MAINSTREAMING CLIMATE-SENSITIVE INDICATORS INTO AN EXISTING FOOD MONITORING SYSTEM

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June 2013

This document is an output from a project funded by the UK Department for International Development (DFID) and the Netherlands Directorate-General for International Cooperation (DGIS) for the benefit of developing countries. However, the views expressed and information contained in it are not necessarily those of or endorsed by DFID, DGIS or the entities managing the delivery of the Climate and Development Knowledge Network, which can accept no responsibility or liability for such views, completeness or accuracy of the information or for any reliance placed on them.

The Climate and Development Knowledge Network ("CDKN") is a project funded by the UK Department for International Development and the Netherlands Directorate-General for International Cooperation (DGIS) and is led and administered by PricewaterhouseCoopers LLP. Management of the delivery of CDKN is undertaken by PricewaterhouseCoopers LLP, and an alliance of organisations including Fundación Futuro Latinoamericano, INTRAC, LEAD International, the Overseas Development Institute, and SouthSouthNorth.

ISBN: 978-9937-8708-2-5

Published by Institute for Social and Environmental Transition-Nepal (ISET-Nepal), for Climate and Development Knowledge Network (CDKN), UK

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Layout design: Digiscan Pre-press, Naxal Kathmandu

Citation as: Dixit, A., Subedi, Y., McMahon, T. and Moench, M. (eds) (2013), *Mainstreaming Climate Sensitive Indicators into an Existing Food Monitoring System: Climate Change and Food Security in Nepal*, Institute for Social and Environmental Transition-Nepal (ISET-Nepal), Kathmandu.

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This study aimed to strengthen the *Nepal Food Security Monitoring System (NeKSAP)* by incorporating climate sensitive food security indicators into the household survey and District Food Security Network (DFSN) data set collected and maintained by WFP-Nepal. The study implemented from November 2011 to mid-November 2012 was a partnership among ISET-N, ISET-International and WFP-Nepal and CDKN (Climate and Development Knowledge Network, UK).

This study has received support from various persons at different stages. We would like to express our appreciation and gratitude to all of them.Kashmala Kakakhel, CDKN, Pakistan coordinated and provided backstopping support on behalf of CDKN and deserves our appreciation for her valuable suggestions. Dr. Madhav Karki, Senior Research Faculty at ISET-Nepal provided much needed input to strengthen the report. Dr. Deepak Rijal, an independent consultant, was involved in the study from the beginning and provided support throughout the study period. We also thank Mariko Kawabata, Pushpa Shrestha, Abesh KC, Dr. Shridhar Thapa, Mana Kshetri and Bakhat Niroula of WFP-Nepal for their support and input. The Field Monitors of WFP-Nepal provided input at different stages of the study.

All our colleagues at ISET-Nepal are thanked for their support, cooperation and contributions. Kamal Thapa and Sravan Shrestha researchers at ISET-Nepal provided much needed support in the analysis of the database and in the GIS system. We express our deep appreciation to Lea Sabbag of ISET-International for her input. Perry K. Thapa provided editorial support and deserves our deep appreciation.

LIST OF ABBREVIATION

AC:	Adaptive Capacity
CC:	Climate Change
CBO:	Community Based Organization
CCVI:	Climate Change Vulnerability Index
CDKN:	Climate and Development Knowledge Network
CLIFSI:	Climate Sensitive Food Security Indicators
DFSNs:	District Food Security Networks
DLFSRI:	District-Level Food security Reference Indicators
FAO:	Food and Agriculture Organization
GIS:	Geographic Information System
GLOF:	Glacial Lake Outburst Flood
GO:	Governmental Organization
GoN:	Government of Nepal
HHs:	Households
IISD:	International Institute for Sustainable Development
IPC:	Integrated Food Security Phase Classification
IPCC:	Intergovernmental Panel on Climate Change
ISET:	Institute for Social and Environmental Transition
ISET-Nepal:	Institute for Social and Environmental Transition-Nepal
LAPA:	Local Adaptation Plan of Action
MCPM:	Minimum Conditions and Performance Measures
MoAD:	Ministry of Agriculture Development
MoFALD:	Ministry of Federal Affairs and Local Development
MoSTE:	Ministry of Science, Technology and Environment
NAPA:	National Adaptation Programme of Action
NeKSAP:	Nepal Khadya Surakshya Anugaman Pranali (Nepal Food Security Monitoring System)
NCVST:	Nepal Climate Vulnerability Study Team
NGO:	Non Governmental Organization
NTFP:	Non Timber Food Products
PPCR:	Pilot Program for Climate Resilience
SAM:	South Asian Monsoon
UN:	United Nation
UNDP:	United Nations Development Programme
UNICEF:	United Nations Children's Fund
USD:	United States Dollar
VAM:	Vulnerability Analysis and Mapping
VDCs:	Village Development Committees
WFP:	World Food Programme
WFP-Nepal:	World Food Programme-Nepal

EXECUTIVE SUMMARY

It is now widely accepted that anthropogenic global climate change and increasing variability and uncertainty of the conditions impinge on people's livelihoods. Climate change is also introducing new sources of vulnerabilities affecting the living conditions of most people in developing countries. As a consequence, livelihoods of those populations dependent on forest resources and agricultural are being threatened. Studies on climate change in Nepal suggest that in the future precipitation is likely to be more variable and will affect water availability for agricultural production and crop yields sensitive to climate conditions may fall and threaten overall food security. That prevailing conditions of poverty and low human development mean that about 3.4 million of Nepali people face food insecurity are reflection of the challenges.

For least developed countries like Nepal the challenges of achieving food security since climate-related hazards become increasingly frequent and more intense is daunting and requires serious and continuous efforts. The challenges are compounded because it is not yet fully known how global and regional climate change processes will translate into local outcomes. Government of Nepal (GoN), multilateral banks, bilateral donors agencies, various research groups, and local government functionaries including agencies such as the World Food Programme-Nepal (WFP-Nepal) are involved in addressing issues of food insecurity through research and evidence based field studies.

In 1963 WFP began its operations in Nepal, which supports the effort to overcome food insecurity, and in 2002 initiated Field Surveillance System, to collect and analyse information on food security. In 2009 WFP, and the then Ministry of Agriculture and Cooperatives established this system as Nepal Khadhya Surakshya Anugaman Pranali-NeKSAP (Nepal Food Security Monitoring System)– a comprehensive food security monitoring system, which collates, consolidates, and analyses food security information, and communicates the product to the decision makers in order to advocate/influence for coordinated, appropriate, and timely action to prevent human suffering due to food insecurity. The District Food Security Networks (DFSNs), established in 72 out of the 75 districts are the core of NeKSAP; they monitor and analyse the food security situation in their districts based on the standardised Integrated Food Security Phase Classification (IPC) methodology and report to the Ministry of Agricultural Development (MoAD) and WFP. Besides this, NeKSAP conducts household survey with some 4,000 observations per annum, and collects market and price information from key markets from across the country. The data thus collected are used to generate insights into local food insecurity that can help decision-makers, including the Ministry of Agriculture Development (MoAD), to develop programmes to minimise suffering due to food insecurity.

This report encapsulates findings of a year long study that proposes mainstreaming climate sensitive food security indicators into NeKSAP. The collaborative study among ISET-Nepal, ISET-International and WFP-Nepal received support from Climate and Development Knowledge Network (CDKN). The study used series of consultations with WFP-Nepal functionaries to review indicators obtained from global literature and NeKSAP. The team analysed NeKSAP and proposed 28 indicators to assess vulnerabilities to climate change. The 28 indicators are to be used with VAM and administered at the household level. In addition, the study has proposed 15 district level indicators. The set of 28 indicators were pre-tested, administered and the data obtained analysed for ranking vulnerability. The proposed indicators were called Climate-Sensitive Food Security Indicators (CLIFSI).

The use of CLIFSI data helped rank Nepal's region for assessing vulnerability to climate change. By incorporating CLIFSI, NeKSAP will be strengthened and become useful for planning and policy making in relation to climate change vulnerabilities. The National Planning Commission, Ministry of Agriculture Development, and Ministry of Science, Technology and Environment will find CLIFSI useful as a decision support tool to design strategies for building resilient food systems as well as to develop the capacity of local households to overcome food insecurity.

STARTING POINTS

In 2011, the Government of Nepal made its policy on climate change public. The policy envisions a country "spared from the adverse impacts of climate change, by considering climate justice, through the pursuit of environmental conservation, human development, and sustainable development [with] all contributing toward a prosperous society". This objective of making Nepal and Nepali society more resilient to climate change is laudable, especially as emerging evidence suggests that Nepal and its people are likely to be very vulnerable to the impacts of climate change.

Achieving this vision of a resilient population will not be easy for Nepal. As one of the least developed countries in the world—it ranks 157 out of 187 on the human development index (United Nations Development Programme, 2011)—Nepal faces fundamental socio-political challenges in its quest to advance up the human development ladder. To achieve resilience, the nation must improve its socio-economic state and its quality of governance while at the same time build its capacity to bear the risks that climate change poses.

The GoN has already initiated a number of programmes that aim to minimise climate change vulnerabilities and build the capacity of individuals, communities and ecosystems. These include the National Adaptation Programme of Action (NAPA), which aims to identify urgent and immediate adaptation needs and implement measures to meet them; the Pilot Programme for Climate Resilience (PPCR), which aims to build national resilience to climate change impacts; and the government-approved Local Adaptation Plan of Action (LAPA), which take resilience to the local level. All three initiatives recognise the importance of assessing baseline conditions and developing indicators before designing plans to achieve development and build resilience and adaptive capacity.

Collectively, indicators enable us to analyse the current state of achievement and thus, through comparison to both an earlier state and a targeted state, to track progress towards certain identified goals, in the case of climate change, wellbeing at national and household levels. Each indicator is a measure of a desired end result and is comparable over space and time. Since indicators reflect the extant status of large systems (IISD, 2011), they establish a set of baseline information to use in evaluating the effectiveness of programmes, policies, and interventions and comparing the status of one place to that of another (Cutter et al., 2010). By comparing baseline conditions with those later assessed during various stages of a project or programme, they indicate whether or not the interventions introduced have played a role in changing undesirable conditions. Thus, they provide a basis for assessing the gaps in development work and the input needed to redesign public policies to overcome those gaps. In doing so, they support the achievement of a vision, goals and objectives.

Great care needs to be taken in selecting indicators if they are to reflect reality. An example illustrates this caveat. The proportion of the population that uses electricity for lighting is one of the 28 socio-economic indicators that the Central Bureau of Statistics developed in 2003 to assess national and district-level development. In the decade between 2001 and 2011, that percentage rose from 39.8% to 67.2%, or, in absolute terms, the number of households that did not use electricity for lighting fell from 2,560,438 to 1,778,520. From the perspective of macro coverage, this indicator shows significant progress. However, if it is put into the context of the 12-hour daily power outages that households connected to the integrated Nepal power system face, it becomes evident that this indicator does not reveal the deep systemic malaise that exists in the energy sector. In this case, the average number of hours of power outage a day would better reflect reality.

If Nepal is to achieve universal coverage of electricity and supply domestic users, service and manufacturing sectors with reliable 24-hour power, its development policy needs to recognise more than just the most obvious indicator—the proportion of households with electricity for lighting; underlying factors, like the efficiency of the supply over time and for all types of consumers, are equally important. To make the electricity coverage indicator more meaningful, it needs to be expanded. One could, for example, disaggregate the sources of supply (hydro, solar, etc.) or analyse the data on a spatial scale; either approach or another altogether would provide the additional evidence needed to suggest and justify a particular revision of an existing public policy on energy. In short, unless indicators are chosen thoughtfully, they will not be useful in promoting development aims.

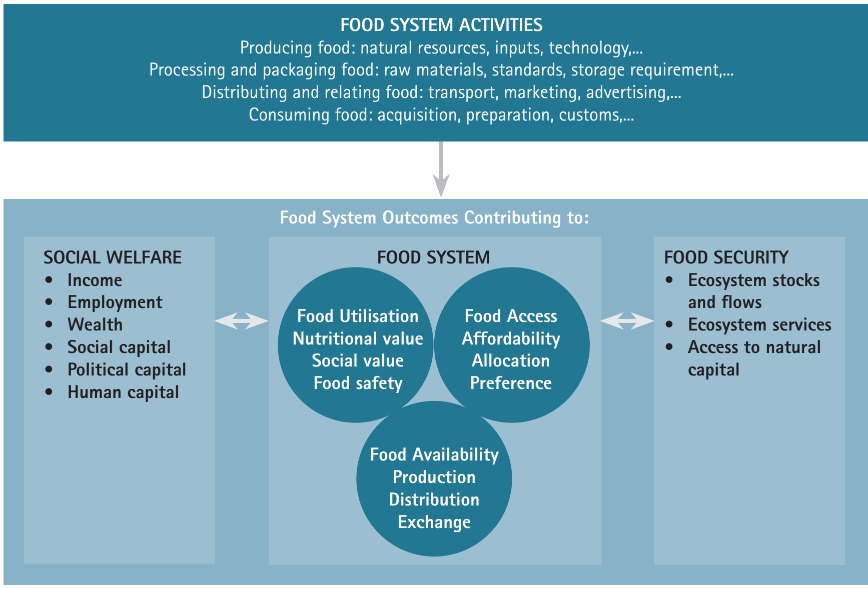
Well-selected indicators can be useful not just in measuring the effectiveness of an intervention but also in assessing food insecurity and other vulnerabilities to climate change, which, as the frequency and magnitude of extreme climate events increase, are bound to grow. Higher temperatures and droughts will reduce agricultural production, and floods and landslides will block roads and destroy bridges, interrupting the distribution of whatever is produced. The result will be an increase in food insecurity. Indicators that assess both food insecurity and the effectiveness of efforts to combat it will put decision-makers in a better position to prepare strategies to build resilience and adaptive capacity. Recent research, including that of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (2007) suggests that global climate change will have debilitating impact on food security, particularly for people at social and economic margins.

Climate change will affect food security directly through its influence on local and regional food systems and their components as well as indirectly because the food systems are interdependent with other core systems, including water, forest and energy, all of which are foundational for wellbeing. For this reason, the likely impacts that climate change will have on each of these systems must be assessed in achieving the government's aim of making all its citizens food secure. This task requires developing a wide range of complementary and comprehensive indicators.

