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Assessing Vulnerability for Climate Adaptation

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3.1. Introduction

Adaptation involves the management of risks posed by climate change, including variability. The identification and characterisation of the manner in which human and natural systems are sensitive to climate become key inputs for targeting, formulating and evaluating adaptation policies. With the guidance presented here, users should be equipped to carry out a vulnerability assessment at the appropriate level of detail and rigour. Not every Adaptation Policy Framework (APF) user will need to undertake a vulnerability assessment; those who do will likely be motivated by a specific need to raise awareness of vulnerability, to target adaptation strategies toward key vulnerabilities and to monitor exposure to climatic stresses. These users can tap the guidance outlined here to hone in on key groups, sectors, geographic areas, etc., assess current and future vulnerability, and integrate observations into adaptation planning and policy making.

If we take the example of human health, climate change is likely to affect the distribution and prevalence of infectious disease vectors, which might lead to increased mortality and morbidity from diseases such as malaria and cholera. However, this outcome is dependent on non-climate factors, including environmental controls, public health systems, and the availability and use of drugs and vaccines. A first step in designing effective adaptation strategies would be to clearly establish the importance of climate change, including variability, in terms of the final health outcomes. In this instance, a vulnerability assessment would target those regions most affected by the health impacts of climatic variability, focus adaptation options on effective interventions for the most vulnerable populations, and produce baseline data and indices for monitoring responses.

While a vulnerability assessment (VA) is important for responding to future climate risks (TP5), the assessment process may also help improve the management of current climate risks (TP4). For example, the vulnerability assessment can be used to address the following questions of immediate relevance to policy-makers and development planners: To what extent are the anticipated benefits from existing development projects sensitive to the risk of climate change, including variability? In what way can considerations of future climate risk be incorporated into the design of development projects?

These questions are particularly germane in developing countries that are witnessing the rapid build-up of long-lived civil infrastructure (such as irrigation systems, transportation systems and urban settlements) and in conditions where natural resources are rapidly degrading (such as desertification, water quality and scarcity, and the loss of other environmental services).

Methods of vulnerability assessment have been developed over the past several decades in the fields of natural hazards, food security, poverty analysis, sustainable livelihoods and related

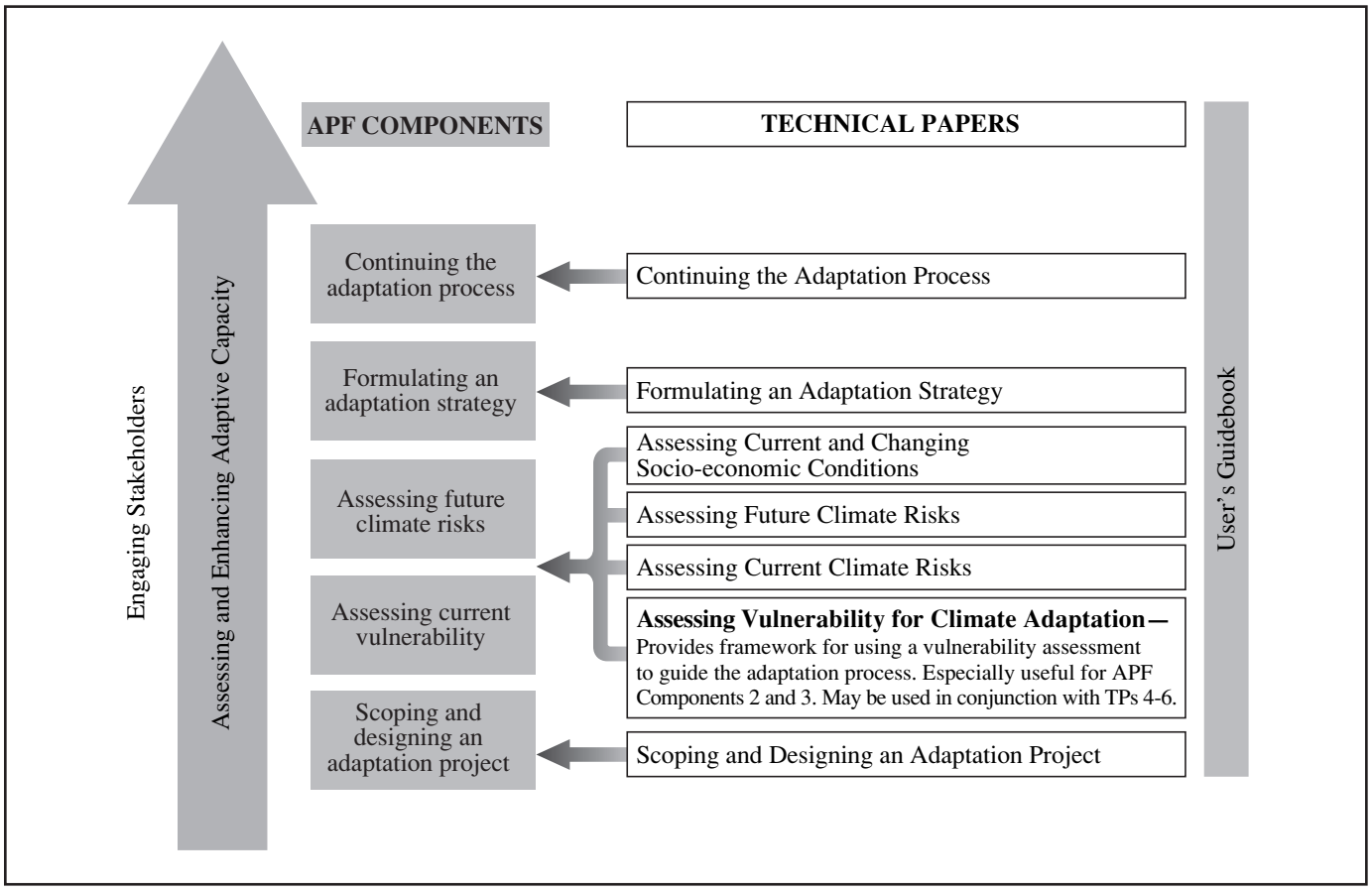

Figure 3-1: Technical Paper 3 supports Components 2 and 3 of the Adaptation Policy Framework

areas. These approaches – each with its own nuances – provide best practices for use in studies of climate change vulnerability and adaptation.

This Technical Paper (TP) presents a structured approach to climate change vulnerability assessment; the emphasis is on the activities and techniques that a technical team could readily implement. The paper recommends five activities and suggests methods that are suitable for different levels of analysis. The five activities link a conceptual framework of vulnerability to the identification of vulnerable conditions, analytical tools and stakeholders. The annexes give further examples and background.

3.2. Relationship with the Adaptation Policy Framework as a whole

An APF vulnerability study can include analyses of current and future climate risks, and socio-economic conditions and prospects, to varying and appropriate levels of detail. Depending upon the choices made in project design (Component 1) regarding adaptation priorities and assessment methods, the guidance in this paper may be used in conjunction with the guidance in TPs 4, 5 and 6. Specifically, elements of socio-economic conditions and prospects (TP6) can be incorporated in the vulnerability assessment; the vulnerability assessment can in turn be used to characterise present (TP4) and future risks (TP5). Completion of the APF Components 2 and 3 provides the basis for targeting and formulating robust and coherent adaptation strategies, policies and measures (TP8), that can be implemented and continued (TP9). In this TP, readers will find an overview of the vulnerability-based approach to an adaptation project, and ways in which this approach can be integrated with others (see TP1, Sections 1.3 and 1.4.4 for an overview of the four major approaches).

The vulnerability assessment is broken down into five activities with close links to the APF Components (Figure 3-1) and the tasks suggested in the User's Guidebook (Figure 3-2). The first activity matches the overall scoping of the project (TP1). The questions described below should be considered in Component 1 of the APF (TP1), where the project team scopes and designs an adaptation project, including reviewing existing projects and analyses, planning the approach to be taken, and planning and using stakeholder input. The vulnerability assessment has implications for each of these tasks. The remainder of the activities focus on APF Components 2 and 3.

This structured approach[1] begins with a qualitative understanding of the conditions of vulnerability, (see Annex A.3.3 for the sequence of activities) and progresses towards the

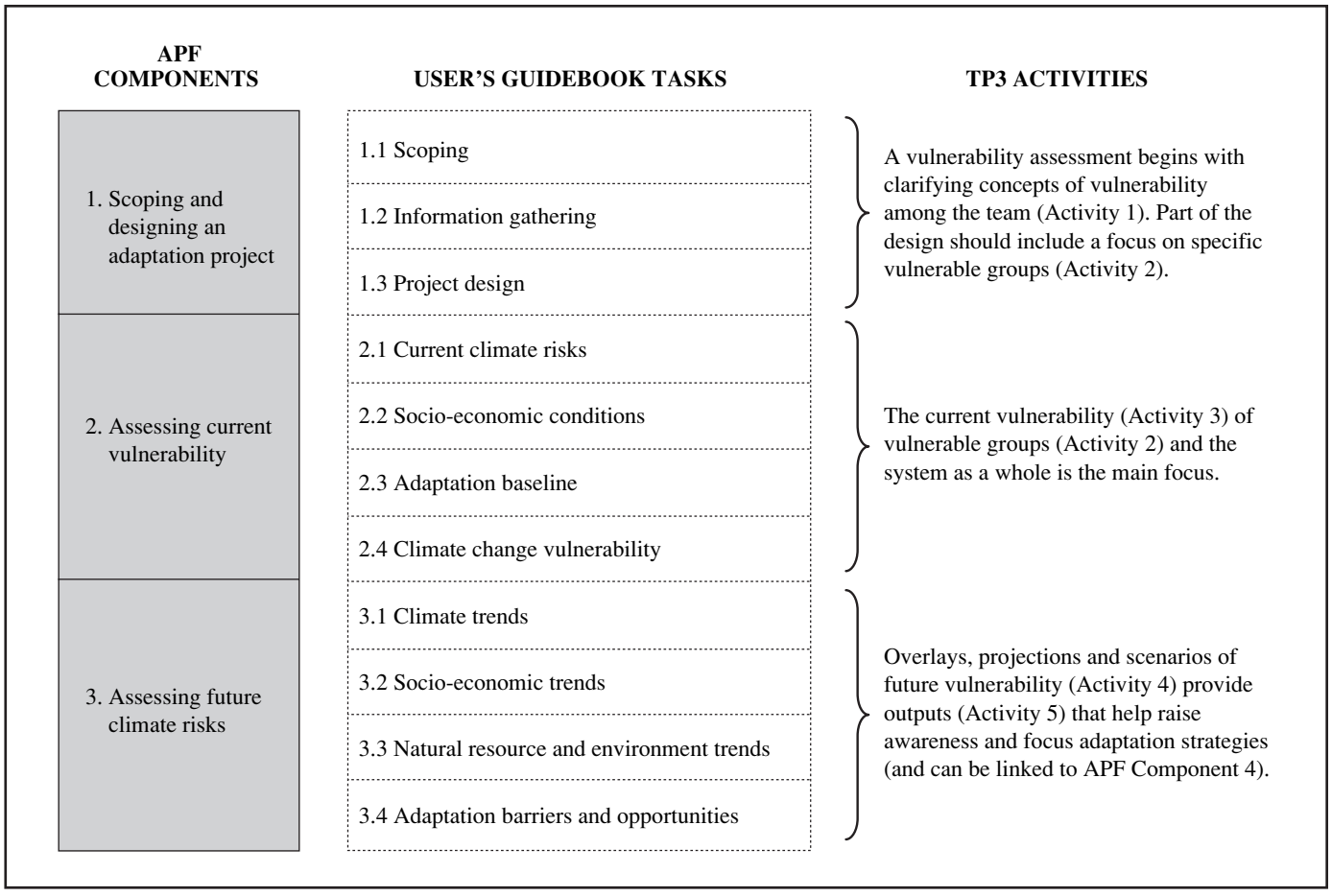

Figure 3-2: Technical Paper 3 activities relate to several Adaptation Policy Framework Components and tasks

development of quantitative indicators. (See Annexes A.3.5 and 3.6 for an illustration of different quantitative approaches). Links to formal models (such as environmental impact models) can be readily integrated into a vulnerability assessment, depending on the user's needs and capabilities.

