On behalf of:

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

of the Federal Republic of Germany

Published by:

ponre Viet Nam

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Strategic Mainstreaming of Ecosystem-based Adaptation in Vietnam: Vulnerability Assessment for Ecosystem-based Adaptation

Report 1

OVERALL APPROACH: VULNERABILITY ASSESSMENT FOR SOCIO-ECOLOGICAL SYSTEMS

icem A study by ICEM

Imprint

Published by
Institute of Strategy and Policy on Natural Resources and Environment (ISPONRE)
479 Hoang Quoc Viet Street, Hanoi, Vietnam
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I http://isponre.gov.vn

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On behalf of
The Vietnamese Ministry of Natural Resources and Environment (MONRE)
The German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB)

GIZ and ISPONRE are responsible for the content of this publication

Vietnam, December 2016

Abbreviations

ADB	Asian Development Bank
ARCC	Ares Capital Corporation
CVCA	Climate Vulnerability and Capacity Assessment
CCA	Climate Change Adaptation
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CBD	Convention on Biological Diversity
CAM	Climate Change Adaption and Mitigation Methodology
CREATE	Climate Resilience Evaluation for Adaptation through Empowerment
CRiSTAL	Community-based Risk Screening tool-Adaptation and Livelihoods
EURAC	European Academy of Bozen/Bolzano
EbA	Ecosystem-based Adaptation
GIZ	Gesellschaft für Internationale Zusammenarbeit
ISPONRE	Institute of Strategy and Policy on Natural Resources and Environment
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IISD	International Institute for Sustainable Development
ICEM	International Centre for Environmental Management
KEA	Key Economic Asset
LMB	Lower Mekong Basin
MRC	Mekong River Commission
SEZ	Special Economic Zone
PES	Payment for Environmental Service
PLI	Promoting Local Innovation
PRA	Participatory rural appraisal
PROVIA	Programme of Research on Climate Change Vulnerability, Impacts & Adaptation
SES	Socio-Ecological System
TOR	Term of Reference
TESSA	Tools for Eco-system Services site-based Assessment
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
UKCIP	United Kingdom Climate Impacts Programme
VA	Vulnerability Assessment
VASES	Vulnerability Assessment for Socio-Ecological System
WWF	World Wild Fund for Nature

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Glossary of terms used in the assessment

Adaptive capacity is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (GIZ 2013: 2). Adaptive capacity is also understood in terms of the ability to prepare for a future threat and in the process increase resilience and the ability to recover from the impact (ICEM).

Climate Change: Changes in climate over a prolonged time. The IPCC (2011) defines climate change as a change caused by natural internal processes or external forcings, or by persistent anthropogenic changes in the composition of the atmosphere or land use. This definition differs slightly from the UNFCCC definition which only focuses on anthropogenic change referring to climate change as a change of climate that is directly or indirectly caused by anthropogenic forces altering the composition of the atmosphere; and which is in addition to natural climate change. Climate change includes the observed and projected increases or decreases in regional and local temperatures, changes in timing and amount of rainfall, sea level rise etc. (ISPONRE, DONRE, WWF, 2013b).

An **ecosystem** is a dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit. Humans are an integral part of ecosystems (MEA 1 2003, 3).

Ecosystem-based adaption (EbA) is the use of biodiversity and ecosystem services as part of an overall adaption strategy to help people to adapt to the adverse effects of climate change (Convention on Biological Diversity 2009).

Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits. (MEA 2003, 3)

Exposure is the degree of climate stress on a particular system or species; it is influenced by long-term changes in climate conditions, and by changes in climate variability, including the magnitude and frequency of extreme events (ICEM).

Sensitivity is the degree to which a species or system will be affected by, or responsive to climate change exposure (ICEM).

A **social-ecological** or **socio-ecological system** consists of 'a bio-geo-physical' unit and its associated social actors and institutions. Socio-ecological systems are complex and adaptive and delimited by spatial or functional boundaries surrounding particular ecosystems and their problem context (ICEM).

Climate change **impact** (or level of risk) is a function of the level of **exposure** to climate change induced threats, and the sensitivity of the target assets or system to that exposure (ICEM).

A **climate impact chain** is a general representation of how a given climate stimulus propagates through a system of interest via the direct and indirect impacts it entails. (CIGRASP)

Multi Criteria Analysis (MCA): A structured approach used to determine overall preferences among different alternative options, where the options accomplish several objectives that may not always complement one another (Department for communities and local government, London 2009). In MCA, desired objectives are specified and corresponding attributes or indicators are identified. The measurement of these indicators is often based on a quantitative analysis (through scoring, ranking, and weighting) of a wide range of qualitative impact categories and criteria. (ISPONRE, DONRE, WWF, 2013a)

Natural farming systems are defined here as the harvesting and use of wild plant and animal species that were once widely distributed throughout the region, and which are now restricted to forested areas both within and outside protected areas. Natural wetland areas are included in this definition. Natural farming systems are closely integrated with other forms of traditional farming systems, providing a range of livelihood activities that complement crop cultivation, livestock husbandry and small scale aquaculture (ICEM).

Non-Timber Forest Products (NTFPs) includes all the materials collected from natural or man-made forests and riverine habitats and used to support local livelihoods. NTFPs include items such as forest and aquatic vegetables, fruit, traditional medicine products, wild animals and aquatic organisms such as fish, molluscs, insects and crustaceans. While the term NTFP implies non-timber items, it does include wood products for home construction, fuel wood and charcoal and handicraft products.[1]

Crop Wild Relatives (CWRs) by comparison are often forgotten by all except the agricultural crop researchers. They do not necessarily have an economic or even subsistence value as do NTFPs. Their importance is as a source of genetic materials for the improvement of existing crops, including the development of resistance to disease and extremes of temperature and drought. CWRs exist side by side with NTFPs in forests and in small patches of unused land.

The region also has a wide range of **landraces** and relatives of many economic plants which are well-known as the region's exports in the world market, for example, durian, mangosteen, rambutan, jackfruit, and mango. A landrace is a local variety of a domesticated animal or plant species which has developed largely by natural processes, by adaptation to the natural and cultural environment in which it lives. It differs from a formal breed which has been selectively bred deliberately to conform to a particular formal, purebreed standard of traits. Landraces are usually more genetically and physically diverse than formal breeds.