FOOD SYSTEM

Though food production is, obviously, important to food security, food security covers far more than just production. Food security is dependent and supported by food systems, which are a set of dynamic interaction between and within the biophysical and human environment that result in the production, processing, distribution, preparation and consumption of food (GECAFS, 2008). They encompass four components of food systems—food availability (with elements related to production, distribution and exchange), food access (with elements related to affordability, allocation and preference) food utilization (with elements related to nutritional value, social value and food safety) and stability (with elements related to food prices, supply chain infrastructure, imports etc.) (see Table 1 and figure 1). Food security is achieved when food system operates such that "all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs" (FAO, 1996). When

FIGURE 1:
Components of a food system



Source: GECAFS (2008)

TABLE 1
COMPONENTS OF A FOOD SYSTEM

Determinant	Likely effects of climate change
Availability of food	Decreases in production due to a variety of changes: More frequent and intense extreme weather events Changes in temperature and rainfall Declines in the availability of arable land and insufficient water for irrigation Unavailability or lack of access to resistant varieties of seed and breeds Increases in pest infestations and the incidence of diseases
Access to food	Damage to infrastructure and loss of livelihood assets Loss of income and employment opportunities
Utilization of food	Increased food safety hazards associated with the increase in pest infestations as well as animal and human diseases
Stability of food	Food price fluctuations, changes in the supply chain infrastructure, and a higher dependency on imports and food aid

Source: FAO (2008); Gregory, et al. (2005); Parry et al. (2005); Schmidhuber & Tubiello (2007) food systems are stressed by external shocks, food security is diminished. This notion that food is a system reminds us that it encompasses a set of interlinked elements, agents and institutions, each of which will variously shape its resilience to climate change (ISET, 2008). For this reason, in an ideal sense, assessing the overall vulnerability of any given food system to climate change requires using a set of interrelated indicators designed to assess all four of its components.

That said, food availability alone can serve as a useful (though not sufficient) indicator for understanding an entire system and its potential vulnerabilities. A comparison of almost three decades of statistics recorded by the Ministry of Agriculture Development (1995-2012) on one indicator of food availability—district-level annual food production and food requirements—is more revealing. On balance,

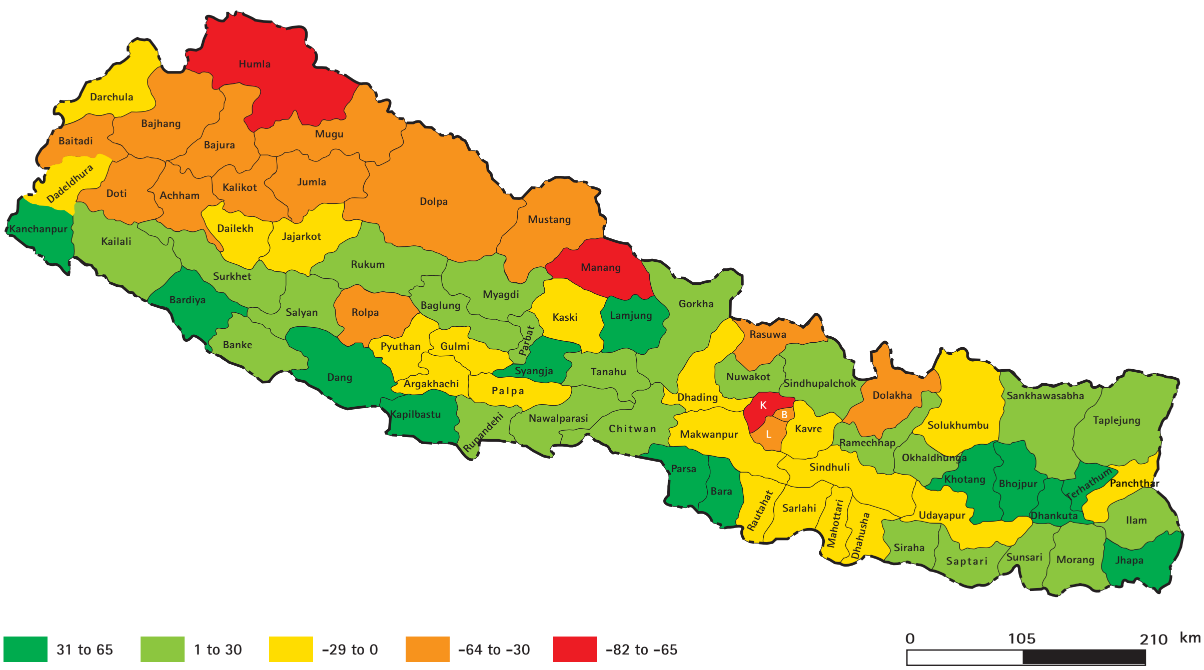


FIGURE 2:
District level food balance (Food production deficit / surplus as a percentage of total requirement over time, 1995 - 2012)

Source: Based on statistical records of MoAD (1995-2012)

Food balance	Colour Indication	Number	Districts
Surplus		14	Kanchanpur, Bardiya, Dang, Kapilbastu, Parbat, Syangja, Lamjung, Bara, Parsa, Khotang, Bhojpur, Dhankuta, Terahthum, Jhapa
Moderately surplus		23	Kailali, Surkhet, Salyan, Banke, Rukum, Baglung, Myagdi, Rupandehi, Nawalparasi, Tanahun, Gorkha, Chitwan, Nuwakot, Sindhupalchwok, Ramechap, Okhaldhunga, Siraha, Saptari, Sunsari, Morang, Ilam, Taplejung, Sankhuwasabha
Transition		20	Darchula, Dadeldhura, Dailekh, Jajarkot, Pyuthan, Arghakanchi, Gulmi, Palpa, Kaski, Dhading, Makawanpur, Rautahat, Kavre, Sindhuli, Udayapur, Sarlahi, Mohattari, Dhanusa, Solukhumbu, Pachthar
Deficit		15	Baitadi, Doti, Bhajang, Bajura, Achham, Kalikot, Jumla, Mugu, Dolpa, Rolpa, Mustang, Rasuwa, Dolakha, Lalitpur, Bhaktapur
Highly Deficit		3	Humla, Manang, Kathmandu

over last the two-and-a-half decades, most districts register more production deficits rather than surpluses. Out of 75 districts, 18 are considered outright food-deficit areas and just 14 districts, have a food-surplus (Figure 2). This food availability indicator does not simply reveal a pattern of potential district-level food imbalances; it provides evidence, which can support the adoption of policies that can address those imbalances. It also provides an aggregate picture of food balance at the national level. In 2010, for example, Nepal's the food deficit was 316,000 tonnes, a 139 per cent increase over the previous year (Gautam, 2012). Clearly, Nepal's growing national-level food-deficit is a concern but it must also be recognised that Nepal's food systems are changing. In fact, the very nature of local food systems is evolving as communities are becoming increasingly dependent on far away regional markets and their historical dependence on localised production-consumption relationships for meeting food needs is changing (Moench et al., forthcoming) and many households purchase food.

While data regarding food balances at national and district levels is useful, it does not reveal the condition of food system components at local level. Particular village development committees (VDCs), wards, communities or households within a district may experience a food deficit though that district as a whole may be a food-surplus district. In many villages and communities, local food production has declined for a variety of reasons, including erratic rainfall and the lack of reliable irrigation water as well as the lack of roads, food distribution systems, and other infrastructures. Other factors reducing food availability include people's growing disinterest in farming and the increasing attraction of non-agricultural opportunities, including the promise of jobs abroad. Youths, in particular, are keen to break with traditional agrarian livelihoods. Local cereal production has also dropped and household cereal imports have risen as farmers increasingly seek the substantial profits that cultivating vegetables and other cash crops promises.

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Suspension bridge (Parbat Distirct) supports population mobility

CLIMATE AND THE CLIMATE CHANGE SCENARIO

Historically, climate remains one of the key determinants of food production in Nepal. Since 1951 Nepal has invested in building public irrigation systems and supporting local farmer-built and -managed small irrigation systems, but agriculture still depends on the monsoon and winter rains and many of the irrigation services are unreliable.

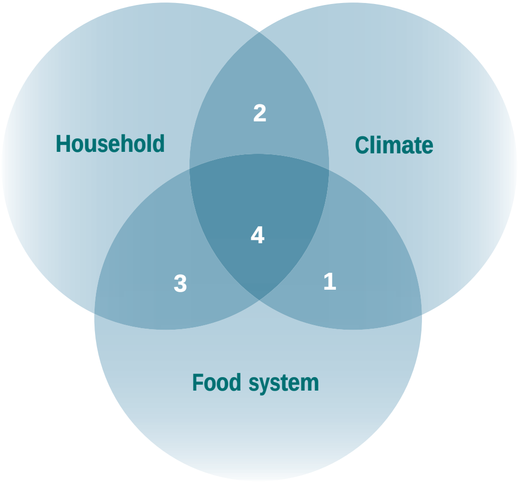
Nepal's three ecological zones increase in altitude from 100 to 8000 masl as one moves the 150 km northward from the Indian to the Chinese borders. It is this dramatic north-south variation which gives rise to its vastly different climatic regions—from humid sub-tropical in the Tarai plain to arctic in the High Himalaya. Its topography makes Nepal prone to various types of climatic hazards, including landslides, slope failures, soil erosion, land mass movement, and floods, all of which regularly result in disasters (Bartlett et al., 2010).

Altitude is the single most influential factor determining temperature variations in Nepal. In the Tarai, the hottest region, the maximum temperature ever recorded exceeds 45^{o}C and temperatures routinely range 22-27 ^{o}C in the summer and 10-15 ^{o}C in the winter. In mountainous regions, in contrast, the summer temperature range is just 5-15 ^{o}C and temperatures remain well below zero throughout the winter. Nepal's maximum temperature continues to rise at an annual rate of 0.04-0.08^{o}C (Lohani, 2007; NCVST, 2009; NAPA, 2010). An analysis of temperature trends at 49 meteorological stations from 1977 to 1994 revealed consistent and continuous warming at an average annual rate of 0.06^{o}C (Shrestha et al., 1999). A later study of temperatures recorded at 45 stations between 1996 and 2005 indicated consistent and continuous warming, but at a slightly lower annual rate, 0.04 ^{o}C (Practical Action, 2009).

The timing and distribution of precipitation across the country are influenced by the South Asian Monsoon (SAM), which brings heavy rains from June to September. In fact, 80 per cent of the total annual rainfall occurs in just these four months, an intensity with profound impacts for the hydrological regimes of the country's streams and rivers. Annual mean precipitation is 1,857.6 mm but shows marked spatial and temporal variations along the north-south and east-west axes (Practical Action, 2009). The South Asian monsoon brings more rainfall in the east than it does in the west, while the winter westerlies have the opposite result. At high altitudes, westerly winds bring precipitation in the form of snowfall. Topographic variations account for the huge disparities in rainfall, whose annual accumulation ranges from a high of over 5,000 mm along the southern slopes of the Annapurna range in the western development region to less than 250 mm north of the Annapurna range on the Tibetan plateau. At the basin scale, there are marked differences in the average annual precipitation between valley bottoms and ridge tops (Domoroes, 1978; Barros et. al., 2003; Dixit and Moench, 2004). Because the number of rain gauge stations is inadequate, existing data sets cannot capture the actual characteristics and nature of changes or variations in the pattern of precipitation, but local people almost everywhere in Nepal suggest that monsoon rain falls less incessantly than it once did. Besides the trend toward intermittent rainfall, the increasing dryness of the pre- and post-monsoon seasons is an important determinant of agricultural production and productivity.

Recent research suggests that the increasing concentration of greenhouse gases in the atmosphere is likely to make precipitation in all seasons more unpredictable and erratic, but we cannot say with certitude if rainfall in any particular area will increase or decrease (NCVST, 2009). Simply put, both the seasonality and volume of water available will change in unpredictable ways. These changes, whatever they are, will ripple through Nepal's complex topography and its diverse local, meso and macro characteristics and development sectors, creating new sources of vulnerabilities. Although no sector will escape the impacts, certain ones such as agriculture, are likely to be more severe than on others (NAPA, 2010). In fact, because agricultural activities are directly linked to precipitation, the production component of every food system will be impacted by the changes in precipitation (Figure 3). Inter-governmental Panel on Climate Change (2007) has recognised this linkage, suggesting that global climate change will likely have debilitating effects on food security particularly among the socially and economically marginalised.

FIGURE 3:
Intersection of household, climate and food system

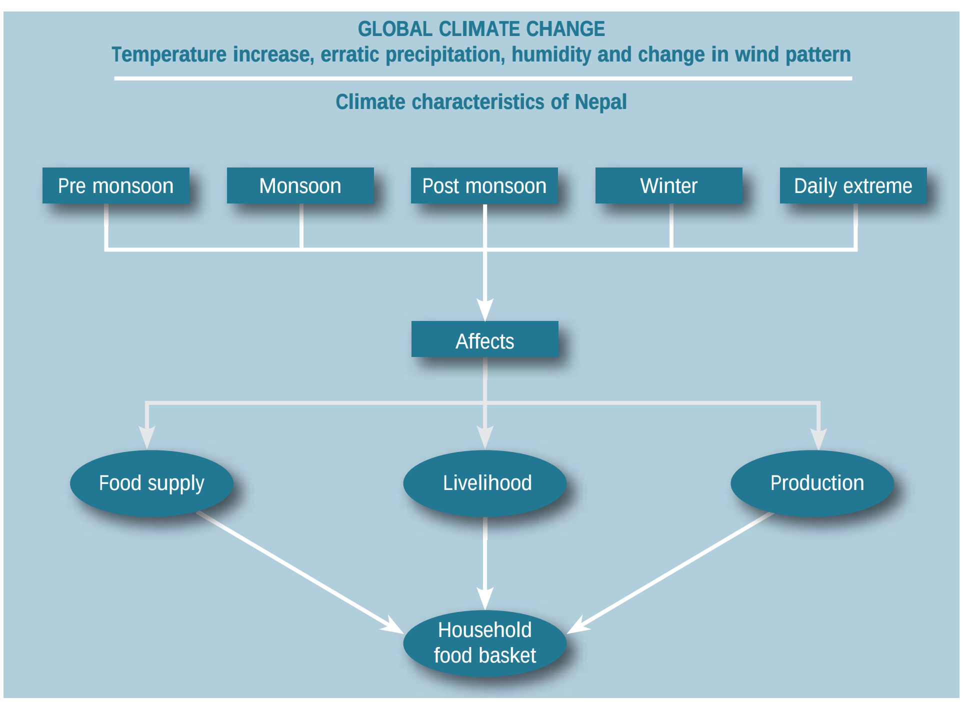


1. Reduced production due to low and erratic rainfall high/low temperature affecting crops
   Flood/landslide leading to loss of assets, disruption in food supply and distribution
2. Higher temperature and increased variability lowers health hygiene condition
   Diseases
   Debilitates low human development condition
3. Low landholding
   Unreliable irrigation and lack of irrigation
   Lack of agricultural input: seeds, fertilisers, access to market
   Poor nutrition
4. Fragile system and marginal households with low capacity face increased vulnerability due to climate change

ASSESSING VULNERABILITY TO CLIMATE CHANGE: CONCEPT AND APPROACH

Human vulnerability to climate change is a function of a population's exposure, meaning that their lives, livelihoods, relationships and assets are either directly or indirectly likely to be impacted by climate change, and its capacity to shift strategies in ways that reduce that susceptibility (ISET, 2008). While this conception of vulnerability is useful, it does not suggest how to evaluate the scale of climate change impacts, the vulnerability of a particular region, or the most vulnerable populations. It also ignores what is known as the "imbedded nature" of vulnerability, or the fact that the vulnerability of a sub-population within an impacted society is the outcome of multiple layers of social marginalisation and political contexts within it. One approach to assessing vulnerability is scientific: physical scientists tend to espouse a natural hazards-based school of thought, a positivist approach to development rooted in the technological management of risk. They consider risk reduction a physical function and equate vulnerability with physical exposure to extreme events and adverse outcomes, the characteristics of the biophysical environment, and natural resource distribution. This approach to conceiving vulnerability is insufficient because it does not consider the question of which sub-populations among the exposed are most affected due to factors beyond just where they live. The social approach to a vulnerability assessment can fill that gap.

