5.8 million hectares of land, which is 39.6 percent of the total area of the country. Of this, 29 percent is forest and 10.6 percent is shrub land. Four biodiversity hotspots (Himalayan, Indo-Burma, Mountains of South West China and Mountains of Central Asia) are found within Nepal Himalaya. The climate and topography nurture about 118 ecosystems, 75 vegetation types and 35 types of forests (Bhuju et al. 2007).

Among five ecosystem (forests, rangelands, wetlands, mountains and agro-ecosystems) identified by Nepal Biodiversity Strategy 2002, forests are deteriorating fast with significant effect to its biodiversity.

Shifting of agro-ecological zones, prolonged dry spells, encroachment and fast growth of a alien and invasive species and increased prevalence of disease and pest is evident in Nepal. These phenomenons have significant impact on biodiversity. Shifting of ecological belt and tree line is expected because of rise in temperature which is also impacted by soil moisture conditions and hostile topographies. Distinct physiological changes are increasingly being reported in terms of alteration n flowering and fruiting behavior of the local plant species including major crops because of shift in rainfall pattern and change in temperature regime. Ultimately these changes are leading to species and habitat loss.¹⁶ Assessment shows that climate change is posing a threat to food security due to loss of some local land races and crops (Regmi and Adhikary, 2007).

Climate change might also induce ecological succession at faster rate and grasslands could be converted to woody vegetation at comparatively shorter periods. Species having low tolerance to climate variability and location specific species might also be wiped out and change the structure of ecosystem.

¹⁵ MoPE (a), 2000. Environment. A journal of the Enviornment, Vol. 5 2000 No. 6. HMG, MoPE, Kathmandu Nepal.

¹⁶ Nepal NAPA (2010).

Water resources and energy: Water is fundamental to life. Around the world, only 3 percent of the earth's water is freshwater; about two-thirds of it is frozen in glaciers and polar ice caps and we have long over-stretched this precious resource¹⁷ - under increased pressure to satisfy the needs of water users throughout the world.

Nepal has 3,252 glaciers covering an area of 53213 km² (about 3.6 per cent of Nepal's total surface area) with an estimated ice reserve of 481 km³ and surface water available is about 225 billion cubic meter per annum, equivalent to an average flow of 7125m³/sec. Nepal has been experiencing water deficit outside of monsoon season. Owing to extreme weather events like drought, low precipitation, intense localized precipitation and over-exploitation of groundwater have led to rapid drop in the groundwater table in many regions.

Already, water-related climate change impacts are being experienced in the form of more severe and more frequent droughts and floods. Higher average temperatures and changes in precipitation and temperature extremes are projected to affect the availability of water resources through changes in rainfall distribution, soil moisture, glacier and ice/snow melt, and river and groundwater flows; these factors are expected to lead to further deterioration of water quality as well. The poor, who are the most vulnerable, are also likely to be affected the most¹⁸.

Temperature drives the hydrological cycle, influencing hydrological processes in a direct or indirect way. A warmer climate may lead to intensification of the hydrological cycle, resulting in higher rates of evaporation and increase of liquid precipitation. These processes, in association with a shifting pattern of precipitation, may affect the spatial and temporal distribution of runoff, soil moisture, groundwater reserves etc. and may increase the frequency of droughts and floods.

Global warming results in changes in rain and snowfall patterns, glacier melt atmospheric water vapor and evaporation, changes in soil moisture and runoff. Out of 2323 Glaciers Lake inventoried, 330 lakes have expanded to become larger than 0.02 sq km and are still expanding. About 21 glacial lakes are already reported to have reached sizes large enough to be critical. The rate of retreat of some glaciers is estimated to be as high as 20m/year.

According to Strategic Programme for Climate Resilience (SPCR, 2011), climate change is expected to cause: (i) greater water scarcity in the High Mountain Region, (ii) affect water quality and availability in the Middle Mountains, and (iii) cause more water-related disasters (flooding, landslide, sedimentation, water-borne disease, vector-borne disease) in the Churia/Terai Region. These disasters are highly

¹⁷Water Program, International Union for Conservation of Nature. 2012. Retrieved from the World Wide Web: <http://www.iucn.org/water/>

¹⁸ UN Water. 2012. Retrieved from the World Wide Web: http://www.unwater.org/downloads/UNWclimatechange_EN.pdf

associated with increase in precipitation during and around the monsoon season, especially floods in the Terai and landslides.

Health/Public Health: Nepal health services are still characterized with weak infrastructure and service quality. This increases the vulnerability of the communities in the face of changing climate and its consequences including extreme climatic events like flood, landslides and droughts.

According to WHO, climate change resulted in the loss of 5.5 million Disability Adjusted Life Years (DALYs) in 2000, a morbidity burden which is increasing¹⁹. The changing climate will inevitably affect the basic requirements for maintaining health: clean air and water, sufficient food and adequate shelter. Each year, about 1.2 million people die from causes attributable to urban air pollution, 2.2 million from diarrhea largely resulting from lack of access to clean water supply and sanitation, and from poor hygiene, 3.5 million from malnutrition and approximately 60 000 in natural disasters.

The changing climatic elements are expected to provide favorable environment for vector and water borne disease. In addition to this, worsening situation of local food self sufficiency and security has led to increasing malnutrition especially affecting infant, child and maternal mortality rates. Increase in temperature in previously sub-temperate climate has increased prevalence of vectors like mosquitoes in mid hills and high hills of Nepal attacking unprepared communities whereas further increment of temperature in humid and tropical areas has led communities more vulnerable to previously eradicated disease like malaria, Japanese encephalitis and kala-azar. The projected increase of climate disasters under climate change (particularly from floods related to glacier melt) would have a direct impact on health in Nepal. It is already evident that malaria, Kalaazar, Japanese encephalitis, and other water borne diseases such as typhoid and cholera are commonly seen in different parts of the country.

Climate Induced Disaster: Nepal is exposed to various types of hydrometeorological disasters and climate change is expected further intensify the existing scenario. According to Ministry of Home Affairs, Disaster Preparedness Network, 2010, more than 4000 people died in last ten year because of climate induced disaster causing economic loss of 5.34 billion USD.

Infrastructure: The present rapid growth and development of the country is unprecedented, with an increase of urban population. The fastest rates of urbanization are leading to development of infrastructure. Growing demands of cities in terms of consumption and lifestyle compound the pace of climate change and increase the risks. Unprecedented disaster, wide-scale disruption and loss due to

¹⁹Climate and Health Council Official Website. 2012. Retrieved from the World Wide Web: <http://www.climateandhealth.org/know.html>

climate change may face many of the infrastructures damaged and will displace people around the cities and rural areas of Nepal.

At the same time many of those people are forced to live in slums and informal settlements that are often built on marginal or dangerous land that is not deemed suitable for permanent residential structures, such as steep slopes, flood plains or industrial areas. Faulty construction methods and missing or inadequate infrastructure design contribute further to slope degradation. These populations are even more vulnerable to the impacts of climate change, such as heavy rain, flash floods, outbreak of epidemics and landslides.

3. Climate Change Vulnerability

According to NAPA vulnerability assessment, 75 districts are classified into five vulnerability ranks,

Vulnerability Ranking	Districts
Very High (0.787-1.000)	Kathmandu, Ramechhap, Udayapur, Lamjung, Mugu, Bhaktapur, Dolaka, Saptari, Jajorkot
High (0.601-0.786)	Mahottari, Dhading, Taplejung, Siraha, Gorkha, Solukhumbu, Chitwa, Okhaldhunga, Achham, Manag, Dolpa, Kalikot, Kohtoang, Dhanusha, Dailekh, Parsa, Salyan
Moderate (0.356-0.600)	Sankhuwasabha, Baglung, Sindhuli, Bhojpur, Jumla, Mustang, Rolpa, Bajahang, Rukum, Rautahat, Panchthat, Parbat, Dadeldhura, Sunsari, Doti, Tanahu, Makwanpur, Myagdi, Humla, Bajura, Baitadi, Bara, Rasuwa, Nawalparasi, Sarlahi, Sinshupalchok, Darchula, Kaski
Low (0.181-0.355)	Nuwakot, Dhanluta, Kanchanpur, Bardiya, Kapilvastu, Teherthum, Gulmi, Pyuthan, Surkhet, Argakhanchi, Morang, Dang, Lalitpur, Kailali, Syanja, Kavrepalanchowk
Very low (0.000-0.180)	Ilam, Jhapa, Banke, Palpa, Rupendehi

The NAPA analysis showed that more than 1.9 million people are highly vulnerable and 10 million are increasingly at risk with climate change likely to increase this number significantly. Most of the people living in mid and far western region are comparatively more vulnerable as the poverty rates are high in these areas and there is lack of basic services and alternative livelihood option. Degree of vulnerability even within the low scored districts may be high due to prevalence of disparity among the population and lack of access to basic services and social protection mechanism.

Climate Change Vulnerability Assessment Methods: Number of approaches has been proposed for vulnerability assessments by different concerned Organizations. Some evolving approaches, assessment methods framed vulnerability in consistent with definition of IPCC.

For example, the CARE International focuses on the qualitative aspects of addressing the underlying causes of vulnerability at a variety of scales (from national to household/individual) (Dazé, Ambrose, & Ehrhart, 2009); Practical Action's Vulnerability to Resilience (V2R) framework stresses the dynamic and cyclical nature of building resilience to climate change (Pasteur, 2010), which makes numerical measurement difficult. Perhaps the most comprehensive framework for assessing vulnerability to climate change, provided by IUCN, also focuses on obtaining qualitative data from communities and triangulating it with scientific data (although some matrix ranking of vulnerability versus adaptive capacity is included) (Marshall, et al., 2009). Tearfund included the quantification of risks posed by various climate-related hazards, which allows for the prioritization and selection of adaptation options (the greater the risk, the greater the need for adaptation options) (Wiggins, 2009). However, Tearfund framework stops there, and does not develop a quantification of overall vulnerability taking adaptation into account. The International Institute for Sustainable Development (IISD) developed CRiSTAL (Community-based Risk Screening Tool – Adaptation and Livelihoods) as an interactive, step-by-step tool for quantifying livelihood components in relation to hazards. However, focus is laid heavily on hazards (with no account of seasonal or projected changes), coping strategies rather than adaptation, and the impact on existing projects, rather than communities. Moreover, like the Tear fund framework, quantification is not carried forward to make an assessment of vulnerability. The Community based tool kit for practitioners developed by LFP and UKAid is based on sustainable livelihood framework and some tools are adopted from CRiSTAL, LOCATE2 and SAS3 tools with existing PRA techniques. The WWF India has developed assessment method based on Livelihood Vulnerability Index⁴ and presented quantitative treatment to IPCC definition to assess vulnerability by setting out indicators that qualifies exposure, sensitivity and adaptive capacity and normalized values for each indicators to come up with five outputs profiles (climate, demographic, agriculture, ecosystem and socio-economic).