3.3. Key concepts: About vulnerability

Vulnerability varies widely across communities, sectors and regions. This diversity of the "real world" is the starting place for a vulnerability assessment. International comparisons of vulnerability tend to focus on national indicators, e.g., to group less developed countries or to compare progress in human development among countries with similar economic conditions. At a national level, vulnerability assessments contribute to setting development priorities and monitoring progress. Sectoral assessments provide more detail and targets for strategic development plans. At a local or community level, vulnerable groups can be identified and coping strategies implemented, often employing participatory methods (TP2).

Although vulnerability assessments are often carried out at a particular scale, there are significant cross-scale interactions, due to the interconnectedness of economic and climate systems. For example, drought might affect a farmer's agricultural yield due to lack of rainfall and pests, reduced water in a major river basin allocated for irrigation, or changes in world prices driven by impacts in one of the "bread baskets". At the same time, the selected priority system for an adaptation project will be affected by linkages to other sectors.

The literature on vulnerability has grown enormously over the past few years.[2] Key articles from a development and sectoral perspective include Bohle and Watts (1993) and Chambers (1989). Extensions related to natural hazards are Blaikie et al. (1994), Clark et al. (1998), and Stephen and Downing (2001). Climate change explorations include Adger and Kelly (1999), Bohle et al. (1994), Downing et al. (2001), Handmer et al. (1999), Kasperson et al. (2002), and Leichenko and O'Brien (2002).

Vulnerability has no universally accepted definition (see Annex A.3.1 and the Glossary). The literature on risk, hazards, poverty and development is concerned with underdevelopment and exposure to climatic variability – among other perturbations and threats. In this view, vulnerability is systemic, and a consequence of the state of development. It is often manifested in some aspect of the human condition, such as under-nourishment, poverty or lack of shelter. Final outcomes are determined by a combination of climate hazards and system vulnerability. In this approach, the focus is on coping or adaptive capacity as the means for vulnerability reduction.

Hazards literature:
Risk = Hazard (climate) x Vulnerability (exposure)

The Intergovernmental Panel on Climate Change (IPCC) tuned its definition of vulnerability specifically to climate change.[3] Using this lens, vulnerability is seen as the residual impacts of climate change after adaptation measures have been implemented. The uncertainty surrounding climate change, impacts scenarios and adaptive processes is such that very little can be said with confidence about vulnerability to long-term climate change.

Climate change (IPCC):
Vulnerability = Risk (predicted adverse climate impacts) – Adaptation

Regardless of which framing is adopted, it is important to ensure that the choice is made explicit, and that the analysts and stakeholders are clear about the interpretation of the different terms. The formal methods proposed below require a tractable analytical definition.

Vulnerability by default corresponds to the hazards tradition, focusing on exposure and sensitivity to adverse consequences. In this TP, vulnerability corresponds to the present conditions (i.e., the vulnerability baseline defined by socio-economic conditions). However, it can be extended to the future as a reference scenario of socio-economic vulnerability. Where the authors refer to future vulnerability related to climate change, the term climate change vulnerability is used, corresponding to the IPCC definition. This requires explicit additions to the default term relating to the future (with climate change):

- Climate change is explicitly forecast
- Socio-economic exposure is forecast: who is vulnerable, why, etc.
- Adaptation to prospective impacts of climate change is included (although there is little agreement as to what sort of adaptation should be considered – whether autonomous, most likely, potential, maladaptive, etc.)

The result can be a plausibly integrated scenario of future vulnerability. Users should be clear that such scenarios cannot be validated or considered forecasts; they are contingent upon too many scientific and socio-economic uncertainties, as well as the iterative nature of human decision making.

3.4. Guidance for assessing current and future vulnerability

The five activities outlined below enable the user to prepare a vulnerability assessment that can serve as a stand-alone indication of

[1] The suggested approach must be considered with some flexibility. Depending on the current status of climate change studies in each country and the specific needs (target group, sector, etc.), the sequence of the different tasks can be interchanged or carried out simultaneously.

[2] Bibliographies, key publications, briefing notes and discussion forums are part of the Vulnerability Network, led by the SEI, IIED, PIK, START and others. The network promotes research and policy on vulnerability/adaptation science: See www.vulnerabilitynet.org

[3] From the glossary of the Third Assessment Report of the IPCC, see www.ipcc.ch/pub/shrgloss.pdf

current vulnerability, or can be integrated with climate change forecasts for an assessment of future climate vulnerability.

3.4.1. Activity 1: Structuring the vulnerability assessment: Definitions, frameworks and objectives

The first activity of the vulnerability assessment team is to clarify the conceptual framework being used, and the analytical definitions of vulnerability. A shared language will facilitate new insights and help communicate to key stakeholders.[4] (See TP2 for an in-depth discussion of stakeholder engagement.)

In the overall scoping, the team likely reviewed existing regional or national assessments that relate to vulnerability, for instance, national development plans, Poverty Reduction Strategy Papers, environmental sustainability plans and natural hazards assessments. If there is a common approach already in use – for instance, in development planning or mapping hazards – then it makes sense to begin with that framework. It may need to be extended to incorporate climatic risks and climate change.

If existing reviews and plans are not available or suitable, then the team will need to develop its own conceptual and analytical framework (see Annex A.3.2 for a team exercise). Stakeholder-led exercises are valuable at this point. The process of developing a conceptual and analytical framework should clarify differences between disciplines, sectors and stakeholders, and focus on creating a working approach and practical steps to be taken, rather than a "final" conceptual model. The output of this activity is a core framework for the vulnerability assessment.

The context of the APF study and its objectives are important for determining the set of questions that the assessment is intended to address. This, in turn, has bearing on the operational definition of vulnerability used in the analysis. For example, a vulnerability assessment could be used at two different points in the APF structure. An initial assessment of vulnerability may be used to identify more vulnerable regions and sectors, or hotspots. These might be treated to more intensive assessment, as suggested in TP4. Another use of the vulnerability assessment might be to feed into the design and evaluation of adaptation policies (TP8), including indicators of vulnerability as criteria (TP7).

Table 3-1 illustrates the linkages between the objectives, the context and the set of assessment questions, using the example of adaptation to sea level rise. Identifying a core set of questions for the vulnerability assessment will also help in carrying out the design of the project, as discussed in Component 1 (TP1).

3.4.2. Activity 2: Identifying vulnerable groups: Exposure and assessment boundaries

Having identified a working definition of vulnerability and a core set of questions for the assessment, the team needs to iden-

Table 3-1: *Objectives, context and analysis questions in vulnerability assessments*

Objective	Context	Analysis questions
Gathering and organising data, identifying data and information needs	Preliminary assessment, often part of related environmental strategy documents	• What are the trends in relative sea level? • What are the geomorphological characteristics of the coastline?
Providing estimates of abatement costs and climate damages	Input of local data to inform international estimates of the benefits of greenhouse gas stabilisation	• What are the physical impacts of sea level rise? • What are the market and non-market losses associated with sea level rise?
Formulating and evaluating adaptation options	Input to development planning and adaptation policy	• What will be the reduction in losses due to a specific adaptation option (such as creating coastal barriers)? • In what way and to what extent should the design of coastal infrastructure accommodate the possibility of sea level rise?
Determining the value of reducing uncertainty through research	Input to research prioritisation	• Which research and observation strategies will have the greatest benefit in reducing uncertainty? • How should observation and monitoring programmes be designed?
Allocating resources efficiently for adaptation	Input to policy prioritisation	• Which coastal region is most vulnerable? • Which region or sector can benefit the most from adaptation actions?

[4] To facilitate an international language of vulnerability, a formal notation may be helpful—see Annex A.3.2 for a complete set of notations.

tify who is vulnerable, to what, in what way, and where. The characteristics of the system chosen for the assessment include sectors, stakeholders and institutions, geographical regions and scales, and time periods. These characteristics are identified in APF Component 1, when assessment boundaries are established (TP1, Section 1.4 and Annex A.1.1).

A multi-dimensional baseline of vulnerability includes:

- Target vulnerable groups (TP1, Section 1.4)
- Group socio-economic characteristics and in particular those aspects that lead to their sensitivity to climate hazard (often referred to as exposure) (TP6)
- Natural resources and adaptive resource management (TP6)
- Degree of (present and/or future) climatic risks that affect each vulnerable group
- Institutional processes of planning adaptation strategies and options

The choice of the target of the vulnerability assessment should be a direct response to the objectives and decision context of the exercise. A fundamental issue is whether the target is people, resources, economic activities, or regions.[5] For example, a focus on food security might take as the core analyses the social vulnerability of livelihoods to a range of threats (from climatic, economic and resource changes). But this would need to be placed in an understanding of regional production, exchange and distribution. Or a focus on biodiversity might begin with detailed modelling of ecosystems and species, with a subsequent analysis of the value of lost ecosystem services for a range of economic activities.

One way to picture the choice is shown in Figure 3-3. The central concern of vulnerability assessment is people – those who should be protected from the adverse consequences of present climatic variations and projected climate change. These might be demographic groups (such as young children), livelihoods (urban poor in the informal economy) or populations at risk from diseases. Even when we focus on people as the target, we have to account for the fact that they are organised into groups at various scales – from individuals to households to communities and complete settlements. At each stage there are different sets of resources, institutions and relationships that determine not only their interaction with climate but also their ability to perceive problems, formulate responses and take actions. TP6 can assist in selecting and using indicators for various socio-economic characteristics in a vulnerability analysis.

Although a focus on groups is preferred, in practice, assessment is often carried out in sectoral or regional settings. Annex A.3.5 provides an example of the link between people as the target of vulnerability assessment and development policy and practice.

The exposure of groups, regions or sectors to climate risk is typically described using indicators. Indicators may reflect different socio-economic characteristics of the targets, including demographics, composition of economic activity, infrastructure and so on. Indicators may describe stocks – e.g., stocks of human, natural and manufactured capital; or flows – e.g., flows of economic goods and services, income and trade. Developing and using indicators requires an awareness of several technical issues including their sensitivity to change, standardising indicators for comparison, the reliability of the data, mapping of indicators, collinearity among indicators, coverage of the relevant dimensions of vulnerability, etc. It is important for the assessment team to examine existing inventories and analyses, as many of these issues may have already been addressed. The literature on indicators provides examples of good practice.