FIGURE 4: **Interfacing global climate change and household food basket**



More particularly, the scientific, natural-hazards approach focuses on the frequency or probability of physical hazards and the likely intensity of exposure or risk (the expected damage and loss) due to the combination of vulnerability and hazards. It entails assessing risk by mapping hazard-prone areas using indicators and the global information system as the National Oceanic and Atmospheric Agency (NOAA) (2010) suggests, risk areas identify geographically (typically on maps) those areas most likely to be affected by a given hazard. But people and resources located within that area at risk from exposure to hazards may or may not be vulnerable to hazard impacts. According to Adger (2006), certain people, groups, and communities are vulnerable because they fail to secure their entitlement to resources and because structural factors leave them disproportionately disadvantaged when faced with disasters. Embedded vulnerability comprises those characteristics that influence their capacity to anticipate, cope with, resist, and recover from the impact of hazards. Because vulnerability depends on being at risk from a specific hazard or set of hazards, the concepts of vulnerability and exposure are inseparable (Blaikie et al., 1994).

This "individual susceptibility" approach has its origins in food security and famine literature. Watts and Bohle (1993) suggest that vulnerability to food insecurity can be conceived in terms of both exposure to stress and crises and the capacity to cope with them as well as the consequences of stress and the related risk of slow recovery from them as determined by socio-economic structures, property relations and capacity. The starting point of this approach, the social approach, is conditions already embedded in a given social context: "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)" (Wisner et al., 2004). The approach considers the "social space" (Bohle et al., 1994) that determines an individual's or a community's exposure to risk, coping capacity and recovery potential.

These conceptual approaches to vulnerability are being examined in detail in the aftermath of the 13th Conference of Parties, held in Bali in 2007. The Bali Action Plan, for instance, declared that more financial resources would be devoted to building adaptive capacity and that funding would target most-at-risk populations and thus created incentives for practical method to assess vulnerability. In fact, vulnerability indicators are now commonly used to capture the disproportionate impacts climate change is likely to have on high-risk areas (like flood plains prone to frequent inundation or hill slopes prone to landslide), fragile systems (like drinking water, road, and communication systems) and individual, households and groups at greater risk. Demand for the systematic assessment of vulnerability has also increased as a result of the need to document the performance of investments in adaptive measures.

When it comes to climate change, the need for vulnerability assessments of both areas and people remain clear (See figue 4). Climate change affects different ecological regions differently: a mountainous region may see less snowfall; a coast, higher tides. Even within a single region, there are differences, both physical and socio-economic. For example, high hilltops face different challenges than the valleys in between and even at the same elevation, leeward and windward hills will be impacted differently. Heterogeneous sub-populations within any given area are also affected differently though, in general, it is the economically and socially marginalised sections of society–the poor, women, children, and those who for political, cultural, religious, or ethnic reasons lack access to capacity and resources–who will be most vulnerable.

Comparing the vulnerability of various places is essential when, as is inevitably the case, resources are limited and target areas must be identified for making decision on priority. Once an area has been identified as being more vulnerable than most, those individuals, households, communities and groups who are already burdened by social and economic deprivations—imbedded vulnerability—need to be identified, as they will also be the ones most vulnerable to climate change. This already complex assessment is complicated by the fact that vulnerabilities differ not just across space and by sub-population, but over time (Vogel and O'Brien, 2004). This complexity has worked against the adoption of a universally accepted definition of vulnerability, much less a universally accepted method of assessing it.

One method of comparison involves using indicators to rank the vulnerability of regions. Maplecroft, a global risks advisory firm, assessed 170 countries using 42 social, economic and environmental indicators, including exposure to climate-related natural disasters, human sensitivity (population patterns, development, natural resources, agricultural dependency, and conflicts) and the adaptive capacity of a country's government and infrastructure to combat climate change and prepare a Climate Change Vulnerability Index (CCVI). According to this index, Nepal is the fourth most vulnerable country in the world. While this finding can provide a basis for decision–making, researchers warn that indictors fail to take into account the heterogeneity of vulnerability within even the smallest of scales, like a neighborhood (Surarez and Ribot, 2003) and that vulnerability analysis must remain open to multiple interacting sources of harm (Ribot et al., 1996).

Since the continuous rise in the atmospheric concentrations of greenhouse gases and rising global temperatures characterising climate change threaten the most basic of systems on which all societies depend—food, water, and energy among them—policymakers must make decisions calculated to minimise vulnerability and build resilience and adaptive capacity. Unfortunately, neither the concept nor the practical measurement of vulnerability gives them a clear way to proceed. Patt et al. (2011) argue that it is too easy for vulnerability analysts to make claims that cannot be supported with credible theory to reconcile competing arguments and that, unless they conduct vulnerability assessments within the domain of policy analysis, they may unwittingly fall into an intellectual debate. The authors suggest that while practical assessment is a necessary step it is not a sufficient one; analysts must be cognisant and make innovative use of the different schools of thought and on-going debates in the policy terrain so that they can assist decision-makers at various levels of government (Dilley and Boudreau, 2001) as well as remain cognisant that vulnerability is a function of both hazard and social context (Mustafa and Ahmad, 2007).

Assessing vulnerability raises many practical questions. How, for example, can analysts designate one area as being more vulnerable than another when climate change recognises no boundaries? How can we judge the future climate scenario of a specific area when general circulation models of climate change lack such predictive capacity? How do the people living in any particular area respond to current climate hazards? What sorts of indicators, particularly those related to food systems, will help establish data sets that can facilitate the assessment of vulnerability and, in doing so, assist in decision-making aimed at building a resilient system that promotes food security?

To minimise the risks posed by climate change in specific locations, planners and decision-makers need to know three key pieces of information. First, they must establish how climate change will affect the ecosystems and core systems (drinking water, energy, communication, and the like) in that area as these are the systems that people rely on to respond to climate and other stresses and thereby to minimise their vulnerability. Second, they must determine which people within a given location will be most vulnerable to the impacts of climate change. Finally, they must assess how local systems and infrastructure are linked to regional and

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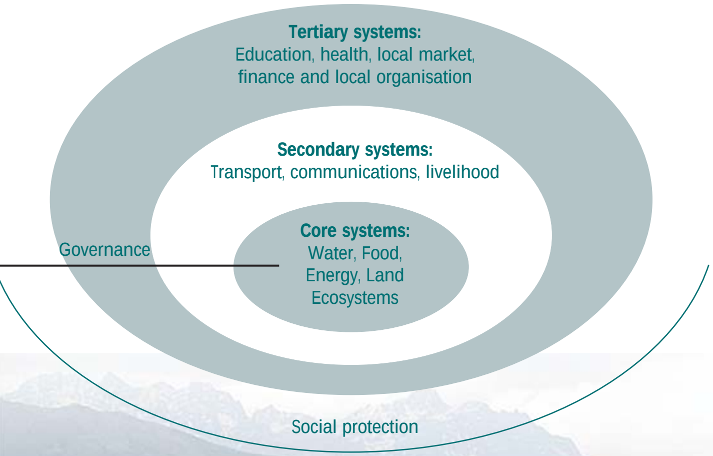
Storage of fodder for livestock (Parbat District) global markets and systems, which, given the changing dynamics within Nepal, will increasingly be the sources of new vulnerabilities. Where systems are fragile, of poor quality, inaccessible, or subject to disruption by climate change-induced hazards, vulnerability will increase. Conversely, if systems are resilient and if certain social and political mechanisms that enable people to take advantage of them exist or are introduced, vulnerability to climate change impacts can be minimised.

This study used the idea that social and economic systems are gateways to services as its foundation for assessing vulnerability (Figure 5). The term "systems as gateways to services" is intended to draw attention to the fact that inherent in the very nature of systems is the notion of differential access—that different actors can make use of the services they provide to different degrees—and emerges from the understanding that adaptation is the ability to switch strategies—to draw upon different systems—to cope with climate change-related and other stresses (ISET, 2008). This approach saw its genesis in the promotion of adaptive responses to flood and droughts (Moench et al., 2004) and was later used to propose a conceptual framework for building adaptive capacity (ISET, 2008). Whether or not individuals, households and groups can switch strategies depends on their ability to access services from both ecosystems and human built systems such as energy, water, mobility and finance. The degree of accessibility itself depends on the decision-making space available to these actors, which, in turn, is a function of other systems, including

FIGURE 5:
Concept of systems as gateways



Source: ISET, (2008)

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Airport in Simikot (Humla District) serves as a gateway transportation, communications, and banking, and access to natural resources. The totality of physical and social infrastructures which exist within any given context, along with availability of resources, create a space within which decisions regarding shifting strategies are made.

The systems-as-gateways framework was used as a methodology for assessing vulnerability for use in Nepal's local adaptation plans of action (LAPA, 2011; Dixit et al., 2010) and the National Planning Commission adopted it in Nepal's most recent three-year plan, which introduces, for the first time in the nation's almost sixty years of such planning, the concept of resilience. The core, secondary and tertiary levels of systems in this approach are shown in figure 5.

The study compared the food security indicators of NeKSAP with systems-as-gateways indicators to identify gaps in NeKSAP's ability to assess the vulnerability of food systems to climate change and proposed an additional set of indicators to plug in the missing information. The merged sets of new and old indicators, CLIFSI, were then used to rank the vulnerability of various geographical locations, namely the eight WFP-Nepal clusters, Nepal's three main river basins, and its five development regions. Once an area is identified as vulnerable, appropriate methods can be used to explore the imbedded social and political factors that make certain individuals, households and communities within that area vulnerable to different shocks, including climate change. This later endeavour, however, was beyond the scope of this project.

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Sloped agro-forestry terrace (Humla District)

FOOD SYSTEM AND WFP-NEPAL

Given these changing dynamics, we must conclude that while the traditionally critical component of local food systems—production—and the dependence of production on local water, land and agricultural systems remain important, the stock and flow of food even at local level is growing increasingly dependent on those infrastructural and organisational systems that function as gateways to the regional and global food and labour markets which supply villages with food itself or with the cash they need to buy food. Any assessment of the vulnerability of Nepal's national and local food systems, therefore, needs to take into account the fact that these systems themselves are changing. Often, it is changes in the components of the food systems as well as in their relationships with other factors that constitute the core determinants of vulnerability. Climate change adds new layers of stress, complicating extant conditions and exacerbating vulnerability stemming from systematic factors. Only by considering both climate- and non-climate-related vulnerabilities can the resilience of food systems be built. The complexity involved when both these dynamics are considered makes the task of achieving universal food security difficult indeed.

National stakeholders' meeting in Kathmandu

While Nepal's physical, ecological and social diversity will provide opportunities for assessing its vulnerabilities to climate hazards and building adaptive capacity, that diversity will also introduce certain constraints. In particular, the country's high rates of poverty and marginalisation, poor governance, and degrading ecosystems will exacerbate its vulnerabilities, inhibit its ability to adapt, and increase food insecurity, as will the following characteristics:

- Limited institutional capacity to respond to various shocks and stresses;
- Great regional and local imbalances in Nepal's natural resource endowment, social composition, economic status, and educational attainment;
- Geologically active topography and diverse geography;
- Rain-fed agriculture dependent on the South Asian monsoon for summer rains and the westerlies for winter rains;
- Exposure to natural and climate-induced hazards; and,
- Increasing dependence on regional food markets and the associated (and heretofore little-experienced) shocks.

Overcoming the above challenges is a daunting task and requires serious and continuous effort. It will be made more difficult because we do not yet know how global and regional climate change processes will translate into local outcomes. Boosting food security necessitates carrying out an assessment of the on-going change processes in the country's food systems and the likely impacts of climate change as well as the outcomes when they intersect. That assessment should be a collaborative effort of the government, multilateral banks, bilateral donor agencies, research groups, local government functionaries and agencies such as World Food Programme-Nepal (WFP-Nepal), which address food insecurity.

WFP-Nepal began to tackle food insecurity in 1963. Today 32 WFP-Nepal field monitors collect data and information related to food security across the country every quarter. In 2009, WFP-Nepal established the Nepal Food Security Monitoring System (NeKSAP) in collaboration with the Ministry of Agricultural Development (MoAD) to enhance the field surveillance system that was established since 2002. NeKSAP is currently being institutionalized into the government system. The data and information collected through the NeKSAP are consolidated and analysed to generate insights into local food insecurity that can help decision-makers, including the Government of Nepal, UN agencies, I/NGOs, develop and implement coordinated and timely actions in the effort to prevent human suffering due to food insecurity.

VAM household survey: A VAM (Vulnerability Analysis and Mapping) survey comprises 188 household-level survey questions that cover a variety of thematic areas such as markets, water and sanitation, migration, crop conditions, income and expenditure, food consumption, sources of food, disasters and shocks, and coping strategies. WFP field monitors conduct the VAM household survey with some 4,000 observations per year, using an advanced database management system integrated electronic data collection using tablets. WFP is conducting the survey since 2002. Besides food security, the data has been utilised by agencies such as Helen Keller International and the Ministry of Health and Population to promote nutrition; others, like, the Ministry of Education and UNICEF, use it in educational programmes.