Vulnerability describes the degree to which a system is susceptible to, and 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 change and variation to which a system is exposed, its sensitivity, and its adaptive capacity (Parry et al. 2007 (IPCC). It is a function of the character, magnitude, and

[1] NAFRI, NUoL, SNV (2007) Non-timber forest products in the Lao PDR. A manual of 100 commercial and traditional products. The National Agriculture and Forestry Research Institute, Vientiane, Lao PDR. Quoting Mollot et al (2004)

rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity. (GIZ 2013: 2).

Vulnerability assessments are methods that measure the vulnerability of an exposure unit or system, e.g. the vulnerability of a community or a natural system like watersheds or ecosystems. Vulnerability assessments identify, quantify and prioritize the vulnerabilities of that system. In general, it is possible to distinguish between top-down vulnerability assessments approaches and bottom-up approaches. In integrated approaches elements of both top-down and bottom-up are combined to complement each other. (GIZ 2013: 2). In this particular project we are using Socio-Ecological Systems as the basic unit on which Vulnerability Assessments are conducted.

I. Introduction

1. Ecosystem-based Adaptation

1. As the world increasingly recognizes the threats that increased climate variability and climate change pose to both human societies and to the ecosystems that support those societies, many are searching for and testing out a range of possible adaptation options. Healthy and well-functioning ecosystems are widely acknowledged to provide society with key services that enhance natural resilience to the adverse impacts of climate change and reduce the vulnerability of people, their livelihood and economic activities, and their built infrastructure, and thus a strong interest has developed in Ecosystem-based Adaptation (EbA).

2. EbA is defined as "the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change" (Secretariat of CBD, 2009).

3. EbA offers an additional or alternative set of possibilities to replace or complement conventional approaches to climate change adaptation that usually rely on hard infrastructure and traditional engineering such as seawalls, saline intrusion barriers, dykes, dams, reservoirs, etc. As in many other countries, these hard engineering approaches are currently the preferred or "business-as-usual" solution in Vietnam. EbA, on the other hand, uses "green infrastructure" and other "nature-based solutions" to address climate change related issues. Some of the advantages of EbA approaches are that they are widely available to large segments of the population, including the poor and otherwise marginalized; they are often cheaper than hard infrastructure solutions; and they provide "co-benefits" such as an improved natural resource base, food supply, a source of income for local people, and biodiversity conservation. Of course EbA approaches may also have some disadvantages - for example hard infrastructure defences provide their full protection effect as soon as they are built - but restored ecosystems such as replanted mangroves may take many years before they are mature enough to provide effective protection. Implementing EbA approaches therefore requires changes in practices and expectations and consequently may be more complicated for government officials to report on.

4. EbA is applicable at all levels and scales from local to international. EbA provides an approach that incorporates comprehensive measures promoting development through ecosystem management. Such measures include, for example, interventions related to sustainable agriculture, integrated water resource management, integrated coastal and marine management and sustainable forest management that use nature to reduce vulnerability to climate change. Through a focus on conservation, restoration and management of ecosystems, EbA at the same time ensures that the resilience of the ecosystems themselves is maintained or improved.

2. "Mainstreaming EbA in Vietnam"

3. The GIZ project "Strategic Mainstreaming of EbA in Vietnam" is working to promote EbA approaches in Climate Change Adaptation planning across government policy and planning sys-

tems. Institutional considerations are thus important. While much of CCA policy is produced at the national level, practical planning for CCA is primarily the responsibility of the Provincial Peoples' Committees. Thus, as part of its portfolio of activities the project has selected two provinces - Quang Binh and Ha Tinh to demonstrate EbA vulnerability assessments and identify EbA interventions.

4. The EbA vulnerability assessments are to be conducted in two main stages, first at the province-wide level, and then subsequently at the community level or local-scale in selected areas. The province-wide VA is intended to enable a province to get a comprehensive overview of climate change issues and identify priorities for action. The province-level VA is "top down", and uses existing information on the province's ecological, social and economic assets; its history of climate-related hazards; as well as development trends and downscaled climate change projections to identify priority climate change adaptation issues and general province-wide EbA solutions. The province-wide assessment also provides the basis for identifying a short-list of specific sites for selection of the local level VA. The local level VA then focuses on a selected area and repeats the analysis of ecological, social and economic factors at the local level, applying more conventional bottom-up methods of field work, local data collection and stakeholder participation, to better understand locally important climate change issues and identify specific, implementable EbA solutions. The results and analysis from both assessments will be made available as a stand-alone Provincial Vulnerability Assessment Report; and one or more stand-alone Community Vulnerability Assessment Reports for each province. Together they will provide clear sets of recommendations for both provincial and local levels.

3. The need for a new approach

4. The EbA vulnerability assessments are intended to demonstrate an approach that can be easily understood and replicated by other provincial governments using existing data and relatively limited national consultant collaboration. A wide range of climate change vulnerability assessment methodologies has emerged over the last decade, and a number of reviews, comparisons and compilations of these approaches are available (Balangue, 2013; Garg et. al., 2007; Morgan 2011; Provia, 2013; Rizvi et. al. 2015; Schipper et. al. 2010; UNFCCC, 2008). Further, recent VAs in Southeast Asia provide concrete examples. These have focused on the wetlands of the Lower Mekong Basin (ICEM, 2011); an assessment that has ranked relative vulnerability of different provinces to identify Hot Spot Provinces in the Lower Mekong River Basin (USAID Mekong ARCC, 2013); a significant stretch of the Mekong River (WWF, 2014); a single ecosystem such as a Ramsar Wetland (e.g. Meynell et. al., 2014) or on urban centres (e.g. ICEM, 2015).

