Community-based Climate Vulnerability Assessment and Adaptation Planning for Resilient Agroecosystems

Investing in Climate Change Adaptation through Agroecological Landscape Restoration: A Nature-Based Solution for Climate Resilience (Technical Assistance 6539)

October 2023

Consultation in Manupali, Philippines. (photo by ICEM)

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Deliverable summaries	TA-6539 Investing in Climate Change Adaptation through Agroecological Landscape Restoration: A Nature-Based Solution for Climate Resilience led to the preparation of the following knowledge products:

- KP1 (1): Landscape Restoration Country Profile: Philippines
- KP1 (2): Landscape Restoration Country Profile: Cambodia
- KP3: Business Models to Encourage Private Sector Participation in Sustainable Land and Forest Landscape Management
- KP4 (1): Climate Change Risk and Adaptation Options Assessment – Sangker River Basin, Cambodia
- KP4 (2): Climate Change Risk and Adaptation Options Assessment – Manupali Watershed, Mindanao River Basin, the Philippines
- KP5: Good Practices Manual on Biodiverse Forest and Landscape Restoration
- KP6: Community-based Climate Vulnerability Assessment and Adaptation Planning for Resilient Agroecosystems
- KP7: Applying Advanced Technologies in Support of Landscape Restoration and Climate Change Adaptation
- KP8 (1): User Manual: Sangker River Basin Decision Support System
- KP8 (2): User Manual: Mindanao/Manupali River Basin Decision Support System
- KP8 (3): Admin Manual: Sangker River Basin Decision Support System
- KP8 (4): Admin Manual: Mindanao/Manupali River Basin Decision Support System
- KP9 (1): Restoration plans for demonstration areas in Cambodia and the Philippines
- KP9 (2): Gender and Social Inclusion in the Mindanao River Basin, the Philippines, and the Sangker River Basin, Cambodia
- KP10: Integrating the principles of ecological agriculture into upland farming systems of Manupali Watershed, the Philippines

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Abbreviations

ADB	Asian Development Bank
ICEM	International Centre for Environmental Management
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Weights and Measures

C	Celsius
cm	centimetre
ha	hectare

Glossary

Adaptation

Ecological, social, or economic adjustments to avoid, mitigate or recover from impacts of climate change threats.

Adaptation planning

A process of identifying a set of prioritized adaptation measures for actions, considering available resources and capacity of implementing agencies, to enhance the resilience of agroecosystem

Climate change threats

Climate change related events that negatively affect farm production and/or other components of agroecosystems, and for which adaptation measures are needed. Climate change threats include rising in air temperatures or changes in precipitation regimes that compel farmers to respond by, for example, modifying the cropping calendar, and extreme weather events with occurrence and intensity affected by climate change.

Community-based approach

Approach that involves communities in identifying and addressing issues that matter to them such as the impact of climate threats.

Ecological agriculture

Ecological agricultural avoids negative unintended natural and social consequences by using assets in a way that does not deplete them, and which maintains productivity and usefulness to society in perpetuity. It seeks to use renewable energy sources and diversify the genetic base while reducing or eliminating inorganic inputs, relying on natural processes and locally available resources. Techniques are generally very diverse and context-specific and may include: soil and stone bunding, terracing, and minimum tillage for soil conservation; cover crops, mulching, and crop rotation for soil fertility; planting basins, check-dams, ponds, tanks, wells, rainfed systems, and drip irrigation for water harvesting and delivery; and intercropping and hedgerows for pest and weed management. By using biological processes in place of off-farm inputs, ecological farming aims to improve soil conditions, diversify species and genetic resources, enhance beneficial biological interactions, recycle biomass, and minimize energy loss.

Extreme weather events

Occurrences of unexpected, unusual, or unseasonal climate related events such as floods, storms, heat waves and prolonged droughts, which are likely to become more frequent or more intense with human-induced climate change.

Resilience

The ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events linked to climate change. More broadly the term describes the ability to maintain essential function, identity and structure, and the capacity for transformation.

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.

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1 Introduction

1.1 Why is This Manual Important?

This manual focuses on agroecosystems, which are ecosystems that humans have modified to produce food and other ecosystem goods and services.[1,2] Agroecosystems exist at the farm, community, and regional scale and vary in complexity, composition, and management.[3,4] At the farm scale, agroecosystems are managed by households, while at the community or regional scale, farm households are joined by other stakeholders to work together to ensure the production of foods and other services for the benefit of the community.

Many agroecosystems are vulnerable to climate change and are substantially affected by higher temperatures, altered precipitation regimes, and the increased frequency and intensity of extreme weather events.[5] In this manual, we define "climate change threats" as climate change related events that negatively affect farm production and other components of agroecosystems and for which adaptation measures are required. Climate change threats include rising air temperatures or changes in precipitation regimes that compel farmers to modify cropping calendars to protect against extreme weather and crop damage. We define "extreme weather events" as unexpected, unusual, or unseasonal climate change-related events.

Climate change threats affect the biotic components of agroecosystems (plants and animals) and abiotic components such as soils, water, and micro-climates, which determine the level of food production and other services generated by agroecosystems.[6,7] Across the world, farmers and other stakeholders have worked to find locally appropriate adaption strategies that can improve the resilience of agroecosystems to climate change threats.[8,9]

This manual builds on a wealth of literature and guidelines for community-based vulnerability assessments and adaptation planning that have been tested in many countries, including Indonesia, India, Cambodia, and Vietnam.[10] The manual draws on the steps and tools in these publications and refines and adapts them as necessary.

In addition, the manual introduces and promotes the principles of ecological agriculture, an approach to agriculture that is gaining prominence as a response to the expansion of intensive agricultural systems that have been shown to cause serious environmental degradation and

[1] Dubey, P.K.; Singh, A.; Merah, O.; Abhilash, P.C. 2022. Managing agroecosystems for food and nutrition security. Current Research in Environmental Sustainability. 4. 100127. doi:10.1016/J.CRSUST.2022.100127.

[2] Abdelmagied, M. and Mpheshea, M. 2020. Ecosystem-based adaptation in the agriculture sector – A nature-based solution (NbS) for building the resilience of the food and agriculture sector to climate change. Rome, FAO.

[3] Xu, W.; Mage, J.A. 2001. A review of concepts and criteria for assessing agroecosystem health including a preliminary case study of southern Ontario. Agriculture Ecosystems & Environment. 83. pp. 215–233, doi:10.1016/S0167-8809(00)00159-6.

[4] Browning, D.M.; Russell, E.S.; Ponce-Campos, G.E.; Kaplan, N.; Richardson, A.D.; Seyednasrollah, B.; Spiegal, S.; Saliendra, N.; Alfieri, J.G.; Baker, J.; et al. 2021. Monitoring agroecosystem productivity and phenology at a national scale: A metric assessment framework. Ecological Indicators. 131. 108147, doi:10.1016/J.ECOLIND.2021.108147.

[5] Mirás-Avalos, J.M.; Baveye, P.C. 2018. Editorial: Agroecosystems facing global climate change: The search for sustainability. Frontiers in Environmental Science. 6. 135. doi:10.3389/FENVS.2018.00135/BIBTEX.

[6] Pareek, N. 2017. Climate change impact on soils: adaptation and mitigation. MOJ Ecology & Environmental Sciences. 2 (3). doi:10.15406/MOJES.2017.02.00026.

[7] Muluneh, M.G. 2021. Impact of climate change on biodiversity and food security: a global perspective—a review article. Agriculture & Food Security. 10 (1). pp. 1–25 doi:10.1186/S40066-021-00318-5.

[8] Boomiraj, K.; Wani, S.P.; Garg, K.K.; Aggarwal, P.K.; Palanisami, K. 2010. Climate change adaptation strategies for agro-ecosystem – a review. J. Agrometeorol. 12. pp.145–160.

[9] Debray, V.; Wezel, A.; Lambert-Derkimba, A.; Roesch, K.; Lieblein, G.; Francis, C.A. 2018. Agroecological practices for climate change adaptation in semiarid and subhumid Africa. 43. pp. 429–456. doi:10.1080/21683565.2018.1509166. https://doi.org/10.1080/21683565.2018.1509166.

[10] Le, T.T. et al. 2021. ICEM. 2021, Simelton, E. et al. 2013., Simelton, E. et al. 2013a.Dewi, S. et al. 2013. ADB. 2011., Mcleod, E. et al. 2015., Declet-Barreto, J. et al. 2020., Trocaire. 2016., CARE. 2019.

biodiversity loss.[11] Ecological agriculture relies on the maintenance and enhancement of functional biodiversity to support crop production.[12]

1.2 Who is This Manual for?

This manual provides guidance to those who wish to assess the vulnerability of agroecosystems to climate change, document adaptation strategies by farmers and local stakeholders, and develop adaptation plans. The manual provides a conceptual and methodological framework for a community-based approach that can help create mutual understanding among stakeholders as they undertake a vulnerability assessment and develop an adaptation plan.

The manual's primary goal is to enable users to develop a climate change adaptation plan for an agroecosystem that can be integrated into government programs or policies. It is suitable for research and development workers and policymakers interested in adopting a community-based approach to investigate the vulnerability of agroecosystems to climate change. The manual does not need to be used in full, and the methodological approach can be adapted to available resources and objectives.

