“Impact of climate on Nepal economy and Way forward”

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Keywords: Land, population, Management, policies and Way forward

Introduction:

Nepal is a land-locked country located between big nations India and China. More than 70 percent of total 27 million people in Nepal are directly or indirectly dependent on land as their basic means of livelihood. However, lack of farm commercialization has limited the contribution of agriculture at one-third of the total Gross Domestic Product (GDP) of the country. One of the many more challenges in macroeconomic field /area facing by our country is land management at a current political unrest situation. Due to the political liquid and translational period, neither our country has been able to increase GDP as the government expected nor, Government has made progress in agriculture business, tourism sector, industrial situation, monetary policy and investment policy.

The scarce land in Nepal has been threatened from different phenomenon. Issue of land has been always a political issue in Nepal as more than 50,000-100,000 people are still landless and different political parties are using them as a ‘vote bank’ in every election for parliaments to local bodies.

On the other hand increasing population, land slide, soil erosion and rapidly growing urbanization across the country have posed a huge challenge to the management of land in the tiny Himalayan nation-- Nepal. Land in the hilly remote areas are increasingly becoming fallow and deserted due to rapid migration to urban areas where land is also under growing pressure of overpopulation which has ultimately led to the encroachment of public land to shrinkage of arable land on the back of increasing urbanization and development of development infrastructure.

Squeezing volume of land due to above mentioned reasons has emerged as the threats to not only land management but also the food security in Nepal which , despite the agricultural country, is still dependent on import of food from neighboring India to fulfill supply deficit amid growing demands for food.

Increasing migration of youths from rural farm land to urban areas within the countries and international labor destinations is another challenge in managing the land for agriculture commercialization in the country. Despite the fact, there were rafts of measures were taken through polices and laws to ensure the proper land management in Nepal, scientific land use is still far cry.

Problems of today, such as drought, forest fires, and flooding, will only be magnified by climate change. In Nepal, changes in monsoon patterns will greatly exacerbate the situation of unacceptable presence of poverty and inequalities of opportunities in the country. While many Nepalese people are coping autonomously to current stresses, the state must design and implement effective strategies to adapt to climate change impact to achieve economic and social progress. Adapting to long and short term climate-related problems need creative engagement among government, market actors and the civic movement.

Climate change has been labeled a "wicked problem", one that is characterized by many underlying strata of nested, intractable and unforeseen predicaments. As the inter-linkages among these many predicaments are non-linear and complex, the solution to this problem falls outside the comfort zone of our conventional knowledge systems. We need interdisciplinary understanding of the challenges faced and the solutions sought, mediated through plural institutional approaches.

Nowhere is the challenge of responding to the varied impacts of climate change more daunting than in the Hindukush-Himalaya region. IPCC's 2007 Fourth Assessment Report designated this region a "white spot" because of the limited number of scientific studies conducted in this region, including Nepal. This paper discusses the physical, climatic and social variability of Nepal. It summarizes climate change scenario results from a recent modeling exercise. While temperature is likely to go up in the region,

precipitation will be more erratic in the future implying increasing uncertainty. The paper suggests that increasing uncertainty does not imply no vulnerability and no adaptation. It then goes on to discuss two types of disasters - rapid and slow onset. Floods and landslides are considered rapid onset disasters while drought, forest fires, snow melt and regional sedimentation fall within the latter category. The risks climate change imposes on both types are highlighted while drawing implications for decision making for adaptation. In conclusion, it is suggested that responses to climate change impacts require plural institutions and that approaches must pursue incremental solutions at local, regional and national scales.

Adaptation: strategy switch for well being

In well-adapted systems, people actually "do well" despite changing conditions Recent research has helped bring about a better understanding of adaptation. It is increasingly seen as adjustments in ecological, social, and economic systems in response to actual or expected climatic stimuli and their effects or impacts. Adaptation it is now recognized, is much more than coping. In well-adapted systems, people actually "do well" despite changing conditions, including those attributable to climate change (ISET, 2008). They thrive either because they shift strategies or because the underlying systems on which their livelihoods are based are sufficiently resilient and flexible to absorb the impact of those changes.