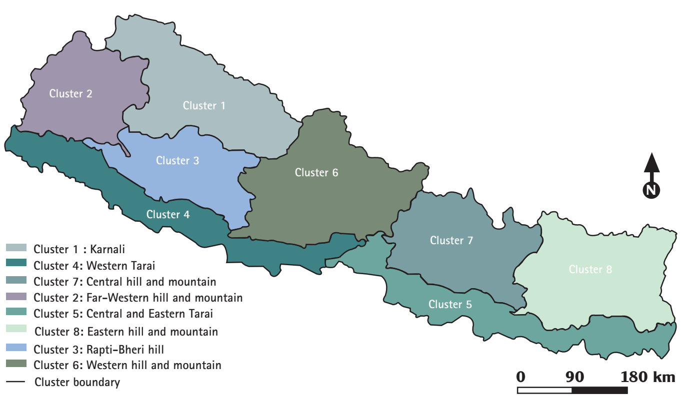
The survey applies a two-stage cluster sampling. A rotation design has been adopted since 2012 to improve estimates of quarterly and annual changes - the statistics of interest from NeKSAP include measures of both level (i.e. the current value) and change (e.g. differences between successive quarters or years) for a range of food security and other variables, and measures derived from them. The country is divided into twelve strata, and wards within strata have been selected with probability proportional to size (i.e. to the number of households they contain, based on the provisional results of the 2011 Nepal Census of Housing and Population). Equal numbers of households have then been selected in each sampled ward. Four rotation groups are sampled in each quarter. Each rotation group contains two wards or primary sampling units per stratum, making a total sample size of 96 (12*4*2) per quarter. With 10 households sampled with equal probability within wards, this gives a sample of 96*10=960 households a quarter, and 3,840 households per year.

District food security networks (DFSNs): At the heart of the NeKSAP system are 72 DFSNs, district-level forums where key stakeholders engaged in food security come together quarterly to analyze food security situation. The DFSNs are chaired by the chief district officer and co-chaired by the local development officer. The DFSN membership includes district agricultural officer, and district health officers along with representatives of local non-governmental organisations and members of civil society.

Before each meeting, the members of the forum collect information on the key food security indicators related to the varying sectors of food systems. These indicators are based on the global integrated food security-phase classification (IPC) and have been adapted to the local context to create 12 district-level food security reference indicators (DLFSRI) (Hollema et al., n.d.). The IPC is an internationally standardised, evidence-based tool, which establishes a “common currency” for classifying the severity and magnitude of food insecurity and allowing for comparisons across countries and over time. It provides decision-makers with a way to analyse food insecurity and develop strategies to respond in both emergency and development contexts.

The data generated by VAM household surveys and DFSN meetings every three months helps stakeholders assess seasonal changes in food systems and identify various challenges confronting food security in Nepal. It reveals how food security is related to other systems and assists in planning responses and implementing strategies aimed at reducing vulnerabilities and building resilient food systems.

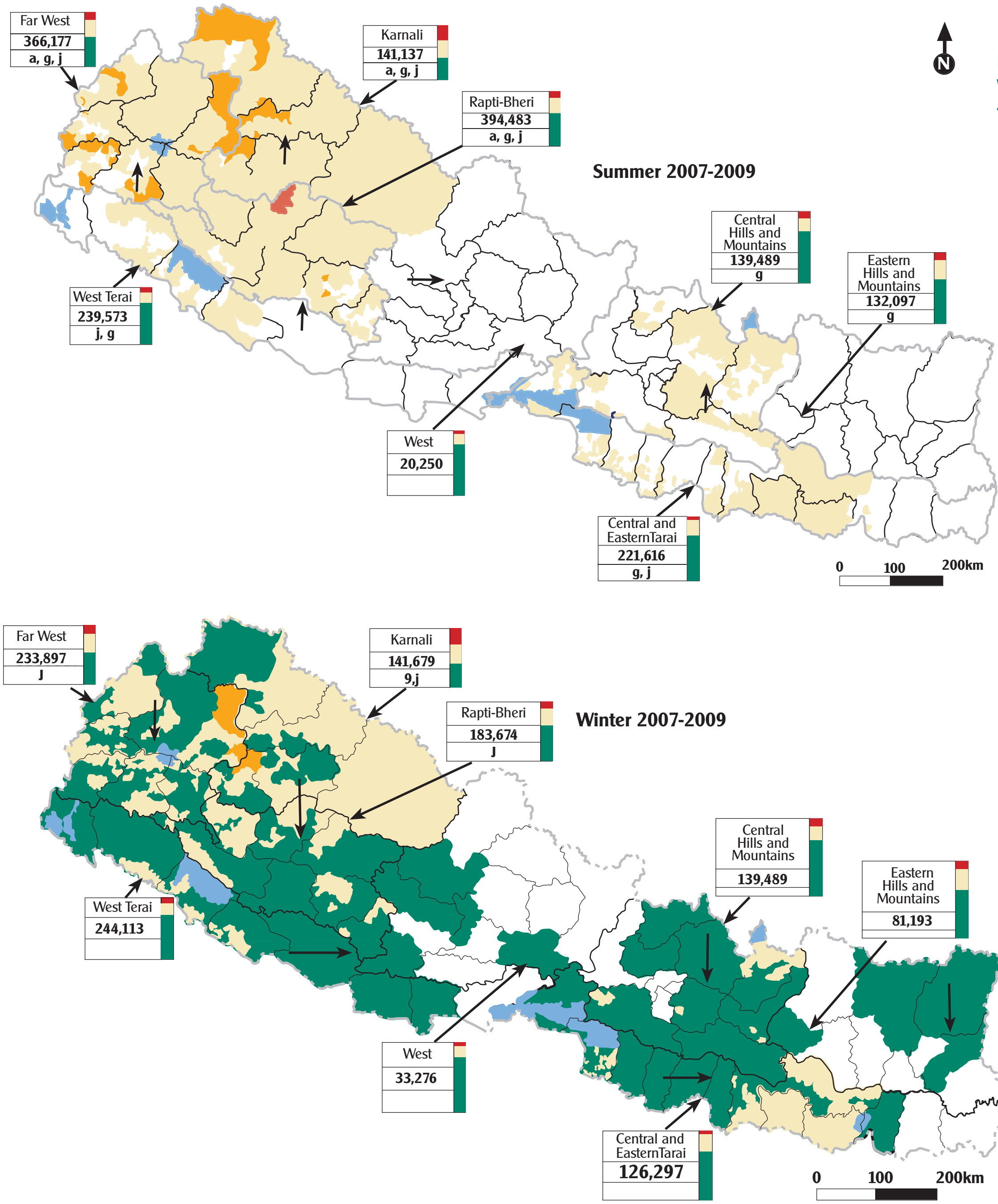
FIGURE 6:
Food-security clusters



To analyse VAM data, WFP-Nepal had previously classified the country into eight clusters (Figure 6) based on geography and food insufficiency and published maps (Figures 7a and 7b) showing the status of cluster-level food security in the summer and winter seasons. WFP Nepal presently classifies the country into 12 cluster for analysis. In this report we use the earlier eight cluster for study.

While these seasonal maps are useful tools for planning strategies for achieving food security both in each cluster and in particular critically-affected populations, their application has been hamstrung by Nepal’s lack of development, limited institutional capacity, diverse and geologically dynamic topography, and local and regional imbalances in natural resource endowment, social composition, and economic context. In addition, because 80 per cent of its precipitation falls between June and September, Nepal is naturally prone to climate-induced hazards, another factor challenging its efforts to promote food security. Climate change will only exacerbate these obstacles, especially as the increasing dependence of Nepal’s food system on regional food markets means it is exposed to the shocks delivered not just by local but also regional impacts of climate change.

FIGURE 7 (a and b):
Winter and summer food security



Food Security Phase Classification

- 1 Generally food secure
- 2 Moderately food insecure
- 3 Highly food insecure
- 4 Severely food insecure
- 5 Humanitarian emergency/famine
- No data
- National parks/wild life reserve/no population area

PS Outlook for the next quarter

Improving Deteriorating No change

Karnali	Name of monitoring claster
116,000	Average no. of people in phase 3 and 4
a,d,e,k	Key immediate causes

Key immediate causes

a. drought b. flood c. hallstorm d. late/early rai
e. landslide f. crop pest disease g. market distrup

RATIONALE OF THE STUDY

The aim of this study was to develop a method for assessing the vulnerability of Nepal's food system to climate change by examining the use and shortcomings of NeKSAP and expanding it into to include climate-sensitive food security indicators (CLIFSI). These new indicators are expected to reveal a broader picture of the vulnerabilities of Nepal's food system especially, though not exclusively as they relate to climate change-induced hazards and to help policy makers at different levels to plan appropriate adaptation measures based on informed dialogue.

Objectives

The study's overall aim was to integrate CLIFSI into NeKSAP. Its specific objectives are listed below:

1. To integrate within NeKSAP climate change indicators that will generate data to assist in planning and policymaking related to climate change adaptation;
2. To analyse data obtained from DFSNs, identifying their deficiencies and usefulness in climate change policy making;
3. To build the capacity of stakeholders to use the new climate change indicators.
4. To sensitise policy makers to the value of the new indicators in meeting policy making objectives and implementing projects regarding the achievement of food security and promoting adaptation to climate change; and,
5. To capacitate climate change stakeholders in the design, implementation, and monitoring of climate change strategies.

The study involved a series of inception and dissemination workshops, debriefings with field monitors, the pretesting of a CLIFSI household survey in four districts, district-level stakeholder consultations, and analysis of NeKSAP and CLIFSI data. The various stages and processes of the project are shown in Figure 8. Four characteristics emerged crucial in assessing the vulnerability of a food system to climate change:

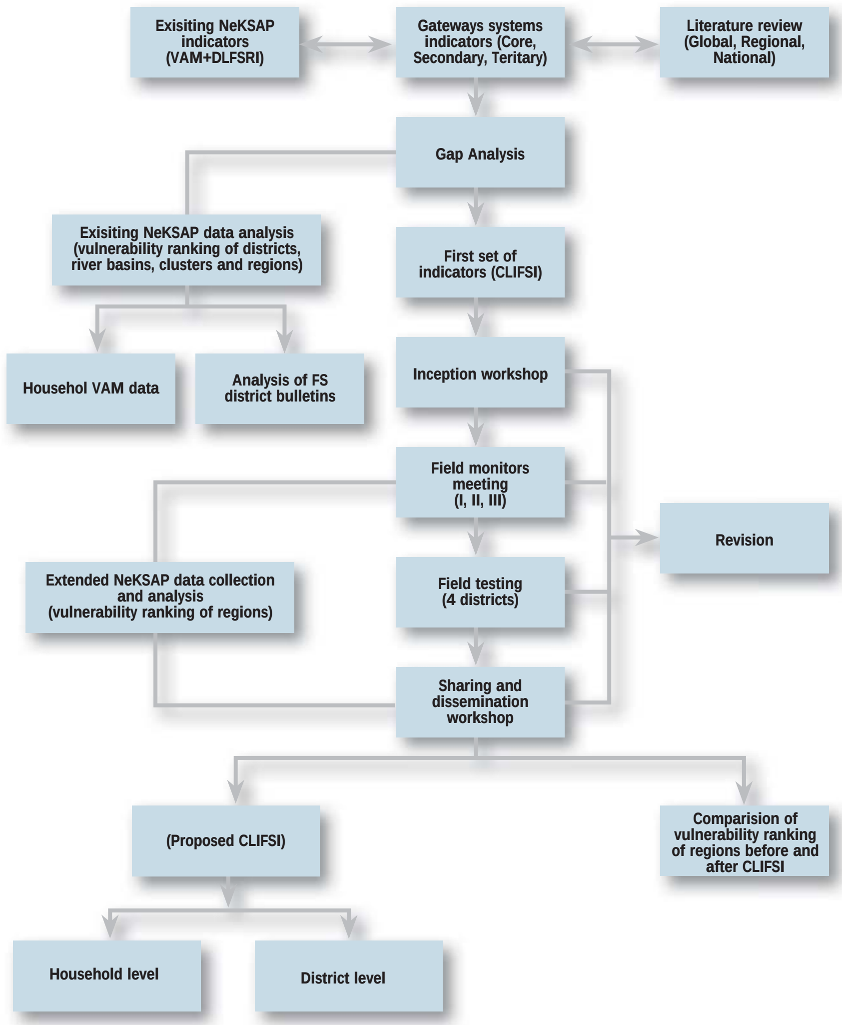
a. The type and extent of those systems, assets and resources that determine the sensitivity of livelihoods to climate change and variability;
b. The degree of access to services from systems that influence adaptive capacity;
c. The availability of and access to information about climate (temperature and rainfall, especially), ecosystems, climate hazards (types, extent and impacts), technological options, and policy provisions as well as to service providers that assist in individual, household, and community decision-making processes; and
d. The presence or absence of social networks.

Methodology

A systematic methodology (Figure 8) was used to develop CLIFSI. VAM and DLFSRI data were analysed and national, regional and global literature on climate-sensitive food security issues were reviewed. NeKSAP was examined using a "systems as gateways to services" paradigm (Dixit et al., 2011) in order to identify the climate change indicators it had overlooked. These gaps suggested a set of proposed CLIFSI, which were presented at a workshop so that national-level stakeholders could provide feedback and suggestions. The field monitors were debriefed regarding the indicators revised on the basis of this feedback to help further revise and separate into household- and district–level sets. Those identified as household-level indicators were then converted into questions and these questions presented to field monitors for yet more input at another debriefing. Once consensus was achieved, it was agreed to pretest the questions in Humla, Parbat, Rautahat and Udayapur districts because they are representative of Nepal's three ecological regions—the mountains, the hills, and the Tarai plains—and the mid-west, central and eastern development regions. The study team worked alongside WFP-Nepal field monitors to pilot the household CLIFSI survey and field test the district-level CLIFSI. This step in turn suggested improvements, which were presented at a third debriefing with field monitors, at which point, the indicators were finalised and classified as mandatory, essential or desirable according to their priority status.

The team also used VAM data to rank districts, river basins and WFP-Nepal clusters for vulnerability and examined food security bulletins on selected food insecure districts. This information, along with that collected using the CLIFSI household- and district-level input was then used to rank the country's three river-basin regions for vulnerability. The findings were presented in a dissemination workshop.