5. However, many of these are very complex and none involves detailed vulnerability assessments and adaptation interventions at larger scale such as entire provinces, encompassing a diverse range of ecosystems, livelihoods, built infrastructure and other economic assets. In addition, while many identify the need to focus vulnerability assessments and climate change adaptation work on "socio-ecological systems"

(SES), none of them provide a methodology for identifying an SES, assessing impacts of climate change on SESs, or even a clear definition of what constitutes an SES. This project is using the definition that socio-ecological systems are:

"complex bio-geo-physical units together with social and institutional actors and their activities"

6. The concept recognizes that social, economic and ecological systems are inextricably linked, and that any separation is artificial and arbitrary. While SESs may be delineated by either spatial or functional boundaries, and their scale can be very variable, in practice they are still difficult to identify conclusively and consistently. This project is testing out an approach to first identifying and mapping SESs across the entire province, then describing priority SESs as the entry point for further steps of the vulnerability assessment, and as the targets for implementation of EbA recommendations.

7. At the same time, the approach being used here recognizes that not everything in a province can be neatly categorized as belonging to a single type of SES. Some things cut across many different SESs. For this reason we are also introducing the concept of Key Economic Activities/Assets (KEA) to include both large scale infrastructure that supports economic activity across the province (e.g. in the transport, energy and water sectors), as well as Special Economic Zones (SEZs).

8. The GIZ/ISPONRE EbA project's approach of starting with a provincial level vulnerability assessment before focusing at the micro-level; and of simplifying the overall process is already innovative and requires more detailed description. In addition the use of SESs and KEAs as the key entry point is also novel, and also requires further explanation and description. This report therefore sets out the overall EbA vulnerability assessment approach as it is being developed and tested. It should be read before reading the provincial reports for either Quang Binh or Ha Tinh.

II. Vulnerability Assessment for Ecosystem-based Adaptation: Concepts and Definitions

9. The overall implementation of the Vulnerability Assessment (VA) requires (i) a conceptual approach that guides the implementation; (ii) a set of methods to be applied under that approach, and (iii) a number of tools that are used in each of those methods. This Brief is laying out the first of these – the overall approach being used.

Table 1: Definition of Approach, Methods and Tools

Approach	A broad strategy and process for an entire assessment**.**
Method	A set or sequence of steps followed to accomplish a specific task within a larger framework.
Tool	A means or instrument by which a specific task is accomplished

Source: Adapted from UNFCCC 2008

10. The conceptual starting point for the approach adopted here is the understanding of vulnerability as originally defined by the IPCC (2007) and now commonly accepted. **Vulnerability** is

defined as the degree to which something (a species, an ecosystem, a group of people, a set of activities, built infrastructure, etc.) is susceptible to, or unable to cope with, the adverse effects of climate change, including climate variability and extremes. Vulnerability is further explained as a function of the character, magnitude, and rate of climate variation to which a system/species is exposed, the system/species' sensitivity, and the system/species' adaptive capacity (IPCC, 2007). Figure 1 presents this relationship visually/graphically.

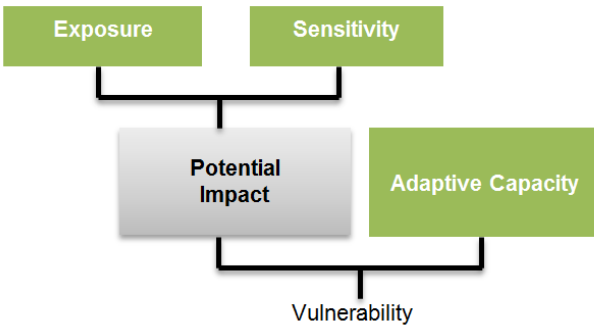

Figure 1: The components of vulnerability (from Marshall et al. 2009; Preston and Stafford-Smith, 2009)

11. **Exposure** is defined as the extent to which a region, resource or community experiences changes in climate. It is characterised by the magnitude, frequency, duration and/or spatial extent of a weather event or pattern. Some regions or sectors or groups of people or species are more exposed to extreme climate hazards than others because of their location

12. **Sensitivity** is defined as the degree to which a system is affected by, or responsive to, climate changes. The sensitivity of ecological systems to climate change is normally described in terms of physiological tolerances to change and/or variability in physical and chemical conditions (i.e. temperature, pH, etc.). Sensitivity of social systems depends on a range of economic, political, cultural technological and institutional factors.

13. Together, exposure and sensitivity describe the **potential impact** of a climate event or change upon an object. However, to understand vulnerability, this interaction of exposure and sensitivity on the ground, is moderated by adaptive capacity.

14. **Adaptive capacity** refers to the ability of the system to change in a way that makes it better equipped to manage its exposure and/or sensitivity to a threat. Although a broad range of factors have been identified which are reported to reflect adaptive capacity, it remains a difficult concept to define explicitly within vulnerability assessments (Adger and Vincent, 2005). Adaptive capacity can refer to the natural ability of the system to adjust to change (e.g. for an ecosystem to retreat inland over time in response to rising sea levels) or to human resource availability and capacity to manage the system to adjust to change (e.g. human, technological, and financial capital) as well as the capacity and political will of governance structures to deploy those resources.

15. While this understanding of vulnerability appears attractive, it is not necessarily a straightforward matter to apply it to either complex ecological systems or complex social systems, even when considering either of these in isolation. Added to this, in the real world, what we are dealing with are actually combined socio-ecological systems that are even more complex.

16. Figure 2 shows the linkages between ecological vulnerability of one ecosystem, and the socio-economic vulnerability of a group of people who are dependent on one or more resources provided by that ecosystem.