However, there has been very less attempt found in existing approaches to downscale the assessment where primary data are collected from community and be thoroughly consistent with IPCC definition on vulnerability to the impact.

4. Addressing to Climate Change

Nepal being least developed country with mountainous characteristics possesses some associated risks and vulnerabilities arising from climate change. To reduce climate change risks, Nepal needs to focus on area/sector specific issues. This could be addressed through:

- Adaptation
- Mitigation
- Climate/ resilience planning
- Policies and good governance

Climate Change Adaptation: The IPCC defines adaptation as the, “adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Adaptation refers to all those responses to climate change that may be used to reduce vulnerability. (Vulnerability is susceptibility to harm or damage potential. It considers such factors as the ability of a system to cope or absorb stress or impacts and to “bounce back” or recover.) Adaptation can also refer to actions designed to take advantage of new opportunities that may arise as a result of climate change. Adapting to climate change will entail adjustments and changes at every level i.e. from local to global. Through adaptation, communities make themselves better able to cope with an uncertain future.

The options for adaptation range from technological options such as using inundation and drought resilient crops, improved land use and reduced deforestation, framing environmental-friendly and green-path supportive planning, to behavior change at the individual level, such as reducing water use in times of drought and reducing, recycling and reusing resources. Other adaptation strategies include early warning systems for extreme events, better water management, and improved risk management, various insurance options and biodiversity conservation.

Adaptation Types: Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.” Adaptation can occur before, during, or after any external stimulus or threat.

Anticipatory Adaptation: Adaptation that takes place before an impact of climate change is observed is known as anticipatory adaptation. For example, a severe drought, flood, or windstorm may be associated with climate change. Measures can be taken in advance to reduce impacts or damage, including provision of additional water supplies or more economical use of remaining supplies (in the case of drought), and steps to protect or remove vulnerable property from floods or windstorms.

Reactive Adaptation: Adaptation that takes place after impacts of climate change have been observed is known as reactive adaptation. For example, provision of relief to the victims and measures to rehabilitate and reconstruct damaged property and communities after the climate event.

Autonomous Adaptation: Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems.

Private Adaptation: Adaptation that is initiated and implemented by individuals, households or private companies is known as private adaptation. Private adaptation is usually in the actor’s rational self-interest.

Public Adaptation: Adaptation that is initiated and implemented by governments at all levels is known as public adaptation. Public adaptation is usually directed at collective needs.

Planned Adaptation: Adaptation that is the result of a deliberate policy decision based on an awareness that conditions have changed or are about to change and that action is required to return to maintain or achieve a desired state is known as planned adaptation.

Adaptation Measures: It is usually respond together to the need for climate adaptation in distinct, but sometimes overlapping ways. Adaptation measures might include actions that promote the chosen policy direction, such as implementing an irrigation project, or setting up a farmer information, advice and early warning programme.

There are potentially many adaptation measures that may be adopted in response to climate change. The Second Assessment Report of IPCC Working Group II mentioned or described 228 different adaptation measures (IPCC, 1995). From an overall framework a commonly used classification groups adaptation measures into eight categories (Burton et al., 1993):

1. *Bear losses:* All other adaptation measures may be compared with the baseline response of “doing nothing” except bearing or accepting the losses. In theory, bearing loss occurs when those affected have no capacity to respond in any other ways (for example, in extremely poor communities) or where the costs of adaptation measures are considered to be high in relation to the risk or the expected damages. For example it is better to continue production with 20% production loss (80% production can be still be harvested) instead of not cultivating at all.
2. *Share losses:* This type of adaptation response involves sharing the losses among a wider community. Such actions take place in traditional societies and in the most complex, high-tech societies. In traditional societies, many mechanisms exist to share losses among a wider community, such as extended families and village-level or similar small-scale communities. At the other end of the spectrum, large-scale societies share losses through public relief, rehabilitation, and reconstruction paid for from public funds. Sharing losses can also be achieved through private insurance such as crop/livestock insurance which will distribute risk.
3. *Modify the threat:* For some risks, it is possible to exercise a degree of control over the environmental threat itself. When this is a “natural” event such as a flood or a drought, possible measures include flood control works (dams, dikes, levees). For climate change, the major modification possibility is to slow the rate of climate change by reducing greenhouse gas emissions and eventually stabilizing greenhouse concentrations in the atmosphere. In the language of the UNFCCC, such measures are referred to as mitigation of climate change and are considered to be in a different category of response from adaptation measures.
4. *Prevent effects:* A frequently used set of adaptation measures involves steps to prevent the effects of climate change and variability. An example would be for agriculture: changes in crop management practices such as increased irrigation water, additional fertilizer, and pest and disease control, Plantation and embankment to prevent landslide and flood respectively.
5. *Change use:* Where the threat of climate change makes the continuation of an economic activity impossible or extremely risky, consideration can be given to changing the use. For example, a farmer may choose to substitute a more drought tolerant crop or switch to varieties with lower moisture. Similarly, crop land may be returned to pasture or forest or other uses may be found such as recreation, wildlife refuges, or national parks.
6. *Change location:* A more extreme response is to change the location of economic activities. There is considerable speculation, for example, about relocating major crops and farming regions away from

areas of increased aridity and heat to areas that are currently cooler and which may become more attractive for some crops in the future (Rosenzweig and Parry, 1994). Shifting of human settlement to a safer location.

7. *Research*: The process of adaptation can also be advanced by research into new technologies and new methods of adaptation.
8. *Educate, inform, and encourage behavioural change*: Another type of adaptation is the dissemination of knowledge through education and public information campaigns, leading to behavioural change. Such activities have been little recognized and given little priority in the past, but are likely to assume increased importance as the need to involve more communities, sectors, and regions in adaptation becomes apparent (Burton et. al. 1998).

Adaptation Approaches: There are two adaptation approaches which are generally practicing by development agencies, which are:

- a) *Community-based adaptation*: Community-based adaptation has evolved alongside the UNFCCC negotiations. As with work on adaptation, community-based adaptation recognizes that environmental knowledge and resilience to climate impacts lie within societies and cultures. The focus should therefore be on empowering communities to take action on vulnerability to climate change, based on their own decision-making processes. The 'bottom-up' aspects of community-based adaptation are in part a reaction to many 'top-down' energy-based interventions, which commonly dominate climate negotiations.

The goal of community-based adaptation projects is to increase the climate resilience of communities by enhancing their capacity to cope with less predictable rainfall patterns, more frequent droughts, stronger heat waves, different diseases and weather hazards of unprecedented intensity.

- b) *Ecosystem based Adaptation*: Ecosystem based Adaptation is ensuring restoration, maintenance and enhancement of ecosystem values, in face of climate change impacts. It is an emerging approach to help people to adapt to the adverse impact of climate change. It is the use of biodiversity and ecosystem services as a part of overall adaptation strategy. It uses sustainable management, conservation and restoration of ecosystem taking into account anticipated climate change impact

trends, to reduce vulnerability and improve the resilience of ecosystems and people to climate change impacts.

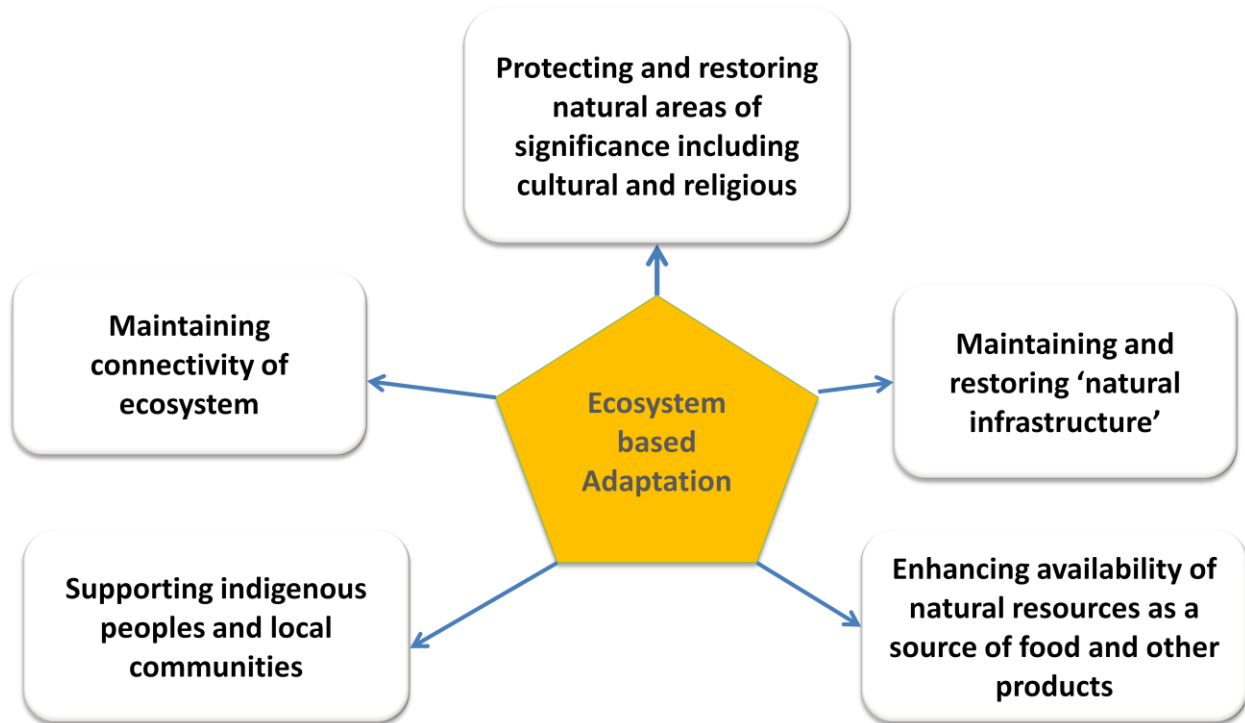


Figure 3: Potential Contribution of Ecosystem based Adaptation

EbA involves collective action among government, communities, conservation and development organizations and other stakeholders to plan and empower local action, to increase environment and community resilience to climate change. It provides cost effective strategies and is especially effective at local level with community involvement. Example of EbA can be management of agriculture land using local knowledge of specific crop and livestock varieties. Watershed management through the maintenance and enhancement of the wetland. Selection of species based on problem for e.g. plantation of tree species with high water retention capacity in drought area.

Climate Change Mitigation: The Intergovernmental Panel on Climate Change (IPCC) defines mitigation as: “An anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases.” Climate mitigation is any action taken to permanently eliminate or reduce the long-term risk and hazards of climate change to human life, property.

The Initial National Communication emphasizes that GHG emission reduction in itself is not a priority for Nepal and it is therefore very important that mitigation measures should go hand in hand with developmental efforts. It further states that climate change issue is a priority only to the extent that it is reflected in the national development objectives in relation to protection of the environment and sustainable development.

This is in line with the Bali Action Plan which calls for “nationally appropriate mitigation actions by developing countries in the context of sustainable development, supported by technology and enabled by finance and capacity building in a measurable, reportable and verifiable manner”. It also calls for effective mechanisms for technology transfer and access to financing and incentives for developing countries.