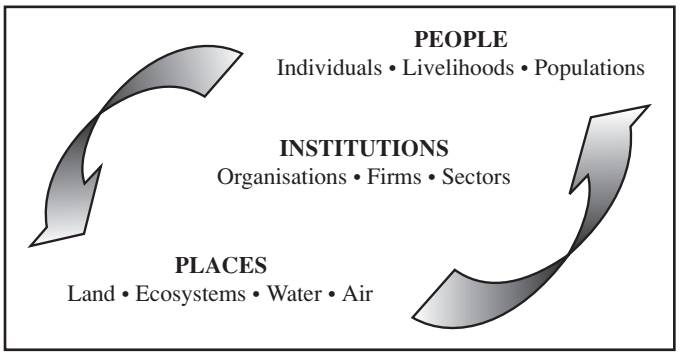

Figure 3-3: Units of analysis for a vulnerability assessment. The central concern of the vulnerability assessment is people, within the context of institutions and the biogeophysical resources of places. The research team and stakeholders can build up such a schema to illuminate exposure to climatic variations and to the drivers of socio-economic vulnerability. For example, "brainstorming" with boxes and arrows on a flip chart can map relationships in various ways (TP2).

The output of this activity is a set of vulnerability indicators and identification of vulnerable livelihoods (or other targets) that, together, form a vulnerability baseline of present conditions. (For additional guidance on developing socio-economic indicators, see TP6.) The collation of vulnerability indicators underpins the analyses and identification of priorities for adaptation. The process of aggregating the individual indicators into a composite view of vulnerability is covered in Activity 5.

3.4.3. Activity 3: Assessing sensitivity: Current vulnerability of the selected system and vulnerable group

Current vulnerability can be expressed as the conjunction of the climatic hazards, socio-economic conditions, and the adaptation baseline (TP6). The first two activities in the vulnerability assessment establish the present conditions of development. Activity 3 directly links climate hazards to key socio-economic outcomes or impacts. In this activity, we develop an understanding of the process by which climate outcomes translate into risks and disasters. This may be done through a variety of approaches ranging from simple, empirical relationships to more complex,

[5] Using the nomenclature outlined in Annex A.3.2, these might be labeled as Vg, Vs and Vr (referring to vulnerable groups, sectors and regions).

process-based models, such as those described in TP4 and TP5. The extension of the analysis to future climate risks is covered in Activity 4.

Climate outcomes are typically described through hydrological and meteorological variables. Depending on the nature of the consequences and the nature of the impacts processes, these variables may be used directly, or secondary variables may be computed. For example, if the team is interested in the sensitivity of energy demand to climate change, a typical directly observed quantity might be daily maximum or minimum temperature, whereas heating or cooling degree-days are quantities that may be more relevant for capturing the relationship between climate and energy demand. Such quantities may need to be derived from primary climate data.

In many sectors and regions, there are already well-developed models and frameworks that describe system sensitivity. For example, there are a variety of crop models (physiology-based or empirical) that link crop yield and output to climate parameters. In many instances, detailed process models may be either unavailable, or too complex for inclusion in the assessment. In such cases, a variety of simpler techniques may be adopted, including empirical models based on analysis of historical data and events or models that look at simple climatic thresholds (e.g., the probability of drought). If it is difficult to implement even simple empirical approaches, an alternative might be to use expert opinion or examples from different, but related settings (e.g., similar countries) to develop understanding of the relationship between hazards, exposure and outcomes.

An important part of this activity is the identification of points of intervention, and options for response in the sequence leading from hazards to outcomes. Not only is this relevant for considering responses in the short-term, it is also important for the evaluation of future vulnerability (Activity 4). The evolution of vulnerability in the future depends quite critically on endogenous adaptation – planned or autonomous.

3.4.4. Activity 4: Assessing future vulnerability

The next activity in a vulnerability assessment is to develop a more qualitative understanding of the drivers of vulnerability, in order to better understand possible future vulnerability: "What shapes future exposure to climatic risks?" "At what scales?" This analysis links the present (snapshot) with pathways of the future, pathways that may lead to sustainable development or increased vulnerability through maladaptation.

This activity requires the analyst to consider ways in which planned and autonomous adaptation may modify the manner and mechanisms by which climate is a source of risk. For example, the gradual evolution of housing stock in a coastal region might alter future outcomes following a tropical cyclone. Similarly, the availability of flood insurance might alter the perceptions of households regarding risk, leading to increased development in flood-prone areas, and therefore to increased damage from the cyclone. In both of these cases, interventions lead to a change in the impacts associated with climate change.

Specific techniques that may be used for this purpose are likely to be qualitative in the first instance. Interactive exercises (such as cognitive mapping) among experts and stakeholders can help refine the initial vulnerability assessment framework (Activity 1) by suggesting linkages between the vulnerable groups, socio-institutional factors (e.g., social networks, regulation and governance), their resources and economic activities, and the kinds of threats (and opportunities) resulting from climatic variations. Thought experiments, case studies, in-depth semi-structured interviews, discourse analysis, and close dialogue are social science approaches that can be used in understanding the dynamics of vulnerability.

More formal techniques include cross-impact matrices, multi-attribute typologies such as the five capitals of sustainable livelihoods or the characteristics of adaptive capacity (TP7), and even quantitative approaches such as input-output models, household production functions and multi-agent social simulation. Before adopting specific quantitative analyses, a useful strategy is to start with exploratory charts and checklists, which can help identify priorities and gaps.

Extending the drivers of present socio-economic vulnerability to the future is typically based on a range of socio-economic scenarios (see TP6 for an in-depth discussion of socio-economic scenarios). Existing development scenarios are the best place to start. Are there projections for development targets? Or, are there sectoral scenarios that may be relevant, as in the visions created by the World Water Council[6]? Otherwise, stakeholder-led exercises in creating visions of the future (including worst-case fears) are worth pursuing (TP2).

Two technical issues need to be clarified in the vulnerability assessment at this stage:

- Most indicators are snapshots of present status, e.g., GDP per capita. However, vulnerability is dynamic and indicators that foreshadow future vulnerability may be useful. For example, future wealth may be correlated with literacy and governance and only weakly correlated with present rates of growth in GDP per capita.
- The common drivers of development need to be related to the target vulnerable groups. National and international trends, e.g., in population and income, may not map directly onto the nuances of marginalization, local land tenure, markets and poverty that characterise vulnerability. Shocks and surprises have disproportionate effects for the vulnerable – as in the macroeconomic failure in Argentina or the prolonged desiccation of the Sahel.

While we suggest that scenarios of future vulnerability are best developed at the local to national level, there are cogent reasons to

[6] See www.WorldWaterCouncil.org

place future socio-economic conditions of vulnerability in a regional to global context. The climate change policy community has its own points of reference (e.g., currently the emissions scenarios completed in Nakicenovic et al., 2000). The vulnerability assessment may benefit from coherence with such international scenarios, although it is methodologically incorrect to suggest that global socio-economic scenarios can be downscaled to local vulnerability – on theoretical, practical and empirical grounds.

Outputs of this activity are qualitative descriptions of the present structure of socio-economic vulnerability, future vulnerabilities and a revised set of vulnerability indicators that include future scenarios. Climate change overlays are included in this activity (TP5). The final activity brings together the indicators into a meaningful vulnerability assessment.

3.4.5. Activity 5: Linking vulnerability assessment outputs with adaptation policy

The outputs of a vulnerability assessment include:

- A description and analysis of present vulnerability, including representative vulnerable groups (for instance, specific livelihoods at risk of climatic hazards)
- Descriptions of potential vulnerabilities in the future, including an analysis of pathways that relate the present to the future;
- Comparison of vulnerability under different socio-economic conditions, climatic changes and adaptive responses;
- Identification of points and options for intervention, which can lead to formulation of adaptation responses.

The final activity is to relate the range of outputs to stakeholder decision-making, public awareness and further assessments. These topics are framed in the overall APF design and stakeholder strategy (TP1, Section 1.4.1 and TP2). Here we review technical issues regarding the representation of vulnerability. The guiding concern is to present useful information that is analytically sound and robust across the inherent uncertainties.

The first consideration is whether stakeholders and decision makers already have decision criteria that they apply to strategic and project analyses. For instance, the Millennium Development Goals (MDGs) may have been adopted in a development plan. If so, can the set of vulnerability indicators be related to the MDGs? Is there an existing map of development status that can be related to the indicators of climate vulnerability? It is always better to relate the climate change vulnerability assessment to

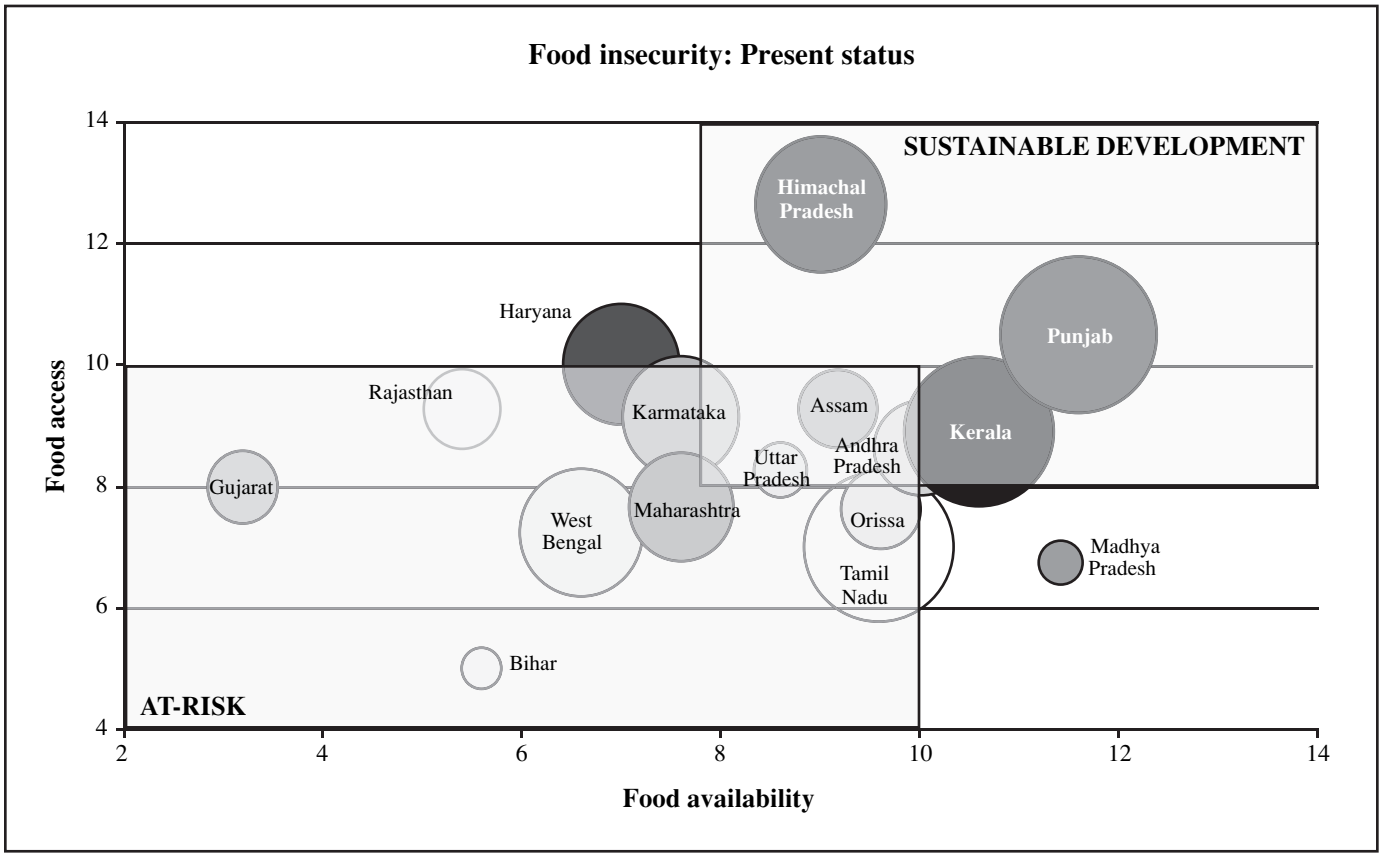

Figure 3-4: Rural food insecurity in India. Three dimensions of vulnerability are shown. Food availability (x-axis) is based on production indicators for each state. Food access (y-axis) aggregates indicators of market exchanges. The size of each bubble corresponds to indicators of nutritional status.
Source: MSSRF (2001).

existing frameworks, terminology and targets than to attempt to construct a new language solely for climate change issues.

