Capacity strengthening in climate change vulnerability and adaptation strategy assessments

Toolkit for Vulnerability & Adaptation Assessments

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In collaboration with:

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Introduction

Many tools and methods exist for undertaking vulnerability and adaptation assessments. It is important to recognize the nature of vulnerability and the concepts behind adaptation to climate variability in order to be able to choose tools that are appropriate and assess what is needed.

Four common methodological challenges are:

- Representing complexity: ecological services are intimately linked with human actions and such closely linked systems tend to be complex with numerous flows and feedbacks that impact on the vulnerability and the ability to adapt.
- Scale: local processes are embedded in or linked to processes at other scales, both geographic and temporal.
- Integration of qualitative and quantitative understanding of vulnerability.
- Dynamic representation of vulnerability processes that integrates the interplay of human actions with environmental stocks and flows. At the same time, adaptation responses change the pattern of future vulnerability.

The choice of suitable tools depends on the environmental system of interest and socio-economic vulnerability. The practical concerns of an assessment – the time and resources available, target audience, and required outcomes – are also relevant. Before the process of scoping tools is undertaken, it is useful to understand what each of the individual tools might be. This compilation outlines the individual tools and the details of how they might be undertaken. It is important to recognize that these are introductory guidelines and that tools should be adapted for specific purposes where necessary.

The chronology of tools is based on their primary use as shown in Table 1. Those that are seen as a key tool for undertaking vulnerability assessments are presented first. They are followed by tools primarily of use for adaptation assessments. It should be noted that many of these tools can have multiple use depending on how they are defined and used. If they are equally as appropriate for vulnerability and adaptation assessments they have been placed in the vulnerability section.

Another way of choosing tools is to locate the assessment within a policy-planning cycle (see Figure 1 below). A policy focus entails a process of issue identification and raising awareness that sets in motion a broad policy statement. For instance, a Poverty Reduction Strategy Paper might set policies to reduce food insecurity. A subsequent analysis of climate change might add to this policy a statement regarding the need for better drought preparedness and responses. Strategic planning goes one step further to lay out a long term set of objectives and strategies. Continuing the drought example, a strategy might set up sectoral and regional drought monitoring and planning committees. This would be a broad approach to adaptation to climate change, linking present development planning (over a time frame of up to 20 years) with concerns for longer term changes in climatic risks. At the operational level, strategies are converted into actions—those measures that are required to achieve the stated strategies and targets. This might include a means to forecast and monitor drought conditions, institutional arrangements to review and test drought contingency plans, and supporting measures to enhance the range of options available during a drought (such as emergency food aid or reallocation of irrigation water). Each of the phases in the cycle are linked together, providing opportunities to revisit planning objectives and consequences over time.

Most of the vulnerability methods are appropriate for a policy-issue identification phase, while adaptation planning is oriented toward strategic planning and operational implementation. However, all of the methods span more than one phase in the cycle.

Figure 1: A policy-planning cycle to frame climate adaptation

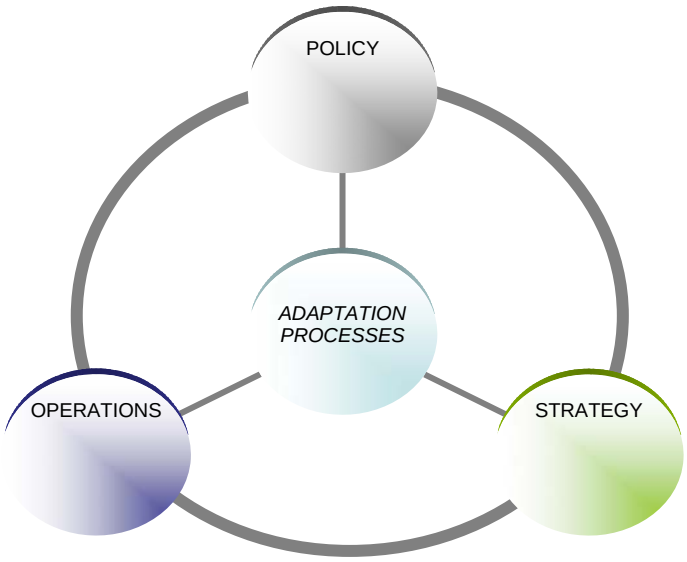

Table 1: List of tools for vulnerability and adaptation assessments

No.	Tool	Vulnerability	Adaptation	Planning cycle
1	Brainstorming	**X**	**X**	**P-S-O**
2	Checklists	**X**	**X**	**P-S-O**
3	Institutional analysis	**X**		**P-S**
4	Livelihood indicator approach	**X**		**S**
5	Oral histories	**X**		**P**
6	Role-play	**X**	**x**	**P-S**
7	Stakeholder consultation	**X**	**X**	**P-S-O**
8	Syndromes and integrated vulnerability models	**X**		**P**
9	Vulnerability indicators/ mapping	**X**		**P-S**
10	Vulnerability profiles	**X**	**x**	**S**
11	Agent-based simulation modelling	**x**	**X**	**S-O**
12	Cognitive mapping	**x**	**X**	**P-S**
13	Decision/probability trees		**X**	**S-O**
14	Delphi technique		**X**	**S-O**
15	Expert judgement		**X**	**P-S-O**
16	Focus groups	**x**	**X**	**S-O**
17	KnETS		**X**	**P-S**
18	Multi-criterion analysis	**x**	**X**	**S-O**
19	Risk analysis	**x**	**X**	**S-O**
20	Scenario analysis	**X**	**X**	**P-S-O**
21	Strategic environmental assessments		**X**	**S-O**

Key: X = Major tool; x = potentially useful;
Policy – **S**trategic planning – **O**perational implementation

Section 1: Vulnerability Assessments Tools

1. Brainstorming

Summary: Free-flowing lists and diagrams of all ideas and options

Description

Brainstorming is a semi-structured process of capturing free-flowing ideas. The process is logical and enables people to think through the process of related elements that might not be thought of otherwise. It is also important as a process of internalising ideas.

Method

Technique: A large sheet of paper can be put on a central table around which everyone sits with a pen or a facilitator can write all ideas that come up on a board or people can write their ideas on post-its that can be stuck on a board/wall. Ideas to be followed up on can be circled or if post-its are used, common ideas can be grouped together. These can be prioritised if necessary. Brainstorming is done in a group setting and therefore enables a range of ideas to be captured in one process. Because of this a large number of ideas are generated in a short time and it is important that information is used in a constructive manner. The initial brainstorming session that lays out many ideas should therefore be followed by a session that evaluates options and enables novel ideas to be used in future planning.

Points to remember for a successful brainstorm:
- Use an experienced facilitator
- Ensure even participation
- Have a clear topic
- No more than 10 people in a group.

It may be useful to use brainstorming for developing a range of adaptation options that may be pursued, or for helping to get a broad range of which stakeholders might be impacted on by certain aspects of climate change. It can also be used by stakeholders that may be impacted on by certain activities. This process will help them to have ownership of the product and to better understand where other stakeholders are coming from.

Example

Brainstorming can be used to gather ideas on many themes. For example, it might be used to establish what risks a certain livelihood group is exposed to. The brainstorm can be taken further by examining the characteristics of certain risks. For example, natural hazards might be specified as a risk and particularly, heavy rainfall and frost. The topic of heavy rainfall can then be brainstormed further by examining the characteristics of the risk. This helps to focus intervention on the range of concerns without excluding some.

Time frame	Current decision, Planning horizon, Long term
Policy target	Operational, Project design, Strategic plans, Awareness
Analytical unit	Individuals, Households, Livelihoods, Regions, Sectors, Macro
Clients	Local, Regional, National, International
Time for assessment	Rapid, Year, Several years
Resources needed	1 PM, Several PM, Multi-disciplinary team
Knowledge	General
Links	www.lama-online.org/vulnAssess.html www.ifpri.org/events/conferences/2002/092302/houseguide.pdf www.cs.unb.ca/profs/fritz/cs3503/storm35.htm http://web.mit.edu/hr/oed/learn/meetings/art_brainstorm.html

2. Checklists

Summary: Matrix inventory and qualitative assessments

Description

Checklists are a logical format that can be used to evaluate a range of options in a cursory manner.

Method

There are many ways checklists can be used. A checklist might be completed by an expert or might be completed by a group of stakeholders. It is the person's evaluation of whether criteria are met or not. It is important that the use of the checklist is clearly established. For example, is the purpose of the checklist to evaluate a range of methods for undertaking a task or a range of strategies for achieving a goal. Once the aim of the checklist is established, different criteria can be added to the matrix. It is useful to pilot the checklist to ensure that it is clear and understandable. The checklist can also be sent to experts for review before it is used. It is also important that research is done before compiling a comprehensive checklist in order to identify all possible option and to establish what criteria are relevant to the situation. Extensive checklists are a relatively fast way of evaluating a wide range of options and may be used as a scoping tool to identify areas for further detailed investigation.

Example

The example shown in Table 2 illustrates how a checklist might be used. The example presents a list of possible strategies for reducing household water consumption (that could have been produced using brainstorming). For each strategy there could be a column of the impact, resources, timeframe. These cells are then filled in as appropriate by being checked off.

Table 2: Checklist to evaluate strategies for reducing household water consumption

	Negative impact on poor	High investment	Short-term	Long-term
Increasing water price	✓		✓	
Decrease the price of water saving devices		✓		✓
Education campaigns on water saving		✓		✓

Time frame	Current decision, Planning horizon, Long term
Policy target	Operational, Project design, Strategic plans, Awareness
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Time for assessment	Rapid, Year, Several years
Resources needed	1 PM, Several PM, Multi-disciplinary team
Knowledge	General
Links	www.wmich.edu/evalctr/checklists/cdc.htm

3. Institutional analysis and stakeholder thematic networks

Summary: The mapping of the key actors and their interactions, evaluation of the formal and informal rules, norms and organisations that govern behaviour

Description

When assessing vulnerability and adaptation, it is critical to understand the context within which people operate. It is key to note that decisions are rarely made in relation to climate risk alone. Institutional change (through change of social, cultural and other norms) can play a much larger role than the signal of climatic variability and change. Institutional change can be highly variable and unpredictable and it can limits and/or facilitate adaptation today and in the future. Institutional analysis requires an assessment of the types of institutions (the rules, norms, values and laws, both formal and informal) governing people and the systems within which they exist. It is this range of factors that are crucial to assess when understanding who is vulnerable and why, as it helps uncover some of the key drivers of vulnerability that may not be clear upon initial analysis of the situation. Institutional analysis is also critical when anticipating how to support adaptation as it will help determine why certain options might be more appropriate and successful than others.

