NGO Group Bulletin on Climate Change Research and Development

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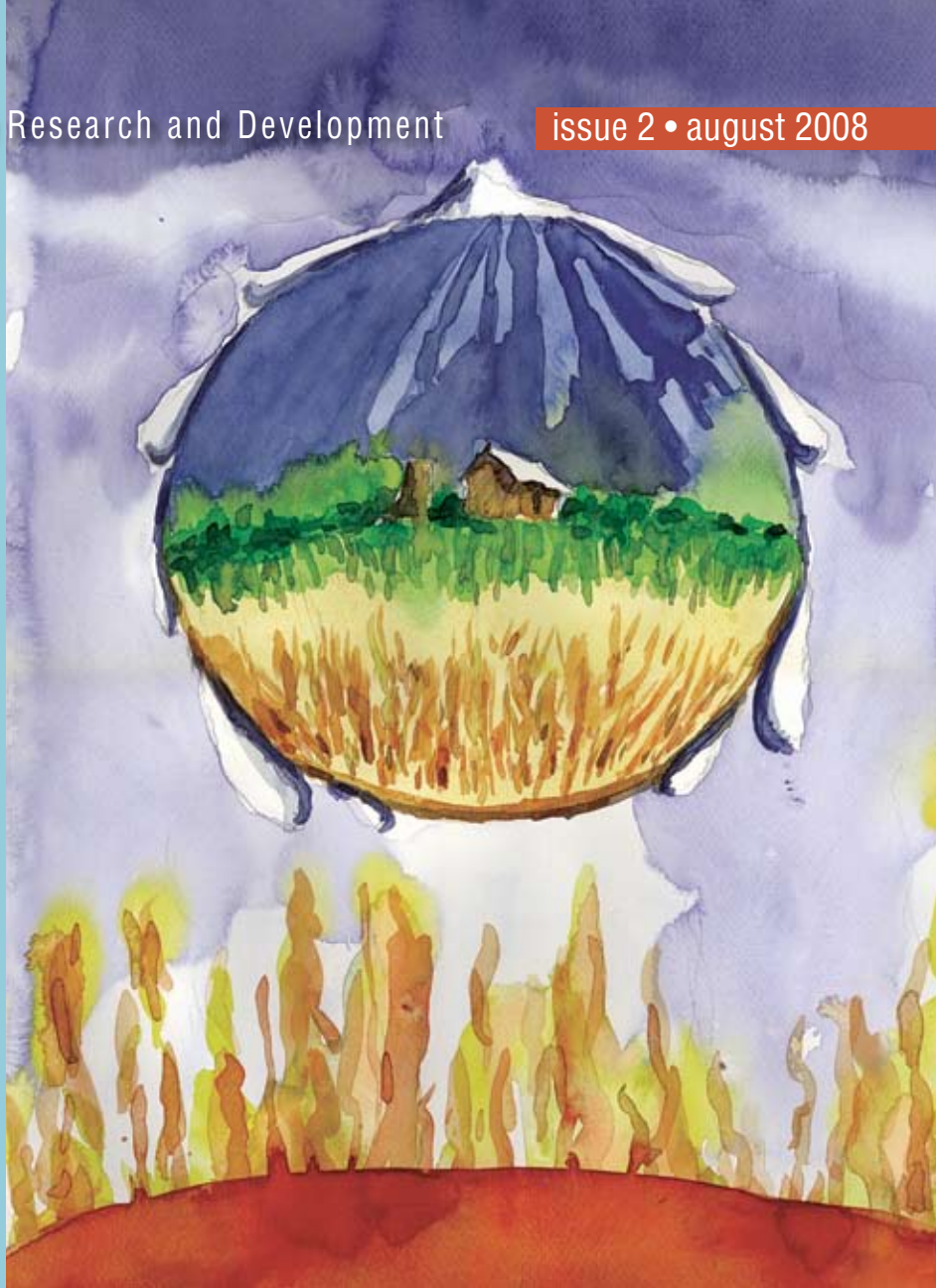
More Action and More Commitment on Adaptation

Melting Glaciers



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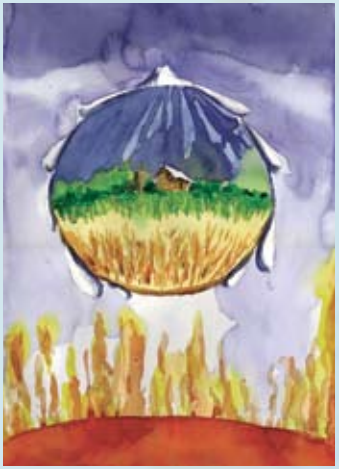

Cover Illustration by
Ms Ashika Sharma
Kumudini Homes, Pokhara

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Editorial Team Bimal Raj Regmi • Gopal Raj Joshi • Lalita Thapa • Sandhya Karki • Shashish Maharjan
Design and Printproduction **wps**, email: wwpsdm@wink.com.np

Editorial

Rapidly melting glaciers and shrinking ice-cover throughout the globe clearly hints that the Earth is getting warmer day by day. Glaciers form nearly 70 percent of the world's freshwater reservoir. Glaciers and ice-cover are the first system to respond quickly to global warming as rising temperature causes glaciers and ice-caps to melt faster. It is estimated that a rise of 4 degree Celsius could result in the disappearance of every glacier on the planet.

In this context, Nepal is no exception: it is a vulnerable country because of its unique and fragile mountain ecosystem. The average temperature in Nepal is rising at a rate of 0.06°C/year despite its negligible share in global greenhouse gas emission. There are over 3,000 glaciers and 2,000 glacial lakes in our country. Rapid melting of glaciers also results in the formation of glacial lakes at high altitudes. There are 20 potential glacial lakes which are on the verge of bursting. Nepal's Himalayan region is considered as Asia's "water tower". Thousands of rivers originate from the Himalayas and quench the thirst of billions of people in this region, while also catering to irrigation, hydropower generation, and other recreational services. But scientific facts show that the Himalayan region is warming faster than any other region in the country. The rapidly increasing temperature in Nepal is a major threat to sensitive sectors like agriculture, biodiversity, water and health. The impacts on these sectors will have major implications on the livelihoods of millions of resource dependent poor and marginalized communities of Nepal.

Developed countries, who are historically the polluters, are responsible for the present problem.

The rapidly increasing temperature in Nepal is a major threat to sensitive sectors like agriculture, biodiversity, water and health.

Despite the fact that our contribution to global warming is insignificant, we are at the forefront to bear the consequences of climate change. It is the responsibility of developed countries to take moral responsibility and to show concern over issues of the least developed countries who are more vulnerable to climate change impacts. The technologically rich developed countries should take a lead role on finding solutions, as well as providing technical and financial support to counter the global crisis. There is a need for more commitment on emission reduction and international cooperation post 2012. The responsibility also lies on developing countries to join hands with developed countries to initiate actions to rescue the planet in peril.

Although Nepal has taken few initiatives in response to climate change, there is more need is to be accomplished in the days to come. Nepal needs to focus on adaptation work to reduce the vulnerability of poor people who are already highly susceptible due to their poverty. Lack of scientific information on various aspects of climate change pertinent to Nepal is a major issue that demands immediate actions. Besides, people are still not aware about causes and impacts of climate change.

Pertinent issues of Nepal related to climate change are not receiving proper attention and priority at both national and international forum.

In this regard, NGOs group on Climate Change has decided to publish a yearly NGO group bulletin on climate change; the first issue was published in 2007 entitled "Up in Smoke–Nepal". The bulletin basically aims to share information and knowledge on climate change and to raise public awareness, as well. We are pleased to present you the second issue of the bulletin. From now onwards, the bulletin will be published with a new title: "Melting Glaciers." We are of the opinion that this title will contribute to raise national and international concern on our fragile mountain ecosystem and vulnerable communities.

Wish you Happy Reading!

Answering Basic Questions on Climate Change in Nepal

Ngamindra Dahal

Energy and Climate Change Coordinator, National Trust for Nature Conservation (ngamindra@gmail.com)

The usual winter rains of Nepal have vanished and dry winter has been the main feature since last 12 years. When talking with farmers in the outskirts of Kathmandu, most of them mention changes like early flowering and ripening of their crops and fruits by an average of two weeks. Extension of southerly winter fogs to Himalayan foothills and stronger presence of haze over Nepal's mountain region are also recent phenomena. These are few examples of people experiencing climate change in recent years. Though such experiences are subject to validation through scientific studies, nevertheless, they reflect climatic changes and impacts.

