STOCKHOLM ENVIRONMENT INSTITUTE

Poverty and Vulnerability Programme
GECAFS Project

Choosing methods in assessments of vulnerable food systems

Political ecology and Actor Network Theory inform the choice of methods of vulnerability assessment and evaluation of adaptation options and processes. A minimum toolkit includes a mental map of the problem space, inventory of stakeholders, actor/livelihood sensitivity matrices, and profiles of vulnerability. Further analyses explore the dynamic nature of food systems through agent based models (from simple rule-based expert systems to more cognitive treatments). Global change scenarios and detailed impact models can be readily linked to this analysis of socio-ecological vulnerability.

A progression of theory to practice

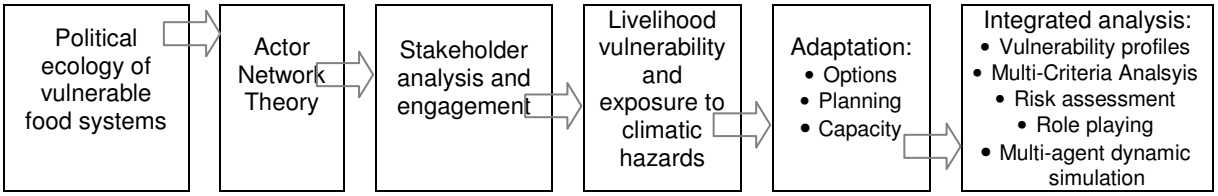
An integrated assessment of vulnerability to multiple stresses needs to be designed with forethought. As a contribution to the GECAFS project, the SEI explored the social theory of vulnerability (Franklin, 2004) and worked with experts to think about practical methodologies. This briefing note brings together the theory and practice. The practical approaches also draw upon work for the National Adaptation Programmes of Action (NAPA) and Adaptation Policy Framework.

The political ecology of vulnerable food systems is an essential starting point to designing an assessment. The emphasis on the dynamic nature of vulnerability over time and multi-level processes provides an initial canvass for choosing methods.

One implementation of political ecology is Actor Network Theory (Callon 1999), which seeks to identify the various actors (human, ecological and physical), the boundaries of the system, and the nature of their interactions. This social theory coheres well with the concept of coupled socio-ecological systems and the analysis of resilience.

One approach to scoping an assessment at this level is mental mapping (Morgan et al. 2002). Experts and stakeholders interact to identify the main actors and drivers of change, which can be readily translated into simple models (e.g., using a declarative modelling language).

Methodological progression:



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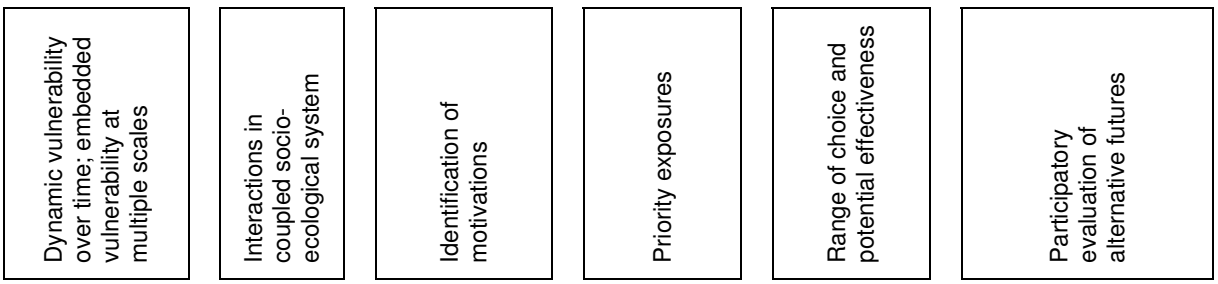

Framing climate change vulnerability needs to be determined regionally, drawing out the negative and positive externalities intrinsic to the processes of production, distribution and consumption. Considering a livelihood system in the light of Sen's entitlement concept would mean that we would have to be sensitive not only to a person's or group's endowment position and exchange opportunities in a particular locality, but we would have to see how such qualities changed over time, at different temporal stages of the food system (however framed), and under particular sets of stresses, again determined locally. It is only through this complex process that climate change vulnerability can begin to be reasonably assessed, as a process and therefore in a narrative, rather than descriptive manner.

The matrix example below shows a first-cut relating multiple stresses to aspects of a food system and the key actors vulnerable to those stresses.