Field studies in South Asia, that aimed to document the factors that increase people's vulnerability to flooding and drought, have identified factors that help people achieve wellbeing by building their resilience, or adaptive capacity. Drawing upon a series of shared learning dialogues with affected communities, non-government organizations and local government officials, researchers have come up with a number of soft and hard resiliency measures which reduce vulnerability to natural hazards. These measures take into account the unique interplay among physical, social, economic and political relationships. The ability to reduce vulnerability to disasters is related to the robustness of the systems (Moench and Dixit, 2004) summarized in Table 1.

Table 1: Factors enabling adaptation

System	Details
Communications	The presence of diversified media and accessibility of information about weather in general and hazards in particular.
Transportation	A system which functions even during extreme events
Finance	Access to banking, credit and insurance products which spread risk before, during and after extreme events.
Economic diversification	Access to a range of economic and livelihood options.
Education	Basic language and other skills necessary to understand risks and shift livelihood strategies as necessary.
Organization and representation	Right to organise and to have access to and voice concerns through diverse public, private and civil society organizations.
Knowledge generation,	The social and scientific basis required to learn from experience, proactively identify

planning and learning	hazards, analyze risk and develop response strategies that are tailored to local conditions.

The robustness of such systems serve as the requisite physical-institutional infrastructure that in turn enables health, education, finances, social networks and markets to exist. Both are foundations for pursuing adaptive strategies. Climate "adapted" systems will help build social resilience. Where such systems are weak or fail, they constrain adaptive behaviors such as livelihood diversification, disaster response and recovery.

Nepal: Land of climate diversity

Despite its relatively small area, Nepal has very diverse climatic conditions, ranging from tropical in the south to alpine in the north. The country's three distinct geographies-the snow covered mountains, the mid hills and the tarai (plains)-embodies this diversity. Its hydrology is fed largely by the South Asian monsoon system (SAM), but the relationship between the timing, volume of monsoon rainfall and the mountain landscape is poorly understood. The dramatic variation in altitude over a short distance has resulted in pronounced pornographic effects, effects which severely limit our ability to explain precipitation dynamics in Nepal. Another complication is that the data set required to explain the processes is limited. Monitoring stations are few-just 280 across the entire country-and hydro-meteorological data has been collected only since the late 1960s. With such a dearth of information, it is impossible to adequately capture the temporal and spatial dynamics of precipitation. As a result, modeling exercises face fundamental limitations.

The diversity in Nepal's climate is matched by the diversity of its multiple ecosystems and flora and fauna species. The mountain, hill and plains landscapes also support a highly diverse array of cultures and livelihoods. Each of these many socio-economic systems is custom-tailored to take advantage of the opportunities offered by specific micro-climates and localized ecosystems and to respond to the constraints they impose on livelihoods. The livelihoods of over three-quarters of all Nepal is based on agriculture

and forest resources, and almost 65 percent of agriculture is rain-fed (MoPE, 2000). Yet only 21 % of Nepal's area is cultivable and the irrigable agriculture depends on the types of local surface sources, most likely to be affected by erratic rainfall. It is clear, then, that climate change has major implications for Nepal's ability to produce food for its population.

The results of global climate scenario modeling suggest that the impacts of climate change may be intense at high elevations and in regions with complex topography, as is the case in Nepal's mid-hills. More than a decade ago preliminary analysis by Mirza and Dixit (1997) found that climate change in the Ganga and Brahmaputra basins is likely to change river flows, which in turn will affect low flows, drought, flood and sedimentation processes. In 1999 Shrestha *et al.* suggested that temperatures are increasing in Nepal and that rainfall is becoming more variable. A decade later, in 2009, a modeling exercise conducted by team of Nepali, American, British, Pakistani and Bangladeshi experts (NCVST,2009) using the emissions scenarios in the IPCC's special report (2007) found that the temperature will indeed increase in the mid-hills and that this region is likely to grow more arid in the non-monsoon seasons. It also suggested that precipitation is likely to be more uncertain and that storm intensity will increase. The report on the exercise included these key insights (NCVST, 2009):