Climate change is the biggest environmental challenge in human history to achieve and sustain prosperity. Growing scientific evidences including the highly acclaimed fourth climate change assessment report by IPCC (Intergovernmental Panel on Climate Change) has reconfirmed that the Earth's atmosphere has already been saturated with greenhouse gases and additional emissions would lead to a global scale disaster. Several basic indicators in our surroundings such as steady rise in temperatures, increasing concentration of greenhouse gases in the atmosphere, and growing weather or climatic uncertainties evidently show that collective impacts of these changes would not be favourable at all to nature and humanity. Given the gravity of impacts of climate change on lives and livelihood sources of an economically poor and climatically sensitive country like Nepal are immense, the issue is yet to be mainstreamed into contemporary dialogues of national priority.

Barring a few isolated cases, Nepal's status on climate change and its impacts has remained largely unknown. In this context, climate change status is discussed relative to a few basic questions.

What does climate change mean to Nepal?

Nepal's physical characteristics, geographic position, topography and weak socio-economic vis-à-vis political conditions make it one of the highly vulnerable countries to climate change, though its share in polluting the atmosphere is negligible. Nepal has already witnessed a number of changes in its mean temperature and climate patterns. Rates of temperature rise range between 0.4°C to 0.8°C per decade which is much higher than the world average. In general small islands, high mountains and polar zones will experience the most severe impacts of climate changes leaving a question mark regarding their very existence. The livelihoods of high mountain regions depend on freshwater in the forms of glaciers, perennial rivers and spring sources. Rapid decline in winter snowfall, retreating glaciers, retreating snowline, and sudden shifts in weather patterns leading to severe water crises at local and regional levels are evident. Lack of information and knowledge about the looming crises in terms of their severity, level of uncertainties and viable alternatives for addressing the challenges are key concerns. On top of these challenges, conditions of poverty and difficult terrain serve as bottlenecks. In this context, climate change has emerged as yet another hurdle to Nepal's progress in the path of development.

What are the major impacts?

Climate change has cross-cutting impacts and encompasses all vital systems. Change in weather patterns means increase in level of uncertainties. As a consequence of reduced snow deposits in the Himalaya, flow levels in snow-fed rivers during dry season will automatically diminish. The increased trends of intense rainfall indicate higher rates of erosion or soil loss and reduced time for recharging groundwater. There are subsequent negative impacts on agriculture, biodiversity, forestry and health. Though one can note a number of changes in basic climate parameters and consecutive impacts on local to regional ecosystem with clear implications on socio-economic sphere, segregating climate change impacts from other influencing factors is not simple. For example, increased number of extreme weather events and corresponding human lives and property losses may be linked not only to climate change, but also to expansion of settlements towards hazardous zones.

The impacts vary depending on geophysical and ecological characteristics of the regions, as well as local capacity or resilience power to cope with stresses. Nepal, having high ecological diversity, is sensitive to climatic changes and is therefore susceptible to face acute stresses. Chain effects of climate change impacts are very likely.

Who will be affected the most?

The general principle is that any natural or human-induced risks affect weaker, poorer or marginalized people the most. This is because their exposure level to risk factors is higher and affordability to cope with stresses is lower. In the context of climate change, Nepal's already poorly developed districts and socio-economically marginalized families are naturally the ones to bear the burden of climate change effects. If the current trend of climatic variability continues, prospects

of infrastructure like hydropower and roads will severely diminish. In this context, Nepal as a least developed country will suffer more than those having better resilience capacity.

What are the best possible options to address the challenges?

Educating the public on emerging issues of climate change would serve as the first step to help them. Assessment of risks and vulnerability at local level is essential to plan and implement any adaptation or mitigation policy. This, however, can be achieved only through overcoming three-fold challenges: investing in research and education, securing international funds supposed to be disbursed to vulnerable developing countries, and placing climate change issue in the national priority.

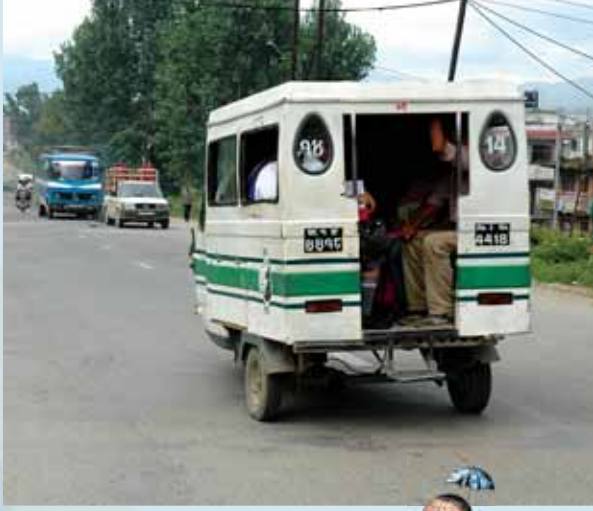
Given the geophysical speciality of the country, Nepal can benefit by:

- promoting water saving technologies, models and practices
- preventing erosion and soil loss through improved landuse practices
- promoting research and education on climate change
- developing alternative road access such as ropeways
- expanding forest cover and participating in carbon trading
- setting policy to promote and transfer efficient renewable energy technologies.

How can an individual become a part of the solution?

Going clean and green is the simple way that one can be part of the solution. As saying is always easier than doing, adopting an alternative path would be a difficult task without strong commitment and motivation. There are plenty of options for an enthusiastic individual. Few examples are given below:

1. **'Carbon neutral' home, office or business:** This is an emerging market based practice that is maturing. For a carbon neutral office or home, you have to know the quantity of fuel used in a fixed period (say in a year), and convert the same into carbon dioxide equivalent (ton CO_2). Taking reference of carbon price at international market, you can buy the same amount of verified or certified carbon reduction units (VERs or CERs) from local or international market. Alternatively, the money can be invested to grow trees or saving a critically endangered forest patch through existing community-based organizations (like community forest users groups) or companies.
2. **Using low-carbon intensive products or services:** It is easy switching into low carbon intensive services or products once you become aware of the causes and effects of climate change. Travelling by mass transport, such as a public bus, is less



Electric vehicle (Safa Tempo)

Simple ways to make a difference

- **Grow as more trees as you can for mother earth:** A single tree can absorb tons of carbon dioxide over its lifetime. Protecting a young plant and forests is equally important as planting.
- **Go for renewable energy:** Be positive about renewable energy such as solar power, hydropower, biogas to lower the consumption of fossil fuel.
- **Save energy:** Turning off your electronic appliances such as television, DVD player, computer when they are not in use will save energy from being wasted.
- **Change a light:** Use a compact florescent light bulb instead of regular light bulb to save electric energy and to cut your electric bill.
- **Promote clean transport:** Choose electric vehicles wherever possible, use bicycle instead of fossil-fuel run vehicles. One electric vehicle can replace 2190 litres of gasoline per year from which 3.5 tons of CO2 is prevented from entering into the atmosphere.
- **Drive less - walk more:** Practice walking, biking, car-pooling or public transport more often.
- **Recycle more:** Always promote recycling and recycled products. You can save 1,200 pounds of carbon dioxide if you cut down your garbage by 10%.
- **Check your tires:** Keeping your tires inflated properly can improve gas mileage by more than 3%. Every gallon of gasoline saved keeps 20 pounds of carbon dioxide out of the atmosphere!
- **Share information:** Talk about climate change with your family and friends. Let them know what you have learned. By sharing information, you are actually being part of the solution.

carbon intensive than a car. Electric vehicles are far better than diesel or petrol-run vehicles. Locally produced food or other items reach your home or office at lesser fuel costs and are therefore more environment friendly than those imported from outside the country.

3. **Running efficiently:** Improving efficiency of any vehicles, engines and stoves or minimizing consumption of hydrocarbon-based fuel is the next good option to become part of the solution. Bundling several schemes together into a sizable energy efficiency project helps develop the same into a project under Clean Development Mechanism (CDM), or any other forms that would attract international funding for the same.

Conclusion

Though climate change may not be as important an agenda as settling Nepal's current political transition, this does not mean that society is spared from the negative impacts of not undertaking timely 'actions.' The gradual decline of winter monsoon and growing intensity and frequency of summer rains provide enough hints for future planning. These trends clearly show that water stresses would further intensify jeopardizing the prospect of hydropower, irrigation, agriculture and better road network. However, the even greater threat is not knowing the threat itself.

