AGROECOLOGY ASSESSMENT OF INDIGENOUS PEOPLES' FOOD SYSTEMS REPORT

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The ROCKEFELLER FOUNDATION

INDIGENOUS PARTNERSHIP FOR AGROBIODIVERSITY AND FOOD SOVEREIGNTY

CONTENTS

Agroecology Assessment of Indigenous Peoples' Food Systems Report

Acronyms and Abbreviations

A-WEAI	Abbreviated Women's Empowerment in Agriculture Index
CAET	Characterization of the Agroecological Transition
ECHO	Educational Concerns for Haiti Organization
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Group Discussion
FPIC	Free and Prior Informed Consent
FIES	The Food Insecurity Access Scale
ICDS	Integrated Child Development Services
IFAD	International Fund for Agricultural Development
IP	Indigenous Peoples
IPFS	Indigenous Peoples' food systems
LSU	Livestock unit
NESFAS	Northeast Society for Agroecology Support
NGO	Non-Governmental Organisation
NSP	FAO's Plant Production and Protection Division
NTFP	Non-Timber Forest Products
OPDP	Ogiek Peoples' Development Programme
PASD	Pgakenyaw Association for Sustainable Development
PES	Payment for Ecosystem Services
PDS	Public Distribution System
REPSERAM	Red de Productores de Servicios Ambientales
PM POSHAN	Pradhan Mantri Poshan Shakti Nirman.
PRA	Participatory Rural Appraisal
SDG	Sustainable Development Goals
SV	Sembrando Vida
SWC	State Welfare Card
TAPE	Tool for Agroecology Performance Evaluation
TIP	The Indigenous Partnership for Agrobiodiversity and Food Sovereignty `
UNFSS	United Nations Food Systems Summit
UIMQROO	Universidad Intercultural Maya de Quintana Roo

Acknowledgement

This report embodies the collective efforts of The Indigenous Partnership for Agrobiodiversity and Food Sovereignty (TIP), alongside its partners and the dedicated support of numerous individuals and organisations committed to advancing Indigenous Peoples' food systems (IPFS) for the benefit of nature, people, and climate. Our heartfelt gratitude goes to the Rockefeller Foundation for their generous funding, which made this research possible. Additionally, we extend our appreciation to CS Fund for their support in producing this report.

We extend our sincere appreciation to the 500 households from the Karen People of Northern Thailand, the Garo, Karbi and Khasi Peoples of Northeast India, the Ogiek Peoples of Kenya and the Yucatec Maya Peoples of Mexico. Your participation and collaboration were essential to the success of this research. We are particularly grateful to the Elders, women, and community members who shared their invaluable agroecological insights into their food systems. The findings of this study are intended to provide evidence on the agroecological outcomes of Indigenous Peoples' food systems and to enhance their resilience and contributions in addressing the climate change crisis.

Our deepest thanks go to our partner organisations for their invaluable collaboration in implementing the Tools for Agroecology Performance Evaluation (TAPE) across their respective landscapes. We acknowledge the essential roles played by the Northeast Society for Agroecology Support (NESFAS) in Northeast India, the Pgakenyaw Association for Sustainable Development (PASD) in Northern Thailand, the Ogiek Peoples' Development Programme (OPDP) in Kenya, and the Universidad Intercultural de Quintana Roo (UIMQROO) and Glocal Bej in Mexico. We also express our gratitude to Kwanchewan Buadaeng from Chiang Mai University and Boonsong Thansritong from ECHO-Asia for their significant contributions.

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The insights from this research highlight the crucial role of integrating Indigenous Peoples Knowledge and practices into broader strategies for sustainable development and climate resilience. We hope that the findings will inform more effective policies and initiatives that uphold the rights, livelihoods, and environmental stewardship of Indigenous Peoples.

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Executive Summary

Global food production is a major contributor to climate change, biodiversity loss, and the decline of ecosystem services, while also failing to provide adequate nutrition for all. This necessitates a re-evaluation of how we meet the increasing demands for safe, high-quality diets within planetary resource limits[1].