- Global circulation model (GCM) projections indicate that the temperature over Nepal will increase between 0.5ºC and 2.0ºC with a multi-model mean of 1.4ºC, by the 2030s and between 3.0ºC and 6.3ºC, with a multi-model mean of 4.7^0C, by the 2090s. GCM outputs suggest that extremely hot days (the hottest 5% of days in the period from 1970 to 1999) are projected to increase by up to 55% by the 2060s and up to 70% by the 2090s.
- GCM outputs suggest that extremely hot nights (the hottest 5% of nights in the period from 1970 to 1999) are projected to increase by up to 77% by the 2060s and 93% by the 2090s.
- GCMs project a wide range of precipitation changes, especially during the monsoon: from a decrease of 14% to an increase of 40% by the 2030s and from a decrease of 52% to an increase of 135% by the 2090s.

On the ground, perceptions of farmers suggest that precipitation is growing more erratic, days are becoming hotter, the pattern of winds, fog and hailstorms have altered and that farmers are becoming more vulnerable. A review of adaptation research confirms their view, identifying Nepal as particularly likely to experience fluctuations in climate (ISET, 2008). Nepal's National Adaptation Plan of Action (NAPA) prepared in 2010 also recognizes that climate will be uncertain and vulnerability will increase.

Slow- and rapid-onset disasters:

Climate-related disasters can broadly be caused by rapid-onset events and slow-onset events. Climate-dependent hazards that arise suddenly, or whose occurrence cannot be predicted far in advance, trigger rapid-onset disasters. They include cyclones and other windstorms, landslides, avalanches and floods. The warning time before these hazards strike ranges from a few seconds or minutes (in the case of landslides), to a few days (in the case of storms and floods).

Most discussions of slow-onset disasters have focused on drought, whose results, in the form of water and food shortages and livelihoods lost, can take months or sometimes years to become evident. Rising temperatures, forest fires, regional sedimentation and accelerated melting of snow and glaciers can also result in slow-onset disasters whose cumulative impact may not be felt for decades although they may contribute to an increase in rapid-onset events such as flash floods.

The distinction between these two types of disaster, however, is in some sense artificial. A disaster cannot occur if there are hazards with little or no vulnerability, or if vulnerability is high but there are no hazards in a given area (Ahmad and Mustafa, 2007). According to Wisner *et al*. (2004), vulnerability means "˜the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard (an extreme natural event or process)'. Disasters result only when a hazard intersects with society's and individuals' vulnerability to it. Vulnerability is also deeply embedded in a given social context, and is a symptom of the marginality of different groups, the fragility of systems and the exposure of populations, activities and systems to specific hazards.

For these reasons, in the case of most disasters, long-term trends are likely to be more influential than short-term impacts and the distinction between slow- and rapid-onset becomes irrelevant. Even so, the distinction can support a long-term, holistic perspective in minimizing risks related to both. It is clear that climate change has emerged as a key driver that exacerbates the risks. In the following paragraphs we discuss the implication of climate change on these two types of disasters. Flood is considered as rapid onset disaster, while drought and forest fire as slow onset.

Flooding:

Floods during the monsoon are a natural phenomenon in Nepal. The country's more than 6,000 rivers and rivulets, with a total of 45,000 km in length, support irrigated agriculture and other livelihoods, but also wreak havoc in valleys and in the tarai when they overflow. The river drainage density of 0.3 km/ km2 is an indication of how close the drainage channels are (Shankar, 1985) and, in consequence, how susceptible they are to floods. Flooding damages crops and property and often results in epidemics. The poor are the most vulnerable to its effects. The scale of the impact of any given flood depends on both natural conditions and the characteristics of the population. Certainly climate change has a bearing on flooding, but it is not possible to scientifically attribute floods to climate change.