Appreciating Local Knowledge, Innovations & Practices to Promote Community Based Adaptation

Bimal Raj Regmi
Lalita Thapa
Rojee Suwal
Suman Shekhar Manandhar
Gyan Bandhu Sharma

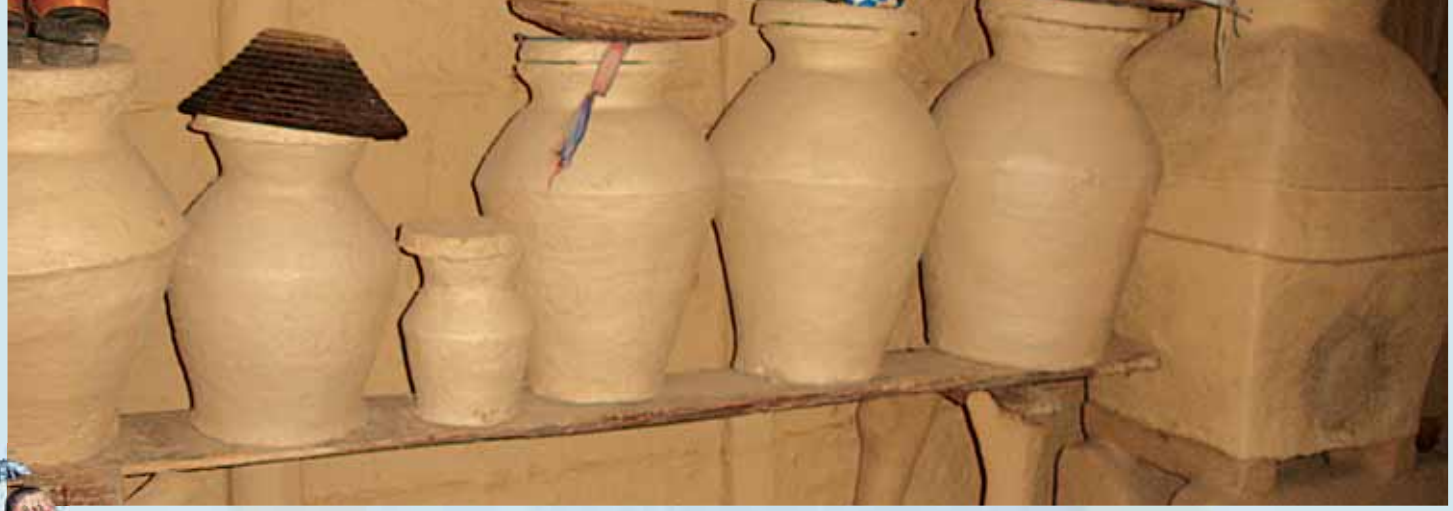
Local Initiatives for Biodiversity, Research and Development (LI-BIRD)
(info@libird.org)

Background

It has been established that the worlds' climate is changing. In Nepal, we find scientific evidence that indicates that average temperature is increasing at a high rate.

Poor, marginalized and disadvantaged people in rural areas of Nepal, who solely depend on natural resources and climate sensitive sectors such as agriculture, forestry and fisheries for their livelihood, are more vulnerable to climate change impacts (Dahal, 2006 and Regmi and Adhikari, 2007). The majority of farmers depend on monsoon rain for crop cultivation. So changes in rainfall pattern may be fatal for farmers. Similarly, extreme rainfall and downpour causes landslides and soil erosion and destroy property or even take life (Regmi and Adhikari, 2007).

For generations, farmers in Nepal have been using traditional methods, local knowledge and innovations of adaptation to climate change (Dahal, 2006 and Regmi and Adhikari, 2007). Local level adaptation strategies among smallholder farmers is one of the coping mechanisms for them to deal with adverse impacts of climate change. These community level evidences and anecdotal information require further investigation. There is need to investigate whether or not existing local knowledge and livelihood assets enable villages to cope with climate change. It needs further examination how local



Vessels used in storage of grains

knowledge and innovations are important in designing research and development interventions targeted for vulnerable communities.

Process

This paper is based on the outcome of research conducted in Solukhumbu (Khumbu region), Kaski (Begnas, Pumdi Bhumdi and Arba VDCs), Tanahun (Serabensi), Kailali (Joshipur), Doti, Mustang, and Bardiya (Belwa) Districts of Nepal. Focus group discussions were carried out with the communities to identify key issues, impacts of climate change and community based adaptation mechanisms. This group discussion was further supported by interviews with key informants and informal discussion with respected village figures to document local knowledge, innovation and practices to promote community based adaptation to climate change.

Findings

Adaptation strategies among smallholder farmers

Communities have been using their own traditional methods of adaptation for generations. There is no early warning system, seasonal forecast or any activities directly related to climate change. The following sections describe community-based adaptation strategies and implications of such interventions in the livelihood of poor communities.

Water Storage System to Cope with Water Scarcity

- Farmers are constructing water conservation pond during the monsoon by communities in Kalabang of Kaski District.
- Farmers of Arba VDC in Kaski District use water harvesting tank to trap rainwater to be used in the dry season.
- Farmers practice waste water collection and drip irrigation for vegetable farming in Begnas VDC of Kaski District (see Box 1).

Management practices

- Farmers are using mulching in vegetable farming to increase soil moisture.
- Some farmers are constructing retention walls along terrace risers to check soil loss and are planting vegetative barriers such as broom grass, mulberry, and Napier grass on sloping lands and roads.
- Farmers are constructing drainage canals in bari lands to check soil loss from intense rainfall and using of vegetative barriers (Broom grass, Napier, Mulberry) to control gully erosion. Trail improvement is also carried out for soil conservation.
- Some farmers use bio-fertilizers and bio-pesticides to improve soil fertility.
- Fodder trees are planted in grasslands to cope with invasion of new grass species.
- Previously, millet was transplanted with maize in early June in Kalabang of Kaski District, but due to lower rainfall in June, farmers postponed transplanting millet till August so that the millet could acquire enough water and result in high yields. Similarly,

BOX ONE

Case One: ***Cultivation of potatoes on heap of soil to reduce loss of soil moisture***

Farmers from Kalabang of Pumdi Bhumdi VDC of Kaski District are experiencing less rainfall during the winter since last 6-7 years. In order to conserve soil moisture, local farmers have started to cultivate potatoes on mounds of soil. According to farmers, this method is effective in conserving soil moisture due to less exposure. Many farmers are now practicing this method in the area.

Case Two: ***Coping with water stresses through drip irrigation***

To cope with water shortage during the pre-monsoon season, drip irrigation system was adopted by farmers of Begnas in Kaski District. The system consists of a water tank and a network of pipes with drippers at predetermined intervals that deliver water in a controlled way to the roots of crops. This method can be used for crops such as cucumber and cauliflower. Farmers reported that drip irrigation saves water compared to bucket irrigation without reducing yield. The people of Chaur also believe that drip irrigation helps in the early maturity of crops.

Case Three: ***Watering for coffee flowering***

Coffee flowering season occurs from February-April. During the flowering season, coffee requires a little rain. However, due to low or delayed rains observed in Chaur of Begnas area, coffee flowering season has been delayed, and this has ultimately affected coffee productivity. Krishna Neupane, a resident of Begnas VDC, Kaski used his own innovation and started sprinkling water on his coffee plants. This has promoted the natural process of coffee flowering.

Case Four: ***Hanging nurseries***

Farmers reported that the number of pests has increased with the rise in temperature. The traditional type of nursery seedling-raising was not capable of reducing losses from pest attack, so farmers of Serabeshi, Tanahun started to raise seedlings by building hanging nurseries. According to farmers, besides controlling pests, this type of nursery also saves seedlings from frost, weeds, fungus (dampening), and red ants.

farmers of Amalchaur of Kaski District started to sow wheat in December instead of November due to less winter rain. According to them, in December, wheat can get moisture from condensation of dew.

- Water was sprinkled on coffee trees in dry season to induce flowering in Begnas, Kaski district (see Box 1). To cope with drought, potatoes were grown in rows so that less amount of water is required. Farmers now sprinkle warm water in nurseries to maintain ambient temperature during the cold weather. Some farmers are spraying ashes in the periphery of nurseries to control ant-attacks.
- Alternative energy sources, such as biogas, which reduces consumption of fuelwood is used by farmers.