Historically, a common approach has been to aggregate the individual indicators into an overall score, referred to as an index. For example, the Human Development Index (HDI) is a composite of five indicators, transformed into standard scores and differentially weighted (UNDP, 1999).

Do stakeholders have a formal multi-criteria framework that illuminates the choice of aggregation procedures and weights (TP8)? If so, an analogous aggregation of the vulnerability indicators data into an index may be informative for them. However, formal multi-criteria approaches are rarely generic and often contentious; the same is true for composite vulnerability indices. As a result, the use of such indices has to be done only with great caution.

A preferable device for communicating the vulnerability assessment is to use multi-attribute profiles. For example, Figure 3-4 plots the food security of states in India according to relative capacities for food production, food access and nutritional status. Many of the states would be considered food insecure. However, the structure of their vulnerability differs, and different adaptive measures are required.

Another aggregation technique is to cluster vulnerable groups (or regions) according to key indicators. For example, climatic risks might be related to different classes of vulnerability. Figure 3-5 suggests an approach that prioritises risks to sustainable livelihoods. More formal methods for clustering, such as principal Components analysis, are becoming more common as well (see Annex A.3.5 for an approach used by the World Food Programme).

The indicators in the vulnerability assessment can be used to evaluate adaptive strategies and measures (TP8). Vulnerability indicators have also been used as the baseline for monitoring development status (TP9). The technical team should consider how its outputs could be used over a longer term. A key recommendation is likely to be improved monitoring and collection of specific data on socio-economic vulnerability.

	Adaptive capacity	
Impacts	*Low*	*High*
High	Vulnerable Communities	Development Opportunities
Low	Residual Risks	Sustainability

Figure 3-5: Clustering climatic risks and present development. In Figure 3-5, the quadrants are clusters of our knowledge of anticipated impacts of climate change, and the capacity of livelihoods or regions to adapt to those impacts. The high-risk cluster is labelled vulnerable communities. If impacts are high but so is adaptive capacity, there should be development opportunities to reduce the climate change burden. However, if impacts are low but uncertain, there may well be residual risks if adaptive capacity is also low. (See Downing, T.E. (2003) for a global demonstration of the approach.)

The output should link to further steps in the APF. The focus on representative livelihoods and multiple scales of vulnerability can form the basis of an analysis of coping strategies. For instance, a multi-level assessment might include an inventory of household coping strategies and their effectiveness in different economic and climatic conditions, how local food markets might be affected by drought, and national contingency planning for drought (including food imports). A consistent analysis across these scales would inform a climate adaptation strategy with specific responsibilities for individual stakeholders (see TP8 for an in-depth discussion of adaptation strategy development).

Ultimately, the qualitative understanding of vulnerability can be developed as storylines that can be used in scenarios that describe future representative conditions (TP6, Section 6.4.6). These may be effective ways of communicating potential futures of concern. Communication methods are diverse; articles from future newspapers, radio documentaries and interviews can all be effective.

A final output might be to revisit the conceptual model (Activity 1). Are there new insights that need to be included? Does the monitoring plan capture the range of vulnerabilities and their drivers? Would the framework need to be altered to apply to different regions or vulnerable groups? Have the priorities for vulnerability assessment changed?

3.5. Conclusions

Performing the five activities outlined in this TP would lead to a substantial vulnerability assessment that could meet the objectives of APF Components 2, *Assessing current vulnerability* and 3, *Assessing future climate risks*, and provide key input to Component 4, *Formulating an adaptation strategy*. The primary output is a set of priorities for adaptation and a panel of indicators for evaluating adaptation options. Further details are available from related TPs on climatic risk (TPs 4 and 5), socio-economic conditions (TP6) and future scenarios (TPs 5 and 6). We emphasise that a vulnerability assessment is a learning experience – the activities identified here are guideposts rather than a sequence of steps to be followed mechanically.

This TP closes with a set of open questions and issues in vulnerability assessment which, we hope, will be informed and refined through studies that implement the APF, as well as the next generation of vulnerability and climate impact assessment studies.

How may vulnerability be quantified? As we have seen in this TP, vulnerability can be regarded as a property or characteristic of target groups, societies and systems, but also as the outcome of a climate or other hazard process. In one case, quantification may involve the use of indicators to describe the con-

dition of the system (e.g., development, infrastructure or poverty indicators), in the other, quantification may be done through the formulation and estimation of hazard-loss relationships (e.g., the dose-response relationships used in health assessments, or the damage functions in climate impact models). Both approaches have similarities – in either case – the user gains a deep understanding of the process through which hazards translate into negative outcomes or into a disaster. It is this understanding which is critical for creating effective adaptation interventions.

Isn't socio-economic vulnerability a product of many drivers and actors? We take the view that vulnerability – as a broad condition of resource use or development – is socially constructed (or negotiated). That is, vulnerability is not just the tail of a probability distribution; it is an essential aspect of social and economic systems. Thus, multi-actor perspectives that analyse stakeholder behaviour are essential. Such methodologies focus on understanding adaptive capacity and the means to implement climate adaptation strategies.

How does vulnerability relate to ecosystems? We prefer to use the word *sensitivity* to describe the effects of driving forces and perturbations on ecosystems and natural resources. It implies a distinction between the biophysical processes and effects, and the values that people place on those changes. Clearly, ecosystem services affect vulnerable livelihoods, so there is a direct link to vulnerability assessment.

Can we predict future vulnerability? Future vulnerability is determined by the co-evolution of a number of coupled processes – the underlying climate hazards, the exposure of target groups, sectors and societies to the hazard, and planned and autonomous adaptation. In many situations, prediction of this co-evolution may be difficult, if not impossible to do. A sobering example of the difficulties in predicting the full impacts of Hurricane Mitch, despite good vulnerability assessments, is described in Ziervogel et al. (2003). In such cases, scenarios could be used as a tool to illustrate changes in vulnerability and for reviewing policy responses. Modelling approaches need to address uncertainties, as well as the difficulties of representing the processes of perception, evaluation, response, implementation and path dependency.

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ANNEXES

Annex A.3.1. Vulnerability definitions and common usage

Definitions in use

The word vulnerability has many meanings. The User's Guidebook provides a definition developed by Kasperson et al. 2002. However, it is not the intention of the APF to impose its definitions on the wider research and policy communities concerned with climatic risks and climate change. This note summarises the main traditions in defining vulnerability and proposes a practical nomenclature. That is, it proposes a consistent terminology rather than force all authors and users to agree with a single definition.

It is essential for users to define vulnerability in their own context. The APF is meant to be useful to a wide set of users, and each will have their own views of what vulnerability is. Nevertheless, in their assessments, users need to make their definitions clear – at least to communicate among their project team and stakeholders. In many cases, those stakeholders have already formed a working definition of vulnerability. Use of those definitions may be preferable to the more arcane language sometimes adopted by the climate change community. Mainstreaming climate change means making our analyses relevant to existing decision frameworks.

Three traditions in defining vulnerability are hazards, poverty and climate change.

The longer tradition in defining vulnerability comes from ***natural hazards and epidemiology***. From this tradition, a common definition of vulnerability is:

> *The degree to which an exposure unit is susceptible to harm due to exposure, to a perturbation or stress, in conjunction with its ability (or lack thereof) to cope, recover, or fundamentally adapt (become a new system or become extinct).* (Kasperson et al. 2000)

The technical literature on disasters uses the term to mean:

> *Degree of loss (from 0% to 100%) resulting from a potential damaging phenomenon.* (UNDHA Glossary of terms)

The key aspect of these definitions is that vulnerability is distinguished from hazard – it is the underlying exposure to damaging shocks, perturbations or stresses, rather than the probability or projected incidence of those shocks themselves.

The ***poverty and development*** literature focus on present social, economic and political conditions. From this tradition, a common definition of vulnerability is:

> *An aggregate measure of human welfare that integrates environmental, social, economic and political exposure to a range of harmful perturbations.* (Bohle et al., 1994)

The important distinctions are: (1) vulnerability relates to social units (people) or systems rather than biophysical systems – which should be described as sensitive to stresses; (2) vulnerability integrates across a range of stresses (not just biophysical) and across the range of human capacities – not just food security, income or health.

In the field of ***climate change***, the IPCC promoted an alternative definition of vulnerability:

> *The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.* www.ipcc.ch/pub/syrgloss.pdf.

The important distinction of the IPCC view is that it integrates hazard, exposure, consequences (impacts) and adaptive capacity. This definition corresponds more closely to the notion of risk in the natural hazards (and other) literature. The difference is that risk assessments are largely based on a probabilistic understanding of the triggering event, a risk tree of contingent impacts, quantification of outcomes and multiple criteria analysis of responses. To date, the IPCC is far from this sort of methodology, preferring to begin with scenarios of climate change and primarily first-order impact analyses.

It should be noted that within the IPCC texts, vulnerability is used in all of the above ways – the official definition has not been established as a consensus among the contributing authors.

Suggested nomenclature for vulnerability definitions

If we accept that there are always going to be many and conflicting definitions of the word vulnerability, perhaps what is needed is a nomenclature – a way of systematically referring to vulnerability in typologies and analytical exercises. For example:

$$ {}^{T}V_{s,g}^{\ c} $$

Where:
T = threat
s = sector
g = group
c = consequence
E.g.: climate change vulnerability in agriculture for farmers' economic welfare

This nomenclature would results in examples such as:

- climate change vulnerability (T = climate change, no other terms specified)
- drought (T) vulnerability for food systems (s)
- drought (T) vulnerability for smallholder (g) agriculturalists (s)
- drought (T) vulnerability for smallholder (g) agriculturalists (s) at risk of starvation (c = health effects of reduced food intake)

The process of conducting a vulnerability assessment can be labelled vulnerability assessment.

If the indicators are mapped, this is extended to a vulnerability assessment map (VAM).

The database of indicators used in a vulnerability assessment (or VAM) can be labelled VI. Individual indicators (VI_X) might carry their own nomenclature, to specify:

t = time period (historical, present or specific projection)
g = group of people, if specific to a vulnerable population
r = region (or geographic pixel)
* = transformed indicators, as in standard scores

Annex A.3.2. Vulnerability concepts and frameworks[7]

The following material was developed as part of a training course on climate change vulnerability and adaptation for the Assessments of Impacts and Adaptations to Climate Change in Multiple Regions and Sectors (AIACC) project (see www.start.org for further details). The objectives of the small group exercise on vulnerability concepts were to:

- introduce the range of definitions of vulnerability
- look at range of methods in vulnerability assessment
- consider ways to apply vulnerability assessment in AIACC projects

The following "vulnerability diagrams", drawn from several studies, were used to brainstorm issues regarding the framing vulnerability in the context of climate change and using vulnerability frameworks in research projects. Other sessions covered vulnerability mapping, livelihood approaches, socio-economic scenarios and the use of indicators.