The manual is designed primarily for community or regional-scale agroecosystems, which are typically managed by groups of farmers and other local stakeholders. The manual can still be used at the farm level, particularly for those investigating vulnerability to climate change and past adaptation measures with farm owners. The manual can be used for vulnerability assessments and agroecosystem adaptation planning in any part of the world.

1.3 Community-based Approach

Local community involvement is integral to climate vulnerability assessments and adaptation planning, as they directly experience the impacts of extreme weather events and climate change.[13,14,15] Local communities can be brought into the process with semi-structured focus group discussions, key informant interviews, consultation meetings, and workshops. Input or feedback from local communities will help the assessment team to better understand the most important climate issues and their impacts, and to assist local stakeholders in adaptation planning. It will provide a sense of the communities' needs and strengths, as well as the resources available to adapt and adjust agroecosystems.

1.4 Principles of Ecological Agriculture

Ecological agriculture is an approach rooted in a set of increasingly well-established principles that, if followed, promote the development of biodiverse and sustainable landscapes. Ultimately, the objective is to "design the strengths of natural ecosystems into agroecosystems".[16] Originally conceived as a holistic approach to food production and landscape management, ecological agriculture emphasizes agricultural practices and the political dimension of agroecosystems and food

[11] Wezel A, Herren BG, Kerr RB, Barrios E, Gonçalves ALR, Sinclair F. 2020. Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review. Agronomy for Sustainable Development (2020) 40:40, pp 1-13

[12] Jeanneret Ph, Aviron S, Alignier A, Lavigne C, Helfenstein J, Herzog F, Kay S, Petit S. 2021. Agroecology landscapes. Landscape Ecol. 36: 2235–2257

[13] ADB. 2011. Community-Based Climate Vulnerability Assessment and Adaptation Planning: A Cook Islands Pilot Project; Manila, the Philippines.

[14] Declet-Barreto et al., 2020; CARE 2019; Wezel et al., 2020. Guide to community climate vulnerability assessments. NRDC. https://www.nrdc.org/sites/default/files/guide-community-climate-vulnerability-assessments-report.pdf

[15] CARE. 2019. Climate Vulnerability and Capacity Analysis Handbook (CVCA). Version 2.0; Den Haag, Nederland.

[16] Magdoff, F. 2007. Ecological agriculture: principles, practices, and constraints. Renewable Agriculture and Food Systems: 22(2); 109–117

systems.[17] FAO[18], for example, identifies 13 principles, of which eight concern farming practices and five broader socio-cultural and political dimensions.[19,20]

The approach described in this report builds on eight of FAO's principles that apply directly to farm design and management:

1. *Recycling:* Use local renewable resources and, as far as possible close nutrients and biomass resource cycles.
2. *Input reduction:* Reduce dependency on purchased inputs, and increase self-sufficiency.
3. *Soil health:* Maintain and enhance soil health and function for improved plant growth by managing organic matter and improving soil biological activity.
4. *Animal health:* Ensure animal health and welfare.
5. *Biodiversity:* Maintain and enhance the diversity of species, functional diversity, and genetic resources and thereby maintain overall agroecosystem biodiversity in time and space at field, farm, and landscape scales.
6. *Synergy:* enhance positive ecological interaction, synergy, integration, and complementarity among the elements of agroecosystems (animals, crops, trees, soil, and water)
7. *Economic diversification:* Diversify on-farm incomes by ensuring that small-scale farmers have greater financial independence and value-added opportunities and can respond to consumer demand.
8. *Co-creation of knowledge:* enhance co-creation and horizontal sharing of knowledge, including local and scientific innovation, primarily through farmer-to-farmer exchange.

Figure 1: Farms are often embedded in the local landscape, and upland agriculture can have significant impacts on the surrounding environment as well as neighbouring and lowland communities and farmers

Source: ICEM

[17] Magdoff, F. 2007. Ecological agriculture: principles, practices, and constraints. Renewable Agriculture and Food Systems: 22(2); 109–117.

[18] HLPE (2019) Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High-Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome, accessed here: https://www.fao.org/3/ca5602en/ca5602en.pdf

[19] Wezel A, Herren BG, Kerr RB, Barrios E, Gonçalves ALR, Sinclair F. 2020. Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review. Agronomy for Sustainable Development (2020) 40:40, pp 1-13

[20] Please see: https://www.fao.org/agroecology/overview/overview10elements/en/

Although the principles have been used to develop more sustainable farming practices in individual farms, farming practices can be more resilient if those principles are applied at a landscape scale which seeks diverse land use and high agrobiodiversity.[21,22] More homogenous landscapes with uniform land use patterns are at greater risk of pest and disease outbreaks due to a decreasing supply of natural enemies and biocontrol services. In contrast, land use heterogeneity and vegetational diversity contribute to livelihood stability and resilience to climate change. Landscapes benefit from the greater range of responses to climate change provided by a more diverse population of plant species. Planting multiple varieties also generates crop complementarities and reduces yield variance and skewness.[23] Greater heterogeneity also means farmers can better exploit the full range of ecological niches in any one site, increasing overall productivity.[24] All of this tends to reduce the risks of crop failure, particularly for economically marginalized farmers, who are less able to access crop insurance.[25]

Limiting the introduction of exotic species is advisable to increase heterogeneity. Exotic and, potentially, invasive species can disturb ecological functions and the balance of agricultural landscapes, replacing indigenous varieties and introducing diseases to which there is no natural resistance.[26,27] Conserving and reintroducing native plant species and maintaining their spatial connectivity over agricultural landscapes can increase resilience.[28] Building resilience requires thinking beyond the scale of the single farm or field and considering the position, quality, and connectivity of farms and semi-natural habitats across the larger landscape.[29] The principles of ecological agriculture applied at landscape scale need to underpin adaptation plans across linked farming systems and natural areas.

[21] Altieri MA, Nicholls CI, Henao A, Lana MA. 2015. Agroecology and the design of climate change-resilient farming systems. Agron. Sustain. Dev. (2015) 35:869–890. DOI 10.1007/s13593-015-0285-2

[22] Jeanneret et al. 2021. Please see footnote 13.

[23] Chavas JP, Di Falco S. (2012). On the role of risk versus economies of scope in farm diversification with an application to Ethiopian farms. Journal of Agricultural Economics. Agric. Econ. 63:25–55

[24] Li L, Tilman D, Lambers H, Zhang FS. (2014). Plant diversity and overyielding: insights from belowground facilitation of intercropping in agriculture. New Phytol. 203:63–69

[25] Hanley, N. (2019) The Economic Value of Biodiversity. Annual Review of Resource Economics. 11:355-755.

[26] Behera RS, Sahu RK. 2019. Native tree species are climate resilient, maintain ecological balance. Available at: https://www.downtoearth.org.in/blog/forests/native-tree-species-are-climate-resilient-maintain-ecological-balance-66135. Accessed on: 15 November 2022.

[27] Murillo C. 2022. [OPINION] Choose native trees over exotics for climate resilience and biodiversity conservation. Available at:https://www.rappler.com/voices/thought-leaders/opinion-choose-native-trees-over-exotics-climate-resilience-biodiversity-conservation/. Accessed on: 15 November 2022.

[28] Behera RS, Sahu RK. 2019. Native tree species are climate resilient, maintain ecological balance. Available at: https://www.downtoearth.org.in/blog/forests/native-tree-species-are-climate-resilient-maintain-ecological-balance-66135. Accessed on: 15 November 2022

[29] Jeanneret et al. 2021. Please see footnote 13.

Figure 2: Building resilience requires thinking beyond the scale of the single farm or field and considering the position, quality, and connectivity of farms and semi-natural habitats across the larger landscape

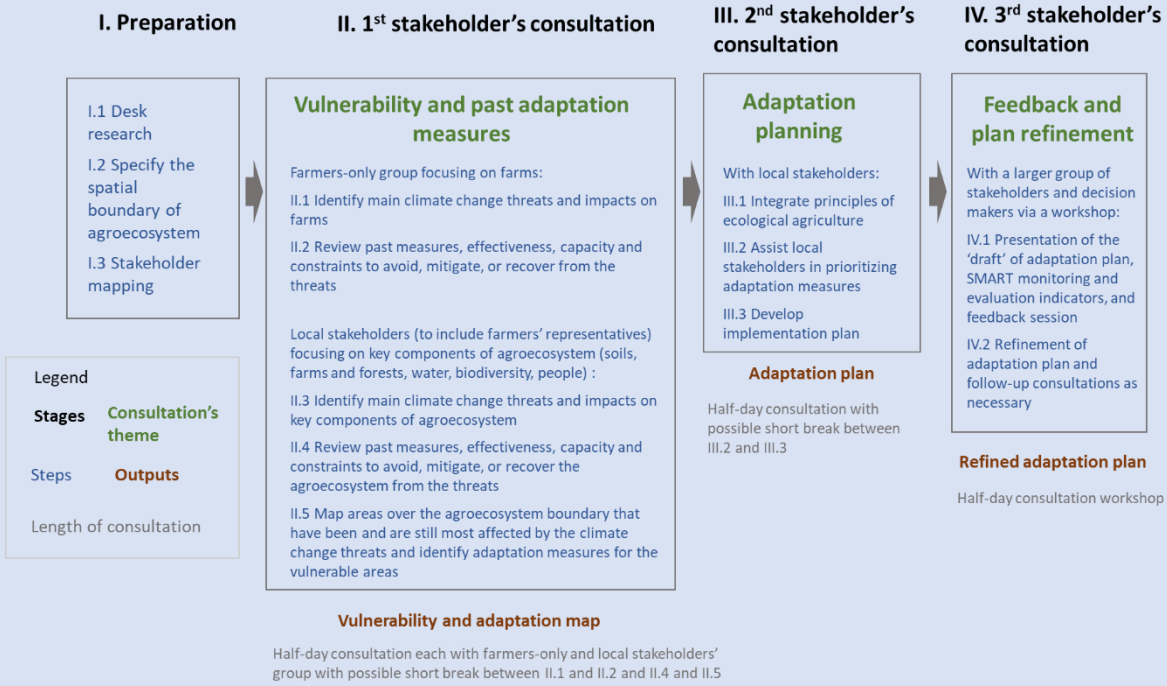
The manual is organized into eight sections. Section 2 sets out the conceptual and methodological framework. Sections 3 to 7 present the stages and steps to carry out the assessment. Section 3 elaborates on the methodology for the preparation stage. Sections 4, 5, and 6 describe activities to engage with farmers and local stakeholders to identify past adaptation measures and develop the vulnerability and adaptation map. Section 7 describes the steps required to open the discussion to a broader selection of stakeholders and refine the plan accordingly.