The Government of Nepal’s Three Year Interim Plan (2007/2008–2009/2010) adopts strategies such as emphasizing relief, rehabilitation, and reintegration; achieving pro-poor and sustainable economic growth rate; increasing investments in physical infrastructure; carrying out inclusive development and targeted development programs; and emphasizing social development, which will make people feel improvements in governance. It expects the private and cooperative sectors will have important roles in the overall economic activities of the country whereas investments from the government sector will be directed mainly to relief, rehabilitation and reconstruction, development of physical infrastructure, and poverty reduction. It is within these contours of the developmental efforts that the GHG emission reduction measures will need to be embedded.

Climate Change: Nepal’s Stand at National and International Level: As a Party to the Convention and being a Non-Annex I country, Nepal prepared the Initial National Communication in 2004 (B.S. 2061)²⁰ and shared with the Parties through the Convention Secretariat. The then Ministry of Environment, Science and Technology were entrusted as the Designated National Authority (DNA) to promote the development of projects for the Clean Development Mechanism (CDM). A few public awareness raising programmes were organized during this period. Similarly, the 2003 Sustainable Development Agenda for Nepal and the 2001 Millennium Development Goals initiatives have also addressed the issue of climate change to a certain extent.

²⁰ Refers to the Nepal calendar year, Bikram Sambat

Between 2007 and 2009, in the process of implementing the Convention, Nepal has: (i) prepared the action plan related to capacity building under the National Capacity Needs Self Assessment Project in order to implement the Rio Conventions (Climate Change, Desertification and Biological Diversity); (ii) issued CDM project-approval processes and procedures to benefit from the provisions of the Kyoto Protocol; (iii) started preparing the National Adaptation Programme of Action (NAPA); (iv) started preparing the Second National Communication (SNC); and (v) implemented a project on strengthening capacity for managing climate change and the environment. Prior to the 15th Session of the Conference of the Parties (COP 15) to the UNFCCC, held in Copenhagen in 2009, the Government of Nepal organized a Cabinet Meeting at Kalapatthar, near the base camp of the Mount Everest, and issued the “Kalapatthar Declaration.” In addition, the South Asian Regional Climate Change Conference “from Kathmandu to Copenhagen” was held and a Memorandum of Understanding was signed by 14 donors and development partners to support Nepal on climate change activities. A status paper for COP 15 was also prepared. In July 2009, a 25-member Climate Change Council, including eight experts, was constituted under the Chairmanship of Right Honorable Prime Minister. Similarly, the Right Honorable Prime Minister, during COP 15, stressed the need for addressing the impact of climate change in the mountains, and that decisions and negotiations of the Convention must consider this issue very seriously. From this, climate change appeared in 2009 as national development agenda. In addition, the Interim Constitution of Nepal (2007) and Three-Year Interim Plan (2008-2010) have also addressed the issue of environmental management and climate change.

The Government of Nepal established the Climate Change Management Division in the Ministry of Environment (MoE) in the first quarter of 2010. The MoE prepared the National Adaptation Programme of Action, which was endorsed by the Government on 28 September 2010. Local Adaptation Plans of Action (LAPAs) are being prepared to implement adaptation programmes. In the process of implementing the statement made by Right Honorable Prime Minister during COP 15, the Mountain Alliance Initiative has been launched, international expert consultations were organized, and relevant reports were prepared. To coordinate climate change activities and implement collaborative programmes, a multi-stakeholder Climate Change Initiatives Coordination Committee (MCCICC) has been formed with representation from relevant ministries and institutions, international and national nongovernment organizations, academia, private sector, and donors. Similarly, with a policy to make the country’s economy and infrastructure climate-resilient, the National Planning Commission has initiated climate-resilient planning tools in the fiscal year 2010-11. It is evident that institutional, collaborative and programmatic activities have been expanded to address the issue of climate change in recent years. Efforts to mobilize funds to implement the programmes on climate change are under way. In addition, private sector and civil society

continued to organize programmes and activities to raise public awareness and promote adaptation and use of renewable energy.

Policy, Programme and Institutions: The Interim constitution of Nepal, 2007, has recognized ‘right to a clean environment’ as a fundamental right (Article 16.1). It also requires conservation of at least 40 percent of the natural forest area of the country (NPC/UNDP, 2011). In January 2011 government endorsed the Climate Change Policy 2011 with the objectives of establishing a Climate Change Center and adopting low carbon development path by pursuing climate resilient socio-economic development, among others.

Three year interim plan (2011-2013) has explicitly stated the sustainable development as a goal and has focused for the first time on the climate resilient planning of infrastructure sector. National Planning Commission has prepared a Climate Resilient Planning Document for mainstreaming climate resilient perspectives in planning process.

Ministry of Environment is the focal ministry of United Nations Climate Change Framework Convention on Climate Change (UNFCCC) and is responsible for coordinating and implementing programmes under the Convention. The MoEnv has also been nominated as the Designated National Authority (DNA) for Clean Development Mechanism (CDM). The Government of Nepal has designated the Ministry to function as the National Implementing Entity (NIE) to the Adaptation Fund Board (AFB) to the UNFCCC as well. Government has established Climate Change Management Division under Ministry of Environment (MoEnv) in March 2010. The government constituted the Climate Change Council chaired by the Prime Minister in July 2009. The Council is high level coordinating body that provided guidance and direction for formulating and implementing climate change related policies and programmes. The MoEnv is the secretariat of the Council. Nepal also has a Multi-stakeholder Climate Change Initiative Coordination Committee (MCCICC) formed to ensure functional coordination and promote implementation of collaborative programmes. The Committee has representatives from government ministries, local bodies, academia, I/NGOs, experts and development partners and is chaired by the Environment Secretary.

In September, 2010, the Government of Nepal endorsed the NAPA to implement urgent and immediate adaptation actions in priority areas. The government has also developed a national framework and approved Local Adaptation Plan of Action (LAPA) in November 2011.

Reducing Emissions from Deforestation and Ecosystem Degradation (REDD) is a proposed policy mechanism for combating climate change that offers an opportunity to put a monetary value on standing forests and could give a way to contribute more substantially to the goal of emission reduction while

protecting the forest resources and bringing investments in forest-related sustainable development for the dependent communities. Ministry of Forest and Soil Conservation (MoFSC) has already prepared a REDD preparedness proposal.

Nepal has already initiated a project proposal to receive support from the donors for REDD. Nepal submitted its views on the UN-REDD initiative on their views on how to address outstanding methodological issues including, assessments of changes in forest cover and associated carbon stocks and GHG emissions, incremental changes due to sustainable management of forest, demonstration of reductions in emissions from deforestation, including reference emissions levels, estimation and demonstration of reduction in emissions from forest degradation, implications of national and sub national approaches, including displacement of emissions, and options for assessing the effectiveness of actions.

Government of Nepal (GoN) has already prepared and submitted an Initial National Communication (INC) report for Nepal and is in the process of preparation of second national communication report. In initial national communication report Nepal has identified and suggested adaptation strategies for sustainability of the production system for ensuring food security, which includes, resource conservation for agriculture sustainability, development of genetically adaptive varieties, full scale production system to hybrid maize programme encouragement to crop diversification programme, promotion of organic farming, development of early warning systems, management of methane emission, promotion of biogas as a source of energy, management of livestock population.

Nepal has been selected as one of the nine countries for implementing Pilot Program for Climate Resilience (PPCR) in 2009 and has received assistance from the Climate Investment Fund of the World Bank. The PPCR aims to demonstrate mechanisms to integrate climate risks and resilience into core development planning complementing other ongoing initiatives and avoiding duplication. The PPCR has drawn out a strategic program for climate resilience (SPCR) within the broader concept of sustainable development and poverty reduction. At present, the MoEnv is engaged in taking inputs for the development of activities for different development sectors.

In order to promote CDM activities and benefit from KP provisions, the MoEnv has issued procedures for the approval of CDM projects. The MoEnv has initially approved 14 projects as potential CDM projects which are at various stages of project development. With a view to promote CDM activities, the MoEnv is organizing annual programmes on capacity building. The MoEnv in collaboration with the Government of India, Ministry of Environment and Forests, and Federation of Nepalese Chambers of Commerce and

Industry organized a national workshop on CDM, REDD and REDD+ from 23-24 January 2011 which was participated by 8 experts from India, and about 50 participants from Nepal.

MoEST, GoN has been working on Training Need Assessment (TNA) for Nepal. Beside this, Nepal has yet to come up with separate law on climate change; however number of laws related to natural resource management, environment pollution could contribute to this.

5. Conclusion

Nepal being least developed country with mountainous characteristics possesses some associated risks and vulnerabilities arising from climate change. To address these risk and vulnerabilities will holistic national policy with tailored strategies, plans and programs and their effective implementation.

Climate change pose major threat and has to be recognized as a major concern with respect to agriculture and food security, water resources and energy, natural resources productivity, forest and biodiversity, human health, infrastructure etc. These impacts raised by climate change on different areas/sectors demands effective measures such as adaptation, mitigation, effective policy and governance as well as integration of these measures at various level. Climate change adaptation policies and programs must identify and consider vulnerable groups. Integrating the impacts of future changes into vulnerability reduction remains a significant challenge at policy and strategic levels, as well as in communities and households. Adaptation measures should entails development of human capital, strengthening of institutional system, sound management of finances and natural resources. Addressing complexity of associated risks will require integration of suitable adaptation measures, approaches and practices.

Nepal has been proactively developing policies, plans, programs and strategies at national level. However this needs to be effectively translated to address ground realities associated with climate change. Nepal need to raise awareness among stakeholders and make their programmes more resilient to climate change impacts, at the same time as advocating for action by others on climate change and adaptation. Sustainable development strategies integrated with Green Economy require institutional arrangements to allow communities to benefit emerging opportunities and reduce the pressure on natural resources. Focused efforts to promote conservation and sustainable use of resources such as water, biodiversity, forests and grasslands etc.

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How new topics are addressed in secondary curriculum: sharing the experience of integrating disaster risk management in educational curriculum

Kedar Rijal
Madan Koirala

1. Background

Young minds, thinking for innovation or imagination of a comfortable life are being followed by a term “climate Change” these days. The meaning ranges from the layman’s view to Climate Scientist. However, it is one of the commonly used terms these days. Understandings of the term and be prepared for it is the demand of time, especially for those young minds.

Nepal, listed as one of the high Climate Vulnerable Country has attempted Mainstreaming climate change risk management in development through a Climate Investment Fund (CIF) funded project Pilot Program for Climate Resilience (PPCR). The Ministry of Environment, Science and Technology (MoEST) is executing “Mainstreaming climate change risk management” in Development Project' one of the component of PPCR, with financing from ADB.

Development and application of knowledge management tools for climate change is one of the three outputs expected by the implementation of the project. In order to achieve this output, seven specific activities have been identified as basic inputs into strengthening the knowledge services of key knowledge partners, namely the MoEST, major research universities, District Development Committees and their local development partners.