Method

Stakeholder Thematic Networks (STNs) are an analysis of stakeholders and the efficiency of the networks within which they operate. STNs enable qualitative information to be analysed through semi-quantitative mapping of relationships that enable the networks and scales of linkages to be visualised.

In order for networks to be classified and for dissemination to be judged as effective or not, stakeholders need to be characterised, relationships between them defined and a description of how the environment controls their interaction included. This can be achieved by accomplishing four tasks; 1), examining users' perceptions of information, 2) establishing the users' role as both received and disseminator of information, 3), the interaction of users uncovers the existing networks and 4), existing networks should be contextualised within their wider decision environment. Stakeholder networks and their components of nodes and channels are a semi-quantiative tools for achieving a thorough institutional analysis. STNs can be extended into multi-agent systems, which are essential when complexity increases as the number of actors, levels and emergence increases.

Example

In the field of agricultural adaptation, it might be assumed that farmers will perceive and respond efficiently to climate signal and that decisions on crop choice, management, inputs and labour are flexible and responsive to market prices; that households will act to optimize profits and/or yields and that adaptation options are within agricultural sector. An institutional analysis of a farming group might be achieved by using a number of tools to gather information about the institutions that govern farmers' behaviour. For example, community timelines would illustrate important events and key changes in livelihoods. Surveys might provide perceptions of tendencies of socio economic change (points of vulnerability/opportunity) and the impact of non-climatic vs. climatic factors influencing decisions.

Different groups are likely to have different perceptions of the impact of institutional change. For example, a subsistence community might view recent change as positive with new availability of welfare support. Semi-commercial farmers might have a mixed view of change, as new programs have been developed but they have been excluded. Input costs have risen and producer prices stagnated. Within this context, crop diversification might also have constraints. Farmers might be informed that shorter-cycle crops are better adapted to future climate variability but there are no subsistence or economic incentives for changing and there is not insurance and credit to support this change.

Time frame	Current decision, Planning horizon, Long term
Policy target	Project design, Strategic plans, Awareness
Analytical unit	Livelihoods, Regions, Sectors, Macro
Clients	Local, Regional, National, International
Time for assessment	Rapid, Year, Several years
Resources needed	1 PM, Several PM, Multi-disciplinary team
Knowledge	General
Further info	Example adapted from Eakin, 2002. Institutional change, stakeholders and adaptation. Presented at AIACC Project Development Workshop: Climate Change Vulnerability and Adaptation, *3-14 June 2002, Trieste, Italy*. www.aiaccproject.org/meetings/Trieste_02/trieste_cd/Open_CD.htm
Links	http://lnweb18.worldbank.org/ESSD/sdvext.nsf/81ByDocName/ToolsandMethodsInstitutionalanalysis (World Bank institutional analysis guidelines) http://lnweb18.worldbank.org/ESSD/sdvext.nsf/81ByDocName/ToolsandMethodsStakeholderanalysis (World Bank stakeholder analysis guidelines) www.nrsp.org.uk/database/documents/1464.pdf (Guidelines for undertaking institutional analysis in natural resources research; includes some stakeholder analysis information (Natural Resources Institute))

4. Livelihood indicator approach

Summary: An assessment of impact of climate stressors on livelihood typologies

Description

The livelihoods concept has become widely utilized as a framework for assessing rural livelihoods. Its strength lies in the ability to look at a wide range of resources, activities and socio-economic elements that make up the livelihood of an individual or household. A livelihood is seen as sustainable when it can: cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets both now and in the future, and not undermine the resource base. This is important in the climate change context as it enables the impact of climate variability to be assessed on different aspects of livelihoods. For example, the direct impact of reduced rainfall might result in reduced yield and so households would have to find alternative food sources or the framework might help to consider that reduced rainfall might lead to reduced opportunities for temporary jobs picking fruit on farms and so casual labour might be reduced leading to reduced household income. In a similar way, the framework also enables a consideration of the range of adaptation options that might be available to households. The livelihood indicator approach builds on the livelihood framework in order assess the vulnerability of livelihood typologies to different stresses. The method takes advantage of expert knowledge in a structured way that builds on bottom-up local observations. It can readily lead to formal indicators. The focus on livelihoods leads directly to targeting and suitable adaptation options while maintaining the key components of each livelihood typology.

Method

The approach requires an initial analysis of the dominant livelihood typologies in the case study region. The threats to these livelihood typologies are then identified. A matrix is developed that assesses how sensitive each typology is to each risk identified. This serves to reveal who is vulnerable to different threats and stresses. The outputs can be ranked according to different variables. For example sensitivity to mortality might have a different pattern than exposure to loss of livelihood or well-being. The livelihood sensitivity matrix is the foundation for further analysis. The approach essentially melds a hazard + vulnerability = risk framework with the common Pressures-State-Impacts-Responses (PSIR) approach. It also links to subsequent steps in a climate adaptation assessment including identification of a range of adaptation options targeted toward vulnerable livelihoods and climatic threats and consideration of criteria for evaluation adaptation options, including effectiveness in reducing vulnerability and relevance to targeted stakeholders.

The exercise could be reported in short (1-page) briefing notes on each vulnerable livelihood:

- Short description of the livelihood
- Characteristics (e.g., according to the five capitals) and relative scores for key indicators
- Geographic location
- Narrative describing exposure to climatic hazards
- Trend in livelihoods, role of other stresses

Example

The example shown in Table 3 is based on farming systems in southern Africa. It shows how different livelihood assets and activities (such as natural resources and farming activities) are impacted by different climate stresses (such as drought and intense rain). These scores are added up to produce exposure indexes. These should not be taken as authoritative ratings, they are intended to show the technique rather than results from formal expert judgements.

Table 3: Example of a livelihood-sensitivity matrix

		Climatic risks						Exposure indices	
		Drought	Dry spells	Intense rain	Flood	Warm spells	… other	*Exposure score*	*Weighted exposure index*
Frequency		*20*	*40*	*10*	*5*	*10*		85	8.88
Resources and Livelihoods									
Ecosystem services									
Soil water balance		5	4	1	5	1		64	*3.59*
Water supply		5	2	2	4	1		56	*2.71*
Water quality		2	1	3	4	2		48	*1.76*
Non-farm wood fuels		3	1	1	2	1		32	*1.53*
Grazing and fodder		4	2	1	4	1		48	*2.35*
… others									
Livelihood activities									
Coarse grain production		5	4	2	3	1		60	*3.59*
Market crop production		5	3	2	2	1		52	*3.06*
Livestock production		4	3	1	3	1		48	*2.76*
Charcoal/wood fuel use		2	1	2	2	1		32	*1.41*
Craft sales		2	1	1	3	1		32	*1.35*
Rural casual labour		3	1	1	3	1		36	*1.59*
Non-farm permanent employment		2	1	1	3	1		32	*1.35*
… others									
Livelihoods	*Prevalence*								
Smallholder farmers	60	5	3	1	3	1		52	*3.00*
Emerging farmers	25	3	2	1	2	1		36	*2.00*
Ranchers	10	4	2	1	2	1		40	*2.24*
Market traders	5	3	1	1	4	1		40	*1.65*
…others									
Impacts score	*100*	*75*	*40*	*20*	*55*	*20*			
Weighted impacts index	***11.55***	*4.30*	*2.55*	*1.00*	*2.70*	*1.00*			***8.88***

Notes:
The example shown here is based on farming systems in southern Africa—these should not be taken as authoritative ratings, they are intended to show the technique rather than results from formal expert judgements.
Exposure score: Sum of the columns for each row divided by the total possible score (25).
Impacts score: Sum of the rows for each column divided by the total possible score (20). This is calculated only for the livelihoods—the preceding rows are elements of the livelihood scores and would result in double counting if added together.
Weighted exposure index: This takes each cell in the row and multiplies it by the frequency for the climatic risk (shown at the top of the table), the sum of these weighted values is then divided by the sum of the frequencies. Note that the frequencies may not add to 100. In Excel this is done using the sumproduct() function.
Weighted impact score: As above, the sumproduct of the cell values weighted according to the prevalence of the livelihood (shown in the left column of values). The sum of the prevalence of livelihoods should be 100, assuming they are discrete groups.
Two aggregate values are shown: The sum of the weighted exposure scores for the livelihoods (8.88) and the sum of the weighted impact scores for the hazards (11.55) might be useful in comparing different regions or scenarios. However, these scores should be used with caution as they have no explicit meaning in and of themselves.
Source: Material prepared by SEI under the UNEP support project for the NAPA workshops organised by the LEG, UNITAR and UNDP.

Time frame	Planning horizon, Long term
Policy target	Project design, Strategic plans, Awareness
Analytical unit	Individuals, Households, Livelihoods, Regions
Clients	Local, Regional, National, International
Time for assessment	Year, Several years
Resources needed	Several PM, Multi-disciplinary team
Knowledge	General
Further info	This is a new approach and there are not extensive resources on the tool.

5. Oral histories

Summary: Qualitative narratives of individuals' histories and strategies

Description

Qualitative methods are an important tool to capture the texture of vulnerability. Oral histories are one type of qualitative tool for assessing local vulnerability and adaptation options. They illustrate the types of adaptations that have occurred in the past. These histories document individual perception of the past state of the environment or society. Oral histories are particularly effective at gathering information on local vulnerabilities over past decades, where there is often limited data.

The information is usually acquired through semi-structured interviews and participatory tools. For example, interviewers might want to establish the perception of rangeland quality over time. They may approach an elderly member of the community and ask them general questions about their perception of past rangeland quality. A participatory tool could be used where a timeline of the last four decades is drawn and the informant is asked to place 5 stones on the years where he/she remembers the rangelands being the best quality and 1 stone on the years where quality was poorest.

Oral histories allow the experiences of different individuals from diverse livelihood typologies to be captured and compared. These accounts can help to piece together a multi-stakeholder view of sources of past vulnerability. The oral histories can provide a qualitative overview of local vulnerability or can be used to suggest key indicators of vulnerability. There is also the potential for these oral histories of past events to help assess future events. Qualitative understanding of vulnerability from oral histories can be further developed as storylines in scenarios of future conditions. Oral histories could also lead into role playing simulations of new vulnerabilities or adaptations. Such qualitative means are effective ways of communicating future vulnerability.

Method

The interviewee should be told what the purpose of the exercise is. They are then asked to talk about how things were in the past. Certain questions can lead the informant to focus on aspects of interest to the interviewer, such as past climate, farming practices or water management strategies for example. It is often useful to have a guide, so the discussion touches on points of interest, such as past climate or historical events. The interviewee should be encouraged to relate examples.