FIGURE 8:
Study methodology



CHALLENGES

This study was undertaken as Nepal undergoes a major social and political transition. The study faced logistical challenges including strikes, closures and disruptions. Despite the difficulties during the course of study, a series of consultations was made at different forums with various groups including DFSNs, WFP field monitors to identify a set of indicators relevant to climate change and food security. Because the processes by which we can successfully adapt to climate change is an understanding in the making, our research underscored the need for continued process of shared learning among climate scientists, development practitioners, farmers, government officials and policy makers, and those involved in implementation, including field monitors to generate synthesised knowledge that help identify range of issues that govern climate change science, adaptation and build resilience. This study made a beginning to that end but was limited by its duration, focus and orientation.

OVERVIEW OF CLIMATE CHANGE INDICATORS

The global research community has proposed a wide variety of indicators that reveal societal and infrastructural vulnerability to climate hazards. Key issues to keep in mind while developing indicators include where the indicators will be applied, who is going to use them and how are they going to be used as well as the availability and scale of relevant data available to develop such indicators, and at what scale such data is collected. The indicators variously proposed can be classified as either vulnerability or adaptive-capacity indicators (Table 2) and used to assess the capacity of various actors, from households to governments at all levels, even supranational, to build a resilient food system. Though this body of indicators was developed for a variety of disparate purposes and users, they all helped generate ideas about the nature of the indicators developed in this study.

TABLE 2

VULNERABILITY AND ADAPTIVE-CAPACITY INDICATORS

Vulnerability indicator	References
Degree of modernisation in the agricultural sector; farmer access to inputs	Adger et al., 2004; Ibarrarán, Malone et al., 2008.
Per cent of land managed or irrigated	Adger et al. 2004; Ibarrarán, Malone et al., 2008.
Access of population to agricultural markets and other mechanisms to compensate for shortfalls in production	Adger et al., 2004; Ibarrarán, Malone et al., 2008
Potential extent of disruptions from glacier melt and extreme rainfall events	Adger, et al., 2004; Ibarrarán et al., 2008
Access of population to basic services to buffer against climate variability and change	Adger, et al. 2004; Ibarrarán, et al. 2008
Dependence on agriculture	Adger et al., 2004
Crop growth and production	Aggarwal, et al., 2004;
Soil erosion rates	Gobin et al., 2002
Biodiversity a. crop and/or genetic diversity b. diversity of land uses, i.e., livestock, cropping, agroforestry, etc.	Cotter &Tirado, 2008; Lin, 2011; Aggarwal, et al., 2004
Fertiliser use per cropland area	Adger et al., 2004; Ibarrarán et al., 2008

⏩

Resilience/Adaptive indicator	
Biodiversity, including a. genetic diversity within a crop and a number of species or varieties in one field. b. a variety of different crops. c. multiple production systems, such as agroforestry management practiced with cropping, livestock-rearing, and fallow land	Adger, et al., 2004; Bartlett, et al., 2010; Cotter &Tirado, 2008; Lin ,2011; Eriyagama et al., 2009 Cotter & Tirado, 2008
Increased production through identification of new technologies which enhance productivity	Gregory, et al., 2005 Aggarwal, et al., 2004, Gregory & Ingram, 2005
Investment in water management: a. irrigation management, harvesting and conservation techniques, and initiatives that increase water-use efficiency b. reduction of groundwater pumping by diversifying agricultural systems	Cotter &Tirado, 2008 IAASTD cited in Aggarwal et al., 2004
Income diversification/ improvement) a. migration to urban centers b. off-farm employment c. remittances from abroad d. new businesses that take better advantage of access to markets	Dixit et al., 2004; Aggarwal, et al., 2004; Bartlett et al., 2010
Increase in income from agricultural enterprises: a. improvement in fertilizer practices, supply, and distribution b. incentives for green manuring to improve soil condition c. improvement in market access d. diversification of agricultural systems from rice-wheat systems towards high-value agriculture (fruits, vegetables, dairy, meat, eggs, and fish)	Aggarwal et al., 2004 Cotter &Tirado, 2008 Adger et al., 2004
Crop insurance	Aggarwal et al., 2004
Investment in infrastructures such as rail, road, and safe food storage	Gregory, 2005
Agricultural planning and technology: a. use of weather and climate information for agricultural planning b. equitable access to and utilization of appropriate agricultural knowledge, skills, technologies and resources c. mechanisms to monitor changes in the quantity and quality of agricultural produce, together with changes in weather and climate	Olubode-awosola et al., 2008

Emerging lessons from global research on climate change adaptation suggests that the resilience of a food system rests not simply on a healthy local food production arrangement but also on livelihood diversification and access to markets, an energy system, banking and communication services, and information on things like weather, technology, and climate change adaptation. Agricultural diversity and high agricultural production as well as social networks and safety nets are also needed to mitigate the negative impacts of climate change. Providing a range of such “resilience factors” is especially crucial in Nepal because 54 per cent of the population people live on less than USD 1.25 per day and 3.5 million Nepali people are moderately to severely food insecure (WFP-Nepal, 2009). Constraints in the national socio-economy also hinder the achievement of wellbeing, as is envisioned by Nepal’s policy on climate change.

INCORPORATING CLIMATE INDICATORS IN NEKSAP

Alone or in collation, and especially at the regional- and sub-regional-scales, the data sets available at the district and national levels and for different sectors, including the National Census, the Nepal Living Standards Survey, and NeKSAP, can serve as useful entry points for assessing vulnerability: their analysis demonstrates a relationship between climate change impacts and food security which, once established, can increase our understanding of the processes that govern adaptation (NAPA, 2010; NCVST, 2009), assess vulnerability and formulate plans to build adaptive capacity. To do so entails developing indicators.

DFSN indicators were reviewed for their usefulness in assessing the district-level vulnerability of the food system while VAM household questionnaire was reviewed and modified to generate indicators to assess vulnerability of Nepal's household level food system to existing shocks. Of the 19 subsets of the 188 VAM household survey questions the following10 contain indicators related to climate change vulnerabilities and adaptation:

1. Demographics and socio-economic status
2. Exposure
3. Coping strategies
4. Crop conditions and availability
5. Food stocks and availability
6. Current access to a source of income
7. Participation in the labor market
8. Participation in programmes
9. Utilisation and consumption of food
10. Water, sanitation and health

In identifying indicators from these two existing tools, the study team sought answers to five key questions, all of which were framed in relation to the vulnerability indicators identified in Table 2:

1. Which indicators help assess the impacts of and vulnerabilities to climate change?
2. Which agencies–the government, communities or non-governmental organisations–will find which indicators are most useful?
3. How will the indicators help in identifying and monitoring the impacts of potential interventions?
4. To what extent are the proposed indicators explicitly linked with food security?
5. At what level–district, river basin, WFP-Nepal cluster, or development region–should the questions be administered and the indicators analysed?

In addition, the study team considered whether the indicators were most suited to core, secondary, or tertiary systems and if they required revision. Any indicators, which did not fall under the systems-as-gateways concept but nonetheless relevant to food security issues, were defined as “other indicators”. The 28 new climate-sensitive indicators, which yield information about both households and systems are listed in Table 3, as are justifications for choosing them. To help WFP-Nepal prioritise data collection when resources are short, the indicators were categorised as mandatory, essential and desirable (Table 4) on the basis of their importance, their role in the food system, and their link to food security

TABLE 3

HOUSEHOLD-LEVEL INDICATORS (CORE, SECONDARY AND TERTIARY) AND JUSTIFICATIONS FOR THEIR SELECTION

Indicators	Justifications
CORE	
Total land area	Land ownership of indicates some income stability and capacity to respond to climatic stresses.
Land affected by climatic hazards	Permanently affected land reduces capacity to adapt
Government agencies functional in community	Provide key information to adapt to climate change
Varieties (species) of food crops found in community	Indicates agro biodiversity enabling diversification.
Changes in cropping practices	Can affect food security (Useful to track as adaptive strategy). Periodic monitoring can indicate the trend. Analysis of data can define the recall period.
Changes in land use over the years	Impinges on food system. Changes might also be a response or adaptive strategy to improve livelihoods.
Noticed changes on the state of plants, herbs, wild edibles and crop species	Affect state of plants, herbs, wild edibles and crop species with implications on food system.
Noticed changes on the state of local livestock, poultry and fisheries	Negative impact on state of local livestock, poultry and fisheries elements of food systems.
Change of the source of drinking water in last 6 months	Climatic factors may alter water sources impacting drinking and irrigation system lowering household food security.
SECONDARY	
Irrigation facility in total cultivable land (seasonal, permanent)	Stable irrigation source reduces impact to climate variability.
Closest type of road and time to get there	Facilitates shifts in strategies and compensate production shortfalls. Locally produced goods can reach market.
Extent food security assets damaged by the hazards	Climate hazards can damage assets (animal sheds, house roof etc.) and exacerbate food insecurity.
Reliability of road networks by season	Seasonal road networks are fragile under increased climatic variability and can limit household’s abilities to commute.

Quality of communication network (both electronic and print) and their frequency of use	Can increase response capacity and warning.
Extent of change of income from agriculture production	Improved practices can improve income and adaptive capacity.
Types of house (Pakka, Semi-pakka, kachha)	Increased frequency of climate hazard may affect semi pakka and kachha houses and storage of food.
TERTIARY	
Member of civil society organizations	Indicates households access to use of forest.
Nearest market to buy necessities and sell local produces	Provide food and selling of local produces generates income.
Nearest health service support from house	Access to proper health services improves food utilization.
Quality of health services	Improves wellbeing.
Number of school going children aged 5-14 years	5-14 years school going children can help adaptive capacity than households without school going children.
Locally available micro finance service and/or loan facility	Availability of loan (with and without collateral) can support food insecure household to seek local business for diversifying livelihood.
OTHERS	
People's perception of climatic hazards in relation to food security	Helps understand their exposure and vulnerability.
Observed changes in crop diseases and pest infestation	Crop diseases and pest infestation affects production.
Changes made in existing post harvest techniques	Techniques govern food access, utilization and preservation helping reduce post harvest losses and climate factors may have role in the changes.
Access to seeds	Diversity of supply indicates secure food system
Use of agricultural inputs	Can increase (or reduce) adaptive capacity depending on access to and type of input.
Crop and livestock insurance	Protect livestock and crops that may be affected.

These 28 indicators were converted into 38 questions and piloted in four districts. After addressing the gaps from the piloting exercise, the revised set of indicators were incorporated into regular household survey between April and June of 2012.

Concurrently, DLFSRI were analysed and revised in consultation with field monitors at a debriefing in Kathmandu and at DFSN meetings in pilot districts. The 15 proposed district-level indicators and justifications for them are provided in Table 5. Like CLIFSI, they were classified as mandatory, essential and desirable (Table 6) to ensure the optimal use of limited resources.

TABLE 4

VAM HOUSEHOLD SURVEY INDICATORS CLASSIFIED AS MANDATORY, ESSENTIAL AND DESIRABLE

Indicators*	System level	Number
Collection Protocol: Mandatory		**14**
People's perception on climatic hazards in relation to food security	Others	
Total area of land	Core	
Irrigation facility in total cultivable land (seasonal, permanent)	Secondary	
Land affected by climatic hazards	Core	
The extent food security assets damaged by the hazards	Secondary	
Member of civil society organizations	Tertiary	
Closest type of road and time to get there	Secondary	
Nearest market to buy necessities and sell local products	Tertiary	
Quality of communication network (both electronic and print) and their frequency of use	Secondary	
Government agencies functional in community	Core	
Changes observed in crop diseases and pest infestation	Others	
Access to seeds	Others	
Micro finance service and/or loan facility locally available	Tertiary	
Extent of change of income due to agriculture production	Secondary	
Collection Protocol: Essential		**10**
Reliability of road networks by season	Secondary	
Nearest health service support from your house	Tertiary	
Quality of health services	Tertiary	
Varieties (species) of food crops found in community	Core	
Changes in cropping practices over time	Core	
Changes in land use over the years	Core	
Changes made in existing post harvest techniques	Others	
Use of agricultural inputs	Others	
Change of the source of drinking water in last 6 months	Core	
Number of school going children aged 5-14 years	Tertiary	
Collection Protocol: Desirable		**4**
Noticed changes on the state of plants, herbs, wild edibles and crop species	Core	
Noticed changes on the state of local livestock, poultry and fisheries	Core	
Crop and livestock insurance	Others	
Types of house (Pakka, Semi-pakka, Kachha)	Secondary	

*The proposed indicators will be collected on a bi-annual basis

TABLE 5

DISTRICT-LEVEL FOOD SECURITY REFERENCE INDICATORS (DLFSRI)

S.N.	Indicators	Justification
1	Change in climatic trend (temperature - hot and cold wave; wind; precipitation - erratic, thunder, hail storm, rainfall, snowfall, GLOF, fog)	Direct link of temperature and precipitation to production of plants.
2	State of water supply at source (River, Lakes, Ponds, Streams)	Irrigation depends on availability of water in rivers, lakes and ponds.
3	Changes in volume of water (potable, irrigation) a. shifting of source up/down b. over or under supply c. water source at origin d. state of run off e. ground water recharge rate f. sedimentation and overflow	Alteration in the volume of water for irrigation and drinking affect the agriculture.
4	Expansion of ecological belts and its impact (e.g. snowline retreat)	Likely to change agricultural production.
5	Cropping intensity (multiple, single, inter cropping etc.)	Cropping intensity influences agriculture production.
6	Phenological (flowering and fruiting) behavior of food crop species (paddy, maize, wheat; potato)	Phenological behavior of the crop affects the agriculture production.
7	Status of wild edibles, herbs, Non Timber Forest Products (NTFP), fodder and forage species	Status affects household incomes and adaptive capacity.
8	Status of local livestock and local food crops	Affects agriculture production.
9	Local level service providers (e.g. cooperatives, NGO, CBO, GO, Natural Resources users groups, Mothers groups, etc.).	Presence of local level service providers builds adaptive capacity of the individuals and families during times of stress.
10	Livestock protection – impacts on the status of livestock due to increase or decrease of forage, fodder and pasture land(i.e. Impacts on the numbers of large and small ruminants including cattle, yak, sheep, goat)	Increase or decrease of forage, fodder and pasture land impacts livestock protection and affects agriculture production.
11	Extent of infestation of diseases, and pests on crops and livestock	Directly affect food production, which climatic factors may exacerbate.
12	Community access to agricultural inputs (Compost, chemical fertilizer, pesticides, seeds)	Agricultural inputs influence food production, reliable access to quality inputs increases adaptive capacity.
13	Change on land use (expansion or contraction of arable land)	Expansion or contraction of arable land affects agricultural production climatic factors may act as influence.
14	Crops and food security assets damaged by climatic hazards (wind, storms and hails)	Damage to crops and food assets due to climatic hazards (wind, storms and hails).
15	Forest area available	Increase or decrease in forest area affects the agriculture production.