The main objective intended of this output is to strengthen the country’s system for generating, managing, and sharing knowledge as an input to make Nepal climate resilient. In achieving the above objective, updating educational curriculum on climate science and resilience is one of the activities to be implemented. This activity is a follow-up to the Report prepared by Consultants to MoEST on *Recommendations for Academic Curricula on Climate Change and Environmental Management*. The Report found that environmental sciences covered key points on environmental management, climate and weather, but climate change concepts needed to be strengthened.

2. PPCR and Component 3. Mainstreaming Climate Change Risk Management in Development

This component envisaged to facilitate mainstreaming climate change risk management into development planning by preparing climate risk management manuals, guidelines and standards for key infrastructure sectors, review major sectoral policies and curriculum in light of climate change and implement a comprehensive program of capacity building for climate change risk management at the national, sectoral, district and VDC levels, targeting students, public sector and civil society.

2.1 Activity 2.4 Review and update academic curriculum to incorporate climate change and environment issues

The Strengthening Capacity for Managing Climate Change and the Environment TA is reviewing the school curriculum (grades 8-10) for environment, health and population courses. Building on both international experiences and local needs, the graduate curriculum programs of all four universities will be reviewed under this TA and a new curriculum developed (for amendment and adoption by the universities as appropriate), particularly to incorporate climate risk, climate adaptation and resilience aspects in the tertiary level of technical education such as engineering and science streams. The TA will help develop curriculum at the tertiary level and encourage for at least a 3 credit elective courses on climate change.

3. Gaps analysis in the review report and present review

The strength of the review report is that it has two spears clearly pointed out for incorporation of the subject: general awareness and specialized knowledge.

3.1 Specialized knowledge deals with the University education.

3.1.1 Present status:

The Master level programs of the universities deal with different aspects of environment and its management. The programs focus on providing specialized knowledge and skills to enable graduates to solve problems within the discipline and manage the respective resources. Natural Science Master Courses emphasize concepts and principles of environment and pollution, human behavior toward environment and environmental management, and natural conservation. They also cover concepts of ecosystems, biodiversity, wildlife and protected areas along with their conservation as well as management. Environment Science Master Programs at these universities cover all the environmental issues such as global warming, deforestation and its effects, ozone depletion, acid rain, pollution and

pollution sources, consequences and control of pollution, along with Environment Impact Assessment tools and environmental management strategies. The courses also include climate change and its impact on nature, environment and society.

3.1.2 Topics suggested:

The topics for inclusion in Master level programs are: climate change impacts, climate change prediction models, forecasting, strategies for climate change mitigation and adaptations, national and international level policy directives and strategies for climate change adaptation and mitigation, climate change risk analysis, decision-making processes: economic, environmental, and social cost-benefit analysis and psychology decisions, perceptions and behavior.

3.1.3 Higher Secondary level (present status and topics suggested):

With respect to the Higher Secondary level (grades 11 and 12) courses, it was noted that there was considerable overlap in some topic areas, particularly concepts of environment, ecosystems and natural resources. Components of climate change as definition, concepts, causes and effects were found insufficient. Thus, a separate chapter within the Environmental Education should be added to address the issue of climate change in particular.

3.2 Secondary level curriculum deals with the general awareness:

3.2.1 Present status:

The secondary level curriculum introduces the concept of environment management right from grades 6 through 10 with brief introduction of the concepts of climate change. There is however room for integration of these concepts into the curriculum. At this level, these environment components are covered: fundamental concepts on environment education and, to some extent, sustainable development.

3.2.2 Present Status on grade 9 & 10 curriculum:

Health, Population and Environmental Education Text Book for grade 9 & 10 covers Concepts of Health, Population and Environmental Education, Determinants of Population Change, explains about the Natural Resources and its conservation, gives the basic understandings of ecosystems, Caring for the earth and Environmental Health and Population. Environmental Status of Nepal, Ecosystem by geographical region and its effects on environment, Management and Conservation of Environment, Biodiversity and its importance. Importance of Biodiversity, Population, Environment and

Development and Sustainable development, No specific topics on Climate Change seem to be incorporated in this subject.

The concepts of environment are little supplemented by practical, hands on activities and experiences. The need is there to integrate fundamental concepts of climate change and environment education in the curricula in a balanced way.

However, Environment Science (*Grade 10*) covers Ecology and ecosystem, Environment pollution, **Climate change and its impact**, Natural resources, Bio diversity, Environment management, and Environmental health.

The subject Social studies gives an overview of International relation, Peace and Co-operation and identifies Climate Change as one of the burning issue of the contemporary world. The text attempts the student to understand what climate change is. Understanding options are both way, through community perception and orienting the students to specific activity as well in order to understand climate change.

3.2.3 Topics suggested:

Global warming and climate change, concepts and awareness toward global warming and climate change, greenhouse gases, ozone layer depletion, causes, impacts and consequences of climate change, human activities responsible for climate change, climate change situation around the world, measures to mitigate the causes of climate change and environmental degradation, mitigating the effects of climate change and environmental degradation, preparedness to live in the environment affected by climate change and networking for services on management of environment and climate change.

4. Gaps in the gap analysis

4.1 University level

The review has made a broader attempt as mentioned in the objective covering 4 major universities offering Environment related courses. Curriculum of majority of the faculties and institutes seem to be well inspected. However, the degrees being offered under Institute of Science and Technology for BSc and MSc and curriculum seem to have received less attention.

The **Master program in Biodiversity and Natural Resource Management** run jointly by TU with the Norwegian University of Life Sciences and funded by the NOMA program of Norway has been

designed to focus on conservation and sustainable use of natural resources and biodiversity. The degree offered is named as Biodiversity and Environmental Management (BEM).

Table 3.2 Proposed curriculum format for climate change in Master's course focusing on Climate Change Impact and Adaptation that deals with major thematic areas in line with the NAPA document, GoN seem proportionate load in Water resource, Agriculture, Health, Infrastructure and Settlement, whereas **Biodiversity** completely lacks the content.

4.2 Secondary Education grade 9 and 10

Fundamental concepts on climate change are ignored in the curricula except an introductory topics in social study of class 9 and basic introduction in Science book of class 10..

4.3 Topics to be incorporated

Focus of environment education and climate change should be laid on awareness raising, building foundational knowledge, developing attitude, skills (basic) building and transfer, participation in school and family activities and small scale practical, hands on projects related to climate and environment.

The school level curriculum should be revised by the CDC by working toward the integration of basic view of climate change and environmental management with preliminary concepts to be integrated into the curriculum of upper primary grades with a gradual switch to moderate concepts to be integrated into the curriculum of higher grades of school education. A collective effort of Ministry of Environment as coordinating agency, with Universities, I/NGOs, experts and civil society members should be brought together into a forum to work jointly to address issues and challenges confronting the society and concerted efforts by them should be made, wherever possible, for the inclusion of messages and concerns into development agenda of common concern.

5. Experience of integrating disaster risk management in educational curriculum of M.Sc. Environmental Science

M.Sc. Environmental Science at Tribhuvan University is running since a decade back. An interdisciplinary subject covering the issues from natural science linkage to social and legal problems is contributing in producing human resource with background knowledge on ecology, geology, hydrology and meteorology, pollution, solid waste managements, environmental law and economics.

Specialization on areas such as Fresh water environment, Water resource development and planning, Wildlife Management and Mountain Environment were the options for the graduate students. Recently, Climate Change has been added.

Considering the vulnerable, hazard prone and risk ridden physical setting of the country, CDES attempted to provide an option of Disaster Risk Management as one of the special areas by 2012 academic session.

Topics suggested for incorporation are: Hazard, Risk and Vulnerability; Disasters in Nepal:

Water induced and geological disasters with spatial distribution of disasters in ecological zones; Disaster Risk Management and Practices; Urban Risk Management; Risk Engineering; Legislation on Disaster Risk Management.

Its output is yet to be assessed.

6. Conclusion.

Management of natural environment and climate change has emerged as a field of academic interest. It is from the learning of a number of studies with exposure to disastrous conditions and loss of livelihood of various communities especially from poor, marginalized and low-income population representing developed and developing countries, as well. Thus, in recent discourse climate change is being assessed from various perspectives such as academic, legal, scientific, policy, planning, and so on.

In recent years, knowledge management institutions especially secondary and higher secondary education boards and universities as well, have given priorities to offer environmental education programs, mostly as part of science or a management course. The focus is generally on ecosystem and natural resources, considering management of those. The linkage between climate change and sustainable development still needs explanations from various perspectives. Vulnerability status of Nepal in the country's list further emphasizes on incorporation of the climate change and environment linkages to be inserted in the curriculum of Secondary level.

The new curriculum should offer a critique of political as well as economic patterns that privilege certain countries over others and should provide conceptual and embodied understandings of climate change science to socio-economic as well as ecological impacts on various communities and

countries of the world. It should also shed light on the adverse impacts of the climate change and environmental degradation threatening to life and property of the human being and nature. It should also broaden the student's understanding of the impact of introducing changes into the environment that degrade the quality of human life-especially for those who occupy the economic and political margins of society. Both theoretical and practical aspects should be taken into consideration while preparing the curriculum (Review report, 2012).

A coherent linkage from primary to tertiary level in climate change and environment management contents will strengthen the understandings of the community to address the problem and make sound the natural environment. Topics on secondary level especially to grade 9 and 10 should be assigned accordingly.

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For Government of Nepal, Ministry of Environment, Science and Technology, June 2012

The process of updating/incorporating climate change curriculum into Secondary and Higher Secondary Education

Parbat Dhungana

Introduction

Despite there are many definitions on education, the process – educating - does not raise controversies. Imparting and acquiring of knowledge, skill, attitude and competency through teaching and learning especially at the school is the process behind most of the formal education. Growing environmental challenges like climate change and strategies to cope with them has further added the importance of (environmental) education. Climate Change (CC) will have wide-ranging effects on the environment, and on socio-economic and related sectors, including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity and coastal zones (UNFCCC, 2007). A study of Intergovernmental Panel on Climate Change (IPCC, 2008) on estimating the effect of climate change on water resource summarizes, “Observational records and climate projections provide abundant evidence that freshwater resources are vulnerable and have the potential to be strongly impacted by climate change, with wide-ranging consequences on human societies and ecosystems”. Secondary interlinks and effects are even vivid. This makes climate change science and coupled human-nature interfaces as one of the important ingredients that must be communicated legibly, so that we all behave in a sensitive way to safeguard our environment as well as be better prepared for the environmental challenges. At present, the stake to communicate this essence of environment has been given to Environment Education through school curriculum in Nepal.

