Global Environmental Change and Food Security in the Indo-Gangetic Plain

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Abstract
The intensification of technological and economic globalisation escalating the emission of greenhouse gases (GHGs) into the atmosphere has contributed to global climate change. The result is more erratic rainfall, frequent and intense floods and increasing water scarcity (NCVST, 2009). Both flood and drought affect food security in many developing countries. Because they own few assets, are uneducated, have no skills, and are, in general, deprived, many poor people do not possess the ability or the resources to recover when extreme floods and droughts disrupt their livelihoods. Since conditions on which their livelihoods depend are increasingly stressed, their lack of capacity to respond to these impacts implies that poor people will continue to live in an impoverished condition. The consequences of these changes in food security on the poor are serious and varied, depending on the food production systems involved. This challenge in the Indo-Gangetic Plain (IGP) is serious. The present collaborative study attempts to understand food system vulnerabilities and identify its challenges in IGP.

Keywords: *food system, vulnerability, IGP, food system determinants, adaptation, GEC*

Introduction
Climate change is only one of the processes transforming societies in the IGP. Other drivers are urbanisation and the penetration of communication systems. As both proceed, populations, particularly those in urban regions and nearby towns, are growing increasingly dependent on ecosystems outside their immediate environments for meeting their water and food needs. Even rural populations import food, opening them up to new sources of vulnerabilities. As urbanisation and developments in communication continue apace and ecosystems degrade, the dependence of local populations on globalised labour, products and markets increases. Indeed, while the impacts of climate change differ according to local conditions, many of these impacts are transmitted to local regions through interactions with globalised systems to create second-order impacts.

Food systems contribute to environmental and other insecurities as interactions between and within bio-geophysical and human environments influence both food system activities and their outcomes (Ericksen, 2007). The over-extraction of groundwater to

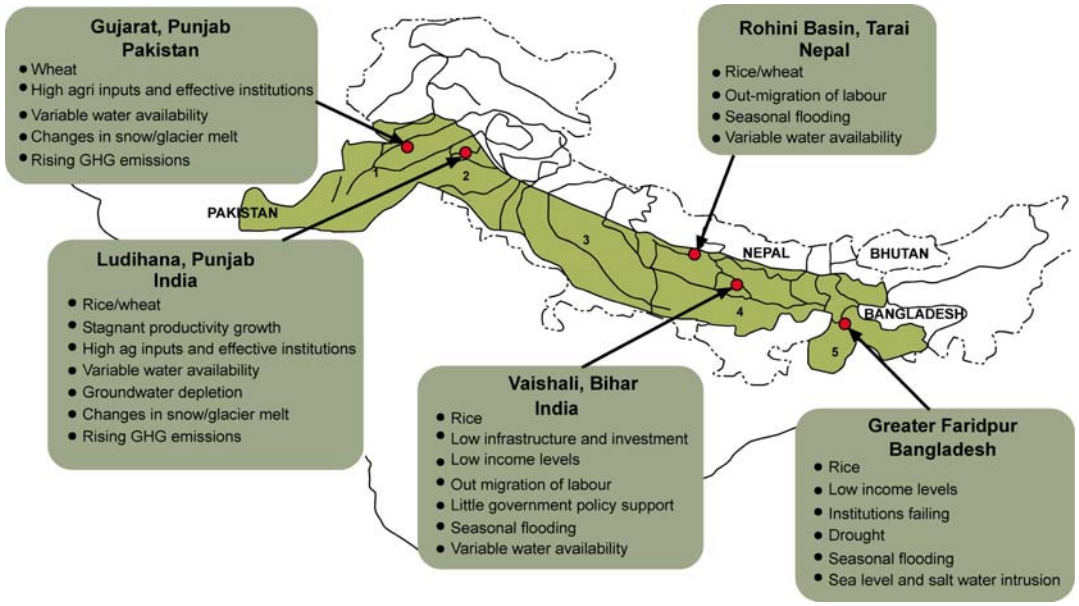

Figure 1. Study sites in IGP
Source: Modified from GECAFS (2008)

overcome drought and the rising demand associated with population growth and development, and the deterioration of surface water sources through pollution have placed additional stress on food systems.