Example

Oral histories used for ecological restoration in Australia Researchers in Australia have stressed the importance of both scientific and anecdotal evidence for research that supports ecological restoration. They have used oral histories to provide evidence that integrates the observation over time by non-scientists. This is critical because 'ecological restoration … is as much a cultural as a biophysical process' (Robertson et al., 2000).

Time frame	Planning horizon, Long term
Policy target	Project design, Strategic plans, Awareness
Analytical unit	Individuals, Households, Livelihoods, Regions
Clients	Local, Regional, National, International
Time for assessment	Year, Several years
Resources needed	1 PM, Several PM, Multi-disciplinary team
Knowledge	General
Further information	Example taken from Robertson, Margaret, et al. (2000): "Environmental Narratives and the Need for Multiple Perspectives to Restore Degraded Landscapes in Australia." Ecosystem Health 6.2 119-33.
Links	www.edheritage.org/wolves/researchmethods.htm http://writing.colostate.edu/guides/research/observe/com3a2.cfm

6. Role-play

Summary: A participatory 'game' to uncover behaviour, trends and expectations

Description

Role playing activities stimulate discussion, pave the way for improved communication, and thus stimulate collaboration. Applicable at both community and agency levels, these activities involve participants as a group in analytic thinking and assessment. This tool's use of information from everyday life in the analysis of development problems carries the added benefit of working around any class and literacy barriers which might exist. Role-play is useful for considering adaptation to future climate because of the exploratory nature of the tool. It is often hard for people to think through what they might do in future if asked a one-off question. However, if they are given the opportunity to think and act through what the process, they might be able to think more realistically about how they could respond and what they might do in the future.

Method

An open-ended story is told to the participants or a written case description is used to describe the setting for the action. The participants are then asked to act out potential scenarios to uncover what might happen under different circumstances. A tape recorder or video recorder is useful to record the role play for the facilitator's reference or for further discussion directly after the dramatization. Transcription of tapes for later use can be a time-consuming process. It is advisable to have a number of observers who document key points or phrases that are mentioned for future analysis. This tool helps the researcher to uncover issues that are not always clear at first. It also helps participants to think outside their usual frame and so provide information for themselves and the researcher on what might constrain or facilitate more appropriate management of resources and assets or creative solutions to a wide range of problems. Role playing can be simple stories with only a few characters or elaborate street theatre productions with a large array of stakeholder characters.

Example

Role-play is used here to determine health priorities. Priority actions need to be defined in order to improve health facilities in a village. The community roles might be the traditional healer, sick child, family head and local dispenser of western medicine. The outside roles might be a regional NGO representative and clinic worker. Participants might use creative props to act out present health problems. They then act out present facilities and solutions. Lastly, they act out potential solutions. This serves as an entry point for discussion, where everyone can comment on the role-play and suggest what they think potential solutions might be. By acting the existing situation out, they are able to think through the process and potential options in a more creative manner.

Time frame	Planning horizon, Long term
Policy target	Project design, Strategic plans, Awareness
Analytical unit	Households, Livelihoods, Regions, Sectors
Clients	Local, Regional, National, International
Time for assessment	Rapid, Year, Several years
Resources needed	1 PM, Several PM, Multi-disciplinary team
Knowledge	General
Further info	Ziervogel, G. (2004) 'Targeting seasonal climate forecasts for integration into household level decisions: the case of smallholder farmers in Lesotho', *The Geographical Journal*. 170.1. 6-21. Ziervogel, G., Bithell, M., Washington, R. and Downing, T. (In press) 'Agent-based social simulation: a method for assessing the impact of seasonal climate forecast applications among smallholder farmers', *Agricultural Systems*.
Links	www.resource.nl/uk/projecten/projectdetail.asp?projectID=2 Page 16 of the report at: http://reports.eea.eu.int/Technical_report_no_64/en/Technical_Report_64

7. Stakeholder consultation

Summary: Consultation with individuals and/or groups affected by future processes

Description

Stakeholder consultation is increasingly being recognised as imperative to any future development. Those who might be affected by change have a right to voice their opinion on what might happen. It is also of practical value to have them involved, as if the process has buy-in, it is more likely to succeed and stakeholders can voice their concerns about the process, which might not have been picked up by external experts. During the process it is important that stakeholders are informed about why they are involved and what role they might play. The process also contributes to long term capacity building by involving and educating a wider group of people about the adaptation process. "Stakeholder" can refer to policy makers, scientists, community members or any others that are part of a decision, either by making the decision or by being impacted on by it. It is important that all groups are considered so that a joint understanding of the issues and solutions can help to ensure sustainability and enhance adaptive capacity. Stakeholder consultation is imperative for considering what type of adaptation strategies should be pursued and how viable each of these options is. Relevant stakeholder groups need to be brought together to identify the most appropriate forms of adaptation and will contribute to the success of implementing adaptation policies.

Method

Designing a stakeholder process entails:

1. Background. What is the context for the process? What links are there to decision-making? How are stakeholders to be identified? Who is facilitating the process? Who is funding it?
2. Framing: What is the composition of the stakeholder group? What are the goals? What is the agenda?
3. Inputs: Stakeholder preparations; agreed rules and procedures, power gaps, capacity building
4. Dialogue/meetings; communication channels; facilitation/chairing; rapporteuring; decision-making, closure
5. Outputs: documentation; action plan/implementation plan, impact official decision-making.

The level of stakeholder engagement can range from passive engagement to self-mobilisation. In passive engagement stakeholders provide information, through meetings where they voice opinions or through interviews. More interactive methods enable stakeholders to initiate and design the process. One method is not necessarily better or worse than the other but it is important to recognise where one needs more active involvement and where it is more appropriate to get initial information.

There are many ways of engaging stakeholders. At the local level, meetings may be held, interviews undertaken, key informants approached. Local government facilities can make it easy for members of the public to be informed of decisions affecting them. At the district and national level, there might be an effort to include civic members in government meetings and discussions. Interest groups might be asked to present their opinions at meetings or gatherings. Policy papers should be reviewed by experts as well as the public and public concerns should be addressed in a manner that is transparent. It is critical that an effort is made to include representatives from some of the most vulnerable groups that may not normally be involved. In order to do this, it is important that these groups are not alienated by complex language and unfamiliar environments.

There should be support for the stakeholder groups so that their involvement is made as easy as possible. There should be enough time allocated to the process so that stakeholders can be made aware of what is going on and have time to respond. There should also be ample opportunities for feedback so that stakeholder participation is acknowledged and the stakeholders' contribution recognised where appropriate.

Example
If a project is designed to help people in a rural village to plant trees, it would be important that the various stakeholders are consulted before the project goes ahead. There might be a meeting planned that invites local chiefs, agricultural extension officers and community members. This will enable the community to voice their concerns and suggestions, thereby enabling a process of tree planting to be designed that is more appropriate to local needs and existing institutions.

Time frame	Current decision, Planning horizon, Long term
Policy target	Operational, Project design, Strategic plans, Awareness
Analytical unit	Individuals, Households, Livelihoods, Regions, Sectors
Clients	Local, Regional, National, International
Time for assessment	Rapid, Year, Several years
Resources needed	1 PM, Several PM, Multi-disciplinary team
Knowledge	General
Further info	Conde, C. and Lonsdale, K. Stakeholder Engagement. In *The Adaptation Process. Technical Paper 2*. Adaptation Planning Framework. Hemmati, M. (2002) Multi-stakeholder processes for governance and sustainability, Earthscan, London. Pretty, J. (1994) Typology of Community Participation, quoted in Bass, S., Dalal-Clayton, B. and Pretty, J. (1995) Participation in Strategies for Sustainable Development, London, Environmental Planning Group, International Institute for Environment and Development.
Links	www.pwcglobal.com/ie/eng/about/svcs/corp_finance/pwc_gn8.pdf www.fao.org/sd/PPdirect/PPre0074.htm www.worldbank.org/wbi/sourcebook/sba100.htm

8. Syndromes and integrated vulnerability models

Summary: Regional analysis of patterns of coupled processes

Description

The syndromes approach aims to 'assess and monitor a multitude of coupled processes taking place on different (spatial and temporal) scales with different specificities'. The goal is to identify where interception can help contribute to sustainable development pathways. The product helps to integrate various aspects of vulnerability to produce a multi-faceted picture of vulnerability. This transdisciplinary tool that draws on both quantitative and qualitative assessments of dynamic patterns, at a variety of scales, can be used to target future development priorities aimed at enabling sustainable development, by identifying patterns of unsustainable development.

Method

Archetypal patterns are seen as most relevant to representing the process of global change. These need to be distilled to establish different syndromes. In order to develop syndromes, similarities between regions are found by looking for functional patterns that are called syndromes. An assessment of these patterns of relationships is achieved by combining qualitative and quantitative approaches. Some 16 syndromes of global change are grouped according to the dominant logic: utilization of resources, economic development and environmental sinks. The results enable critical regions to be identified for different syndromes, so that future development can prioritise key areas necessary for establishing more sustainable systems.

The syndromes of global change as defined by the German Advisory Council on Global Change are:

Utilization syndromes

- Overcultivation of marginal land, combined with rural poverty: *Sahel Syndrome*
- Overexploitation of natural ecosystems: *Overexploitation Syndrome*
- Environmental and developmental problems through abandonment of traditional agricultural practices: *Rural Exodus Syndrome*
- Environmental degradation through agro-industry: *Dust Bowl Syndrome*
- Environmental degradation through depletion of non-renewable resources: *Katanga Syndrome*
- Destruction of nature by tourism: *Mass Tourism Syndrome*
- Environmental destruction through military impacts: *Scorched Earth Syndrome*

Development syndromes

- Environmental and developmental problems caused by large-scale, centrally planned projects: *Aral* Sea *Syndrome*
- Disruption caused to the environment and society as a consequence of inappropriate rural development policies: *Green Revolution Syndrome*
- Disregard for environmental standards in the course of rapid economic growth: *Asian Tigers Syndrome*
- Environmental degradation and urban poverty through uncontrolled urbanization: *Favela Syndrome*
- Destruction of landscapes through planned expansion of cities and infrastructures: *Urban Sprawl Syndrome*
- Environmental disasters as a result of technical failures and industrial accidents: *Major Accident Syndrome*

Sink syndromes

- Environmental degradation through large-scale diffusion of long-lived substances: *Smokestack Syndrome*
- Threats to the environment through the disposal of waste: *Waste Dumping Syndrome*
- Long-term pollution at or near industrial locations: *Contaminated Land Syndrome*

Example

The Sahel syndrome describes the processes that result in the overuse of agriculturally marginal land. This syndrome can be located in certain parts of the world and characterized by a number of factors. The driving forces or core mechanisms of this syndrome include impoverishment, intensification of agriculture and soil erosion, which in turn lead to productivity loss. Various factors might contribute to the disposition towards this syndrome, including socio-economic dimensions, such as high dependence on fuelwood, and natural dimensions, such as aridity and poor soils. The core mechanisms can be quantitatively assessed to determine which areas of the world experience the Sahel syndrome most extensively and intensively.