A study (Dhungana, 2011) has revealed that that there are gaps from policy to practice; “penetration of Environment Education essence gets shallower at each step of its translation from policy to classroom practice”. Asian Development Bank (ADB, June, 2012) reports a significant gap exists in the curricula of Universities, Higher Secondary and Secondary education of Nepal in regard to climate change and environmental management education. In addition the report highlights the specific curricula (tertiary education) dealing with environmental concern still does not significantly incorporate the emerging environmental challenges. The study (ADB, 2012) recommend to focus on Environment Education and climate change to create awareness, building foundational knowledge, developing attitude, skills (basic) building and transfer, participation in school. One of the dilemma that exists (our context,

Nepal) in practice is many subject expert take the contents concerns especially the climate change and environmental literacy only as the teaching learning concern in curriculum. And in most of the cases the major concern of the subject Responsive Environmental Behavior (REB) is left out. The curriculum which does not focus on shaping skill and attitude is going to lead us no way out; an attempt to cope with the emerging environmental challenges will be left behind. In this context this paper focuses on the processes for updating/incorporating climate change curriculum into Secondary Education to our context.

Relevance to Our Context

Various study has substantiated the CC challenges are higher to the developing worlds. Researchers to our levels have also shown that the locals in the communities have been experiencing the effects of CC and at the same time coping with it on their own. Learning on own by ‘hit and trials’ in many stances stands counterproductive and the livelihood gets more challenged. The future is going to be panic as more alarming signal is yet to come. Well there are some I/NGOs and CBOs even helping people making them aware and educated on the challenges. That means some of the process of education is ongoing through other channels. Over the next decades, it is predicted that billions of people, particularly those in developing countries, face shortages of water and food and greater risks to health and life as a result of CC (IPCC, 2008). Including these discussion there are multiple reasons for higher vulnerability of CC impacts to Nepal. The country’s fragile geography, Himalaya fed climate and agriculture and dramatic changes on them due to CC will create a tough challenge for people whose livelihood is linked with agriculture and natural system.

Today’s children and future generations bear the greatest burden of climate change impacts. But while children are among the greatest victims of climate change, they are not only victims. In many well-documented cases it is seen that empowered and well-educated children can influence the adults in their lives, bringing about meaningful and sustainable change. To this end, it is critically important to consider a participatory and skills-based approach that will educate today’s children and young people to be proactive and prepared citizens, empowered to adapt and respond to rapidly changing environments. Their education should prompt young citizens to question and modify existing conditions and structures and move towards enhanced development objectives and disaster risk reduction and preparedness activities (UNICEF, 2008). This is where we see the rationale of brining CC and Environmental literacy, developing basic ecological skills and make citizen behave/practice in a way that is sustainable. These are the basic essence of Environment Education. The school education moreover is and should be contributing to the society. The study by ADB (2012) has already marked that our present curriculum

(grade 9 and 10) has not been able to incorporate the optimum concern on CC and Environmental Education (EE). This shows a need of revision in the existing curriculum to intuit optimum concern on CC and EE. So that the children in future become sensitized ecological citizen and can respond/bring a change to the environmental challenges including the climate change. This would stand a best way to safeguard our 'home' and have sustainable development.

Climate Change and Environmental Education

Not specifically only the CC and EE but environment itself is an important learning place as well as tool for children. Environment stands as a means to teach many other subjects. In this regard, EE is an old subject in practice and did not get attention as a discrete discipline. Still it has been a subject of learning from ancient times. During the process of development of a child, external tangible environment and spatial environment both are equally important. A child as a learner acquires different elements from the environment. Environment and Education are important component of life. There should be no confusions in this aspect that climate is a part within an environment, the discussion here is to specifically mark two concerns: Climate Change Science (literacy) as a part of Environmental Education should reach to every individual as it is going to be a serious challenge to the humankind; and as discussed in the context the human rationality and behavior change must be emphasized so as to dilute the challenge (on environment) over generations. This essential stake should go through Environmental Education. One of the major concern of the paper as how to incorporate the CC and EE concern to the learners will be discussed immediately after the discussion on a some basic philosophy which favor the intention and concern of Environmental Education.

Curriculum Aspects

With above discussion we become very clear that it is very important to see about the philosophical and psychological base while developing a curriculum. A curriculum basically consists of specified goals focused for developing competencies including specified learning outcome. What, to teach? Why to teach? are entirely the philosophical concerns while When and How to deliver are philosophical as well as psychological concerns (of learners) of a curriculum. It is very important to understand that curriculum is not the intended content transfer rather it concerns with transmission of multiple intuits including the behavioral modification and the later may not be directly reflected in the contents. It envisions for developing skills, behavior and competencies; the contents stands as one means,

delivering curriculum has a inter-link with the pedagogy (in the classroom), evaluations, teacher's competencies, and even the immediate school ambience/society. The meaningful learning and attaining curricular goals requires a rigorous exercise at all level. As study show we are quite young formulating more addressee curriculum. Koirala (2008) has mentioned objective, contents, teaching methods and evaluation collectively make up curriculum. He in his writing has mentioned the practice of such curriculum is young to Nepal and dates back to 1972 only. In regard to EE, we just (to recent) came to accept Environmental Education as an important entity; so we need to be very attentive while developing a right curriculum to the right people. At the same time, not all knowledge can be included in the curriculum; the curriculum is a selection of what is deemed to be worthwhile knowledge. The justification for that selection reveals the ideologies and power in decision making in society and through the curriculum (Cohen, Manion and Morrison, 2000). Curriculum is an ideological selection from a range of possible knowledge. This means defining curricular goal is one crucial step in the process of education standards and development. There are many philosophical ideologies saying about the nature of curriculum and ingredients of curriculum. I have picked some of the curricular ideologies here, which match with the concern of Environment Education.

Rational Humanism. A basic premise of humanism is that people are rational beings who possess within themselves the capacity for truth and goodness (MC, 2009). The historic rebirth of learning in the 15th century brought humanist ideology even in education. Contrary to early religious education, rational humanist believe that understanding and conversing about the meaning of literature was more important than memorizing it. Beside certain foreign subjects and some special (need) subjects, all students learn common and most practical subjects. Wilke (1993) highlights the ideology evoking, "Rather than reading textbooks on democracy, science, and math, one ought to read Jefferson, Newton, and Euclid" (p. 8). The process according to Alder (1982), teaches participants how to analyze their own minds as well as the thought of others, which is to say it engages students in disciplined conversation about ideas and values (p. 30). The ideology focuses to facilitate students to grow to their capacity allowing them sparingly to go for secondary textbooks.

Developmentalism. Though Piaget cannot be taken as curricularist, his descriptions incorporate many issues of curriculum. Duckworth (1987), major proponent of Developmentalism takes reference of Piaget to explain this ideology, "I also think more important question, as Piaget noted, is 'not how fast we can help intelligence grow, but how far we can help it grow'" (p. 38). Wilke (1993), with several examples explains developmentalism is focused on understanding the range of abilities children have at various ages, one can provide a curriculum that meets the needs and interest of students (p. 9). This ideology of curriculum emphasizes to pay attention to the way humans grow and learn. Developmentalism advocates

curricularist must take theories of human development on side while developing a curriculum. The curriculum planner should understand children's abilities and capabilities as such information enables curricularist and implementer to plan worthwhile activities for student. Educationist opines that most of the school curriculums of present world align to developmentalism. I find the developmental approach to curriculum practice in curriculum development in Nepal in true sense started in late 20 century, after the start of New Education Policy. But one must not forget even before the emergence of different curricular ideologies, the indigenous knowledge system and practices had been in practices reflecting different approaches (discovered later) of curriculum development.

Reconceptualism. Although John Dewey's work on 1934 shows an attention given to reconceptualism stating one learns through experience, the ideology became prominent after William Pinar's 'Curriculum Theorizing: The Reconceptualists' in 1962.

What is missing from schools ... is a deep respect for personal purpose, lived experience, the life of imagination, and those form of understanding that resist dissection and measurement. What is wrong with schools, among other things, is their industrialized format, their mechanistic attitudes towards students, their indifference to personal experience, and their emphasis on the instrumental and the out of reach (Pinar, 1975, p. 316).

Now days curricularist are deeply concern on finding way out to address what is lacking in school (as indentified by reconceptualists). But the challenges remain on how to understand, evaluate and guide the kinds of experience individual students are having? Reconceptualist rely on ideas, concepts, experiences, and theories from other areas like philosophy, psychoanalysis, researches, literatures, etc. Reconceptualists' two types of experiences, "an experience for having" and "an education for being" lies as the core when it comes to Environment Education. Reconceptualist concern is not to quantify the achievement rather are concerned to transmit the value and experiences that build him/her a mankind.

Critical Theory. It is believed that Critical Theory originated at the Institute for Social Research in Frankfurt, "the Frankfurt School" in 1920. Later scholars took the values of the Critical Theory lies in education too. Schools are not as conventionally though that every hard working fellow will go ahead. Apple (1979) points, "Just as our dominant economic institutions are structured so that those who inherit or already have economic capital do better, so too does cultural capital act in the same way" (p. 33). Critical Theory focuses on curriculum including classroom approach to overcome the constraints of students who in a same society have no voice of their own. Maximizing the advantage to the least

advantaged is a challenge across all fields, to overcome the constraints critical theorists are of the view that curricularist should take the pain of educating within formal and other settings.

Although we have some practices aligned to this ideology, these are not intentional and neither CDC has expertise in this area.

Multiculturalism. Though the roots are different multiculturalism shows affinity with Critical Theory. James A. Bank (1998) the advocate of the ideology says “ethnicity (which he elaborates as distinctiveness) must be dealt by educators” (p. 3). It does not accept the dominant mainstream education with other point of views added on it rather it suggest that one (relevant) perspective is right and others have their own view points. This indicates multiculturalism accepts wide contents as well as classrooms beyond structure. The immediate environment, context and need should reform the school and the system. Comparing the ideology’s application in Nepal’s context, the present opportunities with the school to develop local curriculum reflect that multiculturalism practices on action.

Cognitive Pluralism. In 1983 Gardner came with the views of multiple intelligences in his work ‘Frames of Mind’. This established multiple intelligence over ‘g factor’. Contrary to the early “g factor” Gardner purposed seven types of human intelligence. Gardener’s definition on intelligence also spells about the curriculum:

To my mind, a human intellectual competence must entail a set of skills of problem solving - enabling the individual to resolve genuine problems or difficulties that he or she encounters and, when appropriate, to create an effective product - and must also entail the potential for finding or creating problems - thereby laying the groundwork for the acquisition of new knowledge (Gardener, 1983, pp. 60-61).

Eisner (1992) proponent of cognitive pluralism claims that the idea of cognitive pluralism had started with Aristotle. “However the advancement of plurality of knowledge and intelligence in the field of curriculum last few decades” (p. 317). This means Cognitive Pluralists believes pupils possess plurality in intelligence and knowledge remains in many form of representations. Curriculum should be able to guide learning through variety of forms as well as express the learning in different forms. It would be a challenging task to guess the plurality incorporated in Nepalese curriculum; well it can be a subject for research in the area of curriculum.