2 Methodological Framework

2.1 Four Stages of Vulnerability Assessment and Adaptation Planning

The community-based vulnerability assessment and adaptation planning is organized into four stages, including the preparation phase (Figure 3).[30] Each of the four stages contains steps and activities to be conducted with stakeholders.

Figure 3: Conceptual and methodological framework proposed in this manual



Source: ICEM 2021

The four stages consist of a preparation stage and three stakeholder consultations with farmers and local stakeholders associated with the target agroecosystem. The consultations are conducted mainly through focus group discussions. If the assessment team needs to explore an aspect of the study in more depth or if gathering stakeholders together is problematic key informant interviews or consultation meetings with individual stakeholders or stakeholder groups can be considered.

2.2 Brief Description of Each Stage

2.2.1 Preparation Stage

In the preparation stage, the assessment team collects and analyses existing information about the target agroecosystem and study site. The more information the assessment team can obtain and analyze, the less likely they will overlook important climate-related issues affecting the agroecosystem. The team can also use the information to guide or enrich discussions with farmers and local stakeholders. Desk research should be conducted prior to the community-based assessment to establish the broader context and frameworks within which the plan is implemented.[31] Sources of information include literature reviews, census, climate-related disaster data, meteorological analysis, forestry and land use maps, and sub-national climate policies or programs.

[30] The approach is adapted from ICEM 2021 which proposes three main stages, broken down into twelve steps: (1) impact and vulnerability assessment, (2) adaptation planning, and (3) implementation and feedback. See ICEM. 2021. Climate Change Vulnerability Assessment and Adaptation Methodology for Ramsar sites in India - A guide for Ramsar site managers. Prepared for GIZ. Hanoi, Vietnam.

[31] For further guidance on effective research see: Le, T.T. et al.2021. Development of Climate-Smart Maps and Adaptation Plans (CS-MAP) for Rice Production in Viet Nam; Hanoi, Vietnam; ICEM. 2021. Climate Change Vulnerability Assessment and Adaptation Methodology for Ramsar sites in India - A guide for Ramsar site managers. Prepared for GIZ. Hanoi, Vietnam;

2.2.2 First Stakeholder Consultation

The objective of the first stakeholder consultation is to conduct a baseline and vulnerability assessment, including identifying past adaptation measures in response to climate-related extremes. The assessment team conducts two group discussions with (i) farmers and (ii) local stakeholders, including farmer representatives. Although the discussions can be conducted in parallel, it is recommended to conduct discussions with the farmers group first. The team can then better understand the issues within the agroecosystem and their impacts on farms, which they can test with the broader stakeholder group. This will also enable the team to crosscheck any inconsistencies and establish a more accurate picture of the agroecosystem.

The farmers group should include smallholder farmers, and the discussion should focus on the impacts of climate change threats on farms. The assessment team may want to consider organizing a separate female-only group, as women often have distinct roles in families and communities and may have different perspectives that they may not share in a mixed setting. If the target agroecosystem is a watershed, the farmers-only group can be split into upstream and downstream groups, as in many cases, the two communities confront different climate change threats and may experience different impacts.

The group should be encouraged to identify a maximum of five climate change threats and five farming systems to ensure the discussion can be completed in time. The assessment team should also clarify and agree with the participants a manageable time period as the focus of the session. Limiting the discussion to the previous five years will be adequate in areas prone to frequent extreme weather events. Any longer and farmers might struggle to provide accurate information.

Figure 4: Local stakeholders in the Philippines work with a facilitator to identify climate change threats in the local area

Source: ICEM

The local stakeholder group will discuss climate impacts on farms and other key components of the target agroecosystems. Farmers' representatives can include those assuming senior positions in the

community or government, such as community leaders or representatives from farmers' associations[32] who are knowledgeable about climate-related issues in the target agroecosystems.

Agroecosystems are organized into five key components: soils, farms and forests, water, biodiversity, and people.[33] Only farmer representatives are included in the discussion on the critical components of agroecosystems because it is usually challenging to obtain reliable information from individual farmers on climate issues at a broader landscape scale.

Discussions are usually completed within half a day[34], with a short break between sessions. If the discussion involves more than one group (male and female or upstream and downstream groups, for example), the assessment team can organize parallel discussions with different facilitators and note-takers.

2.2.3 Second Stakeholder Consultation

The objective of the second stakeholder consultation is to develop a draft adaptation and implementation plan. The assessment team will work with the local stakeholder group to develop the plan using outputs from the first consultation. To ensure its relevance, the plan should include roles for smallholder farmers and identify potential benefits that farmers can derive from the implementation.[35] As with the first session, the second stakeholder consultation should take half a day. If it is possible to organize the first stakeholder discussions simultaneously and in the same venue (if two rooms are available), the first and second consultations can be completed on the same day.

2.2.4 Third Stakeholder Consultation

In the third stakeholder consultation, a larger group of stakeholders and decision-makers discuss the draft adaptation plan in a workshop. The consultation can be extended to higher-ranking government officials, leaders of regulatory agencies, or private sector representatives who might have been reluctant to join earlier sessions. Inviting higher-ranking government officials to the workshop will allow them to consider the feasibility of integrating the adaptation plan into government programs and policies.

The session's objective is to refine the plan using the inputs and feedback from workshop participants and identify follow-up actions to help integrate the plan into government programs or policies. Integrating the plan into wider government programs may help elicit support from the private sector, local government and stakeholders, and local communities.

2.3 Facilitating the Sessions

Facilitating the discussions is key to the success of the process. The assessment team will require at least one facilitator and one note-taker for each discussion. Before the discussion, the assessment team will need to ensure that facilitators understand the background and purpose of the assessment and the details of the study site. They will also need to be familiar with climate change-related issues. It may be appropriate to conduct a rehearsal to ensure the facilitators are confident with the process. The facilitators will need to familiarise themselves with the manual, the steps of activities, and associated tools and practice how they will start and lead the discussions. If necessary, facilitators can

[32] In the case of Vietnam, the Farmers' Union exists at different administrative levels (national, province, district, commune) as a socio-political organization of the Vietnamese peasantry. They play key and central roles in leading farmers' movement and are often invited for discussions at community level. For more information: Viet Nam Farmer's Union (vietnamfarmerunion.vn)

[33] Conceptually agroecosystems are more complex, however, for ease of discussion agroecosystems are organized into these five categories. See, for example, Jarvis, D.; Hodgkin, T.; Brown, A. 2016. Chapter 6. Abiotic and Biotic Components of Agricultural Ecosystems. In Crop Genetic Diversity in the Field and on the Farm: Principles and Applications in Research Practices; Jarvis, D., Hodgkin, T., Brown, A., Eds.; Yale University Press, New Haven: Yale, New York. p. 416.

[34] Mainly based on experience of World Agroforestry (ICRAF) team in organizing such consultations in Vietnam.

[35] See, for example: Harvey, C.A. et al. 2018. Climate change impacts and adaptation among smallholder farmers in Central America. Agriculture & Food Security. 7. pp. 1–20. doi:10.1186/S40066-018-0209-X/TABLES/3 and Talukder, B. et al. 2021. Health impacts of climate change on smallholder farmers. One Health (Amsterdam, Netherlands). 13. doi:10.1016/J.ONEHLT.2021.100258.

discuss with the assessment team how to phrase guiding questions so the participants better understand them.

The facilitators' main role during the group discussions is to help ensure that ideas and opinions from each participant are shared. It is best if the facilitators do not dominate the discussion or seek to influence the outcomes. Facilitators do not need to be experts on climate change and agroecosystems. However, they should have a good understanding of the main terms and concepts used in the manual. Good communication and interpersonal skills are generally more important than subject knowledge.

During the discussions, the facilitators will apply the framework described in this manual and guide the participants, while the note taker will document all participants' input. If necessary, the facilitator can ask permission from the participants to record the session. The assessment team and facilitators should ensure, where possible, that the same people (farmers and local stakeholders) participate in all the sessions.