The UN Food Systems Summit (UNFSS) emphasised the urgent need for transformative action in food systems to address global and local challenges such as biodiversity loss, climate change, soil erosion, desertification, immigration, inequity, malnutrition, and conflict. Despite growing recognition of these issues, Indigenous Peoples, who are vital biodiversity stewards and holders of extensive ecological knowledge, remain underrepresented in food systems policy and practice.

Indigenous Peoples have long faced marginalisation and policies aimed at assimilation, which have severely impacted their culture, health, and well-being. Their food systems, deeply connected to the land and based on values of caring and sharing, offer sustainable and equitable alternatives that work harmoniously with nature. However, scientific evidence on Indigenous Peoples' food systems (IPFS) is still limited and fragmented.

In response to this gap, The Indigenous Partnership for Agrobiodiversity and Food Sovereignty (TIP) launched the project, *Demonstrating that People and Landscapes Thrive under Indigenous Peoples' Food Systems,* in 2022. Supported by the Rockefeller Foundation, this project involved a multi-country agroecology assessment of 500 households across 16 landscapes in Northern Thailand, Northeast India, Kenya and Mexico, representing the Karen, Garo, Karbi and Khasi, Ogiek, and Yucatec Maya, Peoples. The primary research tool was FAO's Tools for Agroecology Performance Evaluation (TAPE), adapted to generate robust evidence on the agroecological outcomes of IPFS. TIP also incorporated participatory storytelling to capture the Indigenous Peoples' worldviews and intergenerational cultural knowledge.

[1] **Rockström, J., Edenhofer, O., Gaertner, J., & DeClerck, F. (2020).** "Planet-proofing the global food system." Nature Food, 1(1), 3-5. DOI: 10.1038/s43016-019-0010-4.
Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B. L., Lassaletta, L., ... & Tilman, D. (2018). "Options for keeping the food system within environmental limits." Nature, 562(7728), 519-525. DOI: 10.1038/s41586-018-0594-0.

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This document presents the results of TAPE implementation in these four countries, offering key insights into the sustainability of Indigenous Peoples' landscapes and the agroecological outcomes across the ten Elements of Agroecology. The assessment confirmed the high implementation of agroecological practices within IPFS, with strengths such as exceptional crop diversity, which enhances community food security, nutrition, genetic diversity, and systems resilience. The report highlights the efficient use of natural resources, organic and biological soil management practices, and the strong synergistic relationships within these ecosystems, supported by traditional practices like polycultures and forestry stewardship. High scores in human and social values reflect the community-focused approach that enhances equitable livelihoods and integrates traditional practices with innovations.

The thirty stories collected from the Karen Peoples of Thailand, and Garo, Karbi, and Khasi Peoples of Northeast India and Ogiek Peoples of Kenya, emphasise that their food systems are deeply rooted in locality and designed for all life. These systems co-evolve slowly, blending traditional wisdom with new practices, and are supported by reciprocal management and ethical stewardship. However, the assessment also revealed significant challenges, particularly where commercial agricultural practices and external pressures have undermined traditional governance and institutions.

This report prepared by TIP research team and Indigenous Peoples partners is organised into seven chapters: Chapter 1 outlines the process and methodology, including modifications to the research instrument and the participatory storytelling approach. Chapters 2 through 5 present region-specific evidence: Northeast India (Chapter 2), Northern Thailand (Chapter 3), Kenya (Chapter 4), and Mexico (Chapter 5). Chapter 6 provides a concise summary of findings across all regions, reflecting on TAPE's application in IPFS, highlighting strengths, and identifying areas for improvement. The final chapter offers recommendations for strengthening agroecological outcomes in Indigenous Peoples' food systems and scaling solutions drawn from each country.

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Image: El Dhar

"An Indigenous Peoples Food System is more than just agriculture."

Introduction

1.1 Background

The UN Food Systems Summit (UNFSS) highlighted the urgent need to change course regarding the role of food systems in global and local challenges such as the loss of biodiversity, climate change, soil erosion and desertification, immigration, inequity, malnutrition, and conflict. To attend to these challenges and meet the UN Sustainable Development Goals, the UNFSS urged immediate action to find viable alternatives.While scientists, academia, civil society organisations and governments have responded, Indigenous Peoples, who are key stakeholders, still lack significant involvement in food systems policy and practice.