TABLE 6

CLIMATE-SENSITIVE DLFSRI CLASSIFIED AS MANDATORY, ESSENTIAL AND DESIRABLE

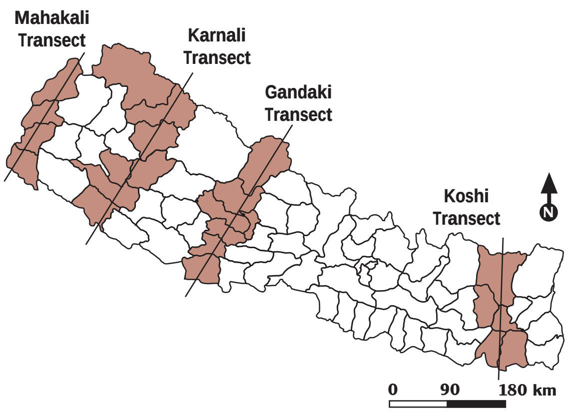
Indicators*	Number	Remarks
Mandatory collection	8	
Changes in climatic trends (temperature: hot and cold waves; wind; precipitation: erratic, thunder or hailstorm, rainfall, snowfall, GLOF, fog)		Indicates when dry, wet, pre-monsoon, monsoon, post-monsoon and winter seasons occur
State of water supply at source (rivers, streams,lakes, and ponds)		
Expansion of ecological belts and its impact (e.g. snowline retreat)		Applicable for higher elevations
Phenological (periodical flowering and fruiting) behavior of food crop species (paddy, maize, wheat; potato)		List of crop species that are representative
Local-level service providers (e.g. cooperatives, NGOs, CBOs, GOs, natural resource users' groups, mothers' groups, etc.).		At household and district levels
Extent of infestations of crop and livestock diseases and pests		Differentiate climatic and non-climatic factors and use at the household and district levels
Changes in land use (expansion or contraction of arable land)		
Crops and food security assets damaged by climatic hazards (wind, storms and hail)		Use at the household and district levels
Essential collection	1	
Changes in volume of water (potable, irrigation) a. shifting of source up/down b. Surplus or shortage c. water source at origin d. state of run off e. ground water recharge rate f. sedimentation and overflow		
Desirable collection	6	
Cropping intensity (multiple, single, inter-cropping, etc.)		
Status of wild edibles, herbs, non-timber forest products (NTFP), fodder and forage species		
Status of local livestock and local food crops		At household and district levels
Livestock protection: impacts on the status of livestock due to increase or decrease of forage, fodder and pasture land(i.e. Impacts on the numbers of large and small including, , sheep,goats, pigs and poultry)		
Community access to agricultural inputs (compost, chemical fertilisers and pesticides, seeds)		Use at the household and district levels
Forest area available		Includes leasehold, community, agro, religious, collaborative, private and government forest accessible to the local community

*The proposed indicators will be collected on a bi-annual basis

RANKING VULNERABILITY USING EXISTING NeKSAP DATA

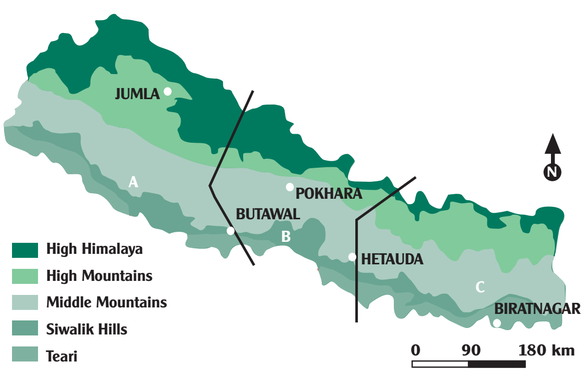
Though the data used for an initial analysis included limited number of CLIFSI, the 2010 data was nonetheless useful in assessing vulnerability to existing shocks after it was categorised into core, secondary and tertiary sub groups of the system (Table 2). The vulnerability ranking thus obtained (without climate indicators) then was compared with what was derived from CLIFSI. Earlier NeKSAP data was not used because the sampling method was different.

FIGURE 9: **Districts chosen for assessing NeKSAP VAM data**



Vulnerability rankings based on this data were determined at four scales—district, river basin, WFP-Nepal-cluster, and river-basin regional—and used to prepare vulnerability maps. First, 25 of the 67 districts in which WFP-Nepal surveyed 2,919 households in 2010 were selected purposively to form four transects from the Tarai to the mountains (Figure 9) and 16 VAM indicators were selected for ranking. To derive a district-level ranking, obviously, the district was considered the unit of analysis and each of the 25 districts was ranked on the basis of a composite of all 16 indicators. The river basin analysis was based on the assumption that the selected districts in each basin would represent the entire basin. Similarly, the selected districts in each cluster and development region were considered representative of the entire area. One more unit of analysis was also used: that of Nepal's three main river-basin regions (the regions used to develop climate scenarios for Nepal and distinct from both river basins and development regions) (Figure 10) (NCVST, 2009).

FIGURE 10: **River basin region area for developing climate scenario for Nepal**



Vulnerability was assumed to be directly proportional to exposure and sensitivity and inversely proportional to adaptive capacity. Thus, if a system is exposed to hazards and sensitive to climate change, it is likely to be vulnerable, but if it has considerable adaptive capacity, its vulnerability will decrease. This relationship is shown in Figure 11 and expressed as follows:

Vulnerability= f(Exposure x Sensitivity x 1/Adaptive Capacity)

The 16 VAM indicators—three related to exposure, four to sensitivity and nine to adaptive capacity (Table 7)—were weighted to calculate the vulnerability index of each of the three river-basin regions. For example, in the Mahakali basin, which included four pilot districts, there were 12 (4 X 3) exposure, 16 (4 x 4) sensitivity, and 36 (4 x 9) adaptive-capacity indicators. The value of each of the three types of indicator was ranked individually. Then a joint value for exposure and sensitivity, with each weighed equally (up to 0.5, for a total possible weight of 1), was calculated. Finally, district-level composite values were calculated by subtracting an adaptive capacity (resilience to vulnerability) value of up to 1 from the joint exposure and sensitivity (total vulnerability) value to yield a vulnerability index value between -1 and +1. This process ensured that the range remained constant even if the number of districts, clusters, river basins or indicators fluctuated. Using a pre-established range from very high to very low vulnerability, five categories of vulnerability were established and colour-coded (Figure 12). Since only limited data was used in its creation, the vulnerability index generated should be treated only as indicative. In particular, it does not reflect the considerable socio-economic diversity among the sub-populations within each district because the data was too general. More details on the results are below.

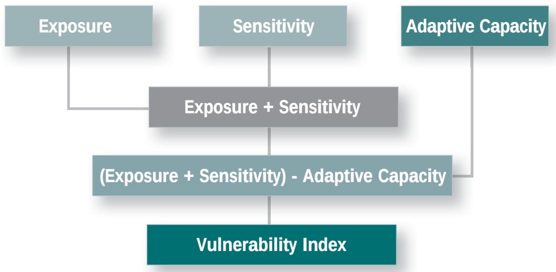


FIGURE 11:
Vulnerability index as out come of exposure, sensitivity and adaptive capacity

FIGURE 12:
The vulnerability index

0.61 to 1	Very high vulnerable
0.21 to 0.6	High vulnerable
0.20 to -0.19	Moderate vulnerable
-0.20 to -0.6	Less vulnerable
-0.61 to -1	Very Less vulnerable

DISTRICT SCALE: Of the 21 districts selected (Figure 9), Surkhet and Dailekh were very highly vulnerable and Humla, Mugu, Arghakhanchi, Gulmi, Mustang and Bhojpur, highly vulnerable. Darchula, Baitadi, Dadeldhura, Jumla, Kalikot, Myagdi. Sankhuwasabha, and Dhankuta

TABLE 7
CLASSIFICATION OF VULNERABILITY USING VAM INDICATORS

Exposure	Sensitivity	Adaptive capacity
Natural shocks	Shock recovery	Literacy rate
Social shocks	Coping index	Land holding size
Impact of CC on agriculture	Cropping pattern change	Sanitation
	Nature based Livelihood	Livestock size
		Drinking water
		Lighting (clean energy)
		Traditional cooking (traditional energy)
		Pakka household (permanent)
		Food stock

FIGURE 13:
Ranking at the district scale

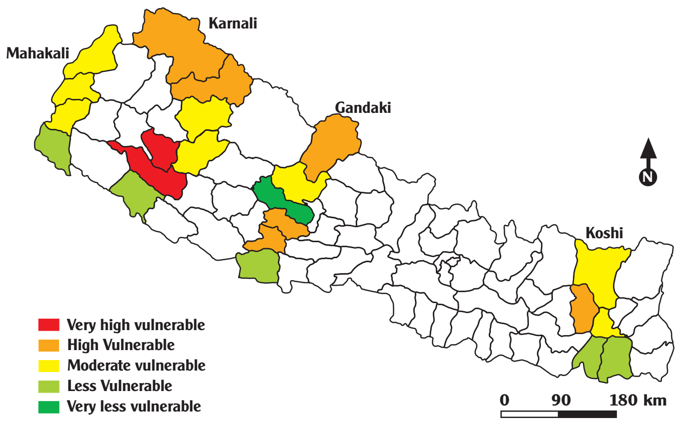


FIGURE 14:
Ranking at the river basin scale

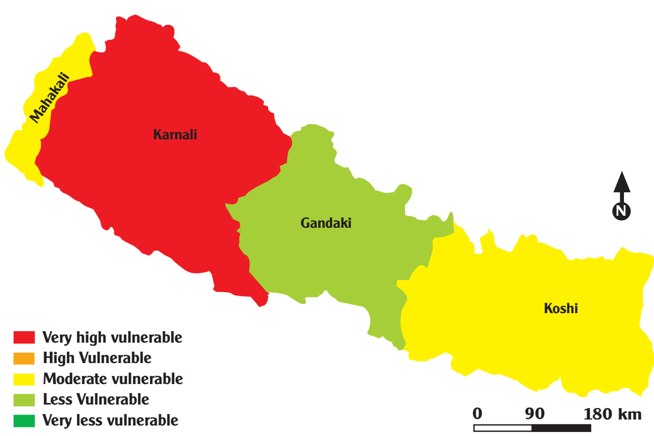
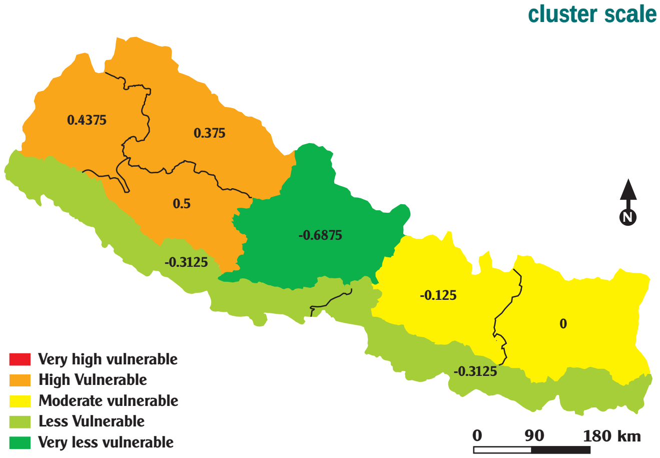


FIGURE 15:
Ranking at WFP cluster scale



were moderately vulnerable whereas Kanchanpur, Bardia, Kapilvastu, Sunsari and Morang were somewhat vulnerable. Only Baglung and Parbat were minimally vulnerable (Figure 13).

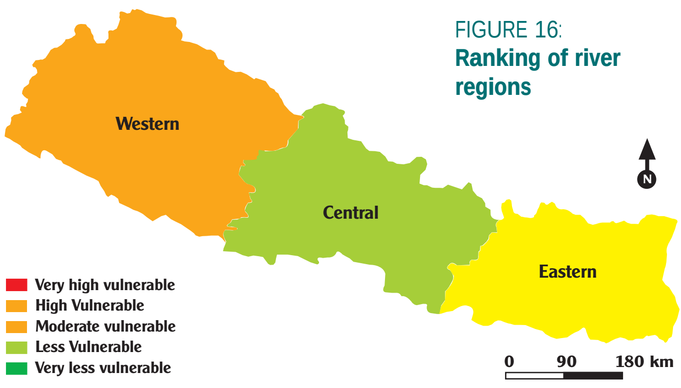
RIVER BASIN SCALE: The analysis showed that Karnali river basin was highly vulnerable, the Mahakali and Koshi moderately vulnerable and the Gandaki somewhat vulnerable (Figure 14).

WFP-NEPAL CLUSTER SCALE: To examine vulnerability at the basin level the data for the selected districts in each of four river basins—Koshi, Gandaki, Karnali and Mahakali—were combined together under the assumption that, collectively, it would represent the basin. The vulnerability index was then calculated by adding the average indexes of all the districts in that basin. The ranking suggested that the cluster containing the hill districts of Rapti and Bheri was most vulnerable while the Western hill and mountain districts were least vulnerable. This finding is unsurprising because most households in Rapti and Bheri face frequent natural shocks, which are exposure indicators, and their access to systems and the services they provide, which determines their adaptive capacity, is limited. In contrast, households in the eastern region have good access to food, alternative fuels, and electricity, all of which are adaptive-capacity indicators (Figure 15).

REGIONAL SCALE: The Karnali river region (western) was highly vulnerable; the Koshi (eastern), moderately vulnerable; and the Gandaki (central), somewhat vulnerable (Figure 16).

NeKSAP data, particularly VAM data, can be used to assess the vulnerability of food systems at the district, river basin, WFP-Nepal cluster and regional scales, but the limited sample size of this pilot study was unable to capture physical or other diversities. At least 50 households per district need to be surveyed every three months to achieve an acceptable level of representation, but less than three-quarters of that number were actually surveyed. Of course, reaching a representative sample would require more resources, but it would be worth the investment.