3 Preparation

3.1 Activity I.1: Desk Research

Purpose	Collect and analyze existing information about the target agroecosystem and study site before conducting the community-based vulnerability assessment and adaptation planning.
Output	Synthesis of literature review on the target agroecosystem, study site and associated climate-related issues. The review might cover secondary census and climate-related disaster data, results of meteorological analysis, available land use maps obtained online or from local authorities and a description of the (national and local) government's relevant policies or programs.
Prerequisites	The assessment team can conduct online research and consult with local authorities at the appropriate administrative level to obtain data such as agriculture, household census, and meteorological information.
Materials	Reading materials on the target agroecosystem and study site, census and climate-related disaster data, meteorological data, land use maps, lists of relevant government policies and programs. A more detailed description of each of these materials is provided below in the 'Guidance and Steps'.
Guidance and steps	The assessment team should ideally conduct the following desk research activities: 1. *Literature review* Check the availability and extract key information from references such as project reports, scientific papers, news articles, or presentations on the targeted agroecosystem and study site, and associated climate change-related issues. Search engines such as Google or Google Scholar can be used for the review. 2. *Check available census and climate-related disaster data* Agricultural and household census data and information about disaster occurrence, impacts, and casualties at the appropriate administrative level can usually be obtained from statistical yearbooks or local authority records.[36] The data may be available online or directly from local authorities.[37] The data can provide a range of preliminary information, including the variation in crop production over time, which can be cross-referenced with information on the occurrence of extreme weather events. 3. *Conduct meteorological analysis* Check the availability of historical meteorological data[38] to identify trends (for example, increasing air temperature or changes to the precipitation regime across years or decades). If sufficient resources are available, the team might consider making future precipitation or air temperature projections based on historical trends or develop climate scenarios. 4. *Check available land use maps* Forestry and land use maps might also contain information on administrative boundaries. Topography maps can show current land uses and historical land use changes (if maps from previous years exist) and the study site's geographical context, such as upstream–downstream or upland-lowland areas. In case no map can be obtained[39], the satellite layer in Google Maps or Google Earth can be helpful. 5. *Understand the context of climate policies or programs* These include national and sub-national policies on climate change mitigation and adaptation, disaster risk reduction, and rural and agricultural development.

[36] In Vietnam, detailed information on climate-related disasters is available from institutions like Disaster Management Policy and Technology Centre. Please see: Trung tâm Chính sách và Kỹ thuật phòng chống thiên tai (dmc.gov.vn)

[37] For the case of Vietnam, online statistical yearbook data are usually available only at the national or provincial level, and they report production of the country's 'main crops'. Please see the General Statistical Office of Vietnam: www.gso.gov.vn

[38] In Vietnam, we can check the availability of daily meteorological data (recorded at least since the 1980s) for our study site with the Institute of Meteorology, Hydrology and Environment (IMHEN). If available, we can purchase the data from this institution.

[39] In Vietnam, the Department of Agriculture and Rural Development (DARD) produced high resolution commune maps in 2010 to support the planning of the new rural policies. However, it is likely challenging to obtain copies.

3.2 Activity I.2: Specify the Spatial Boundary of the Agroecosystem

Purpose	Specify the spatial boundary of the agroecosystem for the assessment and plan.
Output	The spatial boundary of the assessed agroecosystem.
Prerequisites	The collection of available maps for the research site. These include administrative, forestry, land use maps, and digital elevation models (DEM). The team can also undertake a scoping visit or transect walks as necessary, and as resources allow.
Materials	Printed maps with information on administrative boundaries, forestry and land uses, and topography. The maps should have markers of at least two different colours to distinguish between boundaries that are not already illustrated on the map and the agroecosystem's boundary.
Guidance and steps	The team should identify existing boundaries with the support of local partners or representatives from local regulatory agencies who are familiar with the landscape of the potential research site. Where possible, the team should identify: ● Administrative boundaries and boundaries of protected areas, ● Buffer zones, watersheds, and river basins used by local communities and authorities may form the potential boundary of the target agroecosystem. The team may also want to consider identifying boundaries of farm and forest areas that are *intentionally* managed by local communities to produce foods and ecosystem services.[40] These can include infrastructure, markets, or settlements. Ideally, the chosen boundary will coincide with existing administrative boundaries already clearly defined. Creating new boundaries often creates difficulties during consultations with farmers and local stakeholders. Selecting an existing boundary can also help ensure the availability of secondary information.

3.3 Activity I.3: Stakeholder Mapping

Purpose	Identify key stakeholders and their main roles in producing and/or maintaining foods and ecosystem services within the boundary of the agroecosystem.
Output	List of stakeholders with (at least) institution names, contact details, and specific roles in the agroecosystem. The assessment team can use the list to invite stakeholders to the consultation activities.
Prerequisites	List of administrative units, for example, districts, communes, or villages that overlap or intersect with the agroecosystem's boundary. It is ideal if the assessment team has some information on key stakeholders in the agroecosystem from the desk study.
Materials	List of administrative units and an initial list of key stakeholders and their roles in the agroecosystem that were obtained from the desk study.
Guidance and steps	The following provides a series of issues and questions to discuss with partners or representatives from local regulatory agencies who are knowledgeable about different stakeholders and their roles in the agroecosystem: 1. *The hierarchy of agriculture management and support for farmers*: which agencies oversee agriculture management over agroecosystem boundary? Among these, who provides technical support to farmers, weather forecasts, natural disaster warnings and agricultural advice? 2. *Role of private enterprises*: are there farms owned or managed by private enterprises? Do some private enterprises cooperate with farmers in crop cultivation, farm management options and/or post-harvest processing? 3. *Hierarchy of forest management and stakeholder's engagement in forest protection:* which agencies oversee forest management over the agroecosystem boundary? Do farm households participate in forest protection and restoration activities? Is there any payment for the forest ecosystem service (PFES) scheme in the agroecosystem? If yes, how is it organized, and who are the buyers? 4. *Tourism activities*: are there tourism activities in the agroecosystem boundary? If yes, what kind of activities are operated by local community, private companies, or state-own agencies? 5. *Research and development activities*: is there any non-government organization undertaking research and development work in the agroecosystem? If yes, in which area and what is the focus and main objective?

[40] The principle of "intentionality" is discussed in detail in Cabell, J..; Oelofse, M. 2012. An Indicator Framework for Assessing Agroecosystem Resilience on JSTOR. Ecology and Society. 17. 13.

4 Consultation with Farmers-only Group

4.1 Activity II.1: Identify Main Climate Change Treats and Impact on Farms

Purpose	Identify (a maximum of five) climate change threats and (a maximum of five) affected farming systems and establish how and to what extent the farming system has been affected.
Output	Summary table. See Table 4.1 for a template.
Prerequisites	It is ideal if the assessment team already has some information on the main climate change threats to the agroecosystem and the impact on farms from the desk study.
Materials	A0 paper with a sketch of the summary table, markers (not necessarily different colours), a recorder to record all inputs from the participants.
Duration	Around 2 hours
Guidance and steps	1. Clarify the meaning of climate change threats with the participants and provide some examples. 2. Propose and agree with participants on the time scale of interest, for example, the past five or ten years. 3. Identify a maximum of five main climate change threats. Allow the participants to determine what they consider to be a threat. Record which year or years the event took place and its duration in each year. 4. Ask farmers for a maximum of five most affected farming systems. 5. Link each farming system to the identified climate change threats, and establish the main impacts on crop health, growth and survival, farm productivity, and/or product quality. The participants can highlight specific impacts on their farms or general impacts at the community level. 6. To ensure the information can be compared among groups, the facilitators need to guide farmers to express the impacts in quantitative figures, for example: "About 80% rice paddy fields in the community were affected, and rice paddy plants in 50% of the affected field died because of the prolonged dry season". Farmers can also express the impacts in a range: "40–80% of rice paddy plants in farms managed by households in the community died because of the prolonged drought". The facilitators should establish *the impacts* and *how* the climate change threats caused the impacts.