Scoping the food system

Define the region: vulnerability is not limited to a specific geographic coordinates; rather processes operate on multiple scales

Define the temporal scale: historical trends and trajectories are as important as the present status; social and economic vulnerability varies on diverse but often rapid time scales.

Document the processes that generate vulnerability: the risks arise from multiple stresses; the responses at different level may mitigate or exacerbate some vulnerabilities.

Define who is vulnerable: livelihood security is a meta-level concept, but both individuals and systems may be considered vulnerable.

Relate social vulnerability to ecosystem resilience: The resilience of ecosystem services are important for different vulnerable groups.

Identifying stakeholders

Analysis of an actor network requires an inventory of the actors or stakeholders relevant to vulnerable food systems. Stakeholders include classes of vulnerable groups (e.g., marginal populations), local leaders, and decision makers in local and national organisations (government, NGOs, charities).

Stakeholders have specific interests in vulnerable food systems and adaptive capacities, to greater or lesser extent allied to their decision frameworks and processes.

A starting point in the analysis should be an inventory of stakeholders, analysis of their organisational capacity (e.g., mission, legal structure, resources) and a mapping of stakeholder networks that form the basis of social institutions.

Scoping vulnerability

The next step is to evaluate present vulnerability. Here we suggest using a series of matrices to show the relative vulnerability of different groups and activities to climatic hazards.

A livelihood approach starts with the identification of who is vulnerable (above) and adds, to what and to what extent? Using vulnerable livelihoods as the 'exposure unit' has strong synergies with poverty reduction and development planning. A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base. (see www.livelihoods.org; Cannon 2002 explores the link to entitlements (Sen, 1981)).

A matrix starts with the list of livelihoods in the region, such as farmers (smallholders and commercial), fisherfolk, pastoralists and urban poor. Working backwards adds to the list productive activities of these livelihoods, such as food cropping, cash cropping, small livestock and off-farm casual labour (for smallholder farmers). In turn, those activities depend on a range of sectoral services (such as local and national markets), public infrastructure (roads and ports) and ecosystem services (watershed groundwater recharge). Thus, the rows of the livelihood-sensitivity matrix are a hierarchy of the ecosystem, public and economic services that

are essential in productive activities, which are elements of common livelihoods.

The columns in the livelihood sensitivity matrix are the present climatic threats (or opportunities) and trends that are significant for the vulnerable livelihoods. It may be useful to add other stresses and shocks that exacerbate the effects of climatic hazards. For instance, HIV/AIDS, economic recession and civil strife would alter the range of coping strategies that different livelihoods might employ in order to cope with droughts or floods. These become important if they directly affect the adaptive capacity of livelihoods and the ability to implement proposed adaptation strategies.

The matrix can be filled in with relative scores (say from 1 to 5) for the degree to which each hazards affects each service or livelihood.

Evaluating adaptation

The first task in evaluating adaptive options is to identify and characterise the range of options available. A checklist of attributes to evaluate might include:

- Finance, information and skills required to implement
- Time required to plan and implement option
- Stakeholders who will implement the option
- Beneficiaries of the option
- Conflicts with other options or stakeholders

Techniques to evaluate adaptation options range from qualitative checklists (as above) to full cost-benefit analysis. In most cases, some sort of multi-criteria analysis is essential. Various tools are available in this area, from examples of spreadsheets that keep track of the options and criteria to formal decision support models.

The evaluation of adaptation options should make explicit links between the vulnerability of specific livelihoods and criteria chosen for the MCA. For example, the effects of improved food security monitoring should be estimated for a criteria such as 'poverty alleviation among smallholder farmers'.

Further integrated analysis

A minimum level of integration might be a series of vulnerability profiles (whether maps or multi-attribute charts for specific livelihoods) and the evaluation matrix for adaptation options. These should be shown for a variety of scenarios of socio-economic futures and climatic risks.

However, such outcomes are static views of the future, mostly driven by an expert research team. Of course, reality may be quite different. Equally, the views of stakeholders may diverge significantly from those of the experts. More dynamic approaches to integration should be contemplated. The range of choices includes:

Risk assessment. Stakeholders can identify their 'reasons for concern'—the categories of risks, such as the regional food supply/demand balance, agricultural trade and food security for specific livelihoods or marginal populations. Scenarios of future trends and shocks can be assessed using a semi-quantitative scale of risks.