Despite their conservation of biodiversity over large swathes of land, their complex wisdom and knowledge of diverse landscapes and their ancestral rights, Indigenous Peoples have often been a low priority for those in power. Worse still, Indigenous Peoples have faced intentional discrimination and marginalisation; and attempts to assimilate Indigenous Peoples into the mainstream cultures have had devastating consequences on their culture, health, and wellbeing. Indigenous Peoples' food systems (IPFS), including their stewardship of the majority of the world's biodiversity, offer unique insights, practices and the empirical evidence needed to transition to more sustainable food systems. Indigenous Peoples' deep connection with land, and values of caring and sharing, are central to their equitable food systems that work with rather than against nature.

Just as little attention has been given to Indigenous Peoples' food systems in policy, scientific evidence on these systems also remains limited and fragmented. There is an urgent need to strengthen this knowledge and evidence based on the outcomes of Indigenous Peoples' food systems and their driving success factors (FAO, 2021). Recognising this imperative, The Indigenous Partnership for Agrobiodiversity and Food Sovereignty (TIP) undertook a multi-sited project titled, Demonstrating that People and Landscapes Thrive under Indigenous Peoples' food systems funded by The Rockefeller Foundation. In collaboration with field partners in Northern Thailand, Northeast India, Kenya and Mexico, the project aimed to generate comprehensive evidence on the agroecological outcomes of Indigenous Peoples' food systems. It sought to address the growing calls for a robust evidence base on the contributions of such systems to sustainable food system transitions.

TIP selected the FAO-developed Tool for Agroecology Performance Evaluation (TAPE) (FAO, 2019) for this study. Created in response to recommendations from the Committee on Agriculture

and the High-Level Panel of Experts on Food Security, TAPE integrates various agroecological frameworks and incorporates feedback from a wide range of global stakeholders. This globally endorsed instrument was chosen for its comprehensive metrics and multidimensional approach, which align with the holistic principles of agroecology, making it well-suited for evaluating the sustainability and outcomes of Indigenous Peoples' food systems. Although TAPE was designed for diverse agroecological contexts and production systems, the instrument in its original form could not adequately capture the uniqueness of Indigenous Peoples' food systems. Modifications to TAPE were made specifically to capture the plurality of Indigenous Peoples' food systems, the multiple scales of management, and their customary systems of governance and resilience-building

Utilising the FAO Tool for Agroecology Performance Evaluation (TAPE), the research project characterised Indigenous Peoples' food systems across multiple dimensions of agroecology, documenting both qualitatively and quantitatively their outcomes and identifying best food systems practices. The tool was adapted for use within Indigenous Peoples' food systems through an iterative, co-designed approach facilitated by direct engagement with Indigenous Peoples. The project spanned four countries and sixteen Indigenous Peoples' landscapes: Northern Thailand (Karen Peoples), Northeast India (Garo, Karbi and Khasi Peoples), Kenya (Ogiek Peoples) and Mexico (Yucatec Maya Peoples), involving nearly five hundred participating households. These sites were selected to provide a comprehensive representation of various food systems and to capture the dynamic transitions these systems undergo. The communities were primarily agrarian, engaged in subsistence-oriented practices while also seeking to diversify income generation. Prior to conducting the study, Free, Prior, and Informed Consent (FPIC) was obtained from the participating communities and households.

In Northern Thailand, the food systems of the Karen Peoples are exemplified by the four villages: Mae Paw Khee, Hin Lad Nai, Khun Mae Yod, and Huay E Kha. In three of these villages, rotational farming with a fallow cycle of 7-10 years is the predominant system, while Huay E Kha relies primarily on paddy fields. The agricultural landscape also includes home gardens, livestock raising, and collection from fallows, forests and aquatic systems. Hin Lad Nai and Mae Paw Khee further utilise forest gardens, incorporating tea cultivation, agroforestry, vegetable growing, and beekeeping in the fallows and regenerating forests. Both Mae Paw Khee and Hin Lad Nai have opted not to engage in cash cropping. Additionally, these communities produce handicrafts during off-farm periods. The Karen Peoples are matriarchal in their social structure with women playing a central role in both the family and community life.