Table 4.1: Template and example of main climate change threats and impacts on farms

No.	Main climate change threats (max 5), definition, years, length within years	Months											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Extremely hot dry season in 2017-2021: with more than 7-10 very hot days					7 very hot days in May and 10 days in June, maybe above 40°C							
2	Prolonged dry season (drought) in 2018: extended into another two months					Normally only May and June, extended into July and August. In August, nearby streams all dried, limited waters from wells for human consumption							
3	…												
4	…												

	Main farming systems (max 5) affected by the climate change threats	1	2	3	4	5	6	7	8	9	10	11	12
1	Wet paddy rice (variety if possible)					Paddy planted in July, no impact from extremely hot days		Around 30% plants died in July, and 100% died in August, no irrigation, nearby streams all dried					
2	*Acacia mangium* with cassava in the first two years					Almost no impact		Some trees had yellow leaves in July, around 30% of acacia trees died in August					
3	…												
4	…												

Source: Adapted template from Simelton et al.[41]

4.2 Activity II.2: Review Past Adaptation Measures

Purpose	Understand farmers' past adaptation measures, the effectiveness of those measures, constraining factors, and how farmers can be supported to better implement the measures.
Output	Summary table (see Table 4.2) in which past adaptation measures are divided into three categories: ● Those applied before the climate event to avoid or mitigate the impacts. ● Those applied during the event to mitigate the impacts. ● Those applied following the event to recover from the impacts and to avoid similar impacts in the future.
Prerequisites	Facilitators can help farmers recall the main climate change threats and impacts the group has already identified. The summary table of main climate change threats and impacts on farms (from Activity II.1) can be placed on a wall.
Materials	A0 paper with sketch of the summary table, markers (not necessarily of different colours), a recorder to record all inputs from the participants.
Duration	Around 1 hour
Guidance and steps	1. To help farmers to identify *adaptation measures before the climate change threats*, the facilitators can ask the following questions: ● How did you know that climate change threats would happen? ● Where did you get the information? ● Did you foresee the impacts? ● Do you have any access to an early warning system or weather forecast? ● What did you do to avoid or mitigate the effects of the threats on your farms? ● Did you cultivate crop varieties that are more resilient to the threats? ● Did you adjust the cropping calendar? ● Did you consider developing integrated systems such as agroforestry systems (generally considered more resilient to climate change threats)? 2. Investigate farmers' adaptation measures *during the threats* using the following questions: ● What did you do to mitigate the impacts on your farms? ● Do neighbours usually help each other? ● Did you usually get any assistance during the events? ● If yes, from whom and what kind of assistance? 3. Investigate farmers' adaptation measures *following the events* using the following questions:

[41] Simelton, E. et al. 2013. The Talking Toolkit. How smallholding farmers and local governments can together adapt to climate change. Part I; Hanoi, Vietnam.

	● What did you do to recover your farms from the impacts of the climate change threats? ● Did you decide to improve your access to climate information or early warning system? ● Did you get any support or assistance from the local government to recover your farms? If yes, what kind of support or assistance? 4. Identify if the adaptation measures can be considered effective, what the constraints and barriers were and what support the farmers think they would need to better implement the measures?

Table 4.2: Template and example of farmers' past adaptation measures[42]

	Past adaptation measures	
	Related to drought in 2018	**Other climate change threats…**
Before event (to avoid or mitigate)	● Sought information about the possibility of a prolonged dry season from extension service. ● Dug a new but relatively small pond in home yard.	
During event (to mitigate)	● Covered soils with straws and vegetation residues. ● Tried to find a new source of water for crop irrigation but failed.	
Following event (to recover and to avoid similar impact in the future)	● Tried to get information on drought-tolerant rice and maize varieties, but not available. ● Expected to get more reliable and timely weather information and warning system. ● Tried to get seedling subsidies from the government for the next planting season. ● Considered covering soil surface with plastic.	
Can the measures be considered effective? Why? If no, what do you think of more effective measures?	● Covering soil surface with plastic could help reduce drought impact, but needs a higher investment cost than covering with straw and crop residues. ● Can consider digging a bigger pond in home yard. ● If possible, install a water tank.	
Main constraints in implementing the more effective measures	● Home yard is relatively small; need space to cultivate vegetables and for livestock pens too; difficult to dig a bigger pond. ● Not enough money to buy and install a water tank.	
Supports needed to better implement adaptation measures	● Need more reliable and timely climate information ● Drought-tolerant rice and maize varieties ● Training on installing an improved irrigation system ● Financial support to buy and install a water tank	

[42] Adapted from: Simelton, E. et al. 2013. The Talking Toolkit. How smallholding farmers and local governments can together adapt to climate change. Part I; Hanoi, Vietnam.

5 Activities with Local Stakeholders

5.1 Activity II.3: Identify Climate Change Threats and Impacts on Agroecosystem

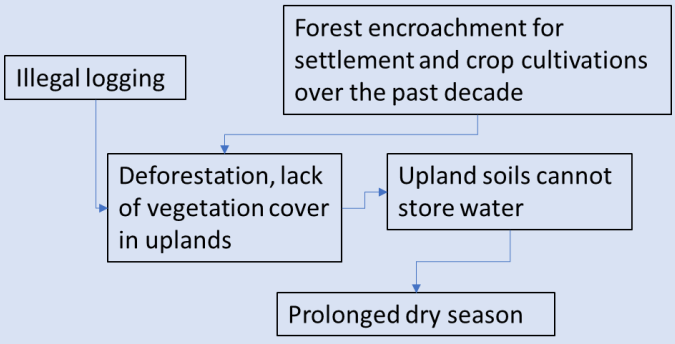
Purpose	Identify main climate change threats, human-caused factors that exacerbate the impacts, and impacts on the key agroecosystem components: soils, farms and forests, water, biodiversity, and people.
Output	Summary table (See Table 5.1 for a template and examples)
Prerequisites	If the consultation with the farmers-only group was conducted in advance, facilitators can use the outputs to better understand the main climate threats and impacts on farms over the agroecosystem and crosscheck any inconsistencies with inputs from local stakeholders as necessary.
Materials	A0 paper with a sketch of the summary table, markers (not necessarily different colours), paper cards of about 10 cm x 15 cm (not necessarily different colours) to record human-caused factors identified by the participants, and a voice recorder to record all inputs from the participants.
Duration	Around 1.5 hours.
Guidance and steps	1. Clarify the meaning of climate change threats with the participants and provide some examples. 2. Propose and agree on the time scale of interest. Ideally, it should be longer or similar to that adopted by the farmers-only group. 3. Identify a maximum of five main climate change threats that have most affected the agroecosystem and ask the group to define the threats and which years and months they occurred. 4. Guide participants to identify the impacts on soils (for example, fertility and texture), farms and forests (for example, affected area and production), water (for example, quantity and quality), biodiversity (for example, plants and animals), and people (for example, food shortage and income). If possible, ensure impacts are expressed quantitatively such as the percentage of farm area damaged, estimated income loss or number of casualties. 5. Ask the participants to identify human-caused factors that exacerbate the impacts of the identified climate change threats by writing down the factors on paper cards, one factor per card. 6. Work with participants to identify and interpret any possible causal relationship among the identified factors. For example, if drought was identified as a climate change threat and the participants mentioned a lack of vegetation cover in the uplands, illegal logging, deforestation, and forest loss as possible factors, a possible causal relationship could be: the illegal logging resulted in deforestation and lack of vegetation cover in the uplands which meant that lands in the uplands cannot hold as much water during the rainy season. The facilitator can sketch a diagram (Figure 5) that helps the participants better understand the possible causal relationship among the factors. **Figure 5: Example of relationships between factors** 

Table 5.1: Template and example of climate change threats and impacts according to local stakeholders

No.	Climate change threats (max 5), definition, years, which months	Impacts on agroecosystem's components (what, how)	Main human-caused factors that made the impacts more serious (what, how)
1	Drought in 2018: two-month extension of the dry season (May-August)	*Soils*: cracked, became very hard, affected future crop production	Forest loss, deforestation, illegal logging, encroachment for settlement and crop cultivations over the past decade, lack of vegetation cover in uplands
		Farms and forests: Income loss because no paddy rice and maize yield, farm households had almost no income in 2018, drought triggered forest fire, lost 20 ha of pine plantation forests; because of water shortage: lost 100% area of paddy rice and maize, 20% of livestock (cows and goats) population died	
		Water: river streams completely dried in mid-July, no water for crop irrigation and livestock	
		Biodiversity: significant loss because of forest fire, forest recovery takes long time	
		People: all households experienced water shortage due to drying wells	
2	Other climate change threats…		
3	…		

5.2 Activity II.4: Review Past Adaptation Measures

Purpose	Understand local stakeholders' past adaptation measures, the effectiveness of those measures, constraining factors and potential capacity development that can enable the local stakeholders to better implement the measures
Output	Summary table (see Table 5.2) in which past adaptation measures are divided into three categories: ● Those applied before the climate event to avoid or mitigate the impacts. ● Those applied during the event to mitigate the impacts. ● Those applied following the event to recover from the impacts and to avoid similar impacts in the future.
Prerequisites	The facilitator helps the participants recall the climate change threats and impacts on the components of the agroecosystem. It is helpful to put the previous summary table on a wall.
Materials	A0 paper with a sketch of the summary table, markers (not necessarily of different colours), and a recorder to record all inputs from the participants
Duration	Around 30 minutes
Guidance and steps	1. Ask the participants to identify adaptation measures *before the climate events* using these guiding questions: ● When, how, and from where do you usually get forecasts of climate change threats? ● Do you have any access to an early warning system or weather forecast? ● What did you do to avoid or mitigate the impacts of the climate change threats on the agroecosystem's components and their services? 2. Ask the participants to identify adaptation measures *during the events* using these guiding questions: ● What did you do to mitigate the impacts on the agroecosystem's components and their services? ● Did you usually get any assistance during the events? If yes, from whom and what kind of assistance?

	3. Ask the participants to identify adaptation measures *following the events* using these guiding questions: ● What did you do to recover the agroecosystem's components and their services from the impacts of climate change threats? ● What did you do to improve farmers' access to climate information or early warning system? 4. Investigate the *link between past adaptation measures and factors that made the impacts of the climate change threats more serious* by asking the participants the following guided questions: ● Were the adaptation measures intended to address the identified factors? If yes, which factors were addressed by which measures? ● Which factors were not addressed by the measures? Why were no measures taken to address the factors?