Along with regular monsoon floods, the country also has two special types of floods: the glacial lake outburst flood (GLOF) and the bishyari. In the Himalayan region, glacial lakes are formed between the end of a glacier and its moraine. According to a study by Mool et al. (2001) there are 2,323 glacial lakes in Nepal covering 75 sq. km. Glaciers have retreated rapidly in the second half of the 20th century, forming, in many cases, ice-core moraine-flanked lakes of melted water. Occasionally, a moraine dam is breached and a lake empties in a very short time, creating a GLOF, causing localised damage to assets and local infrastructure and taking lives.

A bishyari is a flood that occurs when a landslide which dams a river is breached by the reservoir of water which forms upstream of it. They commonly occur in the mid-hills after a cloudburst. Bishyari occurs randomly and cannot be predicted precisely.

Flooding has major implications, not just for livelihoods and food security, but also for overall strategies for adapting to climate change. The impacts of past flood events suggest what future impacts are likely to be if extreme floods become more frequent. They also give indications of how we have failed to respond and suggest how we may do so. The 2008 Kosi embankment breach flood in Nepal-India and the 2010 flood in Pakistan are cases in point. The Kosi embankment breach flood caused by institutional dysfunction (Dixit, 2009: Shrestha et al, 2010) affected 3.5 million people in Nepal and India while the 2010 Indus flood in Pakistan will have major social, economic, and political implications for the country's wellbeing. Subsequent analysis needs to examine linkages among rainfall variability, topography, river geomorphology, drainage congestion and land-use changes.

Both events reflect the fundamental challenges that all aspects of life in South Asia may face in the event of a future disaster of such scale. *If the monsoon pattern alters due to climate change, much of the Ganga basin in India and Nepal would face consequences such as those that Pakistan is currently facing.***If the monsoon pattern alters due to climate change, much of the Ganga basin in India and Nepal would face consequences such as those that Pakistan is currently facing.** As in the case of Pakistan, the rural livelihood, urban food supply, transport, communications, energy, health, water management and institutional systems on which local populations depend will fail. This failure will severely impact poor and marginal populations. As has happened in Pakistan, if the government fails to respond to the immediate humanitarian needs of the affected, non-state actors, some of them militant, may fill the void.

Throughout most of recent history, the government's strategies for flood mitigation have emphasized structural control measures, primarily embankments. Such measures, as recent flood events demonstrate, have proved inadequate and in many cases, detrimental. The limitation will be further exacerbated as the climate continues to change. Alteration in the dynamics of hydrology, geomorphology and social contexts will render structural measures such as embankments increasingly ineffective because the science according to which such measures are designed will become inapplicable. The probabilistic approach they employ uses historic data collected in a stationary hydrological system; obviously, when climate change renders the system non-stationary this approach will fail. Alternatives to structural measures which can help us to adapt

include measures to improve drainage, provide points of refuge during periods of floods and improved early warning systems. Livelihood systems that have a high level of resilience to the disruptions caused by floods also support adaptive strategies.

Aridity and drought:

While the impacts of flooding are dramatic, immediate and widespread, aridity and drought can be considered a slow onset widespread disaster. Climate dynamics, particularly the projected increase in the variability of rainfall regimes, suggest that agriculture in Nepal will face immense challenges as seasonal drought increases. The impact of the 2008-2009 winter droughts on farming and on local food security was severe. In that period, most monitoring stations received less than 50% of normal rainfall, 30% recorded no precipitation at all and temperatures were 1-2oC above average. At the national level, wheat and barley production decreased by 14.5% and 17.3% respectively and the 2009 maize production was also seriously affected. Communities which supplement their food supply from agriculture with forest products also found that the drought had severely reduced what they could harvest. At present, 40 districts, mostly in the West, face major food deficits and the World Food Programme (WFP) anticipates having to provide Nepal with almost four times the food aid it did in the past.