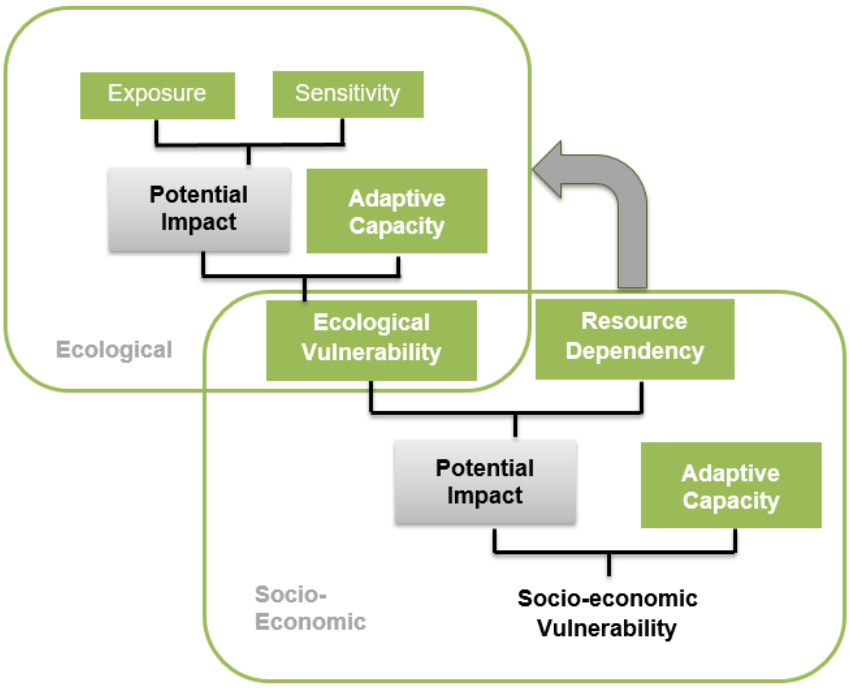

Figure2: Linking ecological vulnerability and socio-economic vulnerability (from Marshall et. al., 2009)

17. We therefore need to develop an approach to explain and provide practical guidance for conducting Vulnerability Assessments to identify EbA options at both the provincial level, and in local level sites, as part of an integrated socio-ecological approach to vulnerability assessments and ecosystem-based climate change adaptation.

18. The proposed **VASES** Approach being developed and tested in this project is underpinned by a conceptual understanding of the basic elements of the relationship between societies and ecosystems, and the fundamental importance of ecosystem services in this relationship. The natural structure and functioning of ecosystems generates goods and services that are of benefit to society. These are commonly referred to as "Ecosystem Services".

19. The simplest definition of Ecosystem Services is "all the different ways in which humans benefit from ecosystems". The Millennium Ecosystem Assessment categorized ecosystem services into 4 groups, namely provisioning, regulating, supporting, and cultural services (see Box 1). At the same time society uses and manages the habitats and species that are found in the ecosystem in many different ways (some of which may be more sustainable than others). The conceptual basis then gradually incorporates additional elements, of both non-climate related development trends, and then of climate-related impacts, before moving on to consider existing adaptive capacity, and finally an identification of overall vulnerability. Based on this, adaptation options can then be identified.

Box 1: Ecosystem Services

Types of Ecosystem Services (after MEA, 2005)

Provisioning:

Benefits we get from products of ecosystems (food fibre, energy, materials, medicine)

Regulating:

Benefits we get from ecosystem processes (air, water and climate regulation; pest and disease- control; protection from erosion, storms and other natural hazards, etc.)

Cultural-spiritual:

Non-material benefits we get from nature (spiritual, aesthetic, recreation, health)

Supporting:

The services necessary to create all the other services (soil formation, photosynthesis, nutrient and water cycling, pollination)

III. Implementation of the proposed VASES Approach

20. Implementation of the VASES Approach consists of four main components (essentially these are the same at the provincial and the local/community levels):

1. **Scoping the context for climate change vulnerability assessment and EbA:**
   - Baseline and trends in ecology, society and economy
   - Identification of major climate-related hazards and their trends
2. **Identification and prioritisation of socio-ecological systems (SES) and key economic assets (KEA)**
3. **Vulnerability Assessment for priority SESs and KEAs**
   - Climate Change Impact Assessment
   - Adaptive Capacity Assessment
4. **Identification of EbA and other related options**

21. These steps are described in more detail below. Additional information on specific topics and data sources is provided in Annex 1.

1. Scoping the Provincial context for climate change

22. Broadly speaking "scoping" is an early project start-up activity conducted to bring focus to a broadly conceived study and determine the specific features it will encompass. Clearly, with a challenge such as climate change, many angles could be pursued; not all would be equally important. The purpose of scoping is then to identify and prioritise the important issues that will be considered in the assessment, and that will lead to the most necessary and implementable EbA solutions. Scoping will be considered in terms of a number of "profiles", each of which will be presented as a chapter in the report. Below, an overview is provided of the contents of each profile/chapter.

Baselines and trends in ecology, society, the economy, and climate

23. **Ecological Profile:** The Ecological Profile examines, maps and assesses the province's ecological context, considering the major ecosystems present, and the geology, topography, (slope) soils, hydrology and prevailing climate associated with them. A baseline situation is described, and an assessment of trends

is used to make projections of future scenarios for ecosystem extent and condition. Baseline data exists, although the type and level of detail may vary from province to province, and accessing the data may be problematic. More difficult will be the detection and projection of trends, but for forest cover and quality (type and condition), some data should be available.

24. **Economic Profile:** The Economic Profile examines how the (provincial or local) economy is structured, identifying (and where possible mapping) the "key assets, actors and activities" in each sector. The baseline situation looks at sectors that are important now, and that will be important in the future, according to (provincial or commune) development trends and plans. It addresses the question what, from an economic perspective, should the EbA vulnerability assessment focus on? Narrative accounts of the economy can be found in the provincial Socio-Economic Development Plans. The annual provincial statistics books provide quantitative overviews of the provincial economy, broadly differentiated by sector and within sectors, but are typically a year out of date. Most recent data, and maps need to be requested from individual departments. Digital data sets and maps are not always available, and some data is not available for free. At the end of the day the quality of the profiles produced will depend on the quality, quantity and timeliness of the information provided by provincial informants.

25. **Social Profile:** The Social Profile provides an account of the province's or community's human population and asks who will be most vulnerable to climate change, to what degree and why, now and in the future. What prospects are there for adaptation and what social trends are likely to increase or decrease vulnerability? Important considerations include population size and structure (including ethnic minorities and other potentially vulnerable groups) population distribution and growth rates, livelihoods, resource tenure, poverty and migration.