Table 5.2: Template and example of local stakeholders' past adaptation measures

	Past adaptation measures	
	Related to drought in 2018	**Other climate change threats…**
Before event (to avoid or mitigate)	● Reminded the community through radio and door-to-door visits about the possibility of an extended and severe dry season ● Reminded farm households to store water for crop irrigation and cover farms with straws or vegetation residues ● Reminded the community to avoid any activity that can easily trigger forest fire	
During event (to mitigate)	● Dig fire lines to extinguish forest fires ● Assisted farmers in finding another source of water for crop irrigation but failed because all streams were completely dried ● Implemented food and social security program for one month (August) by regularly distributing food for the most affected households	
Following event (to recover and avoid similar impacts in the future)	● Explored funding sources for forest restoration ● Strengthened forest patrolling to better protect existing forests ● Helped farmers explore drought-tolerant crop varieties ● Explored funding sources for farmers to install a water tank ● Found areas to dig big ponds for communal uses ● Helped farm households explore potential non-farm activities for income diversification	
Can the measures be considered effective? Why? If no, what do you think of more effective measures?	● Not really; many farm households were still seriously affected ● Need to develop a better warning system, but until now not sure how ● Fire lines were effective and low cost ● According to farmers, the food and social security program was beneficial	
Did the measures address the factors that made the impacts more serious? Which	● The strengthened forest patrolling is expected to avoid existing forests from illegal logging and encroachment ● Reforestation efforts increase vegetation cover	

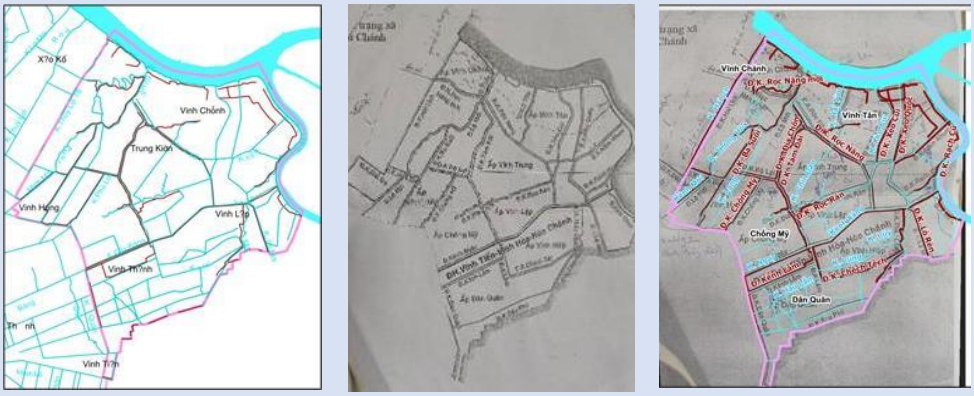
	Past adaptation measures	
	Related to drought in 2018	**Other climate change threats…**
factors were not addressed and why?		
Main constraints in implementing the measures	• Not sure how to build a more effective warning system • Not sure how to prevent forest fires during drought, fire lines are to mitigate not to prevent • Cannot find investors to help farmers install water tanks • Lack of information on drought-tolerant crop varieties that can grow well in the commune	
Capacity development needed to better implement the measures	• Training on preventing and extinguishing a forest fire • Maybe training on how to approach potential investors or building a proposal	

Source: Adapted template from Simelton et al. (2013) [43]

5.3 Activity II.5: Produce Vulnerability and Adaptation Map

Purpose	Develop a map that illustrates the geography of impacts of climate change threats and associated adaptation measures over the agroecosystem's boundary.
Output	A map such as Figure 7 (hereafter referred to as the 'vulnerability and adaptation map').
Prerequisites	The team needs to prepare a printed base map of the agroecosystem with (at least) administrative boundaries, main roads and river/stream networks, and land use/cover and legend. The more detailed the base map, the better the participants can relate the map to their own experiences. To help participants, the map can include key and recognisable landmarks (for example, locations where the community usually gathers such as local markets, religious centres, community houses, schools, or health care centres, and more detailed transportation networks such as small roads or bridges), official and unofficial names of landmarks. The land cover distribution and legend will help the participants associate the map with the landscape of the agroecosystem, as stakeholders are typically aware of the locations of forests, croplands such as paddy rice, tree plantations, and built-up areas. To prepare the base map, the team might be able to get more detailed administration or infrastructure maps from the local government. If the maps are only available in hardcopy format, the necessary information from the maps should be digitized (see an example in Figure 6). If no map is available from the local government, the team can access online sources such as Open Street Maps, Google Maps, or ESRI online database. World countries' gazette database can also be an option, but the team needs to check the accuracy.

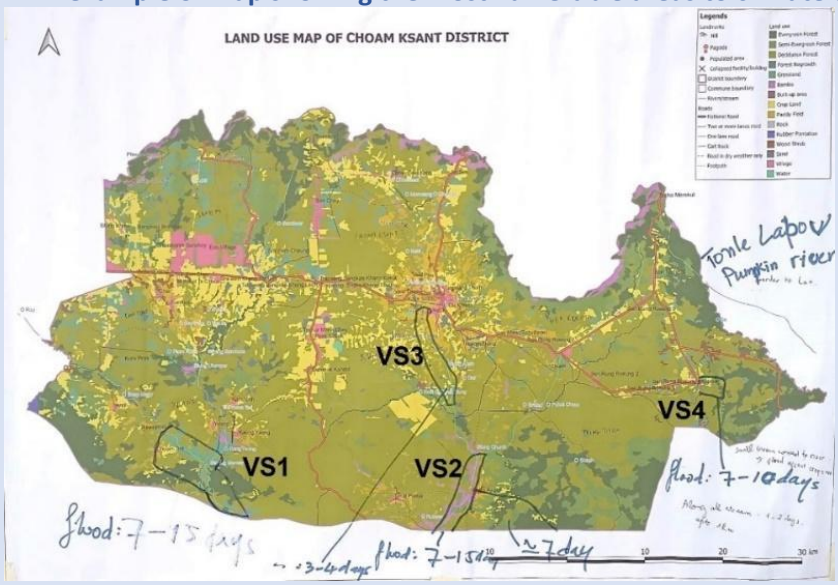
[43] Simelton, E. et al. 2013. The Talking Toolkit. How smallholding farmers and local governments can together adapt to climate change. Part I; Hanoi, Vietnam.

	Figure 6: (a) An Example of the original commune base map cropped from the province map, (b) Commune administration map from local government hard copy, (c) A more detailed commune base map  (a) (b) (c)
Materials	A base map, a laptop to show Google Maps, transparent papers the same size or larger than the base map, paper clips to attach the transparent papers to the base map, and permanent markers of different colours.
Duration	About 1.5 hours
Guidance and steps	1. Help the participants become familiar with the base map and let them provide additional landmarks and/or make corrections to, for example, the name of land uses or landmarks as necessary. If necessary, the facilitators can also use Google Maps in satellite mode (using a prepared laptop) to help the participants become more familiar with the map. The facilitators can begin by showing participants the location of the main roads and the location of the current group discussion and help them to find the location of their village and home on the map. This session is often a useful warm-up or ice-breaking session and can encourage the participants to participate better in the discussion. 2. Explain the meaning of the symbols and colours used in the map, especially colours that differentiate land uses/cover, and confirm land use/cover distribution and names with the participants. If necessary, encourage the participants to provide alternative landcover names, particularly as some terms may not be familiar. For example, “short-term crops” or “seasonal crops” may be more meaningful than the term “annual crops”. The facilitators should also explain crop commodities covered by terms. If possible, encourage the participants to refine some land use/cover classes. For example, "plantations” can be renamed “fruit tree plantations”, “timber plantations”, “banana plantations”, or “palm plantations”. The more detailed the land use/cover classes, the better the participants associate the map with the actual landscape of the agroecosystem. 3. Help the participants recall the list of climate change threats and impacts on farms and other key agroecosystem components identified in earlier sessions. For each threat, ask participants to identify the locations of farming systems or aspects of the agroecosystem that *have been most affected and are still affected*. This can help to identify where previous adaptation measures were not effective. Use a permanent marker to identify the boundary of affected areas. The team can also ask why participants consider those locations as the most impacted by climate change threats and note the participants’ feedback on the map. For example, the areas are considered the most affected because the areas were inundated for longer than other areas. Depending on the number of climate change threats identified in earlier activities, the facilitators can consider producing one vulnerability map per climate threat or one for all climate change threats. If one map is sufficient, different colour markers can mark the boundaries of areas affected by the different threats. Alternatively, several copies of the base map can be prepared. Transparent papers overlayed over the base map can also map different climate threats. Facilitators will need to redraw at least the boundary of the agroecosystem on transparent paper and attach the base map and the paper using paper clips. The

facilitators can mark the boundary of affected areas and the participants' inputs on transparent paper.

4. Assign unique codes for each of the most vulnerable areas (see Figure 7 for an example). The codes are used later during the adaptation planning.