In Northeast India, the study focused on the villages of Darechikgre (Garo Peoples), Dewlieh, Plasha (Karbi Peoples) and Umsawwar (Khasi Peoples). Shifting cultivation is practised across these communities, though its application varies. Dewlieh and Darechikgre rely heavily on shifting cultivation, which follow a fallow cycle of 7-15 years. In Umsawwar, shifting cultivation is practised by only a few households. Plasha combines shifting cultivation with paddy cultivation to meet their staple needs, whereas paddy cultivation is less prevalent in Umsawwar and Darechikgre. In Umsawwar, bun cultivation— vegetable and cereal cultivation on raised beds on slopes following a plot rotational of around 3-5 years—is the predominant system. Home gardens, and collection

from forests, aquatic systems, and grasslands, are integral components of these food systems. The Khasi and Garo Peoples are matrilineal, with lineage and inheritance traced through the maternal line.

In Mexico, the study sites comprised Chacsinkin, José Maria Morelos, Tabasco and X'Pichil representing the Yucatec Maya Peoples. The milpa system is a key feature of these agro-landscapes, integral to a productive food system that includes home gardens and orchards. The milpa involves intercropping maize, beans, and squash, with plots cultivated for 2-3 years and then left fallow for 16-18 years. Many households also raise animals within their home gardens. A few farmers dedicate 1 to 5 hectares of land to growing crops, particularly fruit trees, for marketing. Beekeeping is practised in José María Morelos and X'Pichil. Additionally, the communities rely on forests for harvesting wild fruits, such as currants (Phyllanthus acidus) and sacpá (Byrsonima bucidifolia), as well as for materials used in housing.

From the Mau Forest Complex, Kenya, the four participating villages were Nessuit, Mariashoni, Nkareta and Keneti representing the Ogiek Peoples. Traditionally, the Ogiek Peoples relied on hunting and gathering. However, restrictive policies, resulting from conservation measures and the setting up of protected areas have contributed to a shift towards more sedentary practices, including establishment of home gardens and plantations. Major crops cultivated include potatoes, maize and peas. Livestock is mostly raised within the home gardens. Among the four communities, Keneti still maintains a mix of pastoralism, sedentary farming and honey production. The communities have limited access to forests and only undertake seasonal collection of wild honey, herbal plants and wild berries.