Time frame	Planning horizon, Long term
Policy target	Project design, Strategic plans, Awareness
Analytical unit	Livelihoods, Regions, Sectors, Macro
Clients	Regional, National, International
Time for assessment	Year, Several years
Resources needed	Multi-disciplinary team
Knowledge	Specialist
Further info	German Advisory Council on Global Change (WBGU) (1997). World in Transition: The Research Challenge. Berlin, Springer Verlag. Petschel-Held, G., Block, A., Cassel-Gintz, M., Kropp, J., Lüdeke, M.K.B., Moldenhauer, 0., Reusswig, F., and Schellnhuber, H.J. (1999): Syndromes of Global Change - A qualitative modeling approach to assist global environmental management. Environmental Modelling and Assessment 4, 295-314. Schellnhuber, H.J., Block, A., Cassel-Gintz, M., Kropp, J., Lammel, G., Lass, W., Lienenkamp, R., Loose, C., Lüdeke, M.K.B., Moldenhauer, O., Petschel-Held, G., Plöchl, M., Reusswig, F., 1997: Syndromes of Global Change. *GAIA,* 6, 19-34.
Links	http://www.wbgu.de/wbgu_syndromkonzept_en.html

9. Vulnerability indicators/ mapping

Summary: Mapping of the different indicators of vulnerability for different groups

Description

Indicators and indexes are one way of quantifying the level of vulnerability. An indicator is a single measure of a characteristic and an index is a composite measure of several indicators or indices. Indicators and indexes can be useful when guiding decision-making and prioritising intervention, as they allow for a comparison of characteristics. However, indexes of vulnerability should be treated with caution, precisely because of the complex nature of vulnerability that results in many factors being at play, and the difficulty in capturing the diversity and sensitivity of vulnerability. To be reliable and effective, indicators need to reflect an explicit conceptual framework of vulnerability. Comparing indicators and indexes that assess different temporal and spatial scales is challenging because units of measurement are often inconsistent. This can result in inappropriate comparisons. There are also constraints to combining indicators. The impact of the concatenation of stresses might not be accurately reflected when indicators are added up, even when they are normalized. The combination of stresses that might have catastrophic impacts when combined might not be captured when indexes are overlain. Similarly, critical enabling conditions might be excluded from the assessment and so the value of the indicators is reduced. It is therefore critical that the methods for collecting and combining individual indicators are understood. Indicators can be a useful policy tool, as they enable clear visual mapping of priority areas. However, they should be treated with caution because the dynamics of local vulnerability is not usually captured in the final product.

Method

The first step in an indicator-based vulnerability assessment is to select indicators. Generally this is done with regard to some conceptual framework, but often this linkage is descriptive and poorly related to the selection process. For instance, the common definition of food security as comprising economic, demographic and political dimensions may lead to indicators of GDP per capita, infant mortality and female literacy as 'appropriate' indicators. Each is clearly related to the definition, but not uniquely so and perhaps not the most sensitive indicator for capturing local conditions and multiple stresses. Once an indicator data base has been compiled, its structure should be explored. This is often missing. Questions that help to do this include: What is the range of values? Are there critical thresholds for vulnerability? Are indicators correlated with each other? Are there clusters in the data that capture higher order factors (perhaps corresponding to the original definition)? The next step, commonly done, is to transform the indicators into some sort of standard scores. Often these scores are mapped to identify geographic 'hot spots'. Standard scores are the relative location between the low and high value in the data set, generally in the range of 0 to 1 or 0 to 100. For example, an international comparison of GNP per capita can be expressed as the 0=the minimum (some $200) and 100=the maximum (some $20,000). Some use a range from negative (below the mean) to positive (above the mean) but this implies that negative scores can be balanced by positive scores.

Example

Indexes are used at the global, national and local scale. For example, the Environmental Sustainability Index (ESI) is a global index that assesses the 'progress towards environmental sustainability' of 142 countries. Twenty 'core' indicators (in five categories: environmental systems, environmental stresses, human vulnerability to environmental risks, a society's institutional capacity to respond to environmental threats, and a nation's stewardship of the shared resources of the global commons) are used to give each country a ranking of its environmental sustainability. These core indicators are themselves composed of multiple indicators, based on the best available quantitative data. Although the ESI might not pick up local heterogeneity, the aim is to improve global environmental decision making, so that it can be more informed when comparing countries or regions, using their national indexes.

Time frame	Planning horizon, Long term
Policy target	Operational, Project design, Strategic plans, Awareness
Analytical unit	Individuals, Households, Livelihoods, Regions, Sectors, Macro
Clients	Local, Regional, National, International
Time for assessment	Rapid, Year, Several years
Resources needed	Several PM, Multi-disciplinary team
Knowledge	General
Further info	Downing, T.E. et al. (2001) Vulnerability indices: Climate change impacts and adaptation. Policy Series 3. UNEP, Nairobi. Giardini, D., G. Grunthal, K. Shedlock, and P. Zhang, 1999: GSHAP Global Seismic Hazard Map. [online] http://www.seismo.ethz.ch/ Hewitt, K.,1997: Regions of risk: a geographical introduction to disasters. Longman, Harlow. Myers, N., R. Mittermeier, C. Mittermeier, G.d. Fonseca, and J. Kent, 2000: Biodiversity hotspots for conservation priorities. *Nature*, 403(24), 853-858. Nellemann, C., L. Kullerud, I. Vistnes, B. Forbes, T. Foresman, E. Husby, G. Kofinas, B. Kaltenborn, J. Rouaud, M. Magomedova, R. Bobiwash, C. Lambrechts, P. Schei, S. Tveitdal, O. Gron, and T. Larseon, 2001: *GLOBIO. Global methodology for mapping human impacts on the biosphere.* UNEP/DEWA/TR.-1-3, UNEP-DEWA, Nairobi, Kenya.
Links	http://sedac.ciesin.columbia.edu/es/esi/

10. Vulnerability profiles

Summary: A compilation of indicators into aggregate indices or profiles

Description

Vulnerability profiles enable factors and trends to be compared between households or groups. The profiles enable many of the livelihoods indicators to be included and can illustrate the impact of environmental variability and change that place stress on or cause shocks to households (for example, climatic variability, such as drought). They also help to identify patterns of exposure, sensitivity, and resilience among regions, social groups, and across time according to natural resource dependency of livelihood strategies and individual/household level characteristics. One way of presenting them is in a radial diagram as shown in the examples but they can also be presented as data tables.

Method

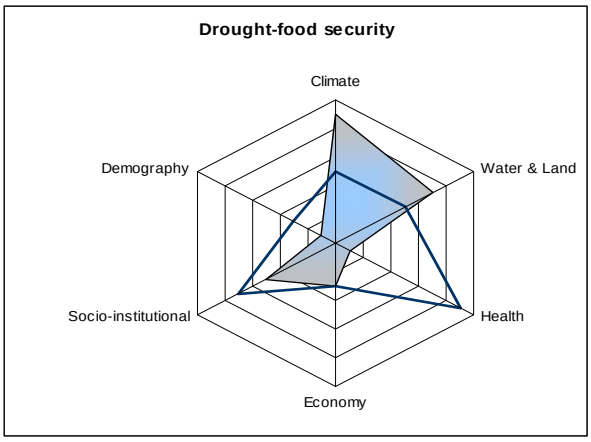
Profiles can be compiled using standard indicators of poverty and vulnerability such as people below the poverty line, illiteracy, health, and other location or "group" specific problems (e.g., higher female illiteracy or higher poverty levels in a certain province). Some of the major socio-economic concerns include population growth, decentralization, the spread of HIV/AIDS, gender relations, fluctuating market price conditions, conflict potential in the region, food security, population migration, and stability of land tenure arrangements. The analysis can use key informant interviews, as well as secondary data in the form of widely collected indicator information and case study material. The profiles may be compiled by the groups themselves using participatory techniques or by external researchers that might assess a range of groups. A matrix should be compiled that draws together the different groups and their scores for the chosen indicators. Radial diagrams can be compiled that illustrate differences in a graphical manner.

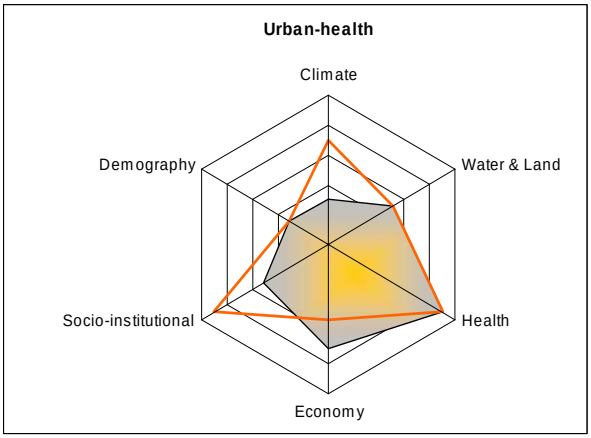
Example

Two hypothetical examples are shown below in Figure 2. The first represents ratings of vulnerability on six attributes related to a situation of rural smallholder food security. The shaded profile indicates a relatively high exposure to climate (primarily drought) and water and land shortages (perhaps poor quality soils and no irrigation). In contrast, economic stresses, demographic characteristics and socio-institutional factors are assumed to be less important (remember this is just a hypothetical example, in this case representing a rural area of low density and subsistence production). The shaded profile is primarily exposure to loss of economic assets. Vulnerability profiles can also be used to represent exposure to health outcomes—the heavy line illustrates a profile of susceptibility to mortality related to drought and food security. In this case, health status is the key attribute, with a strong link to socio-institutional factors (health infrastructure) while climate has a less critical role.

The contrasting example is for an urban slum exposed to health stresses. In this hypothetical example, climate has a less important role for economic exposure (the solid profile) but might spark widespread mortality (and diseases) during heat waves, droughts or floods. Socio-institutional and economic factors are clearly important drivers.