Role playing and policy exercises. Insight into the dynamics and processes driving future vulnerability and the implementation of adaptive options can be gleaned from stakeholder-driven exercises. Role playing is one form of an interactive policy exercise. For instance, a drought crisis could be 'played' for the present and then for a future scenario, perhaps with greater economic trade and an early warning system.

Rule based and multi-agent modelling. Formal models of environmental stresses, the responses of individual actors and social networks can provide a means to test a wide range of scenarios. Simple rule based approaches can be readily implemented, for instance in the Java Expert Systems Shell. More in-depth understanding of actors' perceptions, decision processes and range of options can be developed in multi-agent social simulation frameworks (such as RePast or Mason). Many agent-based languages now facilitate close linkages with geographic information systems and environmental models.

Examples

A matrix approach relates multiple stresses to production, distribtuion, availability and access in a food system. In this example, production and distribution are highly vulnerable to civil war, and primarily the domain of farm labourers and traders among the vulnerable socio-economic groups.

Stresses	Production	Distribution	Availability	Access
Civil war				
Economic pressure				
Weak Governance				

Actors	Production	Distribution	Availability	Access
Farm labourer				
Transporter				
Trader				

A livelihood sensitivity matrix shows three types of exposure as rows: ecosystem services (which might be expanded to include public infrastructure and sectoral services), livelihood activities, and livelihoods (as an integrating element). Climatic hazards can be show for the present and for future scenarios. A range of indices can be calculated from even a simple matrix.

	CLIMATIC HAZARDS					*Exp. Index*
	Drought	Dry spells	Floods	Warm spells	… others	
ECOSYSTEM SERVICES						
Soil water	▲	■	▲	◦		*75*
Water supply	▲	○	■	◦		*60*
Wood fuel	□	◦	○	◦		*35*
Grazing/fodder	■	○	■	◦		*55*
LIVELIHOOD ACTIVITIES						
Food crops	▲	■	□	◦		*65*
Market crops	▲	□	○	◦		*55*
Livestock	■	□	□	◦		*55*
Charcoal	○	◦	○	◦		*30*
Casual labour	□	◦	□	◦		*40*
LIVELIHOODS						
Smallholders	▲	□	□	◦		*60*
Emerging farmers	□	○	○	◦		*40*
Traders	□	◦	■	◦		*45*
Impact Index	*73*	*40*	*60*	*20*		

Key: To convert the symbols into scores: ▲ = 5, ■ = 4, □ = 3, ○ = 2, ◦ = 1.

Five reasons for concern regarding global food systems and food security are proposed. Qualitative risks are identified for each concern, matched to the degree of global warming. Note that this is an illustrative example only (see Downing 2002).

Global warming °C	I: Global food production	II: National agricultural economies and market trade	III: Variability in production	IV: Food security among vulnerable livelihoods	V: Impacts of large-scale droughts and floods
6	Increased potential for shortfalls	Large increases in trade and dependence on imports	Increased variability has significant economic costs	Increased variability and costs in some regions threatens food security	Potential for large scale, prolonged events to trigger migration and economic collapse
5					
4	Increased risks in periods of adverse weather	Risks to economies with existing stresses (water shortages, high temperatures)			
3	Little threat to global food supply		Adaptive mechanisms are possible, but increasing costs	Regional risks are significant for many livelihoods	Prolonged events create serious economic and societal crises
2		Some risk to small economies, e.g. small island states			
1			Periodic shortages cause crises in some countries	Some livelihoods already in crisis	Prolonged events have significant costs at present
0 (present)		Underdevelopment prevalent in many LDCs			

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Morgan, M.G., Fischhoff, B., Bostrom, A. and Atman, C.J. 2002. Risk Communication: A Mental Models Approach. Cambridge University Press, Cambridge.

Sen, A. 1981. Poverty and Famines: An essay on entitlement and deprivation. Oxford University Press, Oxford.

Other relevant briefing notes

- Vulnerability, global environmental change and food systems (overview of vulnerability concepts)
- Vulnerability assessment and mapping (use of indicators)
- Resilience: Contributions to vulnerability concepts and methods
- Political ecology: Contributions to vulnerability concepts and methods
- Vulnerability toolkit (overview of range of tools for vulnerability assessment)

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Poverty and Vulnerability documents and discussions: www.VulnerabilityNet.org

GECAFS: www.Gecafs.org