Change in crops

- In Kalabang of Kaski District, due to drought, khet land (irrigated) was converted to bari land (rainfed), so rice was replaced by millet and mustard. Farmers are now growing drought resistant crops in tari land (semi irrigated). Early maturing vegetable are preferred by farmers. Mustard replaced wheat, which requires less water. Drought resistant rice varieties, such as Mansara and Anga, are now preferred by farmers. Farmers now sow high quality rice like Jetho Budho, a local landrace which they sell in the market and buy cheaper rice like Mansuli.
- Farmers in Mustang and Dolpa Districts are now growing new vegetable species in their homestead due to change in temperature. Similarly, farmers in the flooding areas of Bardiya and Kailali Districts are growing watermelon, sesame, black gram, peanuts and sweet potato to cope with stress environment.

Improved storage system

- Farmers have been making pits to store potatoes. According to farmers, this helps to reduce the storage temperature so that they can store longer.
- Some farmers in Pumdi Bhumdi VDC of Kaski District are protecting their seeds from frost and chilling temperature by covering with plastic and hanging them in safe places.
- Farmers of Joshipur VDC of Kailali District are using earthen vessels to store their paddy, maize and other cereal seeds. These vessels are kept on raised beds to protect from flooding. Similarly, farmers are also raising their level of houses and cattle sheds to keep them safe during monsoon flooding.

Other coping mechanism

- Farmers of Belwa VDC of Bardiya District are planting crops early, dropping late maturing varieties and developing alternative irrigation systems (e.g. pump set).
- Use of new hybrid varieties such as short duration and drought tolerant varieties is also common in many areas of Nepal. But most of the farmers believe that local landraces have stress tolerant traits.

Collaborative responses

LI-BIRD and its partner organizations working in the study area, mostly in Kaski and Tanahun, have been instrumental in introducing biodiversity-based livelihood strategies in the community. This has contributed raising communities'

awareness in conservation and in building their capacity to use natural resources for their livelihoods. Income generating activities have targeted poor and landless communities. There are innovative activities implemented by LI-BIRD and its partners to develop and promote varieties and technologies that can cope with extreme climatic events like drought and flood. Similarly, focus on strengthening and empowering community based institutions made communities more intact and increase their resilience to climate change impacts.

Conclusion and Way Forward

From a poverty reduction perspective, adaptation is already necessary as people's lives and livelihoods face an increasing burden of broader shocks and stresses. Communities have been using traditional knowledge, practices and technologies to cope with adverse climatic stresses. There are few adaptation and coping mechanisms including conservation and sustainable utilization of important and valuable plant species, use of different soil conservation methods (drip irrigation and retention of soil moisture), change in cropping pattern and crop composition, value addition and marketing, and strengthening of local community-based institutions including community-based insurance system. These mechanisms have been further promoted by civil society and non-government organizations working in the area.

Hanging nursery

Some individuals and communities are more vulnerable than others. Reliance on climate sensitive crops, lack of access to alternative livelihoods, remoteness to markets, inferior social services and weak social networks are important factors that contribute to increased vulnerability. Thus it is necessary to assess various livelihood assets of rural communities to understand how it is contributing towards vulnerability of communities taking socio economic and local practices into consideration.

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Climate Change Perception at Micro Scale

Gopal Raj Joshi
Coordinator, Clean Energy Nepal/Clean Air Network Nepal, Kathmandu (gopal.joshi@gmail.com)

Background

This article intends to assess local perceptions of climate change impacts and current adaptive capacity, as well as to assess future climate related risks to identify measures to enhance community adaptive capacity. Phedigaon community of Palung VDC in Makwanpur District, representing a typical village in mid-hill region of Nepal, is the study area. Phedigaon is situated in the western part of the Bagmati watershed within the sub-catchment areas of Kulekhani Watershed and is close to Tribhuvan Highway. It is comprised of about 110 households.

Large scale and climate model based vulnerability assessment work sometimes fail to furnish relevant information on local impacts that really form a basis for catalyzing immediate and practical actions at local level. For this reason, this study has adopted site-based (micro-scale) community vulnerability assessment to formulate appropriate adaptation strategies needed for the most vulnerable people. Community-based vulnerability assessment approach is based on participatory case studies.

The assessment examines the conditions of the community and of various stimuli that give rise to its vulnerability and the interrelationships between them. Impacts or sensitivities are not assumed; they are identified in the research based on information provided by community members. The ultimate objective is to identify opportunities to strengthen the adaptive capacity of the community to better cope with climate change.

Local Perception on Temperature and Precipitation Change

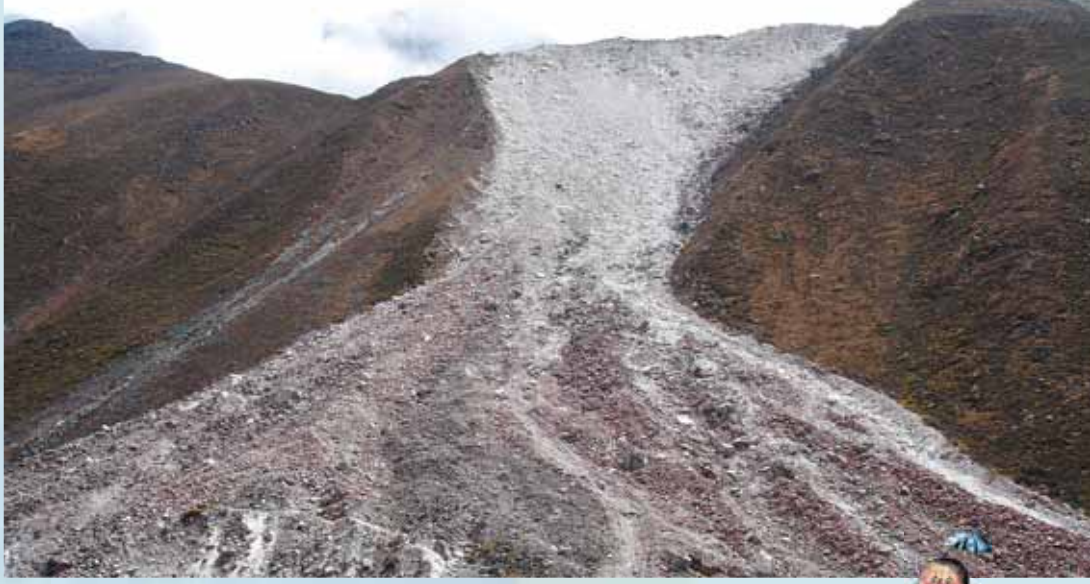
Days and nights during winter seasons used to be very chilly a few decades back. But in recent years, they are experiencing less chilly winter days

and nights. Similarly during summer season, the days are becoming hotter. In the surrounding hills and mountains, the frequency of snowfall in the winter, which used to be high in the past, has decreased. At the same time, the frequency and intensity of frost days have also reduced. According to villagers, the most significantly observed changes are decrease in rainfall amount, delayed monsoon, and shorter period of rainy season. At the same time, unusual and untimely rainfall, heavy rainfall at once, and decreased winter rainfall are other important changes experienced by the local community.

Current Impacts and Vulnerability

From the field survey, the following risks or types of exposure, which were directly or indirectly related to climate change and variability, were identified: natural disasters (like landslides/debris flow/flooding, drought, soil erosion), water scarcity for drinking and irrigation, reduced agriculture and food production, human health risks and loss of forest and biodiversity.

Natural disasters have caused significant damage to socioeconomic and environmental assets of the village. These include loss of agriculture land and crop, loss of properties, human life and animals. Lack of rainfall at proper period and prolonged drought condition has caused a decrease in the production of all crops although the use of chemical fertilizers and pesticides is increasing day by day. Different types of diseases and pests are emerging like recent outbreak of fungus in cauliflower and other vegetables.



Impact of GLOF

Changes in temperature and precipitation is also disturbing the natural water system. This has resulted in drying up wells, springs and other water sources in the community.

Although villagers are unable to identify significant impacts at the species level, majority of them confirmed that forest area in their vicinity is decreasing day by day in spite of their effort to preserve the forest. At the same time, respondents reported less availability of fodder and fuelwood, some respondents said certain plant species had been depleted, whereas some villagers mentioned less availability of birds and animals. Villagers asserted there have been an increase in health problems in the

village such as eye disease (red eye), skin disease (including rashes, itching and dry skin), fever, headache, flu-like symptoms, diarrhoea, jaundice, pneumonia and typhoid fever. They believe this is linked to significant variations in the climate. During rainy season, conditions are more critical and children suffer diarrhoea. During flooding and landslide events, drinking water source usually gets contaminated and sanitation is very poor.