In the small group exercise, the strengths and weaknesses were left blank – to be filled in by the participants. Technical teams undertaking APF projects may find the exercise useful in providing some background to conceptualising vulnerability. No one framework is "best" – all have strengths as well as weaknesses.

Hazard	**:**	**potential threat to humans and their welfare**
+		
vulnerability	**:**	**exposure and susceptibility to losses**
=		
risk	**:**	**probability of hazard occurrence**
disaster	**:**	**realisation of a risk**

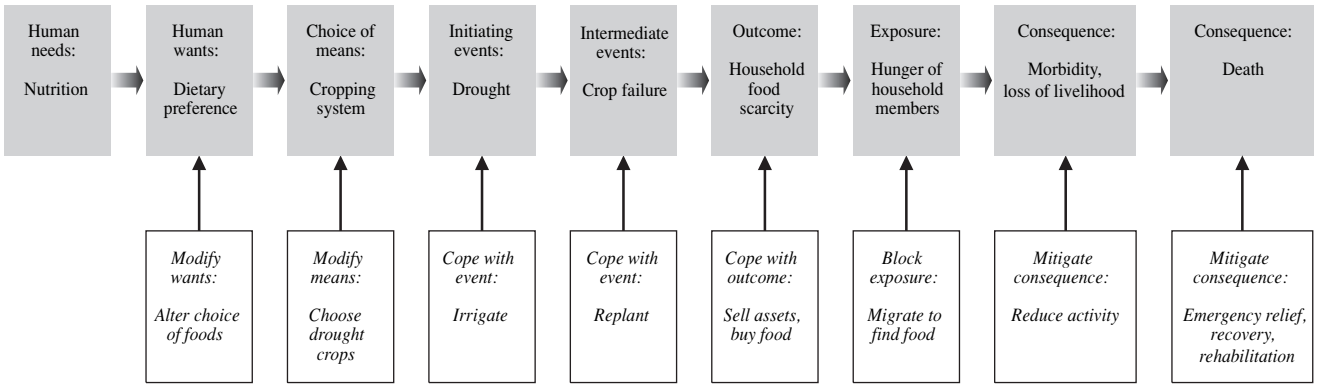
▲ ***Strengths:*** Simple, widely used, clear definitions of key terms

■ ***Weaknesses:*** Not very dynamic, doesn't show what causes vulnerability, vulnerability is limited to a hazard-loss equation

● ***Techniques:*** Indicators, loss equations

Figure A-3-2-1: Definitions of hazard, vulnerability, risk and disasters

[7] See the TP for the references.



Source: after Downing (1991); see also Millman and Kates (1990)

▲ ***Strengths:*** Sequence of the drivers of vulnerability, emphasis on upstream causes, explicit ways to reduce vulnerability, multiple consequences

■ ***Weaknesses:*** Too linear, no feedbacks between outcomes and earlier vulnerabilities, no sense of who chooses options to modify the vulnerabilities, limited environmental forcing to only one place in the sequence

● ***Techniques:*** Linked models, e.g., food systems and crop model, indicators

Figure A-3-2-2: Causal chain of hazard development

RESOURCES	VULNERABILITY	CAPABILITY
Physical/material		
Social/organisational		
Motivational/attitudinal		

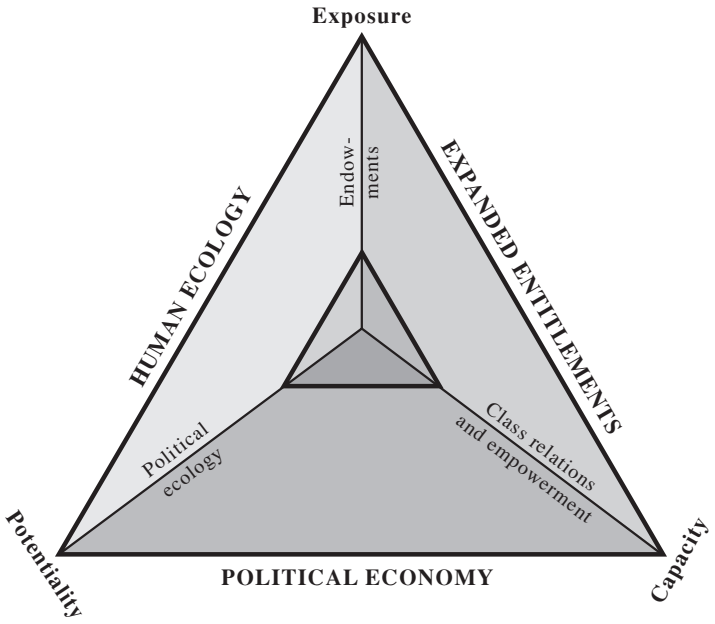
Source: Anderson and Woodrow (1989)

▲ ***Strengths:*** Simple, flexible, brings in local knowledge, shows capability and opportunities, not just physical, includes social capital, intended for rapid use during disasters

■ ***Weaknesses:*** Nothing filled in, no sense of what the major issues are, not clear it would help identify vulnerable groups on its own, no drivers or assessment of future risks

● ***Techniques:*** Surveys, expert judgement and key informants

Figure A-3-2-3: Vulnerability and capability



▲ ***Strengths:*** Leads to complex and comprehensive typology of what vulnerability is, the major drivers, brings in socio-institutional factors – economic class, political ecology, triangle implies more than one dimension of vulnerability and the need to locate vulnerable groups according to different causes

■ ***Weaknesses:*** Academic, using words not in common usage, three dimensions are not orthogonal—hard to convert to an analytical method, what does the shaded centre mean?

● ***Techniques:*** Indicators, descriptive analysis

Source: after Bohle et al. (1994)

Figure A-3-2-4: Three dimensions of vulnerability

PROGRESSION OF VULNERABILITY

ROOT CAUSES ➡	DYNAMIC PRESSURES ➡	UNSAFE CONDITIONS	➡ DISASTERS ⬅	HAZARDS
Limited access to	**Lack of**	**Fragile physical environment**		**Earthquake**
Resources	Institutions	Dangerous locations	**RISK**	
Structures	Training	Unprotected structures		**Wind storm**
Power	Skills		=	
	Investment	**Fragile local economy**		**Flooding**
Ideologies	Markets	Livelihoods at risk	**HAZARD**	
Political systems	Press freedom	Low income		**Volcano**
Economic systems	Civil society		+	
		Vulnerable society		**Landslide**
	Macro-forces	Groups at risk	**VULNER-**	
		Little capacity to cope	**ABILITY**	**Drought**
	Population growth			
	Urbanisation			**Virus and pest**
	Arms expenditure	**Public actions**		
	Debt repayment	Lack of preparedness		**Heat-wave**
	Deforestation	Endemic disease		
	Soil degradation			

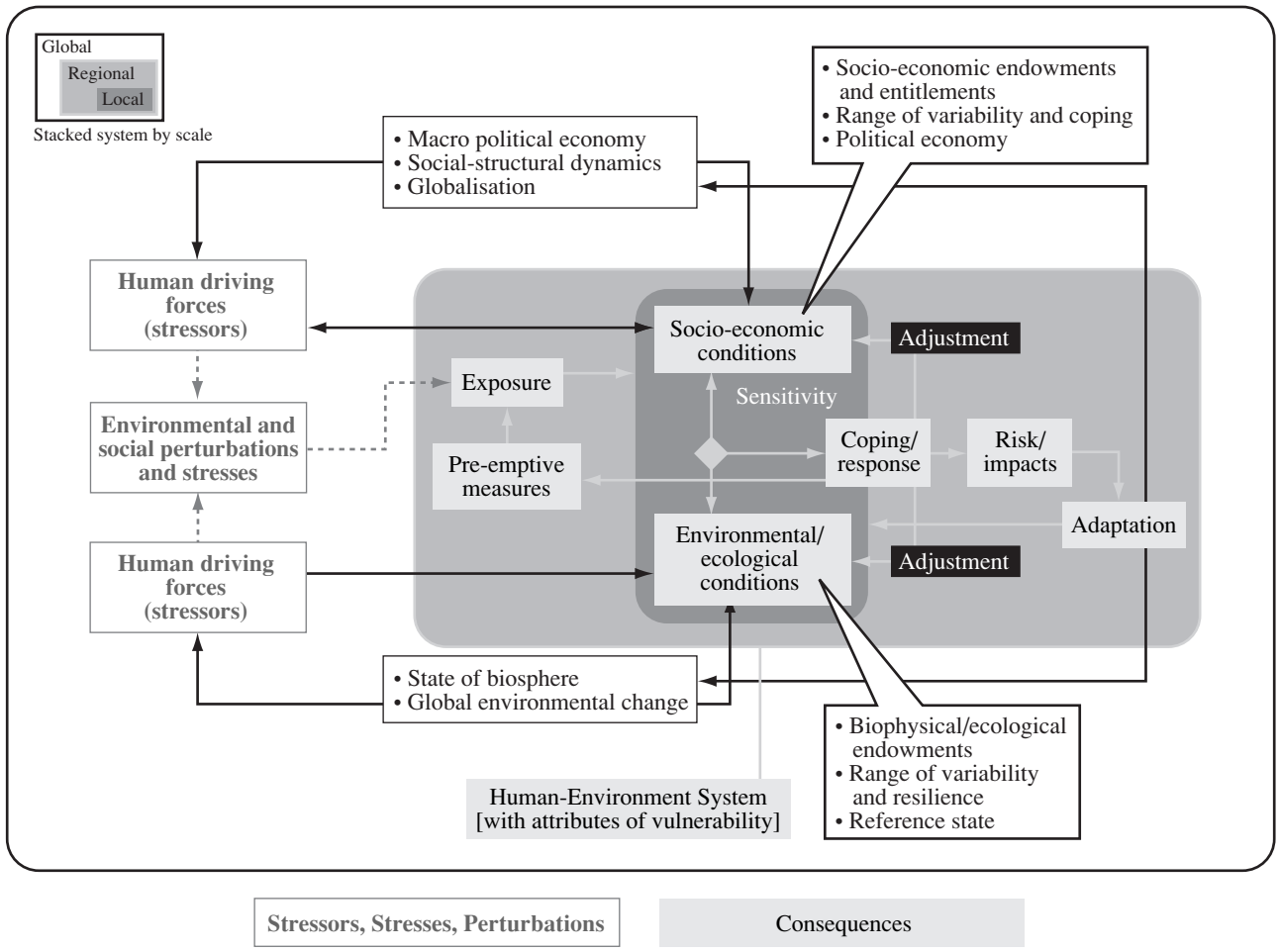
Source: Blaikie et al. (1994)

▲ ***Strengths:*** Detail on causes, comprehensive, understandable

■ ***Weaknesses:*** More descriptive than analytical

● ***Techniques:*** Inventories, indicators

Figure A-3-2-5: Structure of vulnerability and disasters



Source: Kasperson, et al. (2002)

▲ ***Strengths:*** Comprehensive, with relevant boxes, three scales are important, understandable to systems analysts (such as ecologists)

■ ***Weaknesses:*** Not clear how the dynamics at the local scale (sensitivity, adjustment, coping/response) are linked to the larger scales, would need additional material to implement

● ***Techniques:*** Dynamic simulation, choice of indicators

Figure A-3-2-6: Environmental vulnerability

Annex A.3.3. Illustrative planning steps in vulnerability assessment for climate adaptation

The following charts illustrate the process of planning and implementing a vulnerability assessment for climate adaptation. This illustration is not a protocol – it does not include all of the possible choices and methods. Rather, it illustrates the five tasks outlined in the technical paper with specific choices and pathways through planning a project.