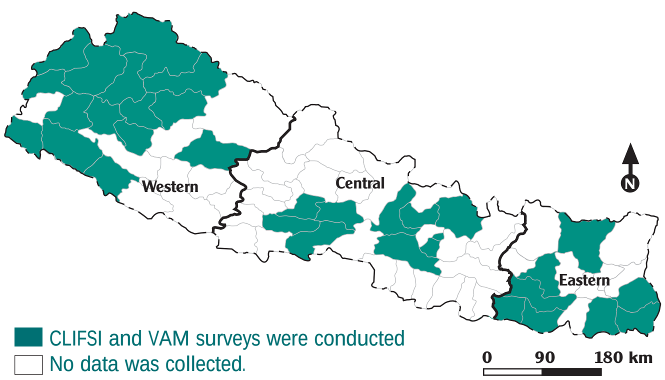
FIGURE 16:
Ranking of river regions



COMPARISON OF VAM AND CLIFSI DATA SETS

The results of the 2012 CLIFSI survey (with climate indicators) were also analysed. Logistical constraints prevented WFP-Nepal field monitors from surveying more than 445 households in 33 districts (Table 8 and Figure 17). Nonetheless, the 27 CLIFSI indicators (Table 9)—four for exposure, seven for sensitivity and 16 for adaptive capacity—were useful in assessing and ranking vulnerability to climate change. The vulnerability indices for the western (Karnali), central (Narayani), and eastern (Koshi) river regions (NCVST, 2009) were estimated under the assumption that, collectively, the selected districts in each region would represent the entire region (Figure 10). The CLIFSI data set was also used to assess the relationship between households' access to systems and their response to climate-related shocks such as drought and floods.

FIGURE 17:
Districts surveyed



The same approach to calculating and ranking the VAM vulnerability index was used to calculate and rank the CLIFSI-based vulnerability index of each river-basin region (Figure 12). The western region, with an index of +0.67, is highly vulnerable, while the eastern and central regions, with indexes of 0.00 and -0.67 respectively, are moderately vulnerable. A comparison of figures 17 and 19 is revealing in their similarity: VAM indicators reveal that western region is highly vulnerable (Figure 17) and CLIFSI indicate very highly vulnerable (Figure 18). The difference is only a matter of degree: both show that food systems in this region are likely to be more vulnerable to climate change than those in other regions. The results are similar, but the CLIFSI results greatly increased the robustness of VAM results, as explained below.

The very high CLIFSI vulnerability ranking of the western river-basin region tallies with the considerable imbalance between its food production and food requirements (Figure 2). While incorporating climate change indicators produces a more realistic assessment than otherwise would be the case, the vulnerability map of river-basin regions (Figure 17) reveals none of the geographical and socio-economic diversities within those regions. However, it does demonstrate that CLIFSI have the potential to assess the vulnerability of food systems at the scale of the WFP-Nepal cluster or even district if a sufficiently full-fledged survey were conducted.

TABLE 8
NUMBER OF HOUSEHOLDS IN WHICH CLIFSI SURVEYS WERE ADMINISTERED

Cluster	District	Sample
Eastern	8	89
Central	10	139
Western	15	217
Total	33	445

A more comprehensive survey could capture the variability in vulnerability that biophysical, socio-economic, and accessibility heterogeneity introduce within any particular region. Another caveat to bear in mind is that while maps are powerful tools to communicate research results and can be used to stimulate dialogue which advances collective learning, they are based on assumptions that convey different meaning to different audiences and their use must be supported by other sources of communication, including narratives, ethnographic, and social science methods.

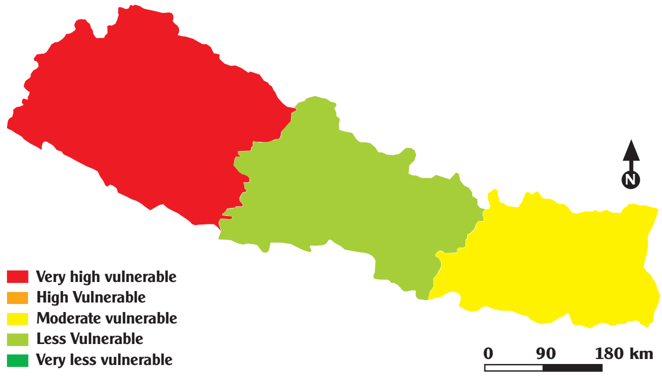


FIGURE 18:
Regional scale ranking of food system vulnerability to climate change

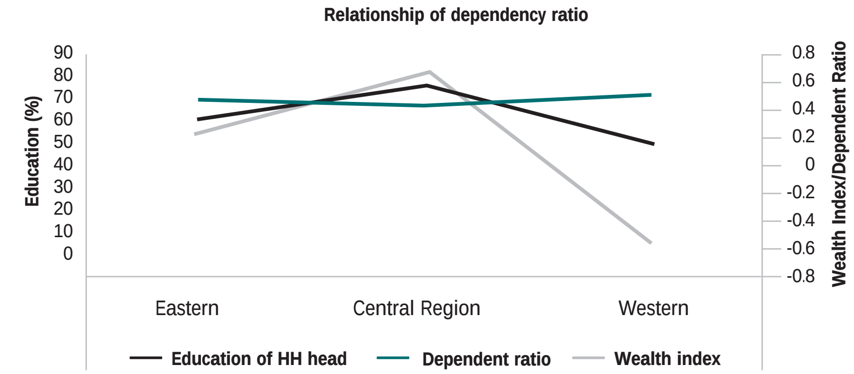
The data obtained from administering a CLIFSI survey provides insight into the relationships between adaptive capacity and preexisting conditions. Clearly, high adaptive capacity contributes to food security or, to put it differently, those who are food secure can adapt to shocks better than those who are not. One factor, which increases adaptive capacity, is education. The educational level of a household head, for example, is positively correlated with the wealth index of that household and negatively correlated with its dependency ratio. Thus, an illiterate head is likely to have little income and lots of mouths to feed and therefore be unable to adapt to climate shocks. A well-educated head, on the other hand, will have many financial assets with which he or she can feed his or her small family. Designing interventions to improve food security involves promoting those factors, like education and wealth, that increase adaptive capacity, and mitigating those, like large family sizes, that decrease it (Figure 19a, b, and c).

TABLE 9

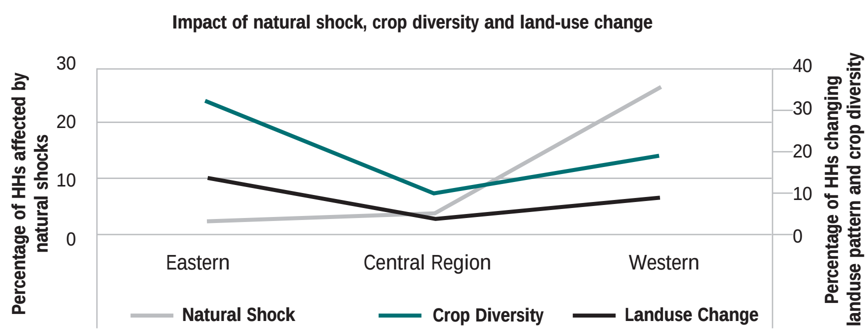
CLIFSI DISAGGREGATED INTO EXPOSURE, SENSITIVITY AND ADAPTIVE-CAPACITY INDICATORS

Exposure	Sensitivity	Adaptive capacity
Natural shocks	Dependency ratio	Literacy rate
Social shocks	Shock recovery	Land holding size
Impact of CC on agriculture	Coping index	Crop diversity increase
Land use change	Pest infestation increase	Livestock size
	Post harvest technique change	Health services (modern)
	Water source change	Drinking water
	Nature based Livelihood	Lighting (clean energy)
		Traditional cooking (traditional energy)
		Pakka houses (permanent)
		Percentage of households with mobile phone
		Food stock
		Number of organizations in the cluster
		Number of functional governmental agencies
		Household finance
		Distance to motorable road
		Walking distance to market

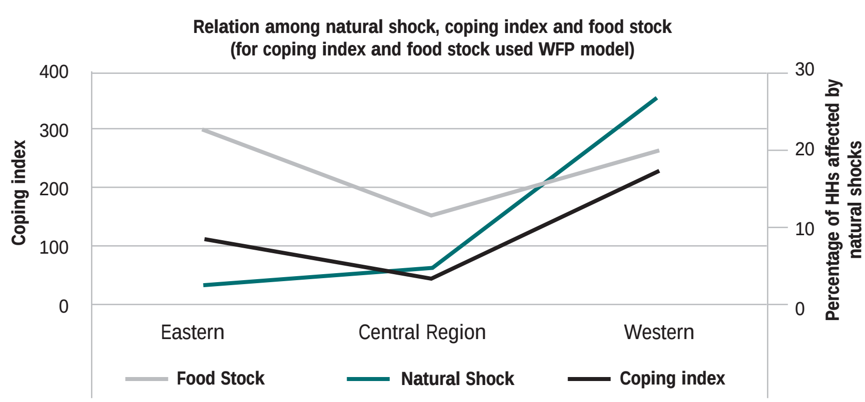
FIGURE 19 (a, b, c):
Preliminary examination of dependence



Correlation (Sensitivity with AC)	
Dependency ratio with education (Sensitivity with AC)	-0.99251
Dependency ratio with wealth index (Sensitivity with AC)	-0.99154
Dependency with wealth index (AC with AC)	-0.968265



Correlation (Exposure, AC)	
Natural shock with crop diversity (Exposure with AC)	-0.1776
Natural shock with Landuse (Exposure with AC)	-0.15326
Crop diversity with Landuse (AC with AC)	-0.999695



Correlation (AC withExposure and Sensitivity)	
Food stock with Natural shock (AC with Exposure)	0.198599
Food stock with Coping index (AC with Sensitivity)	0.59731
Natural shock with Coping index (Sensitivity with Exposure)	0.90466

ANALYSIS OF DISTRICT FOOD SECURITY BULLETINS

The study team did not collect information on DLFSRI, even on a pilot scale, because such a survey was beyond its scope, but it did analyse 35 district food security bulletins that WFP-Nepal produced between 2004 and 2011 using DFSN data. The bulletins present a preliminary picture of the occurrence of disaster, including disease epidemics, as well as the strategies that households adopt to recover from different shocks. Because of their inherent design, the bulletins do not show frequency or severity shocks to the extent desired. As mentioned above they only provide a snap shot. They also include case studies from the far- and mid-western development regions of Nepal, which lie in the Karnali and Mahakali river basins. The state of five selected districts that reported food insecurity in 2009, 2010, and 2011–Bajura, Dadeldhura, Doti, Humla and Mugu–is summarised in Table 10.

TABLE 10

SUMMARY OF DISTRICT FOOD SECURITY BULLETINS FOR SELECTED DISTRICTS

District	Year	Disaster	Coping strategies	Diseases
Bajura	2009	NA	In last quarter, most household in several VDCs sold productive assets, increased dependency on wild foods. Irreversible coping strategy	In the last quarter, most VDCs faced increase in outbreak of diseases. No significant cases of disease in other quarters.
	2010	Disaster led to 20-30 % loss of food stocks and assets in most of the VDCs in first quarter of Losses were high in third quarter and caused 30-50% or more loss of food stocks. Few human casualties.	In the first quarter, most household sold livestock, land and seed Skipped meals. Irreversible coping strategy.	NA
	2011	Only few VDCs were affected by disaster causing 20-30% loss of food assets in first quarter	In first quarter most households in the VDCs migrated, sought wage labour, sold NTFP, consumed wild foods. Traditional coping mechanism	NA

Dadeldhura	2009	NA	NA	NA
	2010	In most VDCs there were no significant natural disasters that caused less than 20 % loss of food stocks and assets. While in 3rd quarter few VDCs faced natural disaster causing 30-50 % loss of food stocks/assets and also causing some human casualties.	In first quarter most households in the VDCs migrated, sought wage labour, sold NTFP, consumed wild foods. In the 3rd quarter, few VDCs changed regular food habits (reduced food quantity, ate less preferred food), borrowed food/ money, sold non-productive assets). Few HHs in VDCs skipped meals Irreversible coping strategies as well traditional coping strategies.	In most VDCs no significant cases of diseases.
	2011	In most VDCs there were no significant natural disasters that caused less than 20 % loss of food stocks and assets.	In first quarter most households in the VDCs migrated, sought wage labour, sold NTFP, consumed wild foods. In the 3rd quarter, few VDCs changed regular food habits (reduced food quantity, ate less preferred food), borrowed food/ money, sold non-productive assets). Few HHs in VDCs skipped meals Irreversible and traditional coping strategies.	In most of VDCs no significant cases of diseases.
Doti	2009	NA	Migration, wage labor, sell of NTFP, consumption of wild food were part of coping strategies and were adopted in all the VDCs.	NA
	2010	In last quarter most VDCs had no natural disasters. It caused only less than 20 % loss of food stocks and assets. Exceptionally in last quarter, few VDCs faced disaster, which caused 20-30 % loss of food stocks and assets.	In all the VDCs people migrated, sought wage labor, sold NTFP, consumed wild food Traditional coping strategies.	The VDCs faced no/few significant cases of diseases and diseases were under control.
	2011	In first and second quarter most VDCs face minor disasters. It caused only less than 20 % loss of food stocks and assets.	Except in few VDCs during January to March, they ate less borrowed food/money and sold non-productive assets.	The VDCs faced no/few significant cases of diseases and diseases were under control.