26. **Climate Profile:** This describes the province's "baseline" climate, and its history of extreme climatic events, supplemented by discussion with key informants at the provincial level on past climate and extreme weather events, and their impacts; observed trends over time; and issues of concern.

2. Identification of Socio-Ecological Systems and Key Economic Assets

27. Based on the understandings developed in the economic, social and ecological profiles, and using the expert judgement of team members, a series of SESs and KEAs can be identified for each province. A preliminary identification will initially be produced for discussion and debate within the team until consensus is reached. Use of Google Earth images to identify different types of land cover, infrastructure and human activities; combined with a series of field visits covering as many different types of areas as possible within the provinces; and use of both existing and newly prepared maps developed by the project, are all extremely important aspects of this iterative approach.

28. The SES and KEA will then be ranked in importance, in light of the ecological, social, economic and climate factors discussed in the profiles, such as: geographic extent; number of people in-

volved; present and projected future contribution to the economy; impacts of past extreme climate events, etc. Individual rankings of SESs proposed by each team member will be combined into an overall score consensus score after discussion and agreement within the team. A selection of the top prioritized SES/KEA will then be described in more detail, including an inventory and assessment of the key ecosystem services that support them.

29. **SES and KEA Profile:** An SES Profile will be prepared for each province, presenting an overall classification of its SESs and KEAs, an SES/KEA mapping of the entire province, and descriptions of some of the priority systems as well as an assessment of the important ecosystem services that support them.

3. Vulnerability Assessment of Socio-Ecological Systems and Key Economic Assets

Identifying Major Threats from Climate Change

30. The 2012 officially approved MONRE-IMHEN climate change projections based on the IPCC 4th Assessment were used to identify parameters of the possible future climates of both Quang Binh and Ha Tinh provinces. Using information on past climate conditions and observed trends; as well as knowledge about which aspects of climate are important for the selected priority SESs in each province, 7 key parameters of climate change were selected for use in the SES Vulnerability Assessment (increase in mean overall temperature; increases in number of very hot days; increase in number of dry days; decreases in rainfall in the dry season; increase in rainfall in the rainy season; changes in storm patterns; and sea level rise).

Assessment of Impact

31. Increasingly climate change is identified as a source of additional pressures on ecosystems, societies and economies. As explained above, `potential impact' is a function of exposure and sensitivity.

32. Using available information and expert judgement the team assigned scores for exposure and sensitivity of each individual SES or KEA to each of the 7 climate measures identified above. Plotting the exposure scores against the sensitivity scores in a matrix similar to that shown in figure 3 below, identifies the scores for potential impact of each of the 7 selected parameters of climate change for each SES/KEA.

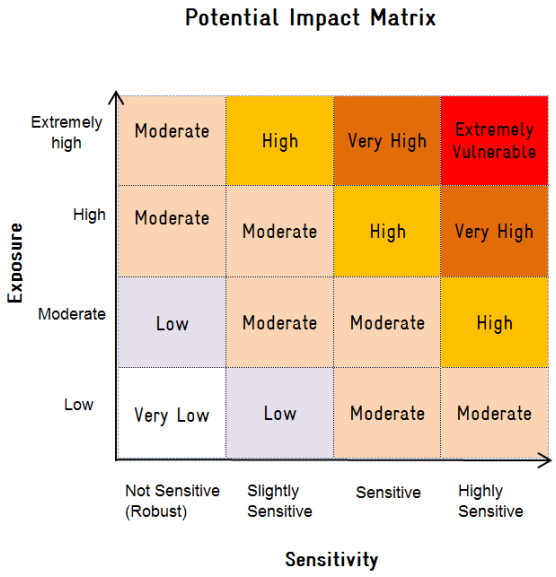

Figure 3: Potential impact matrix: the relationship between exposure and sensitivity in determining the degree of potential impact (Hills & Bennett, 2010)

33. At the provincial level, potential impact matrices can be developed for the different priority socio-ecological systems and key economic assets identi-

fied in the scoping and baseline. At the community level, potential impact matrices can be developed for more finely defined areas.

Assessment of the Adaptive Capacity of SES and KEA

34. With this understanding we can now move on to assess a Socio-Ecological System's existing capacity to adapt to likely impacts. In this case it is useful to consider that ecosystems have limits beyond which they cannot function effectively, but these limits are complex and the thresholds are not always predictable. Sometimes it can take a long time for any impacts to become visible. Natural processes work on very different time-scales than human societies. After an extreme event people are often heard saying things like "*a flood like this has never happened before in living memory*" when in fact such a flood could be a regular feature of say a 200- year natural flood cycle of the river. The different time-frames of human cycles and natural cycles must be recognized and considered.

35. The following components of adaptive capacity have been suggested (Marshall et. al. 2009)

- The capacity to experiment and learn
- The capacity to re-organise
- Flexibility (social, cultural, political, economic)
- The availability of Assets/Capitals (natural, economic, social-cultural, physical (built) and human)
- Gender relations
- Social norms and institutions
- Flexibility of markets
- Environmental Institutions
- Culture of corruption

Overall Vulnerability Assessment

36. Once again using a combination of existing information compiled, knowledge of provincial and local informants and expert judgement of team members, scores can be assigned for adaptive capacity of each SES/KEA to each of the 7 chosen climate change parameters. Then matrices can be constructed plotting the scores for potential impact against the scores for adaptive capacity (similar to Figure 4 below). This allows us to identify overall vulnerability scores, for each of the 7 climate factors in each of the SES/KEAs. Finally the mean overall vulnerability score of each SES/KEA can be calculated as the average of all 7 vulnerability scores for the different climate factors.