Factors contributing to Adaptive Capacity

There are various factors which ultimately reduce or enhance the adaptive capacity of local people.

- **Social Network and Institutional Support:** Social network and institutional support in various forms such as neighbourhoods, relative support, GOs and I/NGOs support, has positive effect on adaptive capacity.
- **Alert and Warning System:** Early warning system and community-based disaster preparedness system are lacking in the community which increases their vulnerability.
- **Physical Infrastructure and Technologies:** Poor facilities and inadequate physical infrastructure and technologies such as roads and irrigation system lower the adaptive capacity of local people. Many people are unaware of cost-effective, simple techniques and technology such as rain-water harvesting and surface water control that can significantly lower the problem of water scarcity.
- **Preventive Measures for Disaster:** The community is in urgent need of the following preventive measures:
  a) Landslide and gully erosion control
  b) Engineering-check dams (stones, concrete), retaining gabion walls
  c) Plantation of amriso and fodder species, bamboo, etc.
  d) Bio-engineering in case of major landslide
  e) Drainage management.
- **Formal and Informal Loan Systems:** Recently, cooperatives and Gramin Development Bank have started micro-finance and micro-credit schemes which have facilitated and motivated housewives to be involved in economic activities. Some micro-finance schemes also have provision for compensating damage during natural disaster and payment on retirement. In conclusion, this financial mechanism has broadened the safety net of local people.
- **Income Generating Activities (IGA):** There are many NGOs (groups and committees) and clubs that implement IGAs in the community. IGA, in the form of micro-credit, plays an important role in vulnerability reduction in two ways. Firstly, it enhances the economic resilience of the community during post–disaster phase. Secondly, it helps in mitigating disaster loss, i.e. in practicing preventive measures.
- **Migration and Remittance:** According to local people, income from outside work, whether local or via international migration, is essential in order to provide cash or other assets that can be exchanged to meet basic food and other needs during disasters and also as a source of assets for rebuilding when damage occurs.

- **Public Awareness and Communication Systems:** People should be well informed and aware on climate change issues so that they are able to synthesise local and indigenous knowledge and skills with scientific knowledge to design effective adaptation strategy. But the community was found to be less aware on issues of climate change which may be a serious setback for the adaptive capacity of local people.

In summary, the village still lacks sufficient financial resources, infrastructure, materials and equipment to effectively cope with risks associated to climate change.

Adaptive Strategies Identified to Reduce Future Climate Related Risks

In the context of projected changes in climatic events and conditions pertinent to the village, the following adaptation strategies were identified by local residents.

- **Sharing Information and Knowledge Management:** The first step towards adaptation should be increasing awareness among local people about climate-induced risks.
- **Preparedness for Risks:** Community-based disaster preparedness strategies including vulnerability mapping, hazard zoning, effective early warning system and community-based disaster reduction plan can enhance the adaptive capacity of the community.
- **Loss Sharing Mechanism:** Insurance could be a potential loss sharing mechanism for disaster victims in the form of micro-insurance and community/collective insurance. For this mechanism, local government should step forward because insurance companies are not interested in individual property.
- **Adopting Technologies and Preventive Measures:** Adoption of appropriate technologies such as gabion walls, bio-engineering, land reclamation, rain water harvesting, surface water management, etc. are highly recommended.

Conclusion

The Phedigaon community has limited adaptive capacity to cope with climate related risks. Local people who solely depend upon agriculture for daily subsistence are especially more vulnerable as the agriculture sector is easily affected by extreme climate events and natural disasters. Among family members, women and children are the most vulnerable to adverse socioeconomic consequences related to climate change such as increased work load burdens, adverse health impacts, and food scarcity.

The community needs to be well informed and empowered to enable them to lessen the adverse impacts of climate change. Community based loss sharing mechanisms such as insurance of crops, properties and human life against natural disaster can play a vital role in increasing community resilience.

Living with Uncertainty: Climate Change and Disasters

Dinanath Bhandari

Programme Officer, Practical Action (dinanath.bhandari@practicalaction.org.np)

Introduction

A study, using participatory vulnerability assessment tools, was carried out in Kadampur and Mirtung villages on the bank of Baulaha Khola in Nawalparasi District, Nepal. The study aimed to accumulate information on changes, impacts and adaptations that have occurred over the past 40 years.

This article discusses how vulnerabilities to disasters are changing in the study area in the context of changing climate and how people are responding to impacts of these changes.

Findings and Analysis

Changes

The studied communities have experienced and are aware that weather patterns are changing over time. They identified changes in the nature of rainfall, temperature increases, winter fog, windstorms, hailstorms and frequencies of disasters like landslides, floods and droughts.

While heat, winter fog, floods and droughts are said to have increased in frequency and intensity, there is great variability in occurrence. Summers are getting hotter, winter fog, locally known as sheet lahar, has increased noticeably over the last 20 years. This prevents sunlight from reaching the land surface causing the temperature to remain low throughout the day. While some experts regard this as being the result of global temperature rise and atmospheric pollution, the people insist that winters are getting colder.

The most commonly noticed change is rainfall which directly impacts on agricultural practices. While meteorological data shows an increase in annual precipitation, the pattern of rainfall has become more erratic. More rainfall is occuring

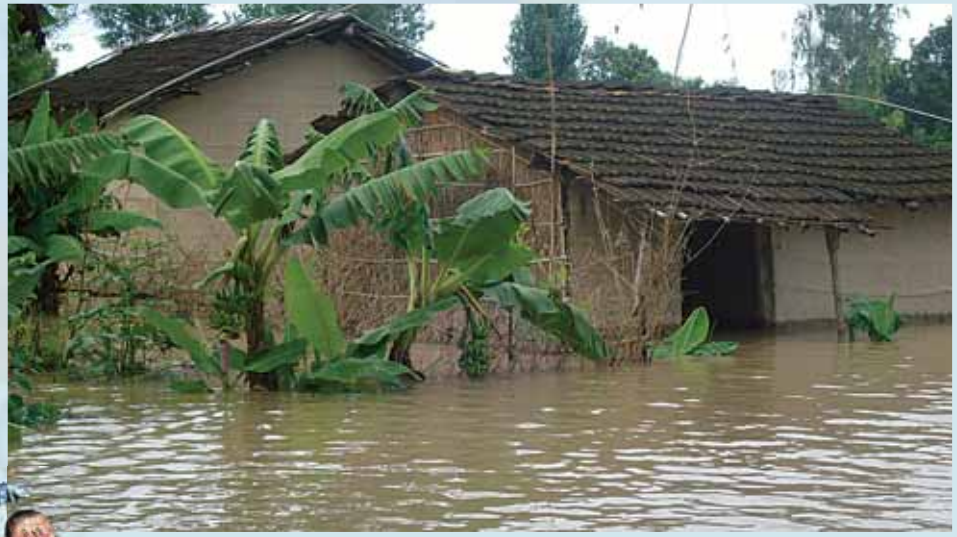
in a shorter period (increased intensity) with often longer gaps between rain events. This disturbs the recharge and discharge of catchments and increases overland flow, landslides and flash flooding. Socioeconomic activities like deforestation, shifting cultivation on hill slopes, over grazing, unplanned settlements, construction of roads and other infrastructure without mitigation measures, all contribute to intensifying landslide and flood hazards and the frequency of disastrous events.

Drought, the lack of sufficient water available for irrigation and domestic use, is increasingly problematic, particularly during the non-monsoon season between October and June. The main stream of the Baulaha Khola dries soon after the end of the monsoon and spring water is not sufficient to satisfy domestic demand. Even during the monsoon, the period between two successive rainfalls is increasing. This creates water-stress for crops. The trend of uncertainty is increasing.

Frequency and magnitude of both dry windstorms and hailstorms has decreased in this area. Old people recalled that in the past there used to be strong windstorms and damaging hail stones between March and August. In recent decades they are less noticeable; people say there has been 'retirement of winds.' A few respondents suggested that this could be due to the lack of forests in the vicinity; others supposed it due to a shift of wind flow. 'They must have gone somewhere,' a group suggested. In an earlier study, both windstorms and hailstorms were found to have increased in frequency in Jugedi Stream watershed. Jugedi lies about 20 km north-east from this area at a slightly higher altitude.