Food system vulnerability can be conceived as both a function and the outcome of the intersection of marginality and the exposure of systems to climate shocks. No matter what the climate change scenario of the future is, local food security will be affected and addressing this issue will require the consideration of multiple expressions of vulnerability. FAO (2009) has predicted that food production will have to increase by 70% by 2050 in order to feed an additional 2.3 billion people and there will have to be much more effort to improve the distribution of and access to food.

The Nepal Water Conservation Foundation (NWCF) with support from the Asia-Pacific Network for Global Change Research (APN) conducted a collaborative study in the IGP to understand food system vulnerabilities, examined from the systemic perspective of food security dimensions: food availability, food accessibility, and food utilisation (Figure1).

The collaborating partners of the study were: Gorakhpur Environment Action Group (GEAG), Global Change Impact Studies Centre (GCISC), Pakistan and Punjab Agricultural University (PAU), Centre for Global Change (CGC), Bangladesh. In addition, the Global Environmental Change and Food Systems (GECAFS), London officers and the Australian National University faculties supported the study.

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Improving Policy Responses to Interactions between Global Environmental Change and Food Security across the Indo-Gangetic Plain (IGP)

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Agricultural and food systems are influenced by socioeconomic conditions, which themselves are affected by macro-level policies and the spread of infectious diseases. These systems, along with changes in climate and demographics and poor agriculture-related infrastructure and widespread poverty contribute to food insecurity in the IGP. The predicted rise in food insecurity and its negative outcomes lower the potential of the IGP, which is characterised by fertile soil, a favourable climate and an abundant supply of water (Agrawal *et al.*, 2004). Its people depend on small-scale and rain-fed agriculture and are among the poorest in the world. Their poverty is often attributed to the regular floods and drought that prevail afterwards (Bandhyopadhyaya, 1999). One of the

Local food collection point: How will climate change and other stressors affect these decentralised systems and contribute to local food insecurity?

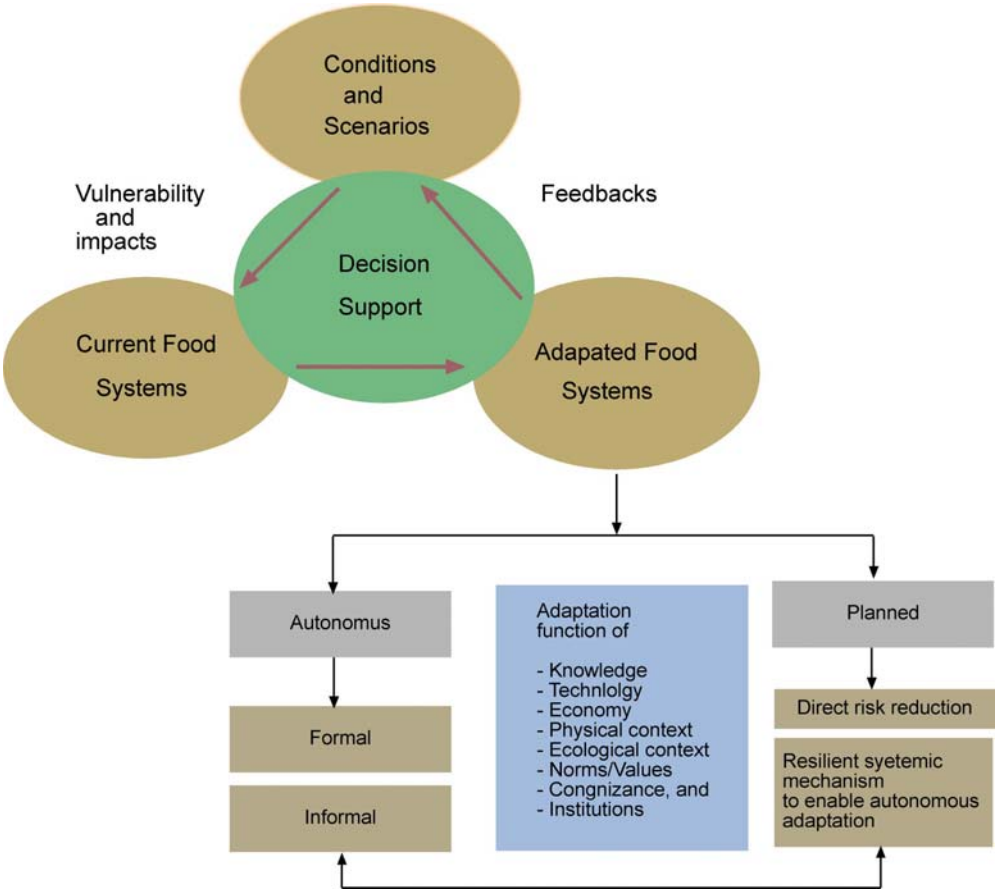

Figure 2. Conceptualising food system adaptation
Modified from GECAFS 2008

major impacts of climate change in the IGP will be serious as precipitation is likely to be more uncertain. A downscaling exercise by Stapleton and Gangopadhya, (2009) in the Rohini Basin, which is a small basin in the IGP, suggests that local climate will become more erratic as more GHGs are emitted into the atmosphere.