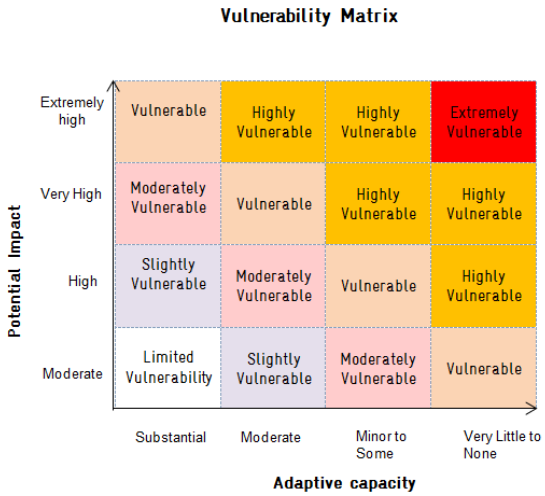

Figure 4: Vulnerability matrix: the relationship between potential impact and adaptive capacity in determining the degree of ecological vulnerability (Hills & Bennett 2010)

4. Identifying EbA and other Adaptation Options

37. In general, the approach to identifying adaptation options is as follows"

- Review most vulnerable SES/KEAs
- Identify where adaptation responses are needed
- Define ecosystem-based and other adaptation options
- Prioritise options
- Identify synergies (packages of interventions)

38. As vulnerability is a function of three elements - exposure, sensitivity and adaptive capacity, then EbA interventions could logically include actions to manage or reduce exposure; manage or reduce sensitivity; and strengthen adaptive capacity. In practical terms though most activities targeting reduced exposure or reduced sensitivity will probably be implemented through increasing adaptive capacity first (see Figure 5).

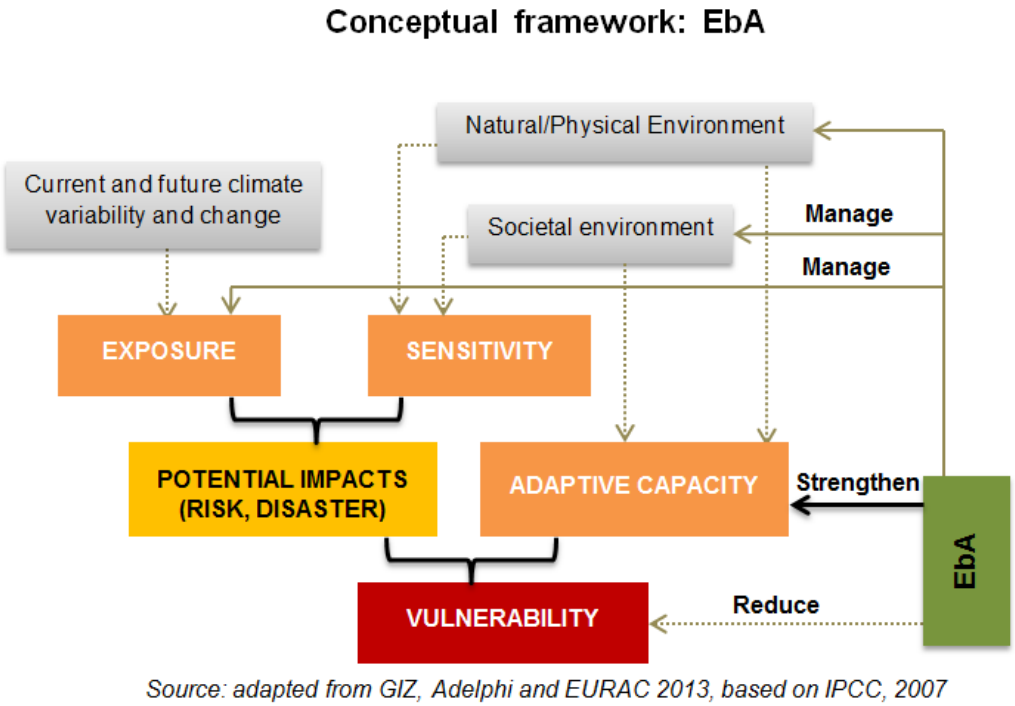

Figure 5: Conceptual Framework for EbA interventions

39. Furthermore, EbA interventions can be identified by:

a) Identifying what can be done to help restore ecosystems, maintain them in good condition, and enable them to adapt to climate stresses, as well as reducing non-climate stresses on ecosystems

Effective management of natural resources and ecosystem services can only be achieved by working at multiple scales, including large scales such as watersheds, landscapes, river reaches and coastal stretches. This often requires government-led action to put in place appropriate management prescriptions (such as designation of protected areas, and specification of management regulations, etc.). However, community-led or community-driven approaches can also be effective at spatial scales much larger than the immediate surroundings of a community

b) Identifying how ecosystem services can be best used to help different social groups (and especially the most vulnerable people) adapt to climate change impacts

In addition to the fact that the ecosystems themselves may be changing as a result of climate change, at the same time human dependence on those ecosystems and their services may also change as a result of climate change. Depending on what happens to their economic and livelihood activities, people in the area of the assessment may become more dependent on the plants, animals and ecological services available to them in the future. How can this be made more sustainable than in the present situation? What new ways can be found to harness ecosystem services for even greater benefits?

c) Identifying how ecosystems can help protect important infrastructure from damage that might be caused by climate change ("climate-proofing")

Improved management of watersheds can reduce land-slide threats to roads, and can reduce erosion that causes rapid siltation of reservoirs, reducing their working life, and can reduce infrastructure damage caused by downstream floods.

d) Identifying "Climate-smart" agriculture interventions

Not all climate smart agriculture interventions may truly be considered as EbA, although some of them undoubtedly are. So for example improved housing for livestock that reduces their exposure to high temperatures that cause stress and reduced production, is climate-smart but not EbA. On the other hand maintaining patches of natural habitat within the farm landscape as a source of natural pollinators and for biological pest control, is definitely an EbA approach. In practical terms recommendations for climate smart agriculture may be bundled into packages that include elements that are both EbA and non-EbA together.

After identifying a potentially wide range of EbA and other related options, it will be necessary to conduct some form of prioritization. In this case criteria can be developed to rank proposed interventions.

e) Identifying policy, strategy, planning, financial and institutional reforms that would translate into more effective adaptive capacity

Interventions such as policy that supports co-management arrangements with shared responsibilities between government agencies and communities in natural resource management; mainstreaming the response to climate change in planning systems across multiple sectors; effective institutional arrangements that support networking and collaboration between communities in a shared landscape/seascape; and Innovative financing mechanisms such as Payment for Environmental Services (PES) will be important in improving adaptive capacity.