In the diagrams, a solid arrow indicates a positive result (Yes). A dotted arrow indicates alternative approaches in the absence of previous information (No). The outputs on the right side of the diagrams link from top to bottom. In fact, not all of the potential linkages are shown. Most importantly, the process is almost certain to be iterative. Tasks feed back to the scoping and data activities with further refinement of the information available and required.

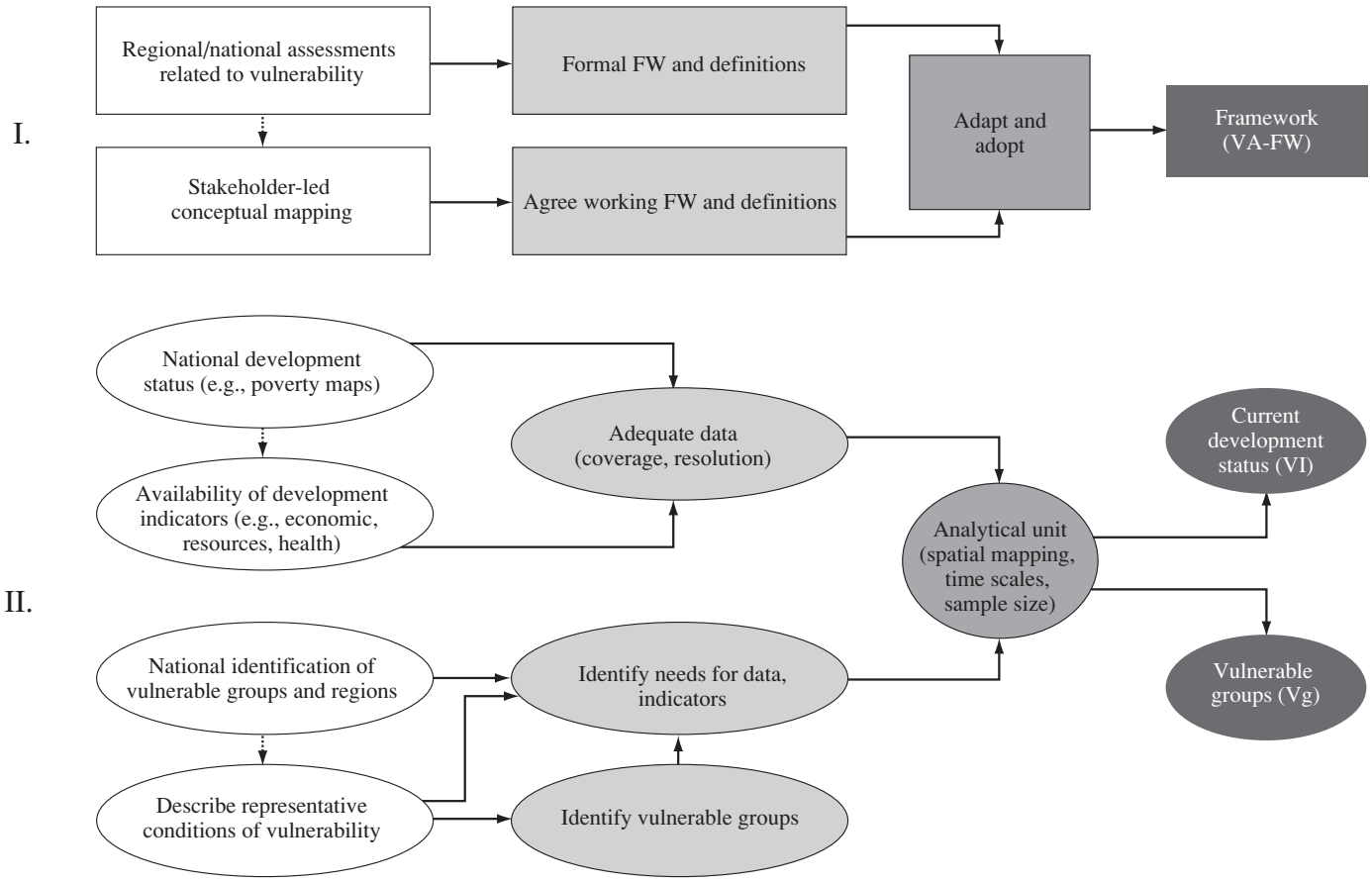
Panes I and II show the first two activities. Scoping the technical details of the vulnerability assessment begins with a review of existing frameworks in use by national planners. If the existing development plans, poverty assessments, strategic environmental plans, etc., are not adequate for framing the climate vulnerability assessment, then a stakeholder-led exercise in conceptual mapping is helpful.

Panes I and II also show choices in compiling a database of indicators, initially of development conditions. This activity also identifies the vulnerable groups that are to be the target of the assessment. Thus, a two-level approach is recommended.

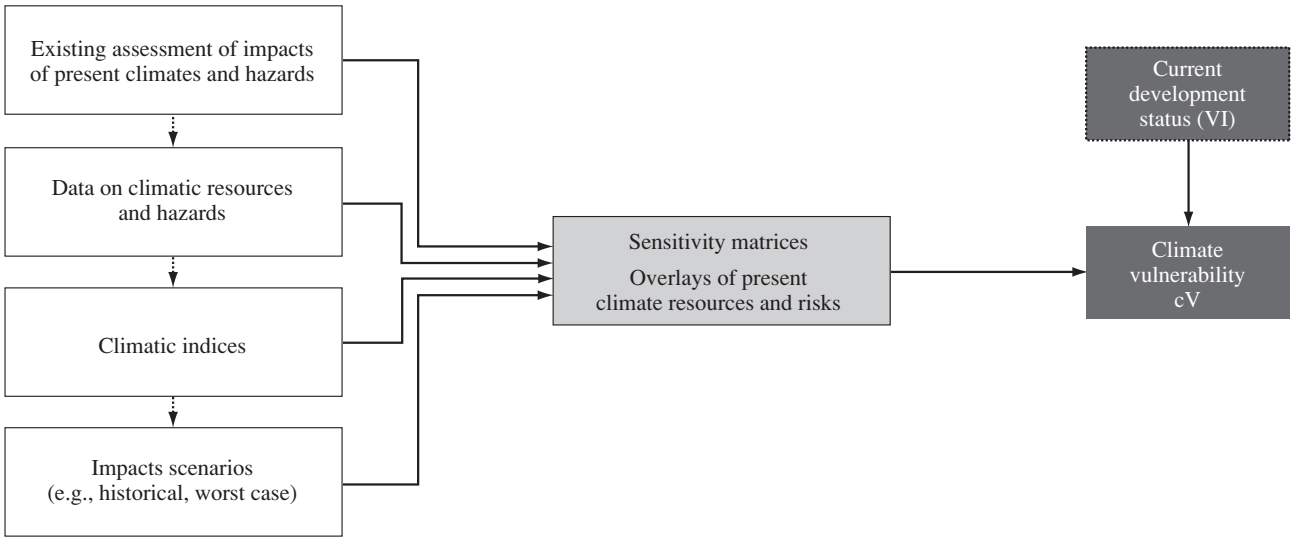
Panes III and IV show choices in characterising present climate risks, resulting in a climate vulnerability assessment. With the addition of scenarios of future socio-economic conditions, the set of vulnerability indicators (VI), the descriptions of their drivers and relationships to specific socio-economic groups (or vulnerable livelihoods) become the data engine for the vulnerability assessment.

Panes V and VI add in characterisations of future climate risks. This is not treated in detail in the diagram. Essentially the same choices as for activity 3 are appropriate.

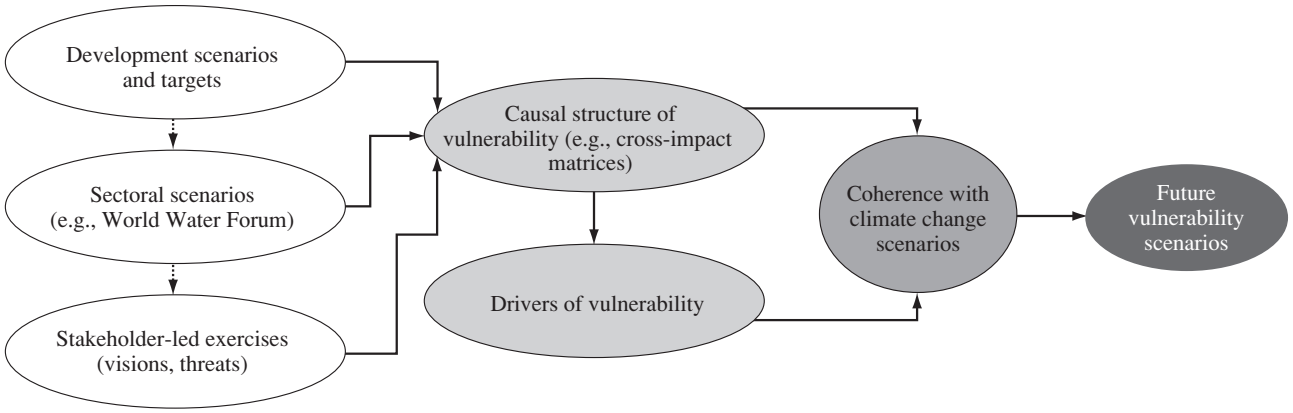
The output of the vulnerability assessment requires some attention. It should be part of the scoping process – linking the vulnerability assessment data with stakeholder decision-making, identification and evaluation of adaptation strategies and the requirements for implementing adaptation policy.



III.


Existing assessment of impacts of present climates and hazards
Data on climatic resources and hazards
Climatic indices
Impacts scenarios (e.g., historical, worst case)
Sensitivity matrices
Overlays of present climate resources and risks
Current development status (VI)
Climate vulnerability cV

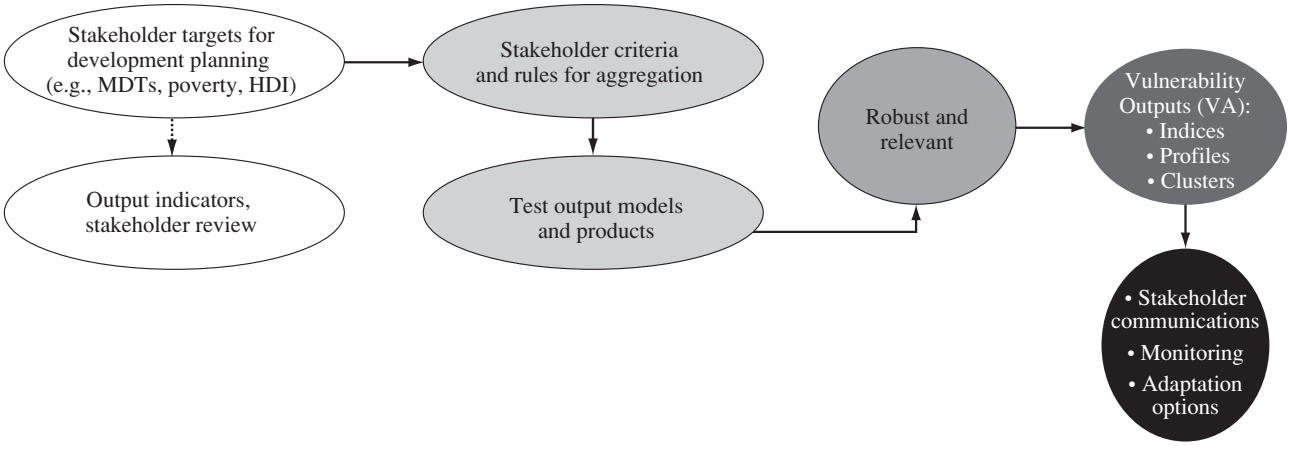
IV.