Besides there are different arguments on what and how a standard curriculum should be, the perspectives are even changing. Schubert (2009) says curriculum should answer the following from different perspectives, “Articulate what you perceive as worth needing, knowing, experiencing, doing,

being, becoming, overcoming, contributing, and/or sharing in the field of curriculum studies. How might this be transmitted, communicated, interpreted, and / or understood and to whose benefit and/or detriment?” (p. 136). Consideration of developmental aspects (both in human and society) justify curriculum is a dynamic. Emergence of different ideology, addressing to needs and developments adds dynamism and demands change of the curriculum. These perspectives clearly indicate curriculum development is ongoing cyclic process. Regular update of curriculum must go on, the early the updates more addressee will be the curriculum. This practical aspect is not truly admired in Nepalese contexts.

What, When and How, Why

This is an important question especially when it comes to Nepalese context as textbook remains to a level of curriculum for most of the practicing teacher (Dhungana, 2011). Teachers hardly get into other concerns of curriculum rather concentrate delivering the contents (limited to textbooks) to the students. This means, we should be very cautious placing the contents in the curriculum, which should be able to incorporate maximum other concerns of curriculum beside literacy; i.e. the skill, behavior, and competency concern. What content (CC & EE) should be in the curriculum is defined by its goals; the basic education early school should emphasize for ‘Knowledge’ and basic ‘Skill’ and ‘Behavioral’ focus in a sequence. The weightage of the skill and behavioral focus should gradually get emphasized on the later classes of basic education. The secondary level should focus on developing competencies so as the pupil would have ecofriendly decisions and transmit its importance to their society and further. Defining content is not a tough task once the objectives have been set. A quick assessment of existing students’ literacy and competency including a careful review of ongoing practices (curriculum, textbook, societal concerns and expertise inputs) and need analysis will clearly define the contents for different levels for school. The general rule of learning and marked success has proceeded from general to specific learning. Sequencing and fragmentation of the concern across the grades is a usual practice during the curriculum development. The basic school education must transmit education which entails to make desired behavioral modification in response to CC and Responsible Environmental Behaviour (REB) - EE concerns. I evaluate; when carefully modeled one can adjust much higher level of information and concerns even at junior grades. A subject expert and curricularist team can fairly make a justice for what specific goals and contents can be catered at a level.

Although, Nepal still lacks specific Environmental Education objectives, the national educational objective gives an attention for Environment Education. The EE course designed for grade 11 and 12 speaks sensibly for the environment conservation. “Objective of national education system emphasizes

teaching of thoughtful protection and wise use of country's natural resources, helping the individuals leads a socially harmonious life in the modern world, and helping the modernization process of the country creating capable manpower for its development" (HSEB, 2008, p. 252). The environmental threats are increasing day by day. The deep concern for environment and to act wisely to protect the environment can be successfully induced through education starting from the very beginning. Teaching on these disciplines has been initiated at primary as well as secondary levels (ibid.). These references stand very important for 'how' to deliver Climate Change and Environment Education. The Curriculum Development Centre, Nepal/policy is not in the state to introduce environmental concern as discrete discipline, also it is not very feasible for a developing country like Nepal. The cost and administration overburden definitely will be other challenges. In this scene the best way to deliver CC and EE to school pupil can be through infusion of the CC and EE concern in the existing discipline. Technically saying CC and EE concern should be placed as interdisciplinary curriculum in schooling. The practices on other part of the world also show EE infused to other subjects. The objectives of the EE can be infused across various disciplines. The knowledge and skill focus should go under existing Science, Environment Science, Environment Health and Population, Social Studies. It is very essential to disaggregate the basic CC and EE concern as fundamental concern and make all educated on it (must components for all learners) ; placing them in the basic subjects that all pupil read. The expanded concept can be placed in optional subjects, for those who wish to have more specific interest; which is a regular fashion across all subjects. While emphasizing the CC and EE concern one must keep in mind that these are no more entirely technical subjects, rather an important aspect that all must learn. Importance of viewing the environment within the context of human influences should be the concern having expanded the emphasis of to focus more attention on social equity, economics, culture, and political structure. This clearly marks the need for interdisciplinary address to CC and EE. Well there are possibilities that the CC and EE concern can be infused across various discipline even in language learning: for example, a language exercise intention could be met by placing an environment story – 'How a farmer adopted the livelihood challenge by Climate Change'. Making an interdisciplinary curriculum is not free of challenges. There must be coherence across disciplines, no overlapping, and synergistic contents to curriculum goal.

Another important concern while incorporating the CC concern to curriculum in our context is the immediate stakeholder interest and strength. The curricularist and subject experts must come to a line on making a definition of curriculum. How to incorporate CC and EE concern should start with a pre study on the standing curriculum more appropriately studied by relevant expert (curricularists). This even include finding a cross disciplinary expert with content concerns as well as curriculum concerns. It is really difficult to cover the entire curriculum concerns through the contents (textbooks) entirely. That means the process does not complete official curriculum; the teachers are equally important component to

deliver the curriculum process. Teacher Training programs (pedagogical concerns) for EE Teachers to intuit CC and EE concerns and transfer accordingly must be emphasized in order to get the optimum output towards the curricular goal. Some of the well tested procedures for imparting CC and EE concerns are; low costs no cost materials; local materials; Classroom outside classroom; Infusing technology in CC and EE classroom; Infusing conventional and emerging pedagogical approach- hands on skills; etc, can be checked for relevancy to our context.

‘Why’ concern had been elaborately discussed above. To reinforce, the concern of CC more specifically EE is not to educate a person rather is to educate a global citizen who make eco-citizenary practice to safeguard humanity and have a sustainable future for humankind.

Conclusions

Despite EE and CC (a component of EE) is a prioritized policy concern of Nepal; the practices do not reflect them. The studies (ADB, 2012; Dhungana, 2011) show gaps in transferring the CC cum EE concerns. The gaps are largely attributable due to insufficiency in content, skill and behavioral and competencies focus. This demands the existing CC concerns in EE curriculum needs revision; the fundamental concepts should reach all learners as well as expand/address the curricular concerns in the existing curriculum. The field even demand to expand professional expertise among involved stakeholders (including CDC, Nepal) in curriculum design and to its translation (to textbook and practice/pedagogy) to intuit environmental concern to pupil. Teachers’ professional development comes as an important part to fairly transmit the CC and EE concern to the young learners. For immediate address to better cope with CC challenges and extending environmental challenges, the teachers can add CC and EE fundamental concerns within different discipline. A continuous process of professional development should go continuously to address emerging issues in school education. This concern should be an expanded strategy within the curriculum development and delivery institution (like CDC Nepal). Further, the present practice of evaluation system within many disciplines including the CC and EE has flaws and must be revisited while amending the curriculum. A strategic address to professionalism can enhance our capacity for CC and future emerging many issues.

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CHAPTER III: GROUP WORKS AND RECOMMENDATIONS

The workshop participants were divided into three groups (Group A,B and C) and assigned three relevant themes to discuss vigorously and come up with applicable recommendations/suggestions. Each group discussed vigorously on the given theme and presented group recommendations in the plenary session. The recommendations and suggestions presented by the groups are given hereunder:

GROUP A:

Group A Theme: Developing Appropriate Content on Climate Change (CC) in the Curricula of Secondary Level Education

Group Facilitator: Mr. Batu Krishna Uprety

Recommendations

Proposed Contents for Compulsory Science, Optional Science and Optional Environmental Science
(Grade 9 and 10)

S.N.	Area and units	Class: 9	Area and units	Class: 10
		Subjects		Subjects
1			To be included under Atmosphere	<ul style="list-style-type: none"> • Green House Gas: concepts, introduction, cause and effects • Methods/Practices to reduce GHG emission • Global Warming: concepts, cause, effects and mitigation methods • Acid rain: concepts, cause, effects and mitigation methods
2	Weather and Climate	Weather: Introduction and Definition <ul style="list-style-type: none"> • Climate: Introduction and Definition Difference between Weather and Climate • Causes and elements of weather change • The basic causes and elements of climate change 	(Climate Change)	<ul style="list-style-type: none"> • Introduction • The causes and elements of climate change (natural and Man-made) • Effects and impacts of climate change in: Agriculture, Forestry, Water Resources, Public Health, Infrastructures, Disaster, and Ecosystem. • National and International initiatives on climate change issue (Policies and Programs) • The role of industrialized nations on climate change agenda

Content to be added in optional Environment Science

S.N.	Area and units	Class: 9	Area and units	Class: 10
4	Climate Change	Subjects	Climate Change	Subjects
		<u>Topics to be added only</u> <ul style="list-style-type: none"> • Concept of climate change in depth • Climate change effects and impacts (with examples from national and global context) 		<ul style="list-style-type: none"> • International initiatives on climate change (International/UN convention on climate change, Kyoto Protocol, Resolutions and declarations) • National initiatives on Climate Change (policies and programs) • Climate change impacts mitigation measures (climate change adoption, impact reduction, GHG emission reduction, technology development and capacity building)

To be included in Optional Science Course

S.N.	Area and units	Class: 9	Area and units	Class: 10
		Subjects		Subjects
1	Climate Change	<ul style="list-style-type: none"> Chemical factors of climate change, Methods for reducing climate change effects and impacts 	Climate Change	<ul style="list-style-type: none"> Climate change adoption practices Use of scientific technologies and methods for reducing GHG emission (e.g. clean energy) Scientific methods for climate change impact mitigation The concepts of carbon trade and its feasibility Types of disaster and their management practices

GROUP B:

Group B Theme: The process of updating /incorporating CC Curriculum in the Secondary Education/text book

Group Facilitator: Mr. Dambar Dhong Angdembe

Recommendations

A. Long term process

- Overview of general objectives of secondary science curriculum in the perspective of environmental climatic change.

- Include the content regarding the environmental climatic change message in different compulsory subjects .
- Incorporate the fundamental concepts of environmental climatic change in compulsory subject like science , HPE and Social study
- Include the expanded concepts in Optional science and Environmental science curriculum.
- Focus on hands-on skills and practice
- Develop monitoring and evaluation tools and mechanism for attitude and behavioral change
- Design and develop teacher training module

Analysis of existing course contents of compulsory science, HPE and other subject .

- Plugging points in the existing curriculum
- Overlapping of contents
- Sequential order of content
- Level hierarchy

B. Short term process

- Development of Teachers resource material
- Development of Student resource material.