Hazards and Impacts

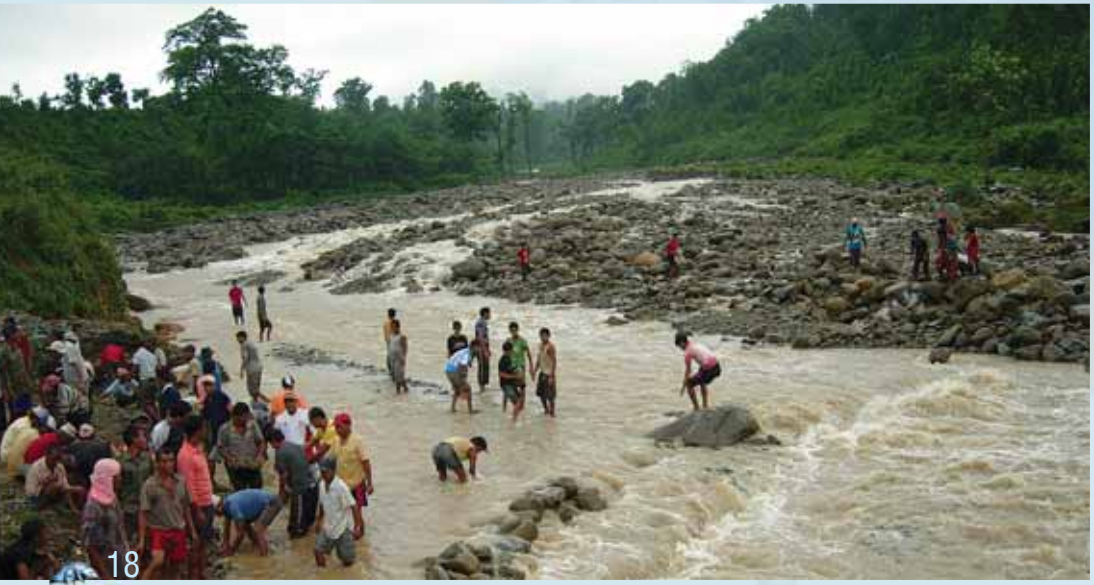
Thirty years ago, Til Prasad Pathak (65 yrs), a resident of Kadampur, could easily walk bare-foot without an umbrella while grazing his cattle during the summer. Now, he observes, nobody is able to do so; it is simply too hot. This illustrates how increased summer temperature adversely affects the mobility and working time of people. The poor and less equipped suffer



Climate induced disaster

most as they have to walk bare-foot and work all day in the open to earn their living. Increased temperature accelerates evapo-transpiration and enhances drought. Casualties due to heat stress (loo as it said) were not reported, but other illnesses due to excessive heat are commonly experienced. However, better awareness for hygiene and improved medical facilities have largely mitigated the impact of rising temperatures on health.

Between June and August, flash floods is a major hazard to the livelihoods of local people. Floods damage irrigation channels, foot trails, arable land, crops, settlements and other properties. In recent decades they have become almost annual events. Historical time trend analyses in different villages reveal that over the past 40 years, the frequencies of landslides and floods in both upstream and downstream communities has increased. In spite of measures taken in recent decades to prevent and reduce losses, the damage suffered has increased in severity and frequency. In 2006, a torrent claimed two human lives and destroyed several houses; while four families had to evacuate their homes in 2007. Flooding has secondary impacts such as spreading diseases and accessing services.



Farmers rebuilding the intake of irrigation channel after the commencement of rain

Drought has an adverse impact on crop production, preventing timely sowing of seeds, transplantation of seedlings and their care.

In the past, fire was a regular occurrence, but people now perceive that the risk of fire has decreased with cessation of windstorms. A similar response was found in earlier investigations in Meghauli. Windstorms used to cause dust-borne diseases such as eye infections. These are now rarer. It is possible that changes in the structure of houses and improved hygiene have contributed to this improvement. Respondents were of the opinion that the decrease in hailstones has a negative effect. They believe that hail stones lower the soil and surface temperature and increase soil moisture in the hot season. They agreed

that it would be better if it rained instead, but as it does not rain the absence of hail contributes to the drought. It is interesting that both have become increasing hazards in Jugedi (Box 2).

Coping and Adaptive Livelihoods

Communities are not static and have developed strategies to cope with changing and uncertain circumstances. A reservoir has been constructed to collect stream water through a channel for use during the dry season. A system has been established to irrigate fields turn by turn. As the amount of available water is unable to meet the demand, it is utilized only for paddy nurseries which need to be established early, before the onset of the rainy season. At other times the water is utilized in kitchen gardens and for cattle. Most of the land is still left fallow during the dry season. Tube wells provide a possible solution to water shortage, but are costly and not always possible.

Many channels have been constructed across the stream to catch and canalize stream flow during the monsoon for irrigation of rice. To prevent sand accumulation, which can be a problem with this sort of irrigation, sand barriers are built at different points in the channel. Intakes for such channels are temporary and are destroyed in advance if there is a possibility of a big flood in the stream. Decisions to close the intakes are based on the observation of clouds and the arrival of rain in

BOX TWO

Largest Hailstone

Hukum Singh Gurung (59), a resident of Khetbari village of Nawalparasi District, had managed his vegetable farm with drip irrigation system to cope with limited water resources available. In April 2007, there was heavy hail storm in the village. His drip irrigation pipe was totally broken along with damage to his zinc plate roof. “I had never seen such big and damaging hail stones before,” he exclaimed with sadness in his face. Apart from the cost of repairing his pipe (about $ 31), he lost his whole crop of vegetables that would have given him about $ 300 – his family budget for more than six months! The story is repeated by all the farmers in the area. “It’s of no use how favourable other factors are on other days; a single event is enough to cause a great loss within a short time,” says Janga Sarki (45). In the earlier week, there was a dry wind storm which uprooted hundreds of trees in their community forest. There were only two rainfall events between October 2007 and February 2008; one in January and another in February. Both brought hailstones and damaged winter vegetables tremendously. “I had never seen such a big heap of hailstones before,” said Sher Bahadur Tamang (50) of Bhotedhap village of Nawalparasi District.

Extensive winter fog has an adverse impact on human and animal health and causes damages to winter crops. People have not so far witnessed deaths due to sheet lahar in their community but have heard of deaths in other parts of Nepal and India. Growing winter crops like oil mustard and potato has almost ceased due to the fog.

the hills of upstream catchments. Planned destruction of the intakes prevents flood waters from inundating farmlands and settlements, and ensures that the remaining sections of the irrigation system are kept intact. Visually monitoring the rainfall in the hills is only effective in the daytime. Flash floods at night remain very damaging.

Communities have constructed flood barriers along the banks of the stream to protect the edges and to deflect eroding current. Throughout the year the poor collect stones, gravel and sand from the stream, which they sell. This provides a small income and helps to deepen the stream bed. The debris of the next flood is deposited and again collected, thus maintaining the flow of the river.

Traditionally people alter their working hours to cope with rising temperatures; working outside in the morning and evening and taking a rest or doing indoor tasks during the mid-day heat. This depends upon individuals' nature and place of work. Coping mechanisms to untimely and excessive rainfall include adaptation through preparedness, altering planting and harvesting time, and so forth. Such measures mature after several trial and error experiments. The challenge of climate change is the uncertainty of the scale, timing and intensity of future change and its consequences.

Conclusion

Climate change has brought adverse consequences to the livelihoods of the community affecting different assets. Disasters are not new nor the result of a single factor, but, as science tells us, human kind is significantly responsible for many of the causative factors. Communities are responding to events but their response would be more effective if causative factors are addressed. Communities do not have resources or technologies to address unpredicted and unforeseen consequences of climate change. In short, they lack adaptive capacity.

Local, national and international efforts are essential. A looming challenge is how to cope with both predicted and unknown adversities. We know that climate change is happening, but exactly what this means and what the consequences will be is largely unknown. Much focus has been given to changing policies and suggested pathways are based on the desk analysis of secondary information. Strategies to reduce vulnerabilities and increase resilience and adaptive capacity are important components of poverty reduction and, when integrated with disaster risk reduction methodologies, provide a mechanism for ensuring livelihoods and justice for innocent victims of climate induced disasters.

Acknowledgements

Author would like to appreciate community members in Kadampur and Mirtung of Nawalparasi District for providing primary information and sharing experiences, events and situations. Dhurba Gautam shared skills on acquiring and analysing information. Ratna Sapkota of SAHAMATI organized meetings, interactions and assisted information collection. Sincere gratitude goes to Pieter Van Den Ende of Practical Action for editing and improving the document.

