Definition of Adaptive Capacity
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1. Introduction

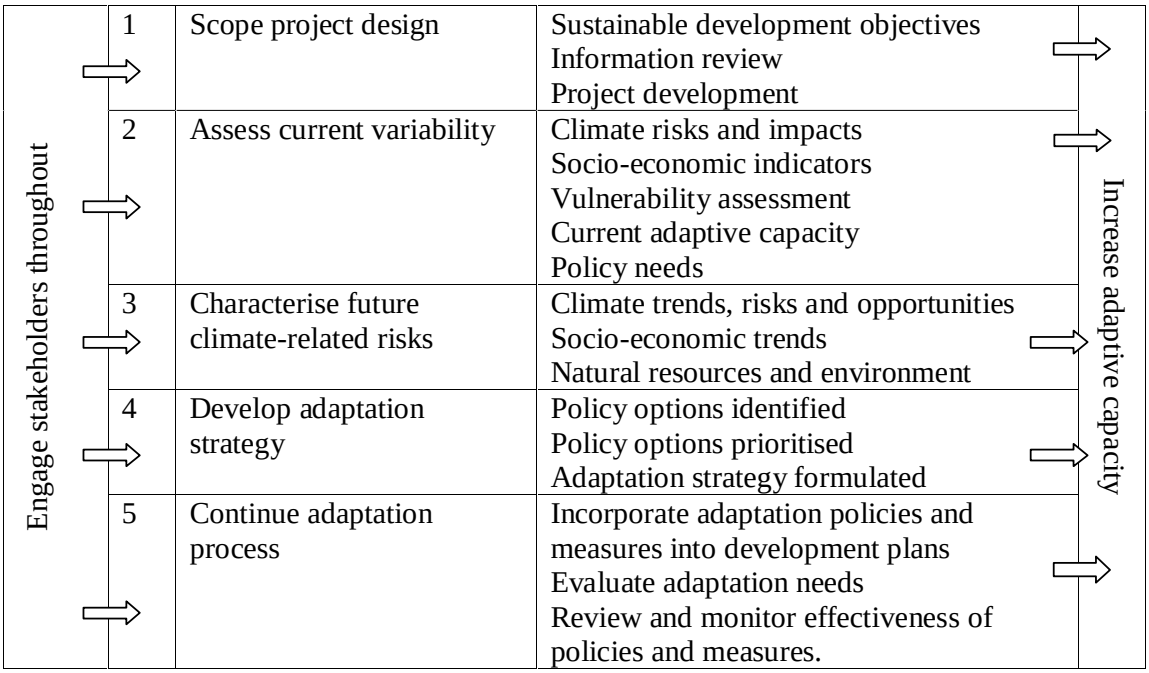
The fundamental approach of the IPCC is that vulnerability is a function of exposure to sensitivity and both can be modified by exercising adaptive capacity (TAR WGII 2001). The aim of the talk was to expand on this notion by presenting an adaptation policy framework, developed by UNEP, which offers some guidance to those trying to understand the vulnerability of a particular system or community.

2. The Adaptation Policy Framework (ADF)

There are 5 key principles:

i. Adaptation policy and measures are best assessed in a developmental context.
ii. Adaptation to short-term climate variability and extreme events are explicitly included as a step towards reducing vulnerability to longer term climate change.
iii. Adaptation occurs at different levels in society, including the local level.
iv. The adaptation strategy and the process by which it is implemented are equally important, and include the review, evaluation and monitoring of adaptation. They are instrumental in driving each stage of the process.
v. Building adaptive capacity to current climate is one way of preparing society to cope with future climate.

3. Schematic diagram of process



4. Application of the framework: a case study

i. Scope project design
Eakin (2000) was worried about the vulnerability of smallholder maize production in Mexico to climate risk. The study focused on the region of Tlaxcala.

ii. Assess current variability
Assessed current variability of climate for agriculture (eg effect of frosts, variable precipitation, droughts…) and current socio-economic circumstances (maize agriculture dominates production for more than 50% of households).