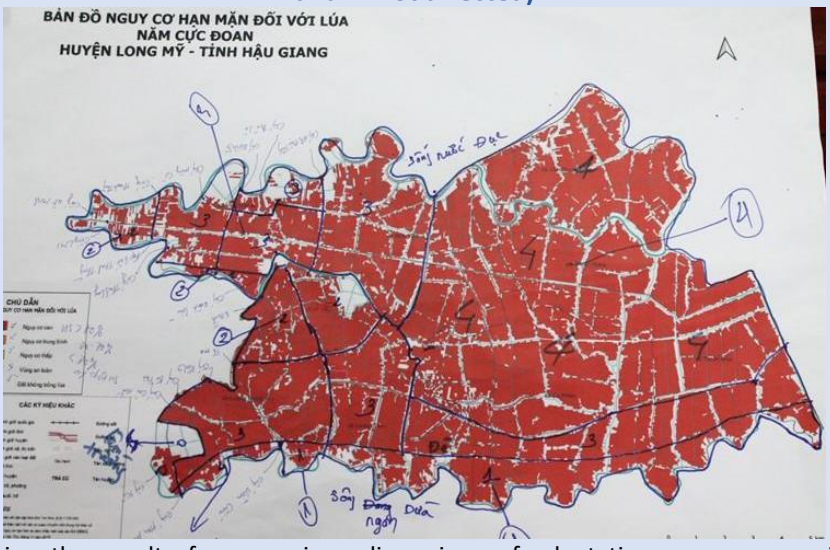
Figure 7: An example of map showing the most vulnerable areas to climate change



5. For some climate change threats, it is useful to identify the areas that have never been or have rarely been affected by the threats. This can give clues as to which adaptation measures might help avoid or mitigate climate change threats' impacts in the most vulnerable areas.

6. The facilitators can also guide participants in identifying the vulnerability levels of all areas in the agroecosystem boundary. An example from Vietnam for paddy rice areas and prolonged drought is provided in Figure 8.

Figure 8: An example of map with vulnerability Levels (1=high, 2=medium, 3=low, and 4=not affected)



7. Using the results from previous discussions of adaptation measures, enrich the vulnerability map(s) with adaptation measures that are likely to effectively avoid, mitigate or recover the vulnerable areas from impacts of future climate change threats.
8. If possible, delineate the boundary.
9. Assign unique codes for the different adaptation measures.
10. Take photos of the vulnerability and adaptation maps.

6 Assist Local Stakeholders in Adaptation Planning

6.1 Activity III.1: Integrate Principles of Ecological Agriculture

Purpose	Guide local stakeholders to understand the principles of ecological agriculture and identify feasible measures
Output	Summary table (see Table 6.1 for a template and examples)
Prerequisites	The facilitators should familiarize themselves with the eight principles of ecological agriculture and some examples of concrete measures
Materials	A0 paper with a sketch of Table 6.1, markers (not necessarily different colours), the list of past effective adaptation measures, and vulnerability and adaptation maps
Duration	Around 1 hour
Guidance and steps	1. Introduce the eight principles of ecological agriculture: recycling, input reduction, soil health, animal health, biodiversity, synergy, economic diversification, and co-creation of knowledge, and provide examples of concrete measures. 2. For each principle, guide the participants to identify feasible measures. The measures can be those proven to be effective in the study or other sites, especially sites with relatively similar biophysical, socio-economic, or ecological conditions as compared to the study site 3. For each measure mentioned by the participants, please check using the list of past effective adaptation measures if similar measures have been used. 4. For any additional measure, please discuss with the participants if potential areas for interventions can be identified on the vulnerability and adaptation map. If yes, please delineate and assign a unique code to the potential area.

Table 6.1: Template and example of measures for each principle of ecological agriculture

Principles	Feasible measures	Similar with past effective adaptation measures? Which measures?
Recycling	Process manures from livestock and apply on farms	
Input reduction	Increase organic inputs from manure and compost	
Soil health	Where possible, introduce nitrogen-fixing trees: scattered over farms, at farm borders etc.	
Animal health	Introduce strips of nutritious fodder grass on sloping lands for livestock feed and terrace formation	
Biodiversity	Restore degraded upstream forests using native tree species for water conservation and non-timber products	
Synergy	Introduce fruit or timber tree species in coffee plantations for shade and income diversification	
Economic diversification	Integrate beekeeping into forestry plantations or home gardens	
Co-creation of knowledge	Organize a monthly event in communal house for farmer-to-farmer knowledge exchange	

6.2 Activity III.2: Set Priority Level of Adaptation Measures

Purpose	Assist local stakeholders in setting priority levels for adaptation measures.
Output	Summary table (See Table 6.2).
Prerequisites	Before the discussion, the assessment team should complete the first two columns of Table 6.2 using the information obtained from previous steps, to include additional adaptation measures that align with the principles of ecological agriculture.
Materials	A0 paper with a sketch of Table 6.2 and added information in the first two columns, markers (not necessarily different colours), the vulnerability and adaptation maps.
Duration	Around 1.5 hours
Guidance and steps	1. Please discuss and agree with the participants on the number of priority levels and main criteria for determining the levels. The facilitators can first propose three

priority levels high, medium, or low priority, with attached criteria such as "urgency in implementation due to severe impacts and casualties from associated climate change threats", "availability of resources", and "technical capacity", to determine the priority levels. It might be necessary to consider further consultation or research for some measures. Some measures may also lay the foundation for implementing other measures or future adaptation investments.[44]

2. Work with the participants to assign a priority level to each adaptation measure and note the reasons for the assignment.
3. For each adaptation measure, guide the participants to identify how smallholder farmers can participate in its implementation and the benefits they can derive from it.
4. If regulatory agencies are involved in the discussion, please identify any supporting government policies or programs that can help to ensure the successful implementation of the adaptation measures
5. An effective adaptation plan usually requires an integrated set of measures across different fields of management and type of instruments.[45] This helps ensure that the plan's development and implementation involve a cross-sectoral group of specialists and stakeholders impacted differently by climate change threats. The assessment team can first classify the measures to check if the adaptation measures identified by farmers and local stakeholders are sufficiently inclusive. ICEM (2021)[46] propose nine categories and provides some examples for each: engineering measures (for example, installing water tanks), bioengineering (for example, grass strips along contour lines to reduce soil erosion in sloping uplands), traditional local adaptation measures (for example, streambank stabilisation using bamboo stakes and vegetations), economic instruments (for example, payment for forest ecosystem services), natural systems management (for example, more effective management of protected forest areas), social responses (for example, resettlement programs), policies and regulation (for example, zoning for development control, for example, no major structure close to the river banks), research and development (for example, research on drought tolerant crop species), and institutional responses (for example, creating an inter-agency network on climate change to strengthen the collaboration among organisations).

   If the assessment team adopts this approach, they should enrich Table 6.2 as necessary prior to the session by adding one column for the category of each adaptation measure.

Table 6.2: Template and example of priority levels of adaptation measures

No.*	Adaptation measures	Targeted areas	Priority level	Role and benefits for smallholder farmers	Supporting policies
A1	Improve early warning system of climate change threats	VS1-4**	High (might not entail high investment cost, can avoid many households from severe impacts of climate change threats)	Get in-time and more reliable weather information through radio, social media, or door-to-door visits with oral guidance as necessary	Need to check natural hazard prevention programs further
A2	Improve implementation of food and	Whole community	High (much-needed program but currently slow implementation,	Get in-time and regular provision of foods during recovery time	Food and social security program, poverty reduction program

[44] ICEM. 2021. Climate Change Vulnerability Assessment and Adaptation Methodology for Ramsar sites in India - A guide for Ramsar site managers. Prepared for GIZ. Hanoi, Vietnam.

[45] ICEM. 2021. Climate Change Vulnerability Assessment and Adaptation Methodology for Ramsar sites in India - A guide for Ramsar site managers. Prepared for GIZ. Hanoi, Vietnam.

[46] ICEM. 2021. Climate Change Vulnerability Assessment and Adaptation Methodology for Ramsar sites in India - A guide for Ramsar site managers. Prepared for GIZ. Hanoi, Vietnam.

No.*	Adaptation measures	Targeted areas	Priority level	Role and benefits for smallholder farmers	Supporting policies
	social security program		need better institutional arrangement and responsibilities)	from impacts of climate change threats	
A3	Introduce drought-tolerant paddy rice species	VS1-4	Medium (takes time for research and testing in local conditions, and currently, no clear funding is available)	Expected to get seedling subsidies, and not all paddy rice plants die during drought	Need to check the agriculture development program further
…					

*A1 means the first adaptation measure etc., and will be referred in the next step when developing the implementation plan, **codes used in the vulnerability and adaptation map

6.3 Activity III.3: Develop Implementation Plan

Purpose	Assist local stakeholders in developing the implementation plan that can inform possible funding sources, and implementing agencies.
Output	Summary table (See Table 6.3)
Prerequisites	Before the discussion, the assessment team provides initial ideas on possible funding sources and implementing agencies in the first two columns of Table 6.3. these can be discussed and refined with the participants
Materials	A0 paper with a sketch of Table 6.3 and added information in the first two columns, markers (not necessarily different colours), the summary table of the adaptation measures and priority levels.
Duration	Around 1 hour
Guidance and steps	1. Discuss and refine possible funding sources for the adaptation measures. Funding can potentially come from the government budgets at the relevant administrative level, official development aid (for example, bilateral projects led by non-government organizations), foreign direct investment, domestic private investment (for example, local private enterprises), or funds collected from society through fund-raising activities or crowd-funding mechanisms. 2. Discuss and refine with the participants who will implement each adaptation measure, and identify the leading and supporting agencies. 3. Help the participants set the expected number of years of implementation for each adaptation measure. The time allocated should reflect the priority levels of the adaptation measures. The participants can adapt the plan to established sub-national or national programs such as the sustainable development agenda or climate change targets.