Development scenarios and targets
Sectoral scenarios (e.g., World Water Forum)
Stakeholder-led exercises (visions, threats)
Causal structure of vulnerability (e.g., cross-impact matrices)
Drivers of vulnerability
Coherence with climate change scenarios
Future vulnerability scenarios

V.


Scenarios and probability distributions of future climates and impacts
Future climate vulnerability cV

VI.


Stakeholder targets for development planning (e.g., MDTs, poverty, HDI)
Output indicators, stakeholder review
Stakeholder criteria and rules for aggregation
Test output models and products
Robust and relevant
Vulnerability Outputs (VA):
• Indices
• Profiles
• Clusters
• Stakeholder communications
• Monitoring
• Adaptation options

Annex A.3.4. Vulnerability methodologies and toolkit

Introduction

To gain an understanding of climate vulnerability and adaptation, four kinds of studies are appropriate:

- What if (WIf) studies are often the starting place for raising awareness among a wide variety of audiences about potential sensitivity to climate change.
- Vulnerability assessments and sustainable livelihood (VASL) approaches begin with present risks, and overlay climate change through a guided process of risk assessment.
- A focus on stakeholders and their decision-making regarding threats and opportunities (STO) leads to strategies for adapting to climate change over a range of planning periods.
- Where specific decisions need to be made, processes for evaluating additional climatic risks have been formulated in climate impacts management (CIM) studies.

For each approach, a different set of techniques is appropriate. The VASL approach is the most common. Below we describe this approach, and then we list a range of techniques for vulnerability and adaptation assessment. An expanded version of this toolkit is available, including a checklist for matching different project design criteria to the choice of methods, flow charts of common vulnerability approaches, and a set of icons for users to build their own flow charts.[8]

Vulnerability assessment and sustainable livelihoods

Vulnerability mapping begins with a snapshot of the present situation – whether applied to a specific hazard (e.g., hurricanes), generic disaster risks or poverty. In this approach, climate risks – both present and future – are placed in context of present vulnerability. Further elaboration provides indications of relative risks and strategies to support sustainable livelihoods.

The approach includes:

- Vulnerability mapping: ideally starting with the concepts and assessments conducted in the course of hazard management or development planning. An increasing number of such exercises have been conducted, providing a good starting place for climate change studies.
- Relating livelihoods to their exposure to risks. Often vulnerability maps do not explicitly recognise livelihoods – the exposure of specific populations to threats and opportunities. Once identified, a matrix of their exposure to development and climate risks helps to focus on the most sensitive livelihoods and those threats that can be managed.
- Description of coping strategies for the identified livelihoods. A qualitative assessment, through interviews, secondary literature, focus groups, workshops, etc., will provide a rich context for considering the relative risks of climatic variations and potential response strategies.
- For selected livelihoods and risks, quantitative models can be constructed – following the approach that Jones terms "coping ranges" (TP4) or more dynamic decision models (as in agent-based systems).
- The qualitative and quantitative assessments can be tested against a range of scenarios of the future (including socio-institutional changes as well as climatic risks).
- It may be desirable to relate the scenario exercises to the initial vulnerability assessment. This might be simply looking at overlays of the present vulnerability and future risks. However, developing innovative techniques to deal with spatial data and relatively long time frames would be worth pursuing.

The main output of this approach should be a relatively robust presentation of present vulnerability and scenarios of future risk, accompanied by a rich understanding of coping strategies for different livelihoods. The integration of climate risk in development planning is a main goal; adopting existing development frameworks and concepts is a key strength.

The toolkit

The key analytical tools are vulnerability mapping and dynamic simulation of sustainable livelihoods. However, the broader techniques of stakeholder participation and risk assessment are essential.

The following table suggests further tools that may be important, with an indication of their suitability according to the following criteria:

1. **Present vulnerability** – including development policy
2. **Problem definition** – scoping of issues and options to be included in analysis and design of projects
3. **Development futures** – pathways of future development
4. **Evaluation of adaptation** – to aid decision-making between specific measures and the selection of options
5. **Strategic planning** – consideration of alternative futures, including cross-sectoral and regional issues
6. **Multi-stakeholder analysis** – analysis of individual stakeholders within an institutional context
7. **Stakeholder participation** – whether stakeholders can readily participate in the application of the tool

[8] The spreadsheet, ClimateScoping.xls, can be found on www.vulnerabilitynet.org in the document hotel.

Table A-3-4-1: *Toolkit for vulnerability/adaptation assessments* [9]

Applications / Tools	Present vulnerability	Problem definition	Development futures	Evaluation of adaptation	Strategic planning	Multi-stakeholder analysis	Stakeholder participation
1. Agent-based simulation modelling			X		?	X	?
2. Bayesian analysis				X			
3. Brainstorming	X	X	X	X	X	X	X
4. Checklists/multiple attributes	X			X		X	X
5. Cost-effectiveness			X	X			
6. Cross-impact analysis			X	X			
7. Decision conferencing			X	X			
8. Decision/probability trees				X			
9. Delphi technique	X		X	X		?	?
10. (Strategic) environmental impact assessment			X	X	X		?
11. Expert judgment	X	X	X	X	X	X	
12. Focus groups	X	?	X	?		?	X
13. Indicators/mapping	X		?			?	?
14. Influence diagrams/mapping tools	X		X		X		X
15. Monte Carlo analysis				X			
16. Multi-criterion analysis				X			
17. Ranking/dominance analysis/ pairwise comparisons	X		X	X			X
18. Risk analysis			?	X			
19. Scenario analysis	?	?	X	?	X	X	X
20. Sensitivity/robustness analysis			X	X			
21. Stakeholder consultation	X	X	X	X		X	X
22. Stakeholder Thematic Networks	X	?	X		?	X	
23. Uncertainty radial charts				X			
24. Vulnerability profiles	X	?	?			X	X

Tool Annotations

1. **Agent-based simulation modelling** – formalism of agents and their interactions at multiple levels
2. **Bayesian analysis** – used to reassess probabilistic data in light of new data; statistical analysis
3. **Brainstorming** – free flowing lists/diagrams of all ideas and options
4. **Checklists** – matrix
5. **Cost-effectiveness/ cost-benefit/ expected value** – econometric techniques
6. **Cross-impact analysis** – used to test robustness of risk assessment and dependencies between events
7. **Decision conferencing** – quantitative analysis of options incorporating the uncertainties in interactive modes
8. **Decision/probability trees** – charts of relationships between decision modes; helpful for generating expected value
9. **Delphi technique** – range of views of experts through iterative written correspondence
10. **(Strategic) environmental impact assessments** – environ-

[9] In the table above, "**X**" indicates that a tool is appropriate for the application in question, whereas, "**?**" indicates that it may be appropriate.

mental impacts taken into account before deciding on development

11. **Expert judgment** – the assessment of experts in the field on specific propositions
12. **Focus groups** – groups of stakeholders that discuss their opinions on certain topics
13. **Indicators/mapping** – compilation of indicators into aggregate indices, often mapped
14. **Influence diagrams/mapping tools** – graphic identification of options when there are a number of decisions
15. **Monte Carlo analysis** – computer based analysis that explicitly assesses uncertainty
16. **Multi-criterion analysis** – scoring and weighting of options using indicators and more than one decision criteria
17. **Ranking/dominance analysis/pairwise comparisons** – preference of options
18. **Risk analysis** – approaches to decision uncertainty including hedging and flexing, regret, minimax and maximin
19. **Scenario analysis** – fuller picture of implications of uncertainty gained through simultaneous variation of key uncertainties
20. **Sensitivity analysis/robustness analysis** – identification of variables contributing most to uncertainty
21. **Stakeholder consultation** – consultation with individuals and/or groups affected by future processes
22. **Stakeholder Thematic Networks** (STN) – mapping of the key actors and their interactions
23. **Uncertainty radial charts** – assessment of the potential uncertainty of options
24. **Vulnerability profiles** – mapping of the different indicators of vulnerability for different groups

Annex A.3.5. Vulnerability to food insecurity in Kenya

Source: Haan, N., Farmer, G. and Wheeler, R. (2001). *Chronic Vulnerability to Food Insecurity in Kenya*. A WFP Pilot Study for Improving Vulnerability Analysis.

The World Food Programme (WFP) has developed the Standard Analytical Framework (SAF), based on a clear conceptual framework of food insecurity. National assessments begin with a literature review to understand contextual issues, enable the study to build from previous research and identify relevant indicators and data needs.

In Kenya, the secondary data analysis sought to identify relative differences in vulnerability to food insecurity between districts and to characterise contributing factors to vulnerability at the district level and prioritise districts for subsequent community-based analysis. (Figure A-3-5-1) A variety of data sets and