After identification of a range of possible interventions, ranking should be carried out using agreed criteria (such as those identified in Table 2).

Table 2: criteria used to rank adaptation interventions (adapted from IUCN, Marshall et al. 2009)

Criteria for adaptation	Description	Action
Need	Individuals, communities and sectors will vary in the extent and immediacy of their vulnerability to climate change.	Decision-makers should rank candidates for adaptation using transparent methods for equitable resource allocation. They should establish clear criteria for evaluating need and recognising urgency in adaptation.
Benefit	Benefits of adaptation actions will vary considerably between actors - can assist with decisions between sectors/regions in which to invest in adaptation action.	Prioritising groups/regions should be done with the development of clear criteria for evaluating benefit- through comparative assessments of economic/social/environmental value.
Scale of Impact	Some interventions may only have an impact at a very local scale, whereas others may have a much broader impact	Prioritisation and decision-making should take into account the scale of the impact
Feasibility	Some adaptation options can be infeasible in practice. Reducing vulnerabilities might be economically/technically/politically too challenging.	Feasibility analysis will help identify strategies which are more practicable. In instances where this is difficult to evaluate- risk-based approach can help with decision making in the face of uncertainty.
Costs	Adaptation options vary greatly in cost - inexpensive options may deliver major benefits with great certainty.	Weighing up costs against feasibility and likely benefits. Decision makers should consider the nature of the vulnerability, the type of adaptation strategy and the institutional context of the adaptation initiative.

40. In a more general sense it is also important to consider

- Promoting local and long-term adaptation solutions that provide security to both people and nature
- Addressing governance issues including resource tenure and access as part of adaptation - in many cases successful adaptation cannot be achieved if

- significant progress is not made on these issues first
- Building on local innovation and sharing approaches and experience between communities, organizations and provinces, supporting the development of capacity at all levels.

IV. Additional considerations

41. Considering all of the complex interactions between societies, economies and ecosystems, it is therefore very clear that to conduct effective vulnerability assessments we need to work in teams that include expertise and experience in social, economic and ecological aspects. We also need a simple overall approach that goes beyond the IPCC idea, to guide and help integrate our thinking.

42. It is extremely important that local government stakeholders engage in the process productively. On the one hand their participation is absolutely necessary to provide access to provincial data and information (as well as their own knowledge and experience) to inform the assessment process, while on the other hand their active participation is also a form of capacity-building for them, through which they can learn the approaches and techniques being used, and benefit from interactions with national (and in this case international) experts.

V. Conclusion

43. What is proposed here provides a structured approach to designing and implementing multi-scalar vulnerability assessments of complex systems for EbA. It is innovative in proposing to implement province-wide vulnerability assessments, and it is innovative in attempting to identify specific socio-ecological systems and then use them as the entry point for impact assessment. At the same time, it is attempting to balance this level of complexity with the need to develop an approach that is understandable and replicable by provincial authorities. The Quang Binh and Ha Tinh vulnerability assessments will provide the first opportunities to test this out in practice. Experience and lessons learned from these pilots will be used to inform any necessary adjustments to the approach in a revision at the end of the project.

Annex

The VASES Approach: 4 Steps for Vulnerability Assessment of Socio-Ecological Systems and Identification of EbA Options

Annex 1 provides a matrix of the information that is needed in relation to each step (1-4) of the VASES Framework, and the methods that can be applied and the range of tools that may be used to generate that information. The list of methods and tools is intended to be more indicative rather than either overly prescriptive or exhaustive at this stage. More detailed descriptions of each of the key methods/groups of tools identified in the table (i.e. CARE's "Climate Vulnerability and Capacity Assessment (CVCA)", ICEM's "Climate Change Adaptation and Mitigation Methodology (CAM)", SDF/IUCN's "CREATE" , IUCN/University of Bern's "PLI", IISD's "CRiSTAL" and general PRA tools will be described in more detail as and when they are actually used.

Stages and Steps	Scope/Objectives	Data Sources and Methods	Output
1. Scoping provincial context: baseline and trends		Meetings with ISPONRE, GIZ and ICEM teams	
(a) Ecosystem and Ecosystem Services Profile Understanding key ecosystems and the services they provide (Can be applied at Provincial level and local level such as sub-catchment, river reach, coastal stretch, cluster of communities or individual community)	**Provincial/local:** Understanding main habitat types, their extent and connectivity species important for economy, culture and food security; ecosystem services important for local livelihoods, economy well-being, etc. as well as the trends in what is happening to these ecosystems over time	**Provincial:** Literature review, provincial meetings, expert opinion • The UNREDD programme Forest Ecological Stratification study for Viet Nam in 2011. • WWF (2013) comprehensive study of the Ecosystems of the Greater Mekong Region, including all Vietnam • WWF (2013) Ecosystems Classification Mapping of Vietnam • USAID (2013) Vietnam Tropical Forest and Biodiversity Assessment • WWF Ecoregions http://www.worldwildlife.org/ecoregions **Local:** Community or local level mapping, supported by drone images, or Google Earth.	Provincial Ecosystem Profile Local Ecosystem Profile
(b) Economic Profile (Profile of whole	**Provincial:** Understanding the overall economic context - major economic sectors and activities supporting GDP, tax revenue, employment, etc. and how they are changing over time. Also major	**Provincial:** Literature review, expert opinion, key informant interviews, focal group discussions; **Local:** PRA Methods and tools e.g. community	Provincial Economic Profile Local Eco-