Figure 2. Examples of vulnerability profiles.





Time frame	Planning horizon, Long term
Policy target	Project design, Strategic plans, Awareness
Analytical unit	Households, Livelihoods, Regions, Sectors
Clients	Regional, National, International
Time for assessment	Year, Several years
Resources needed	Multi-disciplinary team
Knowledge	Specialist
Further info	Hanemann, W.M. 2000, Adaptation and its measurement, Climatic Change, 45. 571-578. Stephen, L. and Downing, T.E. (2001) Getting the scale right: a comparison of analytical methods for vulnerability assessment and household level targeting. *Disasters* 25(2): 113-135.

Section 2: Adaptation Assessment Tools

11. Agent-based simulation modelling

Summary: The formalism of agents and their interactions at multiple levels, including simple rule based approaches

Description

Agent-based models (ABM) use a bottom-up approach whereby phenomena evolve as a result of the local, micro-level interactions between agents. Human actors are represented as software agents with rules for their own behaviour, interactions with other social agents and responses to the environment. Physical processes (such as soil erosion) and institutions or organizations (such as an environmental regulator) may also be represented as agents. A multi-agent system could represent multiple scales of vulnerability and produce indicators of multiple dimensions of vulnerability for different populations. The close coupling with the environment and among social actors can produce emergent behaviour, which is not possible with dynamic simulation or static indicators.

For example, decisions by local farmers to grow a particular crop are affected by global trade and exchange considerations. Where the global price of a commodity drops below a certain level it no longer becomes feasible to cultivate that crop at a local level. By distinguishing between agents with respect to behavioural characteristics and system-related attributes (e.g. wealth, land holding, family size, climate, economy etc.), ABM methods allow for the examination of particular forms of vulnerability – the ways in which certain individuals are more or less vulnerable to food systems, risks and uncertainties than other individuals or organisations.

Agent-based models have an intuitive appeal in participatory integrated assessment. Stakeholders may identify with 'their' agents and be able to validate a model in qualitative ways that is difficult to do for econometric or complex dynamic simulation models. However, ABMs require significant computational resources (proportional to the number of agents) and a paucity of data for validation of individual behaviour is a constraint. Disadvantages of a quantitative approach to vulnerability, such as not representing actor behaviour and the lack of a historical context, can largely be overcome using an ABM approach. The ability to experiment with the extent to which present climate coping strategies are able to withstand future threats is further justification for the relevance of ABM to vulnerability science.

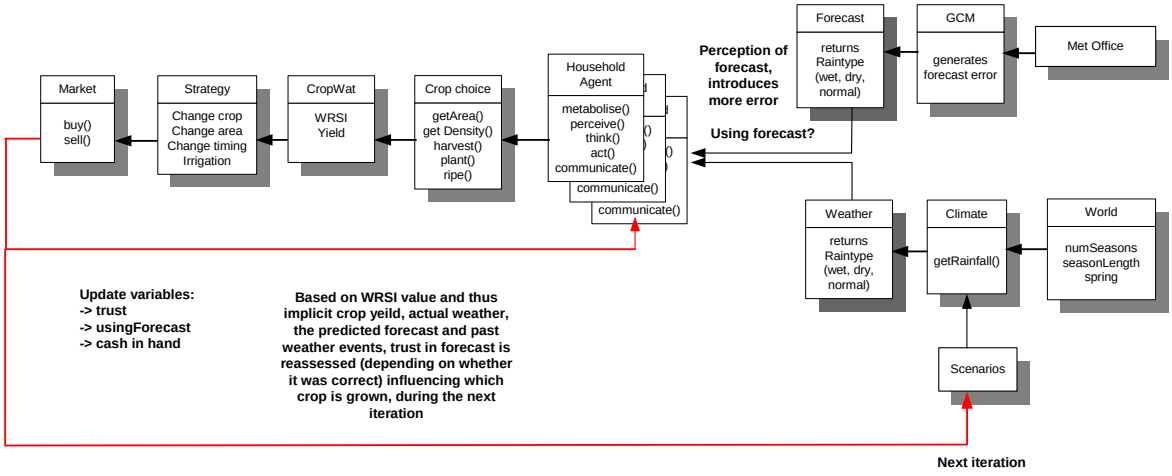
Methods

The agent based model tool consists of a self-contained programme that has an agent that can control its own actions, based on its perceptions of its operating environment. The aim of agent design is to create programmes which interact intelligently with their environment and properties of agents can include: autonomy, social ability, reactivity and proactivity. The social aspect of agent behaviour means that agents do not succeed or fail based solely on their own characteristics but also on their social networks. The degree and quality of social networking and agent dependence upon it can be controlled by the programmer.

Example

Example of an agent-based model is from the Cloud Project (funded by the School of Geography, Oxford, SEI and Tyndall Centre at UEA – see Figure 3) that focuses on the vulnerability of small-holder farmers in a communal irrigation scheme in Mangondi village, Limpopo Province, South Africa. An ABM is based on empirical fieldwork over three years. Farmers' use of various adaptation strategies is incorporated in the ABM to assess the effectiveness of various coping mechanisms under different scenarios. Seasonal forecasts, which some of the farmers are aware of and use, have been included as a source of information which enable further adaptation strategies to be adopted. The ABM enables experimentation with variations in the type of information that is available.

Figure 3: Example of the components of an agent-based model of seasonal forecast utilisation



Time frame	Planning horizon, Long term
Policy target	Project design, Strategic plans, Awareness
Analytical unit	Individuals, Households, Livelihoods, Regions, Sectors
Clients	Regional, National, International
Time for assessment	Year, Several years
Resources needed	Multi-disciplinary team
Knowledge	Specialist
Further info	Huhns, M, and Singh, M. (eds) 1998. *Readings in Agents*. Morgan Kaufmann, San Francisco, 1998. Gilbert, N. and Troitzsch, K.G. 1999, *Simulation for the Social Scientist,* Buckingham: Open University Press, 1999. Moss, S., Pahl-Wostl, C. and Downing, T.E. 2001. Agent based integrated assessment modelling: The example of climate change. *Integrated Assessment* 2(1):17-30.
Links	http://jasss.soc.surrey.ac.uk/JASSS.html http://repast.sourceforge.net/ www.swarm.org/wiki/Main_Page www.irit.fr/COSI/training/evaluationoftools/Evaluation-Of-Simulation-Tools.htm www.agsm.edu.au/~bobm/teaching/SimSS.html

12. Cognitive mapping

Summary: Development of conceptual models using interactive methods with stakeholders

Description

Cognitive mapping applies to a group of methods for measuring mental representations. They help to structure messy or complex data for problem solving. The involvement of different stakeholders helps to establish what the different perceptions of the problem and underlying assumptions are. It is a tool that can usefully summarise and communicate information in a way other than as a literal description of mental images. Mental mapping is a simple example of cognitive mapping. For example, if you asked children to draw their neighbourhood and what was important in the neighbourhood, it would show their perceptions of what was important. It is a useful tool to use: a) when different stakeholders have different perceptions of the problem; b) when the options for addressing the problem are unclear; or c) when a common framework is desired.

Method

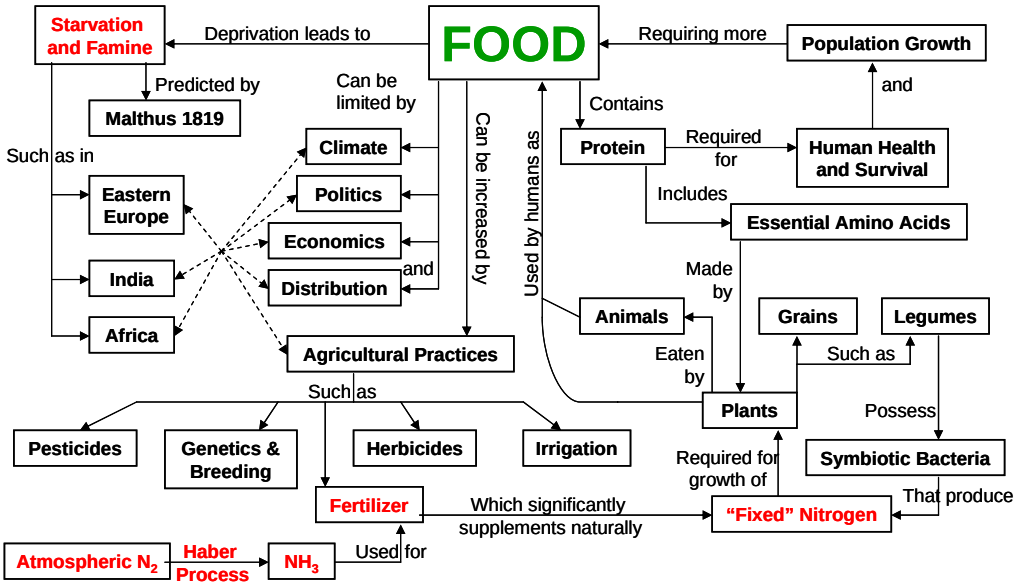
Cognitive mapping follows a general process:

- State what the problem is
- Brainstorm all associated assumptions and solutions
- Group the concepts that emerge
- Build up a hierarchy/topology
- Re-illustrate the concepts so they form a conceptual model
- Go back to participants to see if they are happy with the model; if not, restructure the model until they are
- Produce a formal model

Example

The example shown in Figure 4 shows how a proposition is thought through using a cognitive map that enables a number of different aspects to be captured. The proposition here is, 'Without the industrial chemical reduction of atmospheric nitrogen, starvation would be rampant in third world countries'. The map captures aspects of the food system, including agricultural, political, regional and biological factors.

Figure 4: Cognitive map of food systems without the reduction of nitrogen



Time frame	Planning horizon, Long term
Policy target	Operational, Project design, Strategic plans, Awareness
Analytical unit	Individuals, Households, Livelihoods, Sectors, Macro
Clients	Local, Regional, National
Time for assessment	Rapid, Year, Several years
Resources needed	1 PM, Several PM, Multi-disciplinary team
Knowledge	General
Links	http://intraspec.ca/cogmap.php www.uwsp.edu/cnr/wcee/keep/Resources/Publications/ConceptualGuide/Conceptual_Map_Appendix.pdf www.udel.edu/chem/white/teaching/ConceptMap.html

13. Decision/probability trees

Summary: Charts of relationships between decision nodes; helpful for generating expected outcomes

Description

Decision trees help to visualise and evaluate what the implications of different courses of action from one decision might be. It is a useful process for deciding what action to take when choices will lead to uncertain outcomes. It is therefore a useful tool for adaptation planning, as many of the choices have uncertain outcomes because of the uncertainty of the magnitude and speed of climate change overlain on the uncertainties of socio-economic change.