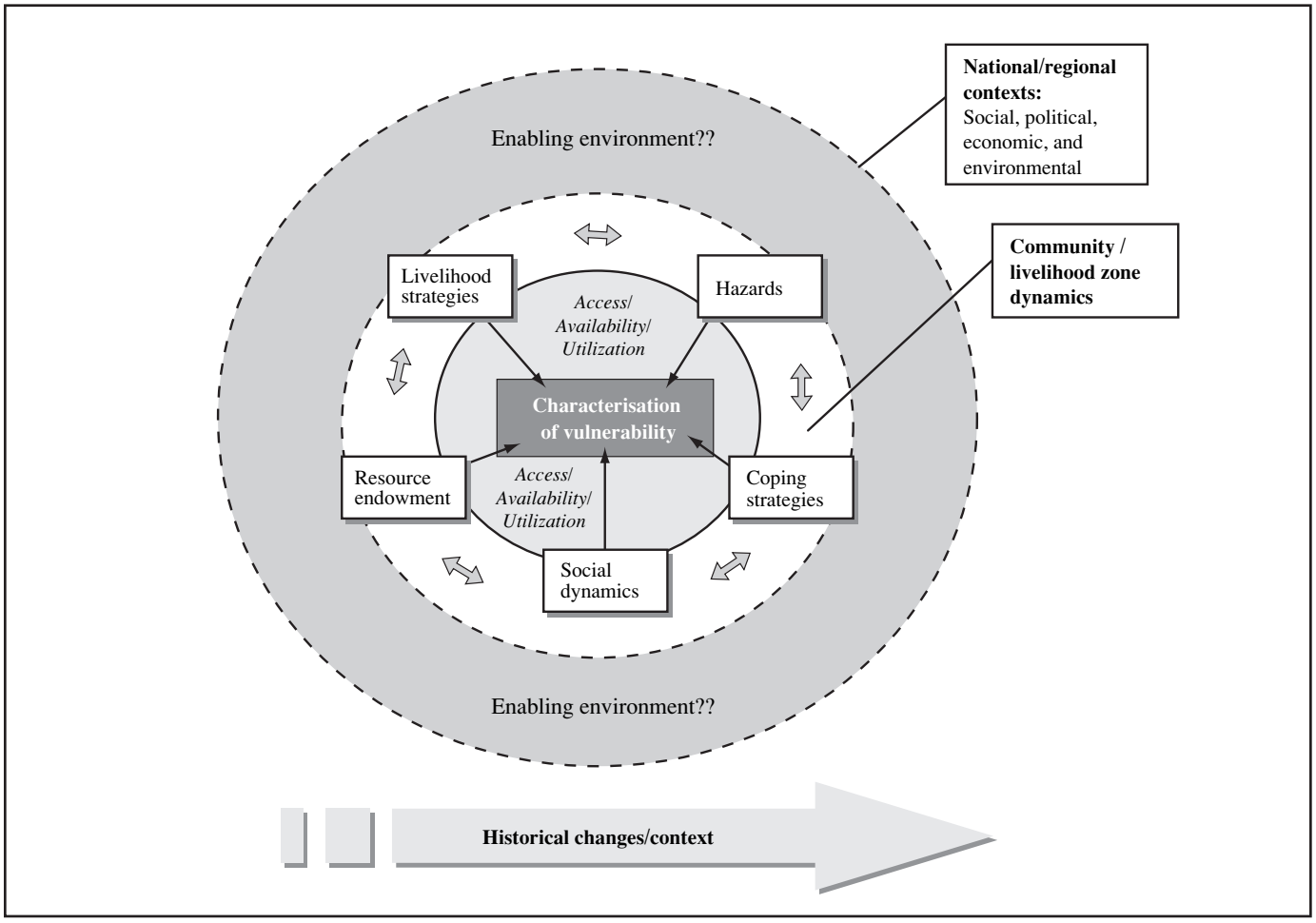


Figure A-3-5-1: Conceptual framework for characterising vulnerability to food insecurity

techniques were employed, allowing for verification of results and a mixture of interpretations. The Geographic Information System mapped 18 variables at the district level: life expectancy, adult literacy, stunting, wasting, livelihood diversification, access to safe water, livelihood fishing, high potential land, mean vegetation condition variation and persistence (using the NDVI), education, gender development, non-agricultural income, proximity to markets, HIV/AIDS incidence, and civil insecurity.

Two techniques were utilised to aggregate the indicators. A deductive approach used Z-Scores (not shown here). The inductive approach used Principal Components Analysis (PCA) and clustering where the raw data for each district were statistically grouped into clusters of districts with similar characteristics, and then interpreted for relative vulnerability.

The PCA (Figure A-3-5-2) indicates highest levels of vulnerability in the arid and semi-arid districts of northern Kenya. The clustering technique shows groups of similar districts (in terms of food security). This PCA and clustering (Figure A-3-5-3) is helpful to understand some of the dynamics of food insecurity. For example, Cluster 1 is strongly and negatively associated with food insecurity characterised by: low adult literacy rates, high wasting, low non-farm income, low market access, low NDVI mean, high annual variance of NDVI, high civil insecurity, and low HIV/AIDS.

The community-based analysis, called Participatory Vulnerability Profiles (PVP), covered 79 villages stratified by livelihood zones in 12 districts selected based on the SDA results and key informant discussions. The goals of the PVP were to: describe relatively homogenous livelihood zones, verify and further disaggregate results of the SDA, characterise community vulnerabilities to food insecurity, characterise and identify proportions of more vulnerable populations, identify both community-level and macro, or structural causes of food insecurity, and identify intervention opportunities.

An important emphasis of the PVP methodology was the direct links between the conceptual framework and the field techniques, enabling the field researchers to better understand the reasons for asking questions in the field. Districts were selected to represent each of the clusters from the national analysis. The field teams, in consultation with district officials, created livelihood zones (LZs) within each district (Figure A-3-5-4). The definition of LZs as used in this study is: *a relatively homogenous area with regard to four variables including main food sources, main income sources, hazards, and socio-cultural dynamics*. The creation of LZs allows the research to sample only a few villages within a large area and make a statement about the whole area. The third layer of sampling was within each community, and involved focus group interviews with various social groups, including the "typical group", the "most vulnerable", women, community leaders, and a mixed representative group.

The analysis revealed broad similarities between the district analysis and the detailed understanding by livelihood zones. Implications of hazards, coping strategies, social dynamics and health on food insecurity led to specific recommendations.

For example, one of the main hazards throughout the most vulnerable districts is drought, which is reportedly occurring more frequently. The relative drought risk by livelihood zone shows variation even within the more vulnerable districts (Figure A-3-5-5).

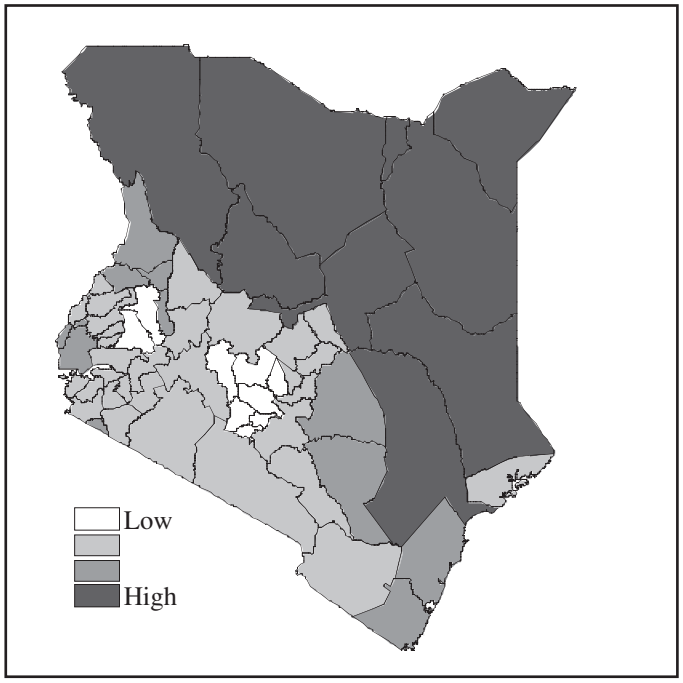


Figure A-3-5-2: Inductive approach: PCA and clustering relative vulnerability to chronic food insecurity

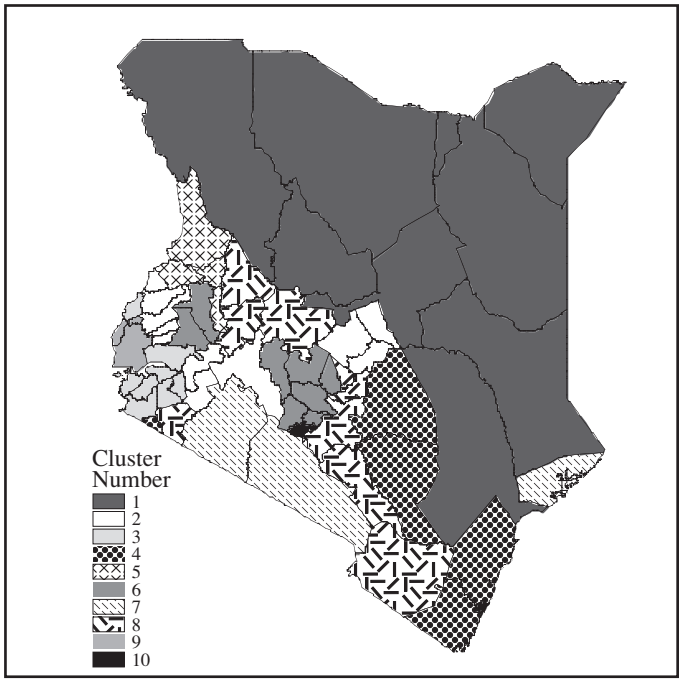


Figure A-3-5-3: Clusters of similar districts from PCA analysis of 18 variables

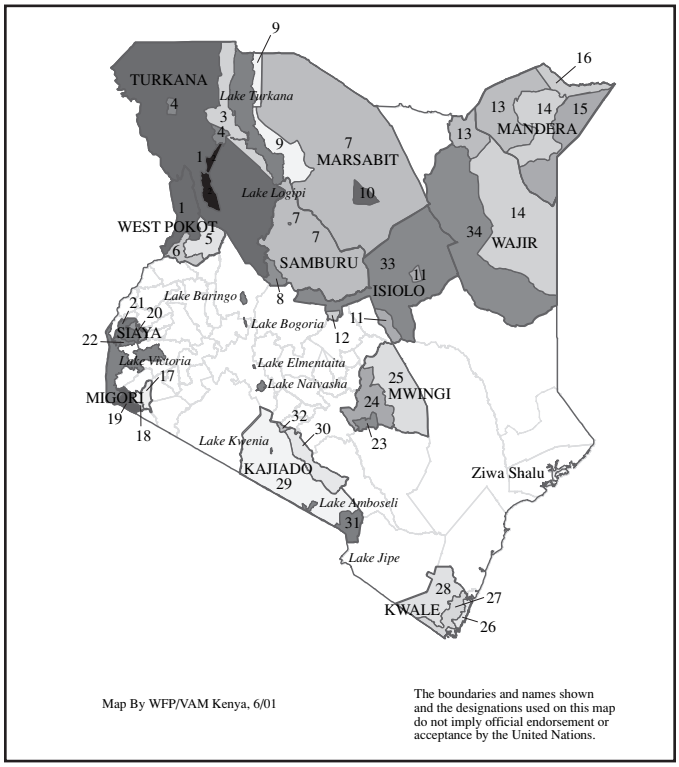


Figure A-3-5-4: Livelihood zones

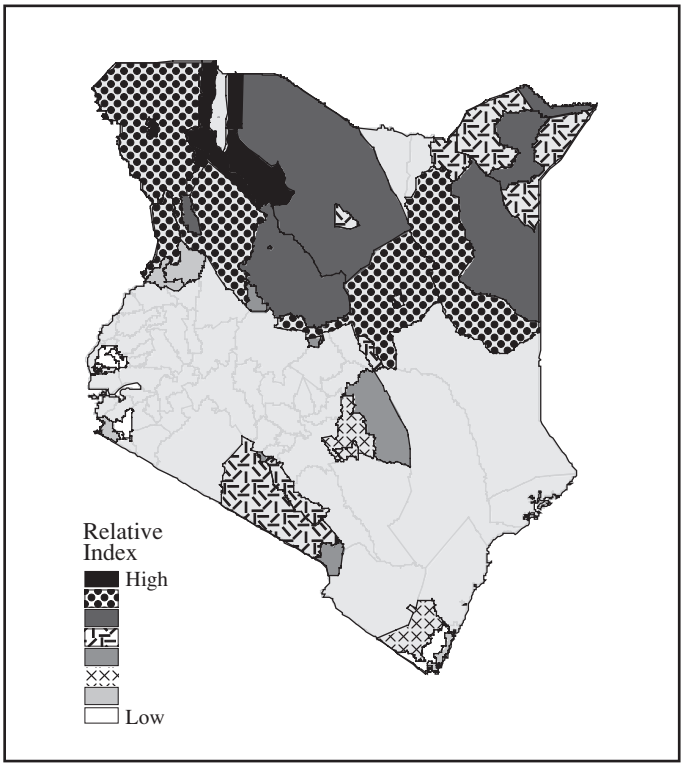


Figure A-3-5-5: Relative drought risk by livelihood zone