Incorporate the CC session/ module in existing teachers' training programme

GROUP C:

Group C Theme: Monitoring, Evaluation and Backstopping Implementation of CC Curriculum in Secondary Education

Recommendations

Objectives of Monitoring, Evaluation and Backstopping

- Preparation of monitoring, evaluation and backstopping strategy of CC curriculum, textbook and implementation process
- Professional supervision of CC curriculum and textbook other related material usage for technical backstopping
- Developing human resource for implementation of M, E and B at different levels-school, district, central (CDC, NCED)
- Periodic follow up of the utilization of the findings of M and E from different levels (concerned units/dept of MoE and MoEST)

Existing Monitoring Mechanism

- MOE
- DOE
- RED
- NCED/ETC
- CDC
- DEO
- RC
- SCHOOL/SMC/PTA

What to monitor/professional supervision

- Curricular objectives based on scope and sequence
- Textbooks-lessons/Contents based on scope and sequence
- Proper integration of CC contents in curriculum and textbooks

- Teaching and learning process/strategy
- Educational materials (availability and usage)
- Participation of teachers, students and stakeholders (e.g.. SMC/PTA/general parents)
- Learning activities-project work, field study/tour/games
- Competitive activities

How to monitor

- Observation
- Progress review
- Interaction
- Informal procedures

Responsible Personnel

- Headteacher
- SMC/PTA
- RP
- Supervisor/Instructor
- DEO/DCCC
- RED/RCCC
- NCED/ETC
- CDC
- DOE
- MOE/MoEST

Evaluation

- Effectiveness of Curriculum Evaluation (Objective, Content, appropriateness, context etc)
- Effectiveness of textbooks (contents, length of lesson, exercise, language, coverage, illustration, social sensitivity etc)
- Effectiveness of supplementary materials
- (source books, charts, poster etc)

- Application and/practice of knowledge, skill, attitude of CC at school, community levels by students, teachers and other stakeholders
- Effectiveness of teaching and learning strategy (classroom pedagogy)
 - Adequacy of techniques/methods used (student-centred. Participatory, consideration of psychological aspects etc)
 - Use of teaching materials
 - Participation of Students in learning process
- Curriculum content evaluation
 - by CDC-experts, monitors
 - feedbacks collected from different stakeholders

Assessment of Learning Outcomes

Based on the curriculum and textbooks the following aspects of learning outcomes will be measured:

- Awareness on CC
- Knowledge of CC
- Skill of CC
- Attitude (norms, values) of CC
- Change of behaviours

Measurement Tools of Learning Outcomes

- Continuous assessment (unit test, monthly test....)
- Test (Knowledge, skills, attitude-values)
- Practical activities-project work, field visit etc.

Backstopping/Professional Support

- Feedback to head teacher, teachers, students through sharing reports based on findings of monitoring and evaluation

- Feedback to Resource Persons, supervisors, DEO and members of DCCC through sharing reports
- Feedback to RCCC, RED through sharing reports
- Feedback to CDC

Monitoring of utilization of Findings

- School level personnel
- District level personnel DEO
- Concerned officials of CDC/MoE
- Concerned officials of MoEST

Preparatory Work

- Design and develop monitoring, evaluation and assessment strategy
- Design and conduct at least 3-day workshop on preparing monitoring, evaluation and assessment strategy and tools
- Prepare human resource for implementation of curriculum and textbooks of CC

CHAPTER IV: GLIMPSES OF WORKSHOP IN VISUAL IMAGES

Visual Glimpses of the Workshop









CHAPTER V: CONCLUSION

The workshop was organized as part of the process for integrating climate change concepts and potential adoption practices into the science curriculum for secondary level education. In order to achieve the expected output, most experience resource persons were requested to give presentation on the topic. Six papers on the given topics were presented in the workshop followed by open discussion session to receive participant's feedback and comments. The participants of the workshop were divided into three group to discuss on three important aspects of the curriculum: 1. Content development, 2. Content integration process and 3. Development of criteria for curriculum monitoring and evaluation.

The groups discussed in depth on the given issues and come up with the relevant recommendations and suggestions towards upgrading the curriculum in science for secondary level education in Nepal. The groups presented their final recommendations in the plenary session and their recommendations and suggestions are included in Chapter III in this report.

Group A reviewed the existing CC content in secondary level courses rigorously and come up with valuable recommendations. Group A recommended the CC contents to be included in general science, optional environment science and optional science courses for grade 9 and 10 separately.

Group B put forth its recommendations on curriculum revision process in two parts: a. long term process and b. short term process.

- a. Long term process included the overview of objectives of compulsory and optional science curriculum with environment and climate change perspective.
- b. The short term recommendations are more focused on the development of resource materials for teachers and students.

Group C presented its findings on monitoring, evaluation and implementation backstopping of CC curriculum for secondary level education. The group extensively reviewed the existing monitoring and evaluation mechanism and recommended the M & E methods and criteria to be used in the future.

It is believed that the workshop has been useful as a basis in upgrading the science curriculum with appropriate contents and adoption practices related to climate change issues. The workshop proceeding and its recommendations can also be taken as guideline for updating climate change content for higher secondary and university levels curriculum Nepal.

ANNEXES

Annex I: List of Resource Persons

S.N.	Name	Presentation Topic	Areas of expertise	Organization	Address
1	Mr. Batu Krishna Uprety	Review of the Findings of Academic Curricula on Climate Change and Environmental Management (TA 7173) with respect to Updating Curriculum of Climate Science in Secondary level Education.	Environment/Climate Change Specialist	Independent	Tel: 479359/483787 E-mail: upretybk@wlink.com.np
2	Dr. B.K. Ranjit, Deputy Director	Existing Climate Change (CC) Contents in the Science Curricula of Secondary (9 and 10 Grade) Level Education	Curriculum Development Specialist	CDC	Cell: 9741013198 Email: sabalranjit@hotmail.com
3	Parbat Dhungana Professor	The process of updating /incorporating CC Curriculum in the Secondary level education	Climate Change / Environment Teacher Training	F. of Education, KU	Cell: 9841440646 Email: parbat@kusoed.edu.np
4	Anu Adhikari Rakshaya Shaya CC Program Officers - CC	Climate Change Impacts and Adaptation in Nepal and its Importance Educational Curriculum	Climate Change Education/ Communication	IUCN	Tel: 5528781 Email: anu.adhikari@iucn.org
5	Kedar Rijal Madan Koirala	How new topics are addressed in secondary curriculum: sharing the experience of integrating disaster risk management in educational curriculum	Climate Change & Environment	F. of Environmental Sciences, TU	Tel: 4332147 KR 9841372943 MK 4108681 (R), M: 9841259938 E: krijal@cdes.edu.np; madankoirala@gmail.com
6	Amita Thapa Magar CCNN Program Officer	Experience sharing on climate change teaching material development	Climate Change Education/ Communication Specialist	Clean Energy Network	Cell: 9841926860 Email: amita@cen.org.np

Annex II: List of Participants

Name of participant form CDC

S.N.	Name	Position	Address (Phone and email)
1	Khagraj Baral	Executive Director	T: 6630797 E: krb202@yahoo.com
2	Dr. Balkrishna Ranjit	Deputy Director	T: 6635046 E: balranjit@gmail.com
3	Dambar Dhoj Angdembe	Curriculum Officer	T: 6634119 E: dambarangdembe@yahoo.com.np
4	Ram Prasad Subedi	Curriculum officer	
5	Hem Raj Khatiwada	Curriculum officer	
6	Samanta Mani Acharya	curriculum officer	
7	Dilman Maharjan	Teacher	9851066525
8	Sangita Mali	Lecturer	9841260297
9	Ramesh Shrestha	Teacher	9841286062
10	Indira Thapa	Trainer	984900209
11	Gyanendra Ban	Technical officer	9841429061
12	Gaurishanker Pandey	Trainer	9841379369
13	Uddhav Karki	Program Director	9851029271
14	Rajendra Kayastha	Teacher	9841285544
15	B.K Jha	Teacher	9851037627
16	Gopichandra Paudel	Teacher	9841378347
17	Vijay Kanta Mishra	Teacher	
18	Dr. Chidananda Pandit	Professor	9841389667
19	Parbati Bhattarai	Teacher	9846079265
20	Umesh Lamsal	Lecturer	9851057599
21	Uttera Shrestha	Teacher	
22	DR. Hridayaratna Bajracharya	Professor	
23	Dr. Anjan Singh	Professor	
24	Pritesh sapkota	Teacher	9841819640
25	Rajendra Pokhrel	Teacher	9841291510
26	Navin Poudel	Teacher	
27	Devendra Karna	Teacher	
28	Nanu Dawadi	Teacher	9841221601
29	Rita Tiwari	Teacher	9841460320
30	Tilak Sashanka	Science Teacher	9841658777
31	Narayan Maharjan	Science Teacher	9841327103
32	Indra Prasad Rijal	Lecturer, TU	9841413322
33	Khil Kumar Pradhan	Science Teacher	9841379730
34	Jagadishor Shrestha	Science Teacher	9841394857

Participants from MoEST

S.N.	Name	Position	Address (Phone and email)
1	Secretary	Secretary, MoEST	
2	Meena Khanal	Joint Secretary and NPD	
3	Prakash Mathema	Joint Secretary, Chief of CCMD	
4	Arjun Thapa	NPM and Under Secretary, CC Section, CCMD	
5	Akhanda Sharma	NPM, Under Secretary, CCMD	
6	Lava Bahadur K.C.	Under Secretary CCCS Section, CCMD	
7	Vinod Gautam	Section Officer, CC Section, CCMD	
8	Sujan Subedi	Section Officer, CC Section, CCMD	
9	Bishnu Gyawali	Account Officer, Account Section	
10	Tulsi Prasad Chaulagain	Section Officer, CC Section	
11	Naresh Sharma	Agro Economist, CDM Section	
12	Priti Anand	Office Assistant, Account Section, MoEST	
Participants from Ministry of Education			
1	Secretary	Secretary, MoE	
2	Tulashi Thapaliya	Under Secretary, Focal Person for TA 7984	
3	Yam Bahadur K.C.	Under Secretary, Counterpart for TA 7984	
Participant from ADB, Nepal			
1	Dr. Surya Singh	Climate Change Management Specialist, Staff Consultant	
TA 7984			
1	Mohan Wagley	Team Leader	
2	Upendra Phuyal	Development Communication and Capacity Development Specialist	
3	Lochan Devkota	Public relation/Knowledge Management Specialist	
4	Tripti Pradhan	Administrative Assistant	

Annex III: Workshop Schedule

Government of Nepal

Ministry of Environment, Science and Technology (MoEST)

Nepal: Mainstreaming Climate Change Risk Management in Development (Nepal:MCCRMD)

Workshop on "Integrating Climate Change Concepts into the Curriculum in Science for Secondary Level Education, Nepal"