Adaptation Financing: Some Options and Ways Forward

Ram Chandra Khanal
Senior Programme Officer, IUCN Nepal
(khanal@iucn.org.np)

Adaptation is not an option but an urgent necessity for many developing countries. The cost of climate change impacts has been estimated at 5-20% of global GDP annually in the absence of adaptation (Stern, 2006). The World Bank has estimated that up to 10% of domestic and foreign direct investment (FDI) flows in developing countries, and up to 40% of Organizational Development Agency (ODA) and concessionary finance, might be at risk from climate–related damages (World Bank, 2006). The adverse impacts of climate change and cost of adaptation have become a substantial challenge to developing countries, since these countries have inadequate resources and capacity, inefficient institution and a weak knowledge base.

Against this backdrop, there is now an urgent need to identify financial ways and means for adaptation financing, both at national and international levels. It is particularly important to implement anticipatory adaptation actions effectively and in time, otherwise the cost of reactive adaptation will be much higher. Exploration of appropriate financial mechanisms is relevant for us in Nepal, since the National Adaptation Programme of Action (NAPA) is in the process of formulation. There are different types and nature of mechanisms or processes that can help to effectively finance adaptation actions. They include:

International Level

At the international level, there are different kinds of funds available for developing countries. Global Environment Facility (GEF) operates three funds: GEF Trust Fund, Least Developed Countries Fund (LDCF), and the Special Climate Change Fund (SCCF). Further, funding opportunities currently available for developing countries to

There are different burden-sharing mechanisms proposed to finance adaptation at the international level. These include 'adaptation beneficiaries pay principle', 'emitters pay principle', 'ability to pay principle,' and 'climate change winner pay principle.'

fund adaptation projects include: the adaptation funds under the Kyoto Protocol, funds from other multilateral environmental agreements, and national and international organizations and agencies. But accessing these funds has become a daunting task for developing countries like Nepal due to the complex and lengthy processes involved. Besides this, allocated funds are not sufficient to address burning issues that developing countries are facing currently. Hence, it is imperative to both improve the processes, as well as determining other financial mechanisms to provide sustainable and sufficient funds for adaptation actions. There are different burden-sharing mechanisms proposed to finance adaptation at the international level. These include 'adaptation beneficiaries pay principle', 'emitters pay principle', 'ability to pay principle,' and 'climate change winner pay principle.' 'Adaptation pay principle' is based on the basic rule of trading of private goods and entails that beneficiaries of adaptation policies and measures bear the cost, since they are benefiting from the actions. This is against the equity principle, since the most vulnerable and poor people in developing countries suffer the most from the impacts of climate change, although they contribute the least to climate change. 'Emitters pay principle,' like polluters pay principle, is based on the amount of emissions from a country or its industry or individual consumers. 'Ability to pay principle' is based on the ability to pay which is typically measured by using GDP or individual income, whereas 'climate change winners pay principle' is based on the positive impacts of climate change. Countries such as Russia and Canada are benefiting from climate change through increasing growing season and associated higher agricultural yields, lower consumptions of energy, and other effects. Based on facts and equity perspective, all these principles except 'adaptation beneficiaries pay principle' are suitable for developing countries.

National and Community Level

The adaptation financing principles can also be applied at the national level. For example, 'emitters pay principle' can start from some selected industries and aviation companies which emit large amounts of

GHGs. Based on learning gained, it can be extended to other transport systems and types of fossil fuel use. Important emitters can be brought under this scope after a thorough study of their GHGs emission. The fund collected through these sources can then be used in the most affected areas to minimize risks posed by climate change.

Besides accessing funds through different financial mechanisms, it is equally important to identify and properly prioritize effective and efficient adaptation actions at the national as well as community level. In general, capacity for prioritization, basic information and research on adaptation actions are inadequate in our context. However, a community consultation carried out in one of IUCN Nepal project sites revealed that there are several adaptation actions being undertaken by communities and they have been selecting and prioritizing adaptation actions based on resource availability, effectiveness of technology, suitability at local level and locally manageable. Development of an adaptation matrix in order to assess the effectiveness of adaptation actions is also important to finance adaptation at different levels.

These mechanisms and processes at all levels — international, national and community are vital to select and prioritize adaptation actions and to use limited resources judiciously.

Way Forward

In order to avoid costly, reactive and unplanned adaptation actions in the future, it is important for policy makers to proactively mainstream adaptation concerns into development planning, and to seek and mobilize resources for climate proof investment in existing development interventions. It is clear that without international co-operation, financing adaptation actions within Nepal is not possible. Nepal should raise issues of climate justice and adaptation financing very strongly in international forum.

Government should start integrating adaptation issues into development planning including NAPA, and search for appropriate adaptation financing mechanisms in order to manage the most pressing development challenges created by climate change.

Research in these issues is very important to plan and manage, hence adequate attention should be given in this front.

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Global Climate Change,
Greenhouse Effects and Soil Organic Carbon Sequestration

Rajan Ghimire
Lecturer, Soil Science Division, IAAS, Rampur
(ghimireg@gmail.com)

Global climate change includes global level change in climatic variables like temperature, rainfall pattern and atmospheric composition. Human induced changes in climate due to increased emission of Green House Gases (GHGs) directly influence people's livelihoods. Most of the warming activities impact various sectors seriously. Among them agriculture sector is also one that is impacted mostly due to erratic weather events, changing climatic variables and degradation of land. Carbon sequestration can provide a remedy against degradation of agricultural soil and overall environmental hazards through increasing sink of carbon in soils.

Introduction

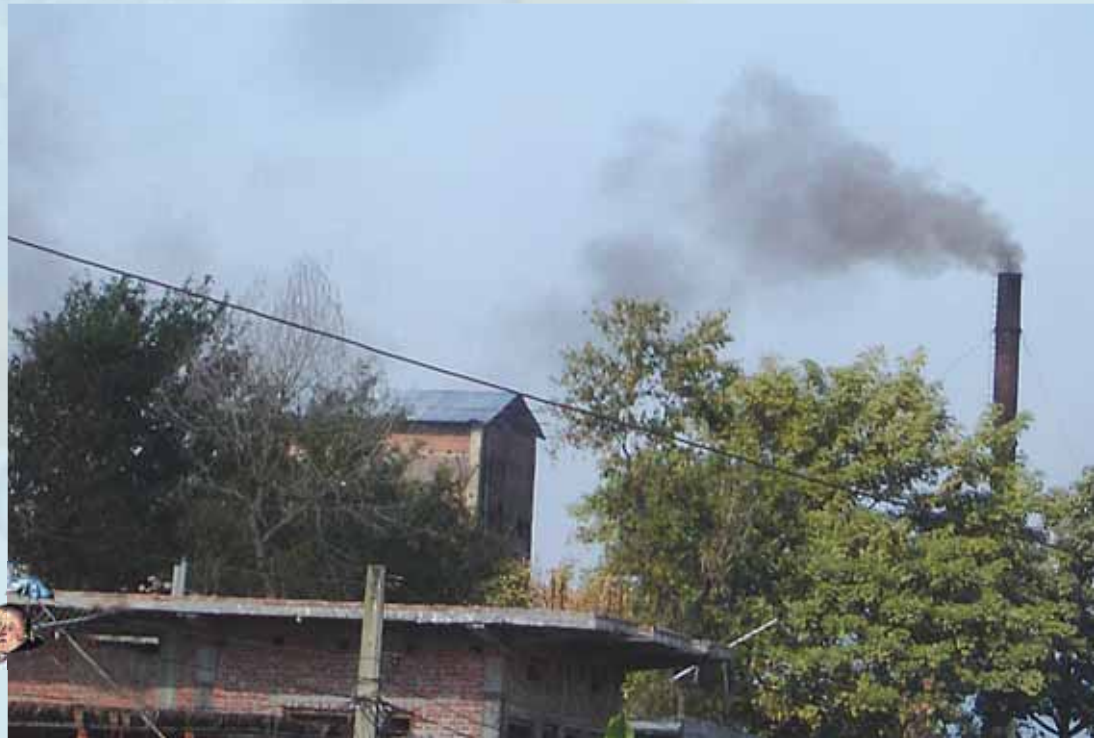
Global scale changes that affect the functioning of the earth system brought about by changing climate is more important than any other environmental changes. This view has been confirmed by United Nations Intergovernmental Panel on Climate Change (IPCC, 2000), and they have called for rapid and immediate actions. Various changes associated with global changes include irregular temperature rise in various parts of the globe, rise in sea level, changes in atmospheric composition, increased storm activity, change in rainfall intensity

and frequency, vegetation distribution and agronomic practices. The changes are continued over geological time as natural processes and are desired when they occur at a slow pace without altering living conditions or posing any threat to the earth ecosystem and ecology. When these changes exceed the natural rate of change due to anthropogenic interventions, it becomes the concern of society as it generates various ecological hazards threatening human existence. To minimize impacts of these changes, we should either reduce the rate of carbon emission or increase carbon sink capacity of soil and overland ecology (Sitaula and Bajracharya, 2006).