Humla	2009	No disaster happened or few occurred that caused less than 20 % loss of food stocks and assets in the	People in most VDCs migrated, sought wage labor, sold NTFP, consumed wild food Traditional coping strategy.	No VDCs faced significant cases of diseases in last quarter
	2010	Few occurred that causing less than 20 % loss of food stocks and assets in the VDCs.	NA	No VDCs faced significant cases of diseases in first, second and third quarter. Some VDCs in 2nd quarter faced few cases of diseases that were kept under control.
	2011	NA	NA	NA
Mugu	2009	In most VDCs, in fourth quarter disaster led to 30-50 % loss of food stocks/assets and also caused some human casualties.	In most VDCs in fourth quarter of, HHs adopted irreversible coping strategies (selling of productive assets - livestock, land, and seed) and skipped meals.	NA
	2010	In first quarter occurrence disaster caused 20-30 % loss of food stocks and assets.	In first quarter people in most VDCs ate less food, borrowed food/ money, and sold non-productive assets. Irreversible coping strategy	In the first quarter, most VDCs faced significant cases of diseases but fairly under control, while in second quarter of the same year most VDCs faced no significant case of diseases.
	2011	NA	NA	NA

As expected, the incidence of disasters varies both within and between calendar years. The shortfalls in food stocks recorded have many causes, including excessive rainfall that triggers landslides and flooding, the late arrival of the monsoon, or inadequate rainfall, all of which can decrease agricultural production and destroy assets. According to NCVST (2009), general circulation models predict that the Karnali river basin (Figure 10) will face increasingly uncertain precipitation and a rise in temperature. In practical terms, these predictions imply that precipitation is likely to become more erratic. The CLIFSI substantiate this finding: Karnali will be more vulnerable than either the Narayani or the Koshi (Figure 19). In the future, Karnali, because of changes in climate exacerbated by the pre-existing state of poor

An old woman processing maize (Parbat District)

nutrition, inadequate hygiene and limited human development that characterise the basin, will face more disasters, pest infestations and disease epidemics, all of which will degrade food security. Though based on only a preliminary exploration of vulnerability, Table 10 does show trends in the occurrence of disasters at district level and how households respond to the local impacts of the disasters. The most common strategy pursued for coping with limited food supplies is eating less food at each meal and skipping meals altogether. In this case, females are most affected, since they are more likely to renounce food or be served less. Obviously, extreme abstemiousness is an undesirable strategy, one that enables a household to cope, rather than thrive. The study team assumes that adaptation is much more than coping (ISET, 2008); it is about building resilience as well as about addressing the question of equity. The matrix can be used to help design better strategies than the current ones, especially if gaps, including quarterly details about precipitation, temperature, and the status of key systems, are filled in. Until then, the WFP-bulletins can serve as a resource to at least begin the process of collective dialogue about strategies to build the resilience and adaptive capacity of food systems in order to attain food security.

One possible way to promote food security is by promoting diversity, thereby capitalising on the ongoing changes in Nepal's food system. As Moench et al. (forthcoming) point out, local production is increasingly being coupled with regional markets, so the robustness of the systems associated with the transportation and distribution of food serve as indicators of resilience. In addition, with the upsurge in migration, households, which face deficits in local production, buy food with remittances (WFP, 2009). In short, both the purchase and local production of food operate simultaneously and provide a measure of diversity to the sources of food available. According to Tyler and Moench (2012), diversity is an indicator of resilience. When it is used as a yardstick to evaluate Nepal's food system, we must conclude that the system, in the aggregate, at least, is resilient, though there is no doubt that pockets of marginalised populations that face food insecurity are widespread. The changes in the food system have also introduced new sources of vulnerabilities that need to be recognised, assessed and mitigated. Whether or not there are core and other systems to meet food needs, the relative frailty or robustness of those systems, in particular in terms of their exposure to climate hazards; and the degree of access local populations have to the services such systems provide, largely determine vulnerability to climate change.

CONCLUSIONS

This study was unique in many ways. First, because it was conducted under the partnership of a private research organisation in Nepal and one in the United States as well as WFP-Nepal, a UN agency, it required an unusual degree of shared understanding about its perspectives, focus, orientation, style and mission. Second, the study refrained from reinventing the wheel; instead, it analysed an existing large-scale database on food systems, mining it for potential indicators and simply filling in the gaps with additional indicators to expand its scope to assess the vulnerabilities of those systems to climate change. Third, it had a practical, forward-looking aim: to build a more resilient and secure food system, one that can respond effectively to the uncertain dynamics of climate change. Fourth, the study showed that by strategically selecting key indicators and analysing the data sets generated using them, the status of food system and its vulnerability could, in fact, be effectively assessed. Fifth, the study pursued a systematic iterative process of designing, revising, collecting data, revising yet again and redesigning to generate evidence that would help in policy making. CLIFSI can thus provide a bottom up approach of vertical information continuum; from households to VDC to the meso level of the districts. This information will be useful for beginning enquiry about policy and planning processes. In the present scheme of things in absence of an effective meso level institutional layer, these insights are not effectively synthesised and used at the national level.

A sixth important advantage was that the study created opportunities for engaging the functionaries of WFP-Nepal, the government and other stakeholders in highlighting the challenges of addressing climate change. Because it adopted a learning-and-sharing approach, the study was able to bring various stakeholders in Nepal together to discuss issues associated with food security, procedures for assessing the vulnerability of food systems, types of indicators and their role and usefulness, and challenges to governance in meeting the objectives of adaptation. Stakeholders also discussed the relation between planned and autonomous adaptation as important issues in food security, although their analysis was not part of study's objective. The considerable time, effort and other resources required to make this approach work, the study helped created space for building a shared understanding among the functionaries of WFP-Nepal and its field monitors and between this agency and other stakeholders.

The proposed CLIFISI and the data collected by launching a pilot study using them can help the government and other stakeholders prepare strategies to meet their adaptation goals. The proposed indicators are not meant to be comprehensive—indeed, given the dynamism of both food systems and climate change, no indicators can ever be—but they can function within the range of climate change uncertainties which are not reflected by historical trends. CLIFSI can be a useful tool in reaching and justifying decisions about the strategies adopted to build a resilient food system and to enhance capacity of local households to overcome food insecurity. The findings expand the usefulness of NeKSAP, enabling it to analysis not just food systems in a static state but their ability to assess vulnerability to climate change.

As it is, NeKSAP contains indicators, which assess the nature of the systems that function as gateways to the services that can help individuals, households and communities switch strategies when faced with stress. This information helps us assess the vulnerability of food systems and of those who rely on them and on the other systems that support them. By adding climate-sensitive indicators, we increase the robustness of our assessment of vulnerability and get a better sense of how it may evolve over time. CLIFSI can be used to rank vulnerability of areas with various spatial boundaries, whether districts, river basins, WFP-Nepal clusters, or river-basin regions. Identifying a spatial boundary is the first step in examining the embedded nature of the vulnerability of the households within that boundary. Only once the most vulnerable of geographic areas has been identified, can stakeholders identify the most vulnerable of populations. CLIFSI also helped establish the baseline necessary for tracking the progress of and evaluating the effectiveness of climate change-related programmes over time and space. The proposed indicators can be included in the National Living Standards Survey, the agricultural census and other periodic surveys, thereby strengthening their databases and enabling them to assess the changing vulnerabilities in their areas of concern.

The study generated a body of information that can be used to design programmes to meet local food security needs as well as to serve as evidence to ascertain how households become vulnerable, how they respond to shocks, and what efforts will add value to their responses as they attempt to become food secure. The results will be useful for the ministries such as Agricultural Development, Science, Technology and Environment, and Local Development to develop programmes at all scales of governance as well as for international and local non-governmental organisations to design interventions.

The analysis will be useful in exploring the role that drivers of change other than climate play in creating vulnerabilities and isolating those induced by climate change alone. A meeting among DFSN partner agencies showed that, in general, district-level decision-makers and development agents will benefit from CLIFSI data while making decisions, and that these benefits will be particularly significant during period of food shortage. With CLIFSI, quarterly DFSN meetings can be a platform to promote synergy among expanded food-security programmes that take into account constraints that are likely to emerge due to climate change. The planners and extension workers of different agencies working in a given district will be capacitated to respond more suitably.

RECOMMENDATIONS

The usefulness of the CLIFSI can be enhanced if the recommendations below are kept in mind:

- The findings are preliminary ones based on the data collecated during one qurter with 445 households. Similar studies need to be carried out in a wider area covering more households. The resultant larger data sets will help determine the appropriate unit of vulnerability analysis, whether it is a district, WFP-Nepal cluster, river basin or river region.
- While the study focused on NeKSAP and developed CLIFSI helpful in assessing the vulnerabilities of food systems to climate change and in improving food security progammes, its lessons are applicable to a variety of other programmes concerned with potential climate shocks.
- Further testing of CLIFSI in consultation with various focal ministries and agencies would improve the robustness of the indicators. The survey should preferably be conducted in WFP-Nepal clusters. The survey needs to be administered bi-annually (summer and winter) to incorporate seasonal differences in vulnerability and so that the quality of the indicators themselves can be enhanced if gaps emerge, as they no doubt will.
- CLIFSI should be included in the national data system and collaborative activities to collect them, beginning with government agencies such as the Central Bureau of Statistics and the Ministry of Agricultural Development. In particular, CLIFSI need to be integrated into the MoFALD's Minimum Conditions and Performance Measures (MCMP) indicators to establish a comprehensive, climate-sensitive data set that can track the impacts and effectiveness of service delivery and build adaptive capacity.
- Climate science is little understood at local level and its influences are not the most pressing of local concerns. Even so, providing farmers with the scientific validation of their lived experience with climate dynamics recorded variously by climate scientists, meteorologists, and other experts can assist in local decision-making and using on-the-ground household- and district-level information to triangulate climatic information recorded at stations located within or nearby any given district are insightful endeavours. A multi-disciplinary team representing researchers, donors, government officials and farmers representative should work together to adequately capture climate change-related data.
- Some district-level indicators such as land-use changes, infestations of pests, outbreaks of diseases, and statuses of wild edibles, plants and herbs could also be collected at the household level and used to cross-validate findings. The data thus collected need to be synthesised at the meso district level and their implications to framing of public policy drawn. Given the absence of such mechanism it is necessary that research groups need to innovate and glean

such synthesis for learning so that the link between grass roots and higher policy-making are bridged.

- Now that stakeholders in climate change have begun to use assessment indicators, the individuals and agencies engaged in the planning and implementation of climate change programmes in Nepal are gradually becoming aware of emerging challenges. Still, development workers and analysts need to join hands to build awareness about climate change, revise the CLIFSI as shortcomings appear and changes occur, and disseminate findings widely. At the same time human capital needs to keep pace with the emerging complexity of what climate and other change processes bring.
- CLIFSI should continue to be administered over time and the process monitored, evaluated and revised. They are just one tool in a package and need to be used in conjunction with other methods that capture social and structural dimensions of vulnerability.
- The study team's engagement with WFP-Nepal field monitors during the study period improved their understanding of climate change issues, and continued efforts need to be made to update their knowledge. Because the process by which we can successfully adapt to climate change is an understanding in the making, researchers must continue to engage those involved in policymaking and implementation, including field monitors, boosting their appreciation of the full range of issues that govern climate change science, adaptation and resilience.

THE WAY FORWARD

Food security situation in Nepal is dynamic, changing by season and by year and the indicators employed to monitor the food security situation should be able to detect those changes. Vulnerability to climate change is an outcome of interaction between socio economic factors and climatic events/trends, and the nature of this interaction needs continuous research because incorporating climate change related indicators into the food security monitoring system would require adjustment in the way that data is and analysed and used. Such overall such approach would enable government agencies prepare strategies to enable individuals, households and communities take short term measures to minimise risks brought about by climate change as well longer-term adjustments.

In the past, food security in Nepal was dependent on localised production-consumption relationships (Moench et al., forthcoming), and indeed, the availability of and access to food do depend on interlinked local water, land and agriculture systems. In recent times, however, the stocks and flows of food in the country have become increasingly dependent on regional and even systems and markets. In fact, such international and regional systems are now as important as local or even national factors in determining food security. Infrastructure and the organisational systems responsible for its functioning are important for achieving food security since they provide the services people need to adapt effectively to stresses related to climate and other changes. Because food insecurity is the outcome of multiple drivers upon which various dynamics are at work, overcoming insecurity will require developing a deeper understanding of systemic interdependence and appropriate response strategies than we currently have.

The indicator-based approach to assessing vulnerability derives from earlier work on poverty mapping and food insecurity, generally, that used socio-economic data from national censuses or aggregated household or community surveys (Leichenko and O'Brien, 2011). The selection of indicators for such assessments is an important step and depends on the availability and quality of data. NeKSAP is one tracking system that can be used to assess vulnerability over a pre-determined timeline, in this case, every three months and every year. This report suggests that even when data is limited to a single collection, CLIFSI are still useful in assessing and communicating vulnerability ranking. By tracking food insecurity and vulnerabilities to climate change respectively, NeKSAP and CLIFSI can become instruments for sparking policy dialogue and bringing about policy changes not just in Nepal but other countries and regions as well.

While CLIFSI have the potential to become a practical tool for decision-making, the existing indicators are limited and need to be expanded and updated. Integrating CLIFSI into the existing food security tracking system, the NeKSAP survey, can save money and see the institutionalisation of CLIFSI within government mechanisms. To make the best use of CLIFSI and maximise value for money given limited resources and the complicated logistics, agencies such as WFP-Nepal and the government of Nepal will have to introduce innovative procedures that must evolve constantly if CLIFSI are to become an effective instrument for developing local strategies to deal with climate change-influenced food insecurities. Additional budget, human resources, decision on frequency of collection and capacity building activities such as technical support and trainings on climate change and food security need to be pursued.

In particular while the proposed CLIFSI will help decision-makers assess which regions have fragile systems and should receive priority, they still must identify those communities, groups, households and individuals who are most marginalised, or have the least access to services from core, secondary and tertiary systems. While recognising how important this sort of identification of most-at-risk populations is, this study made no attempt to identify them, although it does recommend that institutions such as DFSNs are an appropriate place to begin exploring how insights from CLIFSI can be localised. The study further suggests that agencies such as WFP-Nepal, while espousing a systemic perspective, nonetheless pursue bottom-up approaches to identify vulnerable groups and to take ameliorative actions.

Food security in Nepal is intertwined with high rates of poverty and malnutrition and low scores on the human development index but also with the widening and diversification of its market and transport systems (Moench et al., forthcoming). New linkages between local and regional food systems have brought new sources of vulnerabilities, however, the fragility of and the poor services provided by VDC-level basic systems such as energy, transport, communication, health, education and alternative livelihood have not helped marginalised households tackle these vulnerabilities with vigour. Those households with no access to remittances or non-farm income sources are particularly vulnerable to all kinds of shocks, including those due to climate change. Table 20 provides a glimpse of how households in the districts cope by selling off livestock, property, and other assets, in selected districts of the far-west development region that need to be addressed by policymakers.

CLIFSI can assess vulnerability at the level they are administered, whether ward, VDC or district, and, collectively, the data gleaned can help rank the geographical region they lie in for vulnerability. To that end a procedure for collecting data needs to be refined so that an appropriate spatial scale is considered. The ranking can be used as a foundation that will allow for the later pursuit of a bottom-up approach to identify the most vulnerable and marginalised households, groups and communities within that region. Both approaches—CLIFSI-based and participant ranking—are necessary for assessing vulnerability and for planning a resilient food system that would enable adaption. This two-pronged process can help decision-makers systematically identify and reach the most vulnerable, as is envisioned by the country's climate change policy.

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