Date: 8 to 9 November 2012

Time: 08:30– 17:00

Venue: Hotel Himalaya, Kuponjol

Day one: 8 November 2012

Master of ceremony: Mr. Vinod Gautam

Time	Programme	Guests/Speaker/Paper Presenter
	<u>Opening Session</u>	
08:30- 09:00	Registration of participants and Breakfast	All
09:00 -09:05	Chairing the Session	Chair by Secretary of MoEST; Chief Guest: Secretary of MoE
09:05-09:20	Introduction of participants and guests	All
09:20– 09:50	Welcome, workshop objective and highlights of the project (MCCRMD)	NPD/NPM
09:50-10:00	Few words from the Chief guest	Chief Guest (Secretary, MoE)
10: 00 – 10:10	Remarks from Chairperson	Chair Person (Secretary MoEST)
10:10 -10:40	Tea Break	
	<u>Technical Session</u>	
10:40 - 11:10	Climate Change Impacts and Adaptation in Nepal and its importance in Educational Curricula	Ms. Anu Adhikari, and Ms. Rakshaya Shah, IUCN
11:10 - 11:40	Review of the Findings of Academic Curricula on Climate Change and Environmental Management (TA 7173) with respect to Updating Curriculum of Climate Science in Secondary Level Education.	Mr. Batu Krishna Uprety
11:40- 12:10	Overview of Existing Climate Change (CC) Content in the Science Curricula of Secondary Level Education	Dr. B.K. Ranjit, CDC
12:10 - 12:40	How new topics are addressed in secondary curriculum: sharing the experience of integrating disaster risk management in educational curriculum	Dr. Kedr Rijal, Dr. Madan Koirala, F. of Env. Sc. TU
12:40 - 13:10	The process of updating /incorporating CC Curriculum in the Secondary and Higher Secondary Education	Mr. Parbat Dhungana, KU, School of Education

13:10 - 14:00	Lunch Break	
14:00 - 14:20	Experience sharing on climate change teaching material development	Amita Thapa Magar CCNN Program Officer
14:20 - 15:00	Floor discussion	All participants
15:00 - 17:00	Participants will be divided into three group and group works proceed. <u>Tea break at 15:00 hrs</u> GroupA: Developing Appropriate Content on Climate Change (CC) in the Curricula of Secondary Level Education GroupB: The process of updating /incorporating CC Curriculum in the Secondary Education/text book Group C: Monitoring, Evaluation and Backstopping Implementation of CC Curriculum in Secondary Education	<u>Facilitators</u> Group A: Mr. Batu Krishna Uprety Group B: Mr. Dambar Angdembe Group C: Mr. Ram Prasad Subedi

Day Two: 9 November 2012

08:30- 09:00	Registration of participants, Breakfast	All
	Charing the Session	Session Chaired by: Dr. B.K. Ranjit
09:00 - 11:00	Finalizing Group Work and Preparing Presentation	Group Members
11:00 11:15	Tea Break	
11:15 - 11:45	Presentation by Group A.	Presenter to be decided by the Group A
11:45 - 12:15	Presentation by Group B.	Presenter to be decided by the Group B
12:15 - 12:45	Presentation by Group C	Presenter to be decided by the Group C
12:45 - 13:45	Lunch Break	
13:45 - 14:30	Discussion on Presentations by Group A, B and C	
14:30 - 15:10	Few Words by Guests	
15:10 - 15:25	Vote of Thanks, MoEST	Mr. Akhanda Sharma, CDE/ NPM
15:25 - 16: 00	Remarks from the Chairperson and closing	Chairperson
16:00	Tea, coffee, cookies and Day Off	

Annex IV: Press Note in Nepali and English

PRESS NOTE IN NEPALI

वातावरण, विज्ञान तथा प्रविधि मन्त्रालय र शिक्षा मन्त्रालय, पाठ्यक्रम विकास केन्द्रको संयुक्त तत्वावधनमा नेपालमा माध्यमिक तह (कक्षा ९-१०) को विज्ञान विषयको पाठ्यक्रममा जलवायु परिवर्तन विषयवस्तु शिर्षक समावेश गर्ने बारे २ दिने कार्याशाला गोष्ठी (मिति : २०६९/०७/२३ - २४) को आयोजना

वातावरण, विज्ञान तथा प्रविधि मन्त्रालयका सचिव श्री केशव प्रसाद भट्टराईले नेपालको भावी पिडिलाई जलवायु परिवर्तन र त्यसबाट पर्ने नकरात्मक असरहरुबाट बच्न उपयुक्त अनुकूलनका उपायहरु अपनाउन माध्यमिक शिक्षाको पाठ्यक्रम तथा पाठ्य पुस्तकमा जलवायु परिवर्तन विषयवस्तु समावेश गर्नु पर्ने अत्यन्त आवश्यक भएको कुरा व्यक्त गर्नु भयो । हाम्रो सिमित श्रोत साधनलाई मध्यनजर राख्दै प्राथमिकताका आधारमा यस्ता नयां विषयवस्तु समावेश गर्नु पर्ने विचार व्यक्त गर्नु भयो । यसै गरी जलवायु परिवर्तनको संवेदनशिल पक्ष, यसबाट भविष्यमा पर्न जाने नकरात्मक पक्ष, अनुकूलन र समानुकूलनका विषयहरुलाई हाम्रा भावि पुस्ता (Future Generation) मा सप्रेक्षण एवं सुसूचित गर्न अति आवश्यक भएको हामीले महशुस गरेका छौ । यी विषयलाई ध्यानमा राखी वातावरण, विज्ञान तथा प्रविधि मन्त्रालय र शिक्षा मन्त्रालय अन्तर्गत पाठ्यक्रम विकास केन्द्रको संयुक्त प्रयासमा माध्यमिक तह (कक्षा ९-१०) को विज्ञान पाठ्यक्रममा जलवायु परिवर्तनका विषयहरु समावेश गर्न खोजेको छौ । यस २ दिने कार्याशाला गोष्ठीमा जलवायु परिवर्तन विज्ञ, पाठ्यक्रम विशेषज्ञ, प्राध्यापक, शिक्षक, पाठ्यपुस्तक लेखक तथा सम्बन्धित विशेषज्ञहरु र सहभागी सम्पूर्ण साथीहरुले जलवायु परिवर्तनका विविध पक्षलाई कसरी पाठ्यक्रममा समावेश गर्दा र कुन प्रकृया अवलम्बन गरी अघि बढेमा विद्यार्थीहरुले यस बारे राम्रो ज्ञान तथा सिप हासिल गर्न सक्ने छन् भन्ने तर्फ विशेष ध्यान दिई आ-आफ्नो तहबाट योगदान दिनु पर्ने कुरामा जोड दिनु भयो ।

त्यसै गरी शिक्षा मन्त्रालयका सचिव श्री सुरेश मान श्रेष्ठले जलवायु परिवर्तन जस्ता विश्वव्यापी चासोको विषय वस्तुहरु हाम्रो देशको सन्दर्भमा अझ बढी सम्वेदनशिल भएका छन् । त्यसैले यस्ता विषयवस्तुको जानकारीको कमीले पर्ने असरहरुबाट सुरक्षित रहन नेपाली समाजलाई तयार राख्न पर्ने धारण व्यक्त गर्नु भयो । साथै उहांले पाठ्यक्रममा स्वास्थ्य, श्रम, नैतिक आचरण लगायतका विषयवस्तुहरु पनि पाठ्यक्रममा राख्नु पर्ने धारणहरु समेत व्यक्त गर्नु भयो ।

पाठ्यक्रम विकास केन्द्रका कार्यकारी निर्देशक श्री खगराज बरालले जलवायु परिवर्तन जस्ता नयां विषय पाठ्यक्रममा समावेश गरी विद्यार्थीहरु मार्फत जलवायु परिवर्तनको असर सम्बन्धी जानकारी घर-घरमा पुर्‍याउन माध्यमिक तहको पाठ्यक्रममा राख्न महशुस भएको विचार व्यक्त गर्नु भयो । साथै जलवायु परिवर्तन सम्बन्धी विषयवस्तु पाठ्यक्रम तथा पाठ्यपुस्तकमा समावेश गर्नु यो गोष्ठी अत्यन्त बलियो आधार हुने विश्वास व्यक्त गर्नु भयो ।

उक्त गोष्ठी वातावरण, विज्ञान तथा प्रविधि मन्त्रालय अन्तर्गत एशियाली विकास बैंकको आर्थिक तथा प्राविधिक सहयोगमा सञ्चालित 'विकास आयोजनामा जलवायु परिवर्तन जोखिम व्यवस्थापनको मूलप्रवाहीकरण' (Mainstreaming Climate Change Risk Management in Development Project) आयोजनाको कार्यान्वयन गर्ने क्रममा आयोजना गरिएको हो । हाल मन्त्रालयले उक्त आयोजना कार्यान्वयन गरिरहेको छ । गोष्ठीमा वातावरण, विज्ञान तथा प्रविधि मन्त्रालय, शिक्षा मन्त्रालय, पाठ्यक्रम विकास केन्द्र, त्रिभुवन विश्वविद्यालय, काठमाण्डौ विश्वविद्यालय, विभिन्न सरकारी तथा निजी विद्यालयका शिक्षक र अन्य सम्बन्धित संघ-संस्थाका गरी जम्मा ४५ जनाको सहभागिता रहेको छ । उक्त गोष्ठीबाट प्राप्त सुझाव तथा सिफारीसहरु नेपालमा माध्यमिक तहको विज्ञान विषयमा जलवायु परिवर्तन सम्बन्धि विषयवस्तु समावेश गर्नका साथै पाठ्यपुस्तक अध्यावधिक गर्न एउटा उपयुक्त आधारका रूपमा प्रयोग गरिने छ ।

PRESS NOTE IN ENGLISH

Nepal's secondary students to learn more about climate change

Kathmandu, November 8, 2012 - The Ministry of Environment, Science and Technology (MOEST) and the Ministry of Education's Curriculum Development Centre (CDC) have launched a new initiative to educate secondary students about climate change. The two day workshop "*Integrating Climate Change Concepts into Secondary Level Science Curriculum*", (November 8 – 9, Himalaya Hotel, Kathmandu) brought together climate change experts, curriculum specialists, textbook writers and teachers to examine how to improve the teaching of climate science and climate change topics in secondary school science courses. "Climate change is a critical issue for Nepal's development. We need to start educating students on the facts about climate change and prepare them to deal with its impacts on society in the future," explained Mr. Keshav Bhattarai, Secretary, MoEST. "Climate Change adoption is an important issue that need to be addressed in time and incorporation of climate change concepts and adoptions practices into the educational curricula is one of the crucial area to start with" expressed Mr. Suresh Man Shrestha, Secretary, Ministry of Education

The workshop was organized under the 'Mainstreaming Climate Change Risk Management in Development Project' that MoEST is implementing with financial and technical support from the Asian Development Bank. Through this project, which is part of Nepal's Pilot Program for Climate Resilience, MoEST is working with a number of government departments to ensure that the challenges posed by climate change are addressed through multiple efforts across key development sectors, including education.

During the workshop, resource persons made presentations on climate science, climate change impacts on Nepal, strategies for climate change adaptation, synthesizing climate change content for secondary level education, best practices for introducing new topics into secondary school curriculum and priorities for continually updating climate change information in the future. Participants then held group working sessions to start the process of incorporating new learning about climate change into the curriculum materials.

45 participants from the Ministry of Environment Science and Technology, the Ministry of Education, the Curriculum Development Centre, Kathmandu University, Tribhuvan University, and other concerned institutions attended the workshop.

The recommendations from the workshop will be used to update science curriculum and textbooks for secondary level education that are to be distributed in schools next year.

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