Table 6.3: Template and Example of Implementation Plan

No.	Possible funding sources	Implementing agencies	Years of implementation								
			2022	2023	2024	2025	2026	2027	2028	2029	2030
A1	Annual funds for prevention of natural hazards	District's Agriculture Office, extension service	x	x	x						
A2	Annual funds on poverty reduction programs	Department of Social, Women's Union	x	x							

No.	Possible funding sources	Implementing agencies	Years of implementation								
			2022	2023	2024	2025	2026	2027	2028	2029	2030
A3	Project led by non-government organization	District's Agriculture Office, District's People's Committee, Farmer's Union		x	x	x	x	x	x		
…											
…											

7 Consultation Workshop on the Draft of Adaptation Plan

7.1 Activity IV.1: Presentation of the 'Draft' of Adaptation Plan and Feedback Session

Purpose	To present the plan to a larger group of stakeholders and decision-makers and elicit feedback.
Output	Refined adaptation plan
Prerequisites	The assessment team and representatives of local stakeholders who participated in the first two consultations have a draft of the adaptation plan to present and refine with the larger group of stakeholders and decision-makers
Materials	Draft of the adaptation plan, a proposed list of SMART monitoring and evaluation indicators, a recorder or video recorder to document all inputs and feedback from the workshop's participants, and necessary materials to organize a workshop (e.g., computer and projector, audio system, etc.).
Duration	Maximum half day
Guidance and steps	1. Explain the assessment background, study site selection, the conceptual and methodological framework and associated assessment tools, and the two stakeholders' consultations. 2. Present the vulnerability and adaptation map as the main output of the first consultation and the adaptation and implementation plan as the main output of the second consultation. 3. Present a proposed list of SMART (Specific, Measurable, Achievable, Relevant and Time-bound) monitoring and evaluation indicators (See Table 7.1 for an example), including sources and a description of the methodology used to identify the list of indicators (for example, national or international climate adaptation programs obtained from a literature review). Highlight the common challenges to monitoring and evaluating climate programs. These might include financial limitations, lack of human resource and technical capacity, lack of baseline and historical data, a lack of projections of climate impacts, and poor information sharing across stakeholder groups, administration levels, and government sectors.[47] In addition, emphasise that adaptation is not an outcome, and adaptation programs usually aim at enabling economies, institutions, communities, and individuals to achieve more sustainable development by increasing resilience to climate change threats. Therefore, the monitoring and evaluation indicators of climate adaptation and development programs might not look much different.[48,49] 4. If necessary, after a plenary session, the workshop's participants can be divided into groups to provide feedback on the draft of the adaptation plan and proposed list of indicators.

[47] ICEM. 2021. Climate Change Vulnerability Assessment and Adaptation Methodology for Ramsar sites in India - A guide for Ramsar site managers. Prepared for GIZ. Hanoi, Vietnam.
[48] Brooks, N. 2014. Indicators for the monitoring and evaluation of adaptation. IIED Briefing. London, UK. http://pubs.iied.org/17273IIED
[49] Bours, D.; McGinn, C.; Pringle, P. 2014. Selecting indicators for climate change adaptation programming. SEA Change Community of Practice and UKCIP. http://www.seachangecop.org/node/2806

Table 7.1: Template and examples of monitoring and evaluation indicators

No.	Indicators	Units	Related adaptation measures	Proposed measurement approach	Availability of input data	Responsible agencies
1	Number of farm households receive in-time early warning of climate change threats	People or % of the population	A1	Local extension services regularly collect information from farm households in their managed communities	List of farm households under the management of extension service is available	District Office of Agriculture
2	Number of farm households receive in-time and regular food provision from food and social security program during recovery from impacts of climate change threats	People or % from those severely affected by the climate change threats	A2	Staff from the district Department of Social and Office of Agriculture check the number of people severely affected by climate change threats and those who receive support from food and social security program	District Office have updated and detailed data on recipients of food and social security program	District Office of Department of Social and Office of Agriculture
3	Areas of paddy rice severely affected (i.e., more than 50% of plants died) by drought	Hectare or % of the total area of paddy rice in the agroecosystem	A1, A3	District Office of Agriculture and local extension services collect the data from farm households	A list of farm households under the management of extension service and those cultivating paddy rice is available	District Office of Agriculture
…						

7.2 Activity IV.2: Refinement and Follow-up Consultations

After the consultation workshop, if resources allow, the team can consider the following activities designed to assist local stakeholders in integrating the adaptation plan into government programs or policies:

i. Refine the adaptation and implementation plan draft using the input and feedback from the workshop participants and send a copy of the refined plan to the local authorities, asking for their feedback within a specified time. Some local authorities might need to consult with their department to provide official feedback.

ii. Help estimate the cost of implementing the adaptation measures and associated monitoring and evaluation activities. Even a rough approximation can give local authorities and decision-makers a sense of whether the plan is feasible.

iii. If necessary, propose consultation meetings with the different local authorities separately in their offices to obtain and discuss their feedback and inform them of the estimated cost, particularly for adaptation measures that concern them. The assessment team can also ask for input data from the local authorities to improve cost estimations.

iv. Strengthen communication with the authorities responsible for integrating the adaptation plan into government programs or policies. The team should keep the authorities updated about further consultations with other local authorities.

v. Discuss with the authorities responsible for approving the proposed plan which government programs or policies are the most suitable for integrating the adaptation plan and identify any critical steps, processes, and legal procedures. If necessary, the assessment team can offer some assistance by, for example, producing a draft of documents that can help the local authorities accelerate the integration process.

vi. Finally, the team can also provide some capacity development activities to the study site's local authorities or other stakeholders. Sessions could cover the methodological approach and associated tools to gather necessary input data and estimate the monitoring and evaluation indicators.

8 Summary

This manual provides guidance to those who wish to assess the vulnerability of agroecosystems to climate change, document adaptation strategies by farmers and local stakeholders, and develop adaptation plans. The manual provides a conceptual and methodological framework for a community-based approach that can help create mutual understanding among stakeholders as they undertake a vulnerability assessment and develop an adaptation plan.

The manual emphasises the importance of ecological agriculture to promote the development of biodiverse and sustainable landscapes. Ultimately, the objective is to *design the strengths of natural ecosystems into agroecosystems*. Originally conceived as a holistic approach to food production and landscape management, ecological agriculture emphasizes agricultural practices and the political dimension of agroecosystems and food systems. Although the principles of ecological agriculture have chiefly been used to develop more sustainable farming practices in individual farms, farming practices can be more resilient if those principles are applied at a landscape scale which seeks diverse land use and high agrobiodiversity.

The value of ecological agriculture is further reinforced by the observation that more homogenous landscapes with uniform land use patterns are at greater risk of pest and disease outbreaks due to a decreasing supply of natural enemies and biocontrol services. On the other hand, land use heterogeneity and vegetational diversity contribute to livelihood stability and resilience to climate change.

The manual also stresses the importance of local community involvement to climate vulnerability assessments and adaptation planning, as it is local communities who directly experience the impacts of extreme weather events and climate change. The manual describes how local communities can be brought into the process with semi-structured focus group discussions, key informant interviews, consultation meetings, and workshops.

The process takes place in four stages: the preparation stage, followed by three stakeholder consultations with farmers and local stakeholders associated with the target agroecosystem. The consultations are conducted mainly through focus group discussions.

In the preparation stage, the assessment team collects and analyses existing information about the target agroecosystem and study site. The more information the team can gather the richer the context in ensuing discussions with stakeholders. This stage also provides important information regarding climate threats and other issues that can be used to frame sessions with stakeholders.

In the first stakeholder consultation, the team conducts a baseline and vulnerability assessment. The sessions, held with farmers and local stakeholders, identify past adaptation measures in response to climate-related threats and measures employed to combat them. The group is encouraged to identify a maximum of five climate change threats and five farming systems to ensure the discussion is time bound and focused. A critical output of the session will be a vulnerability and adaptation map that will depict the geography of the impact of current climate change threats and the spatial distribution of adaptation measures.

The objective of the second stakeholder consultation is to develop a draft adaptation and implementation plan. The assessment team will work with the local stakeholder group to develop the plan using outputs from the first consultation. Stakeholders are encouraged to incorporate the eight principles of ecological agriculture identified at the beginning of the process. Once measures have been identified, and their suitability tested against stakeholders' experience and knowledge, the measures are prioritised against criteria agreed among all present.

In the third stakeholder consultation, a larger group of stakeholders and decision-makers discuss the draft adaptation plan in a workshop. The consultation can be extended to higher-ranking government officials, leaders of regulatory agencies, or private sector representatives who may not have been involved in earlier sessions. This crucial stage ensures that the process outputs are

socialised among the wider community and those who can help access resources or develop and influence relevant institutions and organisations.

The final documentation and maps will also be invaluable tools to integrate the plans into government programs or policies. As well as advocating for specific measures to increase resilience to existing and anticipated climate threats, the spatial and conceptual detail can help decision-makers understand costings, potential benefits, and compatibility with existing policies and programs.

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