Vulnerability determined to be the fact that households suffer extreme hardships when yields fall below 2000kg/ha. This threshold defines a coping range whose boundary was crossed 30% of the time between 1967 and 1989, generally because July precipitation was too low, leading to variable yields and severe deficiencies. Current adaptation: households routinely adopt a range of risk-averse adjustments (e.g., planting shorter, fast-maturing maize varieties or changing planting dates… Socio-economic uncertainty dwarfs climate uncertainty).

iii. Characterise future climate-related risks
Key questions: how might July precipitation change over time? How often will critical threshold be crossed? A computer programme (COSMIC 1999) was used to get a representative range of not implausible scenarios of July precipitation in Mexico from 14 GCMs and multiple climate sensitivities and emissions trajectories (Yohe et al 1999). Depending on the scenario used, July precipitation was projected to either increase or decrease. Key sustainability index = likelihood that July precipitation will be above a critical threshold.

iv. Develop adaptation strategy
a. Government develops drought-resistant hybrid varieties of maize. Demonstration farms (e.g Plan Puebla 1970s) are important (otherwise people continue to use traditional varieties). Drought resistant maize better does better than traditional varieties (i.e., probability of being above 2000kg/ha threshold higher), under moderate drought conditions but there is little difference during more severe droughts.
b. The government works to disseminate ENSO-based seasonal forecasts.

v. Continue adaptation process
Both adaptation strategies have been implemented, so this case study provides a perfect situation for assessing the effectiveness of the adaptation policy framework. The general conclusion is that traditional maize agriculture is far more vulnerable to socio-economic trends than climate trends.

5. Adaptive capacity
According to Gary, adaptive capacity is not so much something you can measure, but rather a way of organising thoughts.

Determinants of adaptive capacity:

1. The range of available technological options

2. The availability of resources (natural and economic)
3. The structure of critical institutions, the allocation of decision-making authority and the decision criteria that would be employed
4. The stock of human capital
5. The stock of social capital
6. Access to risk-spreading processes (e.g., the ability to spread out variability in exposures; stockpiling; expanding the scope of who bears the cost)
7. Ability of decision-makers to manage information and to determine which information is credible; the credibility of the decision-makers themselves.
8. The public's perceived attribution of the source of stress and the significance of the exposure to its local manifestation (human capital)

These determinants can be used to construct indicators of vulnerability - unitless metrics that recognise adaptive capacity in judging relative vulnerability (and are added up in an adhoc intuitive way to get some idea of adaptation).

6. Vulnerability index based on adaptation determinants

(For further details see Yohe and Tol, 2001)

a. Feasibility Factor: a feasibility factor denoted FFj can be assigned to all the determinants for each adaptation option (denoted by subscript j) according to:

$$FF_j = \min\{ff_j(2), \ldots ff_j(8)\}$$

Where ffj are subjective judgements of the strength of each determinant.

b. Efficacy Factor: the ability of adaptation option (j) to influence a system's exposure or sensitivity to an external stress can be reflected in an Efficacy Factor EFj - a subjective index number assigned from a range running from 0 to 1.

c. Coping Capacity Index: the potential contribution of any adaptation to a system's social and economic coping capacity can be defined as the simple product of its overall feasibility factor and its efficacy factor, i.e.,

$$PCCj \equiv \{EFj\}\{FFj\}$$

7. Example

Tol et al (2001) report on the assessment of adaptation against increased risk of flooding in the Rhine delta.

Six options were identified in the Netherlands:

1. Some excess water in Germany
2. Accept more frequent floods
3. Build higher dykes around river
4. Deepen and widen river
5. Dig a fourth river mouth
6. Dig bypass and create northerly diversion.

Option / Determinant	1	2	3	4	5	6
Resources						
Total Cost	3	5	4	4	1	2
Distribution	1	3	4	5	1	1
Institutions						
Structure	1	4	5	4	2	3
Participation	2	2	3	5	1	2
Criteria	2	1	5	4	3	2
Human capital	1	2	5	4	4	3
Social capital	1	3	4	5	2	2
Risk spreading	2	1	5	4	4	3
Information						
Management	1	3	5	4	2	2
Credibility	1	2	4	5	3	3
Awareness	3	3	5	5	3	3
Feasibility factor (FF)	1	1	3	4	1	1
Efficacy factor (EF)	0.8	1.0	1.0	0.6	0.8	0.6
Coping Index (PCC)	0.8	1.0	3	2.4	0.8	0.6

Determinants ranked 0-5

Results

Option 3 (build higher dykes) was the strongest, primarily because the institutions are already there, the human and social capital is strong, risks are spread and information management is high. The notable weakness was the public participation was relatively low due to a growing sense that dykes are unnatural.

The framework is useful because it helps identify the important issues associated with each different option. The numbers are less important than the relative ranking of the different option. The lowest/weakest determinant is widely recognised as the key factor affecting adaptive capacity; i.e., the weakest link.

Reference

Yohe, G. and Tol, R.S.J., 2002. Indicators for social and economic coping capacity - moving towards a working definition of adaptive capacity. Global Environmental Change **12** 25-40.

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