The obvious impacts of climate change on food production and food security at the local level are likely to be compounded by other on-going processes. Hill agriculture has been in decline over the past one-and-a-half decades despite significant effort and resources invested by both the government and the donor community, primarily because of the effects of Nepal's recently concluded armed conflict. As production has declined, local populations have become increasingly dependent on imported food and thus on the conditions of global markets. Climate change, thereby, makes them more vulnerable to fluctuations in global production and global market prices. An even more serious implication of erratic rainfall is on functioning of drinking water supply systems. These systems use springs and other local water sources which could be seriously affected by changes in rainfall patterns.

Forest fires:

It is not only agriculture and regional grain markets which impact food security. Forestry and other production systems, which are themselves impacted by climate change, also are key influence. Community forestry in Nepal is a major success story, one linked to success in promoting livestock rearing and increasing milk production, livelihoods which have especially benefited women in households with seasonal male migrants. Increasing forest cover is also perceived as a key mechanism for promoting cost-effective carbon banking which mitigates greenhouse gas emissions, while providing local populations with an array of products that help them adapt to climate change. If, however, the mid-hills become drier, as is predicted, the unintended consequences of promoting community forestry may be devastating. An increase in the frequency and intensity of droughts, if coupled with extended forest cover, will greatly increase the risk of forest fires. Already, in the spring of 2009, smoke from fires blanketed much of the Himalaya, from Kashmir in the west to Meghalaya in the east.

These fires not only had a negative impact locally but also had potentially major implications for glacial and snow melt rates at higher elevations. In addition, in comparison with areas with extensive vegetative cover, areas affected by fire and drought generate far higher sediment loads because they are more vulnerable to landslides, erosion and debris flow after intense precipitation and because they exhibit "flashy" runoff patterns. The problem of sediment transfer has long-term implications. The rivers of Nepal already transfer huge amounts of sediment derived from natural and geological processes such as landslides and other mass movements and the erosion of riverbeds and banks. Rainfall events, particularly cloudbursts, accentuate these processes thereby increasing regional sedimentation. Coarse sediment deposition is particularly intense at the base of hills, where river gradients decline dramatically as they enter the plains. In this zone, rivers shift their channels frequently.

These dynamics will clearly have an impact on sedimentation processes, but the extent of that impact is not easy to quantify. The challenge is particularly complex because it has never been possible to measure sediment base-loads, which are mobilized during intense flooding events. This lack of precise information is significant as water and

sediment fluxes determine the design, operation and functioning of structural control measures such as embankments.

Forest fires have other indirect long-term impacts, too. The difficulty in establishing seedlings after a fire will prolong the time before villagers can gather non-timber forest products (NTFPs). The loss of forest implies loss of local livelihoods. It may also affect integrity of local water sources, as increased instances of local landslides may damage them while changes in pattern of local rainfall may affect groundwater sub-processes in the mountains. On the other hand, if higher intensity rainfall becomes more frequent, it means that landslide events in the mountains will become more common.

Implications for policymaking on adaptation:

Together, the emerging dynamics of climate change as they relate to flooding, aridity, drought and forest fires could significantly increase the impact on local-level food and livelihood systems. The implications of these dynamics for policymaking for adaptation are immense. Understanding the interactions among forest, agriculture, water management, disaster risk reduction and other livelihood systems on the one hand and climate scenarios on the other, has implications for the development of effective strategies for adapting to both short and long term impacts of climate change. Failure to explore these linkages will jeopardise the country's ability to adapt to climate change. The Government of Nepal recently completed its national-level adaptation plan (NAPA) with support from UNDP-GEF, DFID and DANIDA. The preparation involved a series of shared learning dialogues in locations along three north-south transects. The document identifies different priority projects and recognizes the need for local-level adaptation plans which are currently being designed.

While government-initiated planned adaptation has been occurring, the populations in many regions have been responding autonomously to stresses. Autonomous adaptation includes individual or collective responses that populations, communities, businesses and other agencies undertake on their own in response to the opportunities and constraints they face as the climate changes. These may involve changes in practices and technologies, diversification of livelihood systems, accessing financial resources

such as micro-insurance and micro-credit, migration, reconfiguring labour or resource allocation and collective action to access services, resources or markets (NCVST, 2009). In Nepal, autonomous adaptation occurs mostly in the poorly-documented informal sector.