In the IGP people will be subjected to more flooding and its effects, including inundation, bank-cutting and sand deposition. Coastal Bangladesh and Pakistan are likely to face stress in the form of tropical cyclones, storm surges, rising sea levels and salt-water intrusion. The poor in the IGP may face major impacts if climate change-related hazards decrease rice yields and rice-producing countries increase their prices or restrict exports. In addition, while the population of the IGP is part of the global labour market, it has little leverage to increase wages. Also, much attention is focused on location-specific events such as extreme storms, but these types of second-order impacts, where the effects of climate change are transmitted across regions through interconnected systems, may become more profound and difficult to manage. Enhancing food security needs to focus on these challenges too.

Insights

By exploring responses to the interaction between Global Environmental Change (GEC) and food security issues across selected sites of the IGP, the present study brought to light the following insights:

i. Efforts need to be made to document the utility of different types of decision support tools, including cost-benefit analysis, vulnerability assessments, climate risk assessments, planning for uncertainty and resilience planning, gender and social dimensions, multi-stakeholder consultations and SLDs. Decision support systems can help translate research evidence into policy action.

ii. Communication among locals, policy-makers and researchers needs creative approaches to develop decision support systems. In developing such systems we must recognise that policy activities need to involve plural actors, and that such activities occur at various scales from local to national to global.

iii. Scenario development is a useful tool for displaying various options for addressing issues under different sets of conditions. Irrespective of the climate change scenario used, food security will be affected and will hamper the ability of local populations to adapt.

iv. Food systems are vulnerable to disruptions caused by the impacts of climate change and can be improved by increasing productivity through

promoting different farming systems or off-farm activities. Improving the preservation of food improves the utility and productivity of farm produce. Food-processing activities help make food available during the lean season. Crop-processing could provide employment for women and the poor.

v. The links and interdependence between basic energy, water, food, finance, health, communication and other infrastructures, the diversification of livelihoods, and the ability to shift strategies as conditions change contribute to overcome household food insecurity. Diversification away from climate-sensitive livelihoods like rain-fed agriculture will increase adaptive capacity because diversification increases the number of independent income flow options a household has.

vi. Households with the ability to anticipate and respond to climatic-related hazards and to recover from them can adapt better than others who cannot. The impact of climate change-related hazards is worsened when geophysical vulnerability interacts with the vulnerabilities created by social, economic and political processes. Existing forms of marginalisation created by gender and social exclusion lower an individual's capacity to adapt to hazards created by the changing climate and multiply existing threats.

vii. Adaptation occurs at two levels: planned and autonomous. Autonomous adaptation is defined as those decisions made independently of the direct involvement of the state or its organisations. Attributing impacts to climate change will be necessary for implementing targeted activities as planned adaptation. Adaptation is a function of knowledge, technology, economy, physical and ecological contexts, norms/values, cognisance and institutions (Figure 2).

viii. Multi-stakeholder partnerships and social networks serve as important foundations that enable adaptation to occur. Resilient communities should be prepared for any eventuality and learn from the unexpected in order to strengthen their anticipation, response and recovery strategies.

ix. The formulation of appropriate policies to address food insecurity requires integrating skill and knowledge of governments, markets and society. Interaction among researchers and policy-makers is important in generating, transferring and using knowledge that combine modern and locally-based mechanisms.

Conclusions

In the IGP the vulnerability of food systems to GEC is increasing. Food determinants like production levels, land quality and infrastructure will all be negatively impacted by GEC stresses, with the result being an increase in food prices, deterioration in food storage and handling, and a decline in household income. GEC is likely to increase the vulnerability of the population which already has a low adaptive capacity. Building resilience requires ensuring access to food, drinking water, sanitation, education and reliable energy.

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