Province and of individual villages or clusters of villages with similar livelihoods in shared ecosystem at local level)	infrastructure supporting the economy, and future development plans **Local:** Understanding the economy at a more local level including patterns of major livelihood activities , including their dependency on ecosystem services	mapping, community transects, historical timelines, seasonal calendars, risk mapping, ranking exercises, market surveys, household consumption surveys, etc.	nomic and Livelihood Profile
(c) Social profile (Profile of whole Province and of individual villages or clusters of villages with similar livelihoods in shared ecosystem at local level)	**Provincial:** understanding the overall socio-cultural, context of the province including ethnicity, poverty, migration, etc. **Local:** Understanding the social dynamics in a selected locality - livelihoods and culture of communities including how they use and manage natural resources	**Provincial:** Literature review, expert opinion, key informant interviews, focal group discussions; **Local:** PRA Methods and tools e.g. community mapping, community transects, historical timelines, seasonal calendars, risk mapping, ranking exercises, market surveys, household consumption surveys, etc.	Social Profile
(d) Climate Profile	Understanding current climate characteristics in the local area, previous extreme events and major concerns on climate risk from the perspective of different stakeholders;	**Provincial:** Current climate information and Information on past extreme events from provincial sources **Local:** Climate risk mapping, climate risk calendar and seasonal (livelihood) calendar, Venn diagrams, timelines, historical transects, etc.	Provincial Climate Profile Local climate profile and risk map
2. Identification description and mapping of SESs	Identification of all SESs and KEAs in each Province, ranking of their importance, fuller descriptions of selected priorities in each province and short-list for	Information in profiles a-d, and mapped information collected or prepared for these profiles; Google Earth, expert knowledge and opinion of team mem-	Provincial SES and KEA Profile

and KEAs	selection for micro-level assessment. Mapping of priority SES and KEAs	bers	
3. Vulnerability Assessment of priority SESs and KEAs			
(a)Identifying potential impacts on SESs and KEAs	**<u>Provincial:</u>** Understanding potential climate impacts on priority SESs, main sectors of provincial economy, important production systems, and key infrastructure assets, including both exposure and sensitivity to climate risks. This includes consideration of how ecosystem functions and processes, habitat extent and condition and species will change under pressure of climate impacts These climate impacts also have to be seen in the context of understanding how broad economic development trends are already putting pressure on the ecosystems, and are at the same time putting pressures on livelihoods and the way of life in the province **<u>Local:</u>** Understanding how communities dependence on ecosystem services will change, and the way they use and manage ecosystems under the conditions of changing climate – including changes in which	**<u>Provincial:</u>** ICEM CAM Methodology Downscaled Climate Projections overlay on key SESs and KEAs, Hydrological modelling Review of government policies and plans and private sector investment, key informants interviews, focus group discussions. Assessing impacts of past extreme variation in climate pattern or extreme weather events on species and habitats, and their ability/speed of recovery. **<u>Local:</u>** Tools for ecosystem services site-based assessment (TESSA) SDF/IUCN "CREATE" (Shott and Mather, 2012) and/or CARE CVCA Methods (Daze et. al. 2009).	Impact matrix and narrative for priority SESs and KEAs Impact matrix and narrative for local level

	products and how much of them are harvested; how much is consumed in the household and how much is sold; changes in customary rights, resource access/tenure and locally agreed use rules; changes in community-based management institutions;	Climate risk mapping, climate risk calendar and seasonal (livelihood) calendar, Venn diagrams, timelines, historical transects, etc.	
(b) Adaptive Capacity of SES and KEAs Provincial: Understanding Adaptive Capacity at the Provincial level Local: Understanding Adaptive Capacity at the Community Level	**Provincial:** Understanding the extent to which provincial policy, investment decisions, regulations and standards, institutional structures, planning processes, and management regimes support effective adaptation. Understanding previous responses to extreme events at the provincial level. Also understanding how ecosystems and their component species and habitats are able to respond and adapt to climate impacts. **Local:** Understanding the extent to which community-based institutions and different user-groups/interest groups can support changes in livelihoods, agricultural practices and local use of natural resources. Understanding household coping strategies in response to previous extreme events.	**Provincial:** Literature review, expert opinion, key informant interviews, spatial analysis **Local:** SDF/IUCN CREATE tools (Shott and Mather 2012) + University of Bern/IUCN PLI tools (Roth and Rist, 2012)	Description of Provincial Adaptive Capacity Description of local adaptive capacity
(c) Overall Vulnerability Assessment = (exposure x sensitivity) /adaptive capacity	**Provincial:** Vulnerability of priority SESs and key infrastructure supporting large-scale economic activity	ICEM CAM Methodology Ranking of cells in matrix of Potential Impacts versus adaptive capacity (Can be applied at both provincial and local levels)	Vulnerability scores and ranking of 10 key SESs Key local vul-

	Local: Vulnerability of specific examples of selected SESs		nerabilities that need to be addressed
4. Identifying EbA Options for SESs and KEAs	**Provincial:** - what changes in provincial policy, investment decisions, regulations and standards, institutional structures, planning processes and management regimes will support adaptation, including by maintaining or enhancing the future flow of environmental services that supports provincial development - what conservation and restoration or other management action to be undertaken or led by government agencies will enhance adaptation e.g.: • establishment of new protected areas, • expansion of core zones • changes in use rules in buffer zones • provision of increased resources for forest fire management • changes of harvest quota and plot size in production forest • increasing use of native species in production forest plantations • Increasing diversity of species in coastal protection forests • Etc. - how can ecosystems be used to help "climate	**Provincial: ICEM CAM Method,** Literature review, expert opinion; adoption of best practice. **ADB Guidelines** (ADB 2011; 2012; 2013)	List of potential EbA options at provincial level with initial prioritization and one or two concept notes Short-list of proposed EbA interventions at the local level

	proof" infrastructure and support sustainability of key economic sectors in the face of climate impacts - which "climate-smart" agriculture interventions could be widely applicable across large areas **<u>Local:</u>** Identifying opportunities for community-based institutions to conserve and restore species and habitats through e.g.Changes to access and tenure rules and agreements • Changes to fishing/harvesting/collecting/ hunting, areas, periods, gear or allowed quota • Establishing closed seasons or no-take zones • Etc. Identifying how households can change components of their livelihoods, change their agricultural practices and change their use of natural resources and management of ecosystems for sustainable long-term CCA/resilience benefits (especially for the most vulnerable groups). Identifying how ecosystems can help "climate-proof important community infrastructure	**<u>Local:</u> CREATE,** (Shott and Mather, 2012) **PL**(Roth and Rast 2012) and **CRiSTAL** (www.cristaltool.org) community meetings and discussions	

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