Method

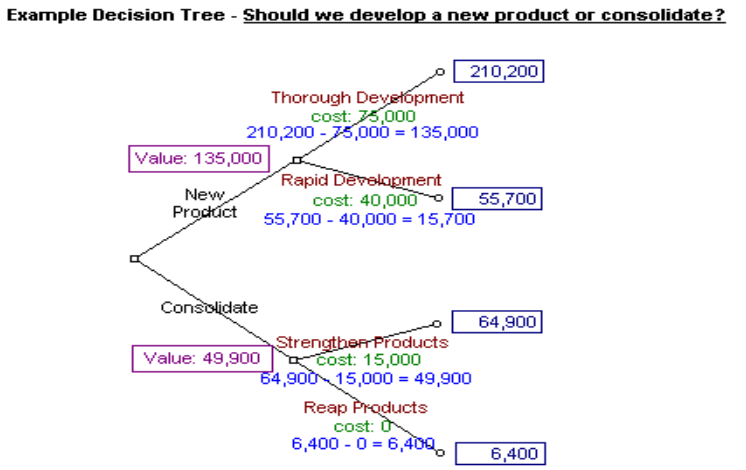
Four steps are involved in developing a decision tree: 1. structuring the problem as a tree with end nodes as pay-offs associated with scenario; 2. assigning probabilities to events in the tree; 3. assigning payoffs with particular paths; 4. deciding what action is to be taken. Decision trees start by articulating the decision. The key options that are being considered are then drawn radiating out from the initial decision. Squares should be used to represent decisions and circles for outcomes. The certainty of the decision result can be illustrated by using large circles for certain outcomes and small circles for uncertain outcomes. The decision tree should be evaluated once all options have been presented. The tree can be evaluated in a number of ways. The different options might each be given a percentage as to how likely they are to occur (with the total adding up to 100%) or each decision might be evaluated on the likelihood of it being successful/good, average or poor. Each option can also be given an estimated cost of executing the decision. The tree can be supported by narratives on the payoffs, risks and uncertainties accompanied by each decision. For example, if a decision tree is used to help decide which adaptation options to pursue, it might highlight where there is information missing, the type of stakeholders who would be involved in different decisions and the perceived effectiveness each decision might have on reducing the impact of different climate stressors.

The decision tree process can be undertaken by an individual and evaluated by different groups of stakeholders. It can also be undertaken as a participatory process. The tree can be drawn on flipchart paper or it can be done using cards and string that are pinned to the wall.

Example

Figure 5 shows a decision tree that relates to evaluating the cost of either developing a new product (or could be a new adaptation strategy) or consolidating an existing product (which could equate to strengthening existing adaptation strategies). The value of developing a new product (end gain, 210,000 – cost, 75,000 = 135,000) is much greater than consolidating. This helps to give financial support to following one decision over another. The social and political costs and trade-offs have not necessarily been accounted for and so another tool would be needed to establish further information.

Figure 5: Decision tree



Time frame	Current decision, Planning horizon
Policy target	Operational, Project design, Strategic plans
Analytical unit	Households, Livelihoods, Regions, Sectors, Macro
Clients	Local, Regional, National, International
Time for assessment	Rapid, Year, Several years
Resources needed	Several PM, Multi-disciplinary team
Knowledge	Specialist
Links	www.psywww.com/mtsite/dectree.html www.dtreg.com/dtintro.htm (programme-based tree)

14. Delphi technique

Summary: The range of views of experts through iterative written correspondence

Description

The Delphi technique aims to elicit judgement and information from a range of experienced participants without bringing them together. The information they provide is used to help develop planning suggestions and aid decision making. The objectives might include identifying trends and future implications of decisions, dealing with priorities or obtaining expert views about issues affecting the community.

Method

First the key issue are identified. A coordinator is required to establish and coordinate communication between participants. The issue or question is sent via email, fax or letter to the participants. Their response is required and short bullet-style is preferable. The coordinator collates all the responses and sends out a new list to participants with the lists of responses and asks participants to comment on the strengths and weaknesses of the various responses and provide new ideas that might have emerged. The coordinator collates all responses again and sends out asking for additional comments and clarifications. This process continues until there are no new ideas and it is clear that everyone has provided as much information and judgement as they can. It is then necessary to resolve the process. If consensus has already emerged, the list of final ideas might be clear and they should be compiled in a report that presents the most supported ideas along with their strengths and weaknesses. If there is not consensus, the coordinator can circulate a list of ideas and ask participants either to rank the top 5 or to score each idea out of 10, according to feasibility and urgency. A final list could then be compiled and circulated in a report. The process can take a few days up to a few weeks. It is important to have a neutral coordinator who does not bias the process as this is one of the chief criticisms of this approach.

Example

Questionnaire 1

The purpose of this questionnaire is to elicit your ideas regarding the following issue:

How do you think water use of local households could be reduced?

Please brainstorm the idea and list as many ideas as you have to respond to the issue. It is preferable that you keep your response brief and just note down a phrase or single sentence. Your response will be anonymous.

Idea 1:
Idea 2:
Idea 3:

Questionnaire 2

This questionnaire reports the ideas sent in response to the first questionnaire and asks for the strengths and weaknesses of each idea. New ideas should also be included on the issue.

Idea 1: ……
• Your clarification (if any):
• Strengths:
• Weaknesses:
Idea 2: ……
• Your clarification (if any):
• Strengths:
• Weaknesses:
New ideas:

Time frame	Current decision, Planning horizon
Policy target	Operational, Project design, Strategic plans
Analytical unit	Individuals, Households, Livelihoods, Regions, Sectors, Macro
Clients	Local, Regional, National, International
Time for assessment	Rapid, Year, Several years
Resources needed	Several PM, Multi-disciplinary team
Knowledge	Specialist
Links	http://instruction.bus.wisc.edu/obdemo/readings/delphi.htm www.msue.msu.edu/msue/imp/modii/iii00006.html www.slais.ubc.ca/resources/research_methods/group.htm www.iit.edu/~it/delphi.html

15. Expert judgement

Summary: The assessment of experts in the field on specific propositions

Description

Expert evaluation requires specialists to present their opinion of options giving their reservations and support where appropriate. Two to three analysts may be asked to evaluate the system with reference to established guidelines or principles, noting down their observations and ranking the options. Expert judgement can be conducted at various stages of a process. It is helpful to have done some analysis of the decision or project context in order to provide the experts with background information. The approach can be undertaken by bringing experts to one location or by asking them to correspond by email or letter. It is a rapid means for getting expert and outside opinion on a project and often lead to suggestions for improvement. There may be a focus on the problematic aspects of the project as the method is normally not used for the identification of the strengths.

Method

The panel of experts must be established in good time for the evaluation. There should be an agreed set of evaluative criteria so that there is some consistency between evaluators. The experts should not communicate with one another until the initial evaluation has been completed. After the initial evaluation, the analysts can collate the problem lists and collectively evaluate responses. A list of identified problems, which may be prioritised should be produced. A report detailing the identified problems should be provided to the project development team. The report should clearly define the ranking scheme used if the problem lists have been prioritised.

Example

Expert judgement can be used in many instances for both vulnerability assessments and adaptation assessments and planning. For example, if there was a decision to undertake adaptation in the water sector, a team of experts might be assembled to help decide on possible strategies. This team could include hydrologists, engineers, water resource managers etc. Once an adaptation strategy is chosen, for example, to increase the use of water saving devices, another team of appropriate experts could be consulted on how best implement the strategy.

Time frame	Current decision, Planning horizon, Long term
Policy target	Operational, Project design, Strategic plans, Awareness
Analytical unit	Individuals, Households, Livelihoods, Regions, Sectors, Macro
Clients	Local, Regional, National, International
Time for assessment	Rapid, Year, Several years
Resources needed	1 PM, Several PM, Multi-disciplinary team
Knowledge	General
Further information	Royal Society of Canada (1998) *Expert Panels: Manual of Procedural Guidelines.* Version 1.1. Ottawa (Ontario), Canada. Source:www.rsc.ca./english/expert_manual.pdf Woodhouse, P. (1998). People as Informants. Finding Out Fast: Investigative Skills for Policy and Development. A. Thomas, J. Chataway and M. Wuyts. London Thousand Oaks New Delhi, Sage**:** 127-146.
Links	www.viwta.be/files/handboek.pdf - Participatory methods manual; Expert panel technique, pg. 87

16. Focus groups

Summary: Groups of stakeholders discuss their opinions on certain topics

Description

Focus groups are suitable for accessing collectively held, shared, local, cultural and situational knowledge and expertise. They draw from a group of stakeholders by providing a forum in which people discuss their opinions on certain topics. A focus group is therefore necessarily a focussed discussion. This requires identifying one or two questions that evoke a range of responses. This is done by keeping conversation going through skilled facilitation. The goal is to elicit perceptions, feelings, attitudes, and ideas of participants about the topic.

Focus groups are not generally appropriate for evaluation and therefore the nature of discussion should be more qualitative than quantitative and this requires questions to be carefully constructed, so that they don't require quantitative answers. The group should provide a secure place for people to share their knowledge about the local context which requires skilful facilitation that allows everyone to feel that their contribution is valued. Depending on cultural factors, this may be supported by having relatively homogenous groups. For example, in African culture it is useful to have separate focus groups for men and women as due to cultural norms, women might not answer as openly if there are men in the group. In other circumstances, it might be more useful to have a wide range of stakeholders to get a variety of opinions on a topic.

Focus groups help to elicit dominant perspectives from the local scale. They can also enable participants to learn from each other and facilitate an understanding of other people's perspectives. For example, a group of rural women might be asked about how seasonal forecast information is useful to them. Half the group might suggest that the information is helpful as it helped them prepare for a short season of below normal rainfall in the past. The other half might disagree and say the information is of no value to them, as they do not trust it. Further prompting might reveal that those who did not trust the information, do not have access to money to buy additional resources and so could not buy drought-resistant varieties or that the half not trusting it, heard the information via someone who preferred traditional forecast measures. Issues such as these will not necessarily be apparent from survey or other quantitative data, yet can help to ensure that intervention is sensitive to social institutions.

Method

Process:

- 5 to 10 participants is a good number
- Introductions and facilitator explains purpose
- Facilitator outlines topic to be discussed and asks people to comment
- Facilitator monitors input closely and ensures that everyone talks and no-one dominates the process
- A rapporteur takes notes, picking up key themes and perceptions about them
- The discussion can also be recorded and transcribed
- The discussion should last for between one and two hours.