Food and forestry:

The implications of climate change for food and forest policy are serious. Where food security is concerned, the question is whether to pursue strategies that depend on strengthening local agriculture or those that rely on importing food from regional markets using remittances and other sources of income. Forestry is the other sector likely to be affected. Many in the international community are promoting a programme to reduce emissions from deforestation and forest degradation (REDD) in developing countries and since Nepal's community forestry efforts are seen as a major success, it is likely that Nepal will see an increase in investment in reforestation. Unless the risk of fire can be minimized, changing climate conditions could make reliance on forestry for carbon banking and local adaptation counter-productive both at the local level and in relation to the regional climate conditions that influence basin-level water availability and sediment loads. These changes could, in turn, affect attempts to support local livelihoods through irrigated agriculture and diversification into local, forest-based activities. Should such strategies fail, local populations will increasingly rely on either migration or direct support from international institutions to meet their basic needs.

Migration:

In Nepal, **migration, whether seasonal or long-term, is a key strategy of adaptation for many households.** While it does reduce risk and in the short term can contribute financial resilience through remittances and reduced reliance on land-based livelihoods, it also alters community relationships and local resource management dynamics. The long-term implications of such a strategy could debilitate the social and economic health of the country as domestic skill and expertise declines. At the same time, increased income from remittances can fuel an increase in consumer spending that makes little contribution to the national economy with the end result that the GNP depends on a fragile and consumerist remittance economy. A study by the National Planning

Commission (NPC, 2010) suggests that the financial benefit from short-term seasonal migration to India is low and that the associated health risks are high.

Way forward:

The discussion above demonstrates that climate change is a complex problem in Nepal and raises more questions than provides answers. Uncertainty is high and models do not tell us specifically what is likely to happen. However, uncertainty about what the impact will be does not mean that we should do nothing. People will be more vulnerable and the need for adaptation will be crucial. What are the possibilities for adaptation? Who decides how to adapt and how is that decision made? How are the perspectives of the affected and those who are already making autonomous decisions included? What can the government do in terms of planned adaptation? Answers are not easy because every group in every community right across Nepal has its own set of vulnerabilities. In addition, since vulnerability is dynamic, those sets of **vulnerabilities will alter as climate change begins to impact the inter-linkages among livelihood systems, water management, disaster risk reduction, agriculture and forestry and financial instruments.**

Financial opportunities that help reduce risk include access to credit, the formation of self-help groups that disburse loans and micro-credit, crop insurance and access to local markets. These mechanisms can provide individuals with a safety net, should crops or assets be damaged by floods, drought or forest fires and provide incentives for behavioral change. For instance, micro-credit and loans can help farmers cultivate drought or flood-resistant species and increase crop variety. They also enable them to access seeds and equipment more rapidly in the aftermath of a flood event. Non-financial options for improving resilience include the expansion of communication networks. The use of local radio stations and cell phone networks increases the potential of information flow and the likelihood that communities will be more aware of key issues related to climate and weather. Such systems can also foster the functioning of early warning systems. Improved awareness gives individuals more time to move assets, such as livestock and food, to safer places prior to a flood event. The feasibility and long-term implications of such policies for adaptation need to be explored further.

We began this paper by arguing that climate change is a '"˜wicked' problem. The above discussion demonstrates that this indeed is the case in Nepal, where development, meteorology, social context and responses to climate change adaptation intermesh in a complex way. The problem has no simple answer or silver-bullet solution. Clearly, approaches to respond to the challenges need to be conceived in terms of plural institutions (Verweij and Thompson, 2006) and incremental solutions (NCVST, 2009) designed to overcome key constraints and enable Nepali households to adapt to new conditions as and when they emerge. The approach must strive to remain flexible particularly because of the tendency of government agencies to move towards unitary or rigid paths, away from those that are plural and reflexive.

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