Continued emission of greenhouse gases at its current rate will result in warming of the earth leading to unexpected rise in global temperature. Despite the extent of this warming, its local, regional and global impacts are uncertain. Identification and selection of actions to mitigate GHG emissions will be a great challenge because these emissions are strongly tied to human activities that support life systems. However, these activities cover a wide range, from ones crucial to human wellbeing to those leading to prosperity and luxury of people. This provides opportunities to search for possible options to replace emission intensive activities with less intensive ones like conservation agriculture, sustainable soil management, etc. One of the appreciated technologies to increase sink of carbon in agricultural system is sequestration of organic carbon in soil and conservation from degradation.

Greenhouse gases and its effect

A number of gases which are involved in warming process of the earth by trapping solar radiation are known as green house gases. These gases include: Carbon Dioxide (CO_2); Methane (CH_4); Nitrous oxide (N_2O); Chlorofluorocarbons (CFxClx); and Ozone (O_3). Of these gases, the single most important gas is carbon dioxide which accounts for about 55% of the change in the intensity



Green house gas emission from industry

of the Earth's greenhouse effect. The contributions of the other gases are 25% for chlorofluorocarbons, 15% for methane, and 5% for nitrous oxide.

Anthropogenic Contribution to Global Warming

The concentrations of several greenhouse gases have increased over time. Human activity increases the greenhouse effect primarily through release of carbon dioxide and other greenhouse gases. Some of the human induced sources of greenhouse gases include:

- Burning of fossil fuels and desertification leading to higher carbon dioxide concentrations.
- Livestock and paddy rice farming, land use and wetland changes, pipeline losses, and covered vented landfill emissions leading to higher methane atmospheric concentrations. Many of the newer style fully vented septic systems that enhance and target the fermentation process also are major sources of atmospheric methane.
- Use of chloro-fluorocarbons (CFCs) in refrigeration systems, and use of CFCs and halons in fire suppression systems and manufacturing processes.
- Agricultural activities including use of fertilizers, that lead to higher nitrous oxide concentrations.

Soil organic carbon sequestration

The level of organic carbon in a given soil at any given time is a function of complex interactions of climate, physical, chemical and biological processes in soil and its regulation in the soil-atmosphere continuum. Carbon sequestration in soil-plant system is the process of removing carbon directly or indirectly from the atmosphere and its storage in soil or plant during a given period of time over a given area (Feller et al., 2001). It is medium and long term storage of carbon in terrestrial ecosystems to reduce GHGs in the atmosphere and enrich soil with carbon. It has ecological, as well as environmental functions. Small change in soil carbon can have important implications on global carbon balance (Trumbore et al., 1996) and its environmental quality. The benefits of sequestering soil organic carbon to sustain crop productivity can support the livelihoods of marginal communities. There is large potential for carbon sequestration in soils through adoption of appropriate land management techniques as land use change is the major source of carbon emission from agriculture sector. Some promising land management practices with notable effects on soil organic carbon sequestration and increasing resilience of community to adapt to climate change include:

- Adoption of conservation/organic/ sustainable agriculture,
- Agro-forestry system and sustainable management of forest resources,
- Minimum tillage technologies that minimizes economic pressure to farmer and minimizes soil fertility loss from marginal land
- Sustainable land use planning and soil fertility management,
- Control of soil erosion and land degradation,
- Recycling of crop residue and biomass for maintaining soil fertility,
- Crop intensification, balanced agricultural inputs; reducing resource-mining agricultural practices and adoption of low external input.

Conclusion

Human induced changes in global climate and associated effects are the most serious issue as it has considerable effect on the earth system. Thus, there is need to have fundamental understanding on climate change, global warming and its effect on our livelihoods. Human activity has brought this overarching situation. However, there is great opportunity to mitigate environmental hazards and increase sustainability of agriculture through sequestration of carbon in agricultural soils. Alternative land management is desired to increase resilience of communities and adaptive capacity against climate change induced disasters.

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News and Events

Bali Roadmap

The 13th Conference of Parties (COP-13) meeting of the United Nations Framework Convention on Climate Change (UNFCC) agreed on the Bali Roadmap to facilitate international negotiation on global commitments to reduce greenhouse gases in the post-Kyoto regime (2012). There were delegates from 180 nations attending the conference. Most scientists and civil society organizations agree that the Kyoto Protocol alone will not save the planet, and a more robust and inductive plan is needed. There is now only a year left for all nations to reach a consensus on a concrete plan to cut emissions at a significant percentage and revive the spirit of Kyoto protocal.

SAARC Action Plan on Climate Change

The South Asian Association for Regional Cooperation (SAARC) has adopted a three-year Action Plan on Climate Change at the SAARC ministerial meeting which was held in Dhaka from 1 to 2 July 2008. Environment ministers and experts of all eight SAARC nations met in Dhaka to discuss on issues and potential collaborative measures that can be undertaken to minimise the adverse impacts of climate change. The SAARC Action Plan focuses on seven priority areas: climate change, climate change mitigation, actions for technology transfer, finance and investment, education and awareness, management of impacts and risks due to climate change, and capacity building for international negotiations process.

Climate Change in COP-9 of the Convention on Biological Diversity

The ninth Conference of Parties (COP-9) meeting of the Convention on Biological Diversity (CBD) was held from 16 to 29 May 2008 in Bonn, Germany. The meeting was dominated by a hot discussion on climate change issues and its impacts on biodiversity. Scientists and civil society organizations were skeptical and worried about the promotion/subsidization of biofuels as clean energy to reduce global warming. Their worry was that ethanol produced from biofuels increases consequences global warming, destroys forests, and inflates food price.

Orientation cum Training on Community-Based Adaptation to Climate Change in Nepal

LI-BIRD organized a one day training for NGO members, government officials, and community based organizations in Pokhara on 28 June 2008 in order to build capacity of professionals and development workers for mainstreaming climate change issues in their plans and programs. The training was a good opportunity for participants to become familiar with climate change science, major issues, policies and adaptation mechanisms. The training brought together participants working on different climate change issues and widened their understanding and thoughts on climate change. It also contributed towards building confidence of professionals of government and civil society organizations.

A Regional Workshop on Adaptation to Climate Change and the Role of Civil Society in Least Developed Countries

A South Asia Regional Workshop on Adaptation to Climate Change and the Role of Civil Society in Least Developed Countries was held at Yak & Yeti Hotel, Kathmandu, Nepal from 19 to 21 April 2008. The workshop was organized by International Institute for Environment and Development (IIED) and Capacity Strengthening in Least Developed Countries on Adaptation to Climate Change (CLACC) Programme, co-sponsored by Practical Action Nepal and hosted by LI-BIRD. Participants from various environmental, development and humanitarian NGOs, and international as well as national NGOs from India, Bangladesh, Nepal and Bhutan participated in the meeting. The workshop reached a consensus to urgently develop collaboration and networking on climate change issues among civil societies, NGOs, INGOs and other relevant stakeholders from the region and beyond.

Third International Conference on Community Based Adaptation (CBA) to Climate Change

Third International Conference on Community Based Adaptation (CBA) to Climate Change will be held in Dhaka, Bangladesh from 22 to 26 February 2009. The conference is being jointly organized by IIED, Bangladesh Centre for Advanced Studies (BCAS) and the RING Alliance. The main aim of the conference is to share latest developments in adaptation planning and practices, priority sectors and measures at different levels, and disseminate knowledge among stakeholders and actors. For further information please visit *www.bcas.net.*

Further information

Local Initiatives for Biodiversity, Research and Development (LI-BIRD)
P.O. Box 324
Pokhara, Kaski, NEPAL
Tel (+977)-61-535357/526834
Fax (+977)-61-539956
Email info@libird.org
Web www.libird.org