Example

A focus group discussion might involve sitting down with 6-10 women to ask them about the role of agriculture in their village. The discussion might focus on what activities women undertake, what decisions they can take and the constraints faced. Depending on time and will, the discussion might start to look at how future options.

Table 4: Guideline for focus group questions

Questions NOT to ask in focus groups	Questions suitable for focus groups
Is excessive rainfall destructive to households and fields?	How do people deal with excessive rainfall? What impact does it have on households?
Is drought a problem in this area?	What enables people to cope when conditions are dry and there is no water?
Do many people have their own vegetable gardens?	What are the ways are in which people ensure food in the household?
Is crime a problem?	What are the main social problems in the area? What can be done about them?

Time frame	Current decision, Planning horizon
Policy target	Operational, Project design, Strategic plans
Analytical unit	Individuals, Households, Livelihoods, Regions, Sectors
Clients	Local, Regional, National
Time for assessment	Rapid, Year, Several years
Resources needed	1 PM, Several PM, Multi-disciplinary team
Knowledge	General
Further info	Barbour, Rosaline S. and Jenny Kitzinger, eds. 1999. *Developing focus group research: Politics, theory, and practice.* London: Sage. Greenbaum, Thomas L. 1998. *The handbook for focus group research.* Thousand Oaks: Sage. Morgan, David L. 1997. *Focus groups as qualitative research, second edition.* Thousand Oaks: Sage. Pretty, J.N, Guijt, I. Scoones, I. Thompson, J (1994) *A Trainer's Guide for Participatory Learning and Action*, IIED, London.
Links	www.slais.ubc.ca/resources/research_methods/group.htm www.mapnp.org/library/evaluatn/focusgrp.htm http://link.unm.edu/Library_Documents/focusgrp.htm www.viwta.be/files/handboek.pdf - Participatory methods manual; Expert panel technique, pg. 97

17. Knowledge elicitation tools (KnETs)

Summary: The use of artificial intelligence techniques for classifying and formalising elicited knowledge

Description

The need to understand empirical data in a formal way is imperative when faced with multiple responses of humans to their environments. Techniques for classifying and formalising elicited knowledge can be used to reveal new avenues for field investigation. This information can subsequently be inputted into agent based models.

Methodology

The methodology requires intensive interaction with real world agents. After interviews with key domain experts, a non-leading questionnaire is distributed to a random sample of informants to assess the representativeness of the knowledge gained from the chosen key domain experts and their ability as key informants. Further knowledge that is elicited from the main experts is validated using an interactive questionnaire. Possible relationships within the data produced from the questionnaire, are revealed through the use of a machine learning algorithm. Analysis of output from the machine learning algorithm allows the construction of decision trees which are used to create production rules for incorporation into an agent based model. These prototypical rules are further validated using an interactive learning program to refine and prune the decision trees as necessary. Validation can also be carried out during further interviews. As a part of the validation phase, data from the constrained information processing task is subjected to a machine learning algorithm. A further learning program is then used in later interviews to assess the accuracy of data produced by the machine learning algorithm. This validates the understanding of the decision sequences and the relationships between key concepts observed during interviews. The data is divided into a training and a test set. The rules that are produced by the algorithm on the training set, can be corroborated by validating them using the test set. Once a high degree of correlation is established on the rules, they can be put into a prototypical knowledge base to be tested again with experts during follow-up interviews

Example

In the example shown in Figure 6, based on research into farmer adaptation in East Kent, England, the most important domains in the decision making process were the environmental, economic, climatic and strategic domains. The strategic domain was derived from informant interviews and contained expertise on adaptive options. These types of knowledge each required elicitation from their respective sources of expertise. It was necessary to confirm the configuration of circumstances which caused each adaptation strategy to be invoked.

Figure 6: Screen shot of the program used for process tracing

Time frame	Planning horizon, Long term
Policy target	Operational, Project design, Strategic plans, Awareness
Analytical unit	Individuals, Households, Livelihoods, Regions, Sectors
Clients	Local, Regional, National, International
Time for assessment	Rapid, Year, Several years
Resources needed	Several PM, Multi-disciplinary team
Knowledge	Specialist
Further info	McGraw, K. L. and Harbison-Briggs, K. (1989). Knowledge Acquisition. Prentice-Hall International Editions. Russell, S. J. and Norvig, P. (1995). Artificial Intelligence - A Modern Approach. Prentice-Hall.
Links	http://herzberg.ca.sandia.gov/jess/

18. Multi-criterion analysis

Summary: Scoring and weighting of options using indicators and more than one decision criteria

Description

Multi-criterion analysis (MCA) enables options to be evaluated using a range of criterion that includes unquantifiable analysis, especially when distributional implications need to be considered. The purpose of using MCA is to aid decision making rather than to evaluate option on monetary terms. It is useful for assessing options for adapting to climate change as there are many factors that need to be considered including equity, efficiency, short or long term benefits as well as many other non-monetary factors.

Method

In order to undertake MCA, the following steps should be completed:

1. Decision context
2. identification of objectives
3. Options for reaching objectives
4. criteria to evaluate options
5. analysis of options
6. Analysis of results
7. evaluation and feedback

In the first case the decision should be clarified and the potential options identified. In order to choose an option, criteria should be established, by which to evaluate each of the options. It is important to note that the criteria can be both qualitative and quantitative. A criterion can be seen as a 'standard' or 'indicator'. It is important that the criteria is relevant to the decision context and that it is sensitive to the cultural, social and economic factors for each country or area for which adaptation options are being considered. The criteria often related to advantages or disadvantages, whether quantitative or qualitative. In the context of climate change, the options might be assessed in terms of their ability to decrease the risk of climate change impacts and the contribution to sustainable development. The range of options can be entered into a matrix and then each option assessed for a range of criteria. A score may be used to evaluate each option or absolute units might be used (such as cost or number of people affected). Each criteria can have a different unit. All the units are then standardized by interpolating and ranking from 0 to 100 for example, increasing for benefits. The scores can then be averaged and the options ranked. The criteria can also be weighted if some are seen as more important than others.

Example

MCA example from NAPA guidelines: Cape Verde

In Cape Verde, among the poverty alleviation (PRSP) objectives proposed, the creation of opportunities for increasing income through sustained economic growth, as well as for improving the living standards of the local populations, constitute major strategic orientations. Poor, economically and socially vulnerable populations currently represent a third of the total Cape Verdean population, whereas 10 years ago 15% of the population was considered very poor.

Exploration of livelihood exposure and sensitivity to climatic hazards identified the following clusters as the principal concerns:

- Coastal, traditional fishing communities exposed to coastal storms, sea level rise and coastal erosion
- Small-scale agriculturalists exposed to drought
- Urban poor exposed to drought, intense rainfall and flooding.

Also of concern, but somewhat lower in priority (in this hypothetical example) might be:

- Critical sectoral infrastructure, such as bridges between ports and agricultural areas
- Sensitive ecosystems, such as coastal wetlands, that provide services for priority economic activities

The following preliminary list of might provide potential interventions options:
Option 1: Developing fodder crop cultivation in areas with the least agricultural potential.
Option 2: Developing intensive livestock farming (especially goats), in arid zones.
Option 3: Building reservoirs to capture and channel excess superficial water runoff from rainfall.
Option 4: Introducing drip-irrigation, particularly in horticulture.
Option 5: Developing more resilient crop species.
Option 6: Developing chemical fertilizers for use in combination with organic manure.
Option 7: Developing a joint management system for forest resources.
Option 8: Developing renewable energy resources and Liquefied Propane Gas (LPG).
Option 9: Protecting the industrial and tourist complexes of Sao Vicente in the Santa Maria Bay.
Option 10: Rationalizing sand and gravel extraction.

Obviously, not all of these options can be implemented due to financial constraints and/or lack of capacity to take on the activities. Some of them may be discarded, or amended. The selection among these options is done by establishing criteria for selection. The different criteria are not all expressed in the same unit of measure. Some are expressed in absolute values, but not necessarily in the same units (costs, rates etc.), others are awarded scores. Binary choices (such as yes or no) are also possible, as well as a variety of different scoring scales. Thus, the values must now be standardised; that is, expressed in one common unit, according to one common scale. This standardisation is done by plotting each criterion value on an axis (linear interpolation), ranging from 0 – 1, or from 0 – 100, increasing in value when it concerns 'benefits' (advantages) and decreasing in value based upon the cost criterion (disadvantages). This standardisation process is then undertaken for all options and criteria, yielding the results, of the most suitable option to follow.

Time frame	Current decision, Planning horizon
Policy target	Operational, Project design, Strategic plans
Analytical unit	Livelihoods, Regions, Sectors, Macro
Clients	Local, Regional, National, International
Time for assessment	Rapid, Year, Several years
Resources needed	1 PM, Several PM, Multi-disciplinary team
Knowledge	Specialist
Further info	Brans, J.-P., Mareschal, B., 2002. *PROMÉTHÉE-GAIA: une méthodologie d'aide à la décision en présence de critères multiples*. Paris, Éditions Ellipses, 188 p. Eder, G., L. Duckstein and H.P. Nachtnebel, "Ranking water resources projects and evaluating criteria by multicriterion q-analysis: an Austrian case study", J. of Multi-Criteria Decision Analysis, 6 (5): 259-271, 1997. Raju, K.S. and C.R.S. Pillai, 1999. Multicriterion decision making in river basin planning and development. *European Journal of Operational Research.,*112:249-257. Tecle, A. and L. Duckstein, "Concepts of multicriterion decision making." In: H.P. Nachtnebel (ed.): Decision Support Systems in Water Resources Management, Chapter 3, pp. 33-62, UNESCO Press, Paris, 1994.
Links	www.unitar.org/ccp/samoa/boschkhan.pdf - presentation of approaches to prioritising adaptation options http://www.citg.tudelft.nl/live/binaries/ec906edd-af0e-4ba1-bcd8-18e7e7cd73ab/doc/paper137a-0853.pdf - example of flood risk www.rri.wvu.edu/pdffiles/bukenya2012.pdf - example of prioritising Uganda's parks for ecotourism

19. Risk analysis

Summary: Approaches to decision uncertainty including hedging and flexing, regret, minimax and maximin

Description

When decisions are it is important to consider how certain the outcomes will be. Uncertainty is a result of a lack of knowledge of both the hazard and their impact. Where knowledge of both is good, then risk can be characterised both quantitatively and accurately. Where knowledge is not good, it is important to specify what the level of uncertainty is and why. This requires risk analysis.

Method

In the climate context is useful to list the climate variables that are important, as shown in Table 5. A checklist helps to provide initial risk screening. The characteristics of potentially significant or relevant climate variables can then be identified and the different characteristics defined. This can include a preliminary assessment of sensitivity and confidence. This approach helps to encourage a rigorous analysis of climate influence.

Table 5: Climate variable checklist

Types of variables

- Primary: CO2, sea-level, temperature, precipitation, wind, cloud cover
- Synoptic: Weather types, pressure, storm track, lightning
- Compound: Humidity, evapotranspiration, mist, fog, growth season
- Proxy: Soil Moisture, river flow, wave climate

Characteristics of variables

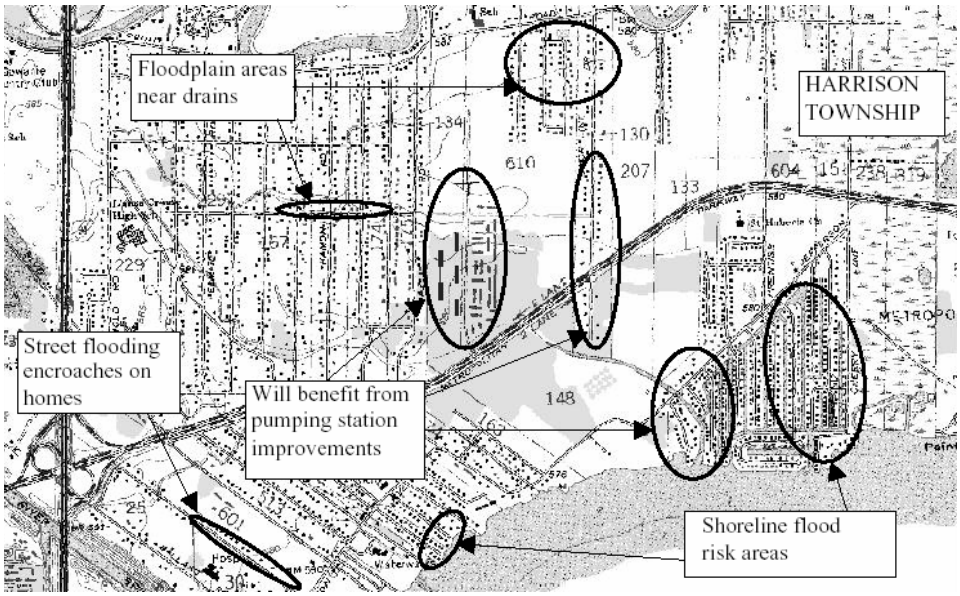
- Magnitude and Direction: Increase, decrease, rate of change
- Statistic: Average, time-integrated, variability and frequency
- Averaging period: Instantaneous, hourly, annual, decadal
- Joint probability events: Consecutive, coincident or joint occurrence, and variables correlation

Approaches to take to ensure risk is thoroughly evaluated: - include confidence estimates in data (such as skill of seasonal climate forecasts) - timescale of variables - state the knowledge of the hazard and consequence Once the climate risks are understood, it is important to recognise that future climate change is only one source of decision uncertainty. It is therefore critical to consider climate adaptations and assess whether they might have an impact on future climate. It is also important to consider the uncertainty associated with implementing the adaptation options. Assumptions and sources of uncertainty should be treated explicitly in risk and impact assessments in order to reach robust decisions.

Example

Example of flood hazard and risk analysis is taken from www.michigan.gov/documents/7pub207_60741_7.pdf. A flood vulnerability map (Figure 7) is used to identify areas that experience current flood problems. Evaluation criteria are then used and rated. This enables a list of priority hazards to be produced with the associated risk.

Figure 7: Identification of flood risk



Time frame	Current decision, Planning horizon, Long term
Policy target	Operational, Project design, Strategic plans, Awareness
Analytical unit	Individuals, Households, Livelihoods, Regions, Sectors, Macro
Clients	Local, Regional, National, International
Time for assessment	Rapid, Year, Several years
Resources needed	Multi-disciplinary team
Knowledge	Specialist
Further information	Motroni A., Duce P., Spano D., Canu S., (2002) – "Estimation of climatic risk for agriculture in a Mediterranean region". Proc. of the 16th International Congress on Biometeorology. Kansas City, Missouri, USA, 28 October – 1 November 2002, 308-309. Summary - www.fao.org/sd/climagrimed/pdf/ws01_17.pdf Kienast, F., Wildi, O. and Brzeziecki, B. 1998. Potential impacts of climate change on species richness in mountain forests - An ecological risk assessment. Biological Conservation 83(3): 291-305. Commonwealth Department of Health and Ageing, Australia. 2002. Human health and climate change in Oceania: a risk assessment. www.health.gov.au/internet/wcms/Publishing.nsf/Content/health-pubhlth-publicat-document-metadata-env_climate.htm
Links	www.michigan.gov/documents/7pub207_60741_7.pdf www.climatechange.govt.nz/resources/local-govt/effects-impacts-may04/html/page7.html - New Zealand Climate Change Office, risk assessment process

20. Scenario analysis

Summary: The fuller picture of implications of uncertainty gained through simultaneous variation of key uncertainties

Description

Scenarios are possible futures. The future is unknown and so it is necessary to consider many alternatives of what the future might be, taking account of the full range of imaginable futures. From this population of possible (or plausible) futures, a number of outcomes can be chosen and combined to produce coherent consistent scenarios that can help to envision possible futures. The approach allows expected impacts from the reference case to be compared to those from scenarios of more concerted action (optimistic visions) or of deteriorating environmental and economic conditions (increasing the reference vulnerability). At present there are two dominant modes of scenario construction. The most widely known and visible ones are constructed by relatively small teams, usually experts chosen to represent different sectors, working at a generalised and often global level. This 'top-down' approach provides a consistent framework for a variety of studies. 'Bottom up' scenarios tend to be oriented toward more local levels with a base in participatory and stakeholder methods. Bottom up scenarios are more likely to capture local vulnerabilities and dynamics. It is considerably more difficult to construct a participatory, representative process around global scenarios. A practical constraint is the type of data available and the level of detail needed in the data. Scenarios have tended to be used for specific enquiries. For example, scenarios might focus on global food security or global climate change. It is therefore of paramount importance that they are used with the acknowledgement that they do not include all sectors or characteristics but focus on the outcome of certain futures. The ability of scenarios to cover a lot of ground and their ability to consider future options has resulted in their growing use in the field of vulnerability assessments.

Method

The scenario planning process is as follows:

- comprehensive discussion about how participants see shifts coming in society, economics, politics, technology, etc. related to the topic of enquiry
- group draws a list of priorities or a sensible range of options
- sketch out rough pictures of the future based on these priorities (scenarios)
- could support with storylines or narratives of the dominant scenarios
- identify early warning signals that are indicative of a particular scenario occurring
- monitor, evaluate and review

Example

The Special Report on Emission Scenarios (SRES) presents the scenarios of greenhouse gas emissions for the IPCC. The SRES scenarios focus on four possible futures up to the year 2100 that have distinctly different directions of development. The categories they use to determine "future" characteristics include demographic change, economic development, and technological change. However, the SRES are not oriented toward socio-institutional vulnerability.

Time frame	Current decision, Planning horizon, Long term
Policy target	Operational, Project design, Strategic plans, Awareness
Analytical unit	Households, Livelihoods, Regions, Sectors, Macro
Clients	Local, Regional, National, International
Time for assessment	Rapid, Year, Several years
Resources needed	Several PM, Multi-disciplinary team
Knowledge	General
Links	www.grida.no/climate/ipcc/emission/ www.gsg.org/ Examples: http://ideas.repec.org/p/fpr/eptddp/98.html (Ugandan coffee)

21. Strategic environmental assessments

Summary: Consideration of all environmental impacts taken into account before deciding on development

Description

Strategic Environmental Assessment (SEA) is a decision support tool that aims at integrating the environmental aspects of decisions in a structured manner. It aims to assess the policies, programmes and plans that have long-ranging implications on broader aspects of society. It also has an up-stream focus, in the sense that it does not just carry out an environmental analysis of decisions already made. By providing a systematic process it aims to evaluate the environmental consequences at the earliest appropriate stage of decision making along with economic and social considerations. The SEA approach developed from the environmental impact assessment (EIA) process. Unlike the EIA process, SEA attempts to contextualise a project in the broader framework. It can include sensitivity mapping of the area, risk analysis and social impact assessment. When focussing on adaptation, it is a useful tool to use when the adaptation option has been decided on. A SEA will help to evaluate what the environmental impacts will be of a proposed project, plan or policy.

Method

SEA should be an on-going process that updates the initial assessment to consider any new developments and information. The benefit of SEA is that it should pick up on the environmental impacts that might be ignored if a study of the proposed project was done in isolation. It therefore encourages consideration of environmental and social objectives at a variety of scales. It also encourages consultation between government and non-government stakeholders. A strength is that is facilitates the process of choosing the most appropriate site for a project given a wide range of factors. It is therefore an important tool to use once adaptation options have been chosen, in order to ensure that there will not be unintended social, economic or environmental impacts.

Example

A SEA process might be undertaken before a key adaptation strategy is implemented. For example, if flood levees are to be built, an SEA could be undertaken to ensure that there was stakeholder consultation from those directly impacted. The SEA would include an assessment of the downstream environmental impacts. It would also consider the policies that might support or undermine the project in the future and how the levees would impact a wider range of stakeholders than those directly impacted.

Time frame	Planning horizon, Long term
Policy target	Project design, Strategic plans
Analytical unit	Livelihoods, Regions, Sectors, Macro
Clients	Local, Regional, National, International
Time for assessment	Year, Several years
Resources needed	Multi-disciplinary team
Knowledge	Specialist
Further information	Partidario M.R. (1996). Strategic Environmental Assessment: Key Issues Emerging from Recent Practice. *Environmental Impact Assessment Review*, 16, 31-55. Sadler B. (1998). Recent Progress in Strategic Environmental Assessment. *Environmental Protection Bulletin*, No.55, pp 1-10. Dalai-Clayton, B and Sadler B. (2005) *Strategic Environmental Assessment: A Sourcebook and Reference Guide to International Experience,* Earthscan, IIED: UK.
Links	www.adb.org/Documents/Guidelines/Environmental_Assessment/ www.iied.org/pubs/pdf/full/7790IIED.pdf www.unep.ch/etu/publications/EIA_2ed/EIA_E_top14_body.PDF