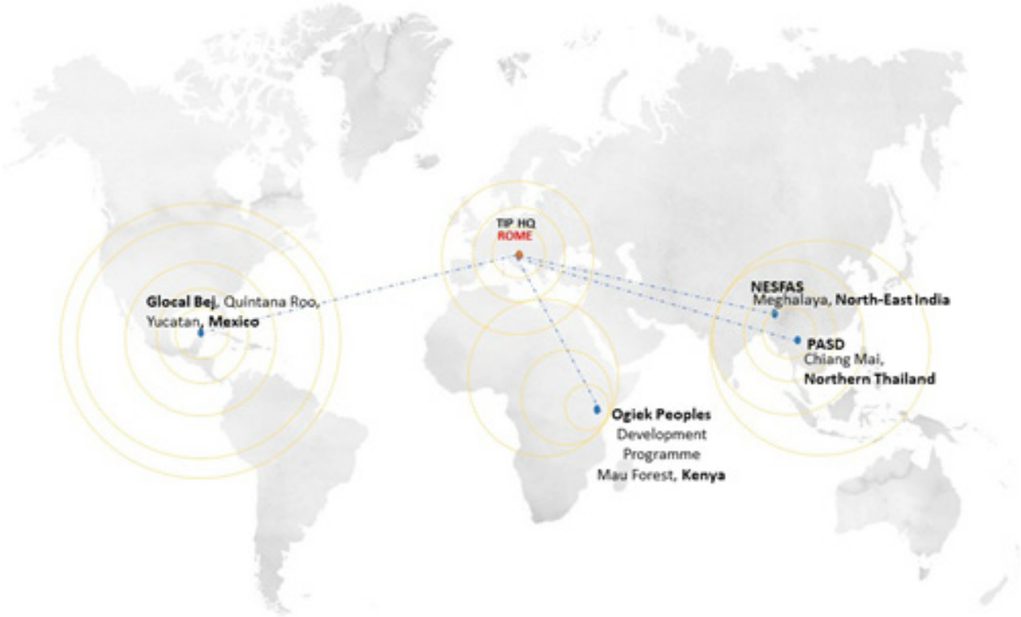

Figure 1: Map indicating the locations of project partners in Northern Thailand, Northeast India, Kenya and Mexico.

The project also initiated a dialogue between Western and Indigenous epistemologies through the ancient tradition of storytelling. It engaged the Karen Peoples of Thailand, the Garo, Karbi and Khasi Peoples of Northeast India and the, Ogiek Peoples of Kenya to co-design and implement the collection of stories about their food systems, practices, and worldviews

A key step in the process was providing learning opportunities for Indigenous youths and Indigenous Peoples to overcome the barriers hindering their meaningful contribution to solving current global food system crises. The Indigenous Peoples' youths trained to use the TAPE instrument and describe the TAPE themes and concepts in context of their food systems took leading roles as researchers, enumerators and facilitators. The involvement of Indigenous Peoples Elders, women and knowledge holders with expert food systems knowledge facilitated the sharing of knowledge in an interculturally sensitive way.

The subsequent chapters provide a comprehensive overview on the implementation of the tools in the four countries. This includes in depth analysis of the methodologies employed, the specific adaptations made to address the unique attributes of Indigenous Peoples' food systems, and the key findings that emerged from the research. These findings will shed light on the diverse practices, outcomes, and insights gained from each region, contributing to a richer understanding of how Indigenous Peoples' food systems can inform and drive more sustainable and equitable food system transitions.

1.2 Objectives

The primary objectives of using the FAO Tool for Agroecology Performance Evaluation (TAPE), complemented with storytelling, within the context of Indigenous Peoples' food systems are to:

1. Demonstrate Agroecological Outcomes: To show that Indigenous Peoples' rights-protected landscapes and food systems achieve expected agroecological outcomes, enhancing food and nutrition security, well-being, and ecological regeneration

2. Strengthen Knowledge and Evidence: To enhance the understanding and evidence base regarding the effectiveness of IPFS and the factors contributing to their success thereby facilitating their broader adoption and transitioning to more sustainable food systems

3. Empower Indigenous Peoples (IP) Youth: To equip IP youth with evidence and confidence in the contributions of IPFS, providing with skills, articulate TAPE themes and concepts, and support the scaling of TAPE studies in other regions

4. Advance Participation of Indigenous Peoples: To advance the consideration of Indigenous Peoples, integrating their interests and expertise in food system and natural resource management, using their values of care, sharing, and consensus-building. This includes exploring innovative ways of engaging and involving IP in development programmes and creating IP led consultation framework

CHAPTER
1

Methodological Report - Bridging Western Science and Indigenous Ways of Knowing.

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About this report

This report has been prepared by the TIP research team and Indigenous partners that have used the instrument. In subsequent sections, this report outlines the process of modification to the TAPE instrument to support its application to Indigenous Peoples' food systems. Key adaptations relate to the scale of assessment, diversity of production systems, and governance regimes. The report also describes the process of co-creating a method to collect Indigenous Peoples' stories. These stories help to convey the values and principles underlying the results obtained by TAPE. Finally, the report describes the novel and innovative way in which these two approaches

were combined and used to enrich one another in the production of agroecological evidence. The results of TAPE and a critical reflection on its use in Indigenous Peoples' food systems are provided in subsequent reports in this collection.

1.1 Generating evidence using the Tool for Agroecological Performance Evaluation (TAPE)

1.1.1 Background

In recent decades, agroecology has emerged as an alternative approach that promises to move beyond the status quo of food production by delivering increased food production sustainability, meeting ecosystem needs and the needs of local communities. Originating in the 1930s, agroecology was first defined as the application of ecological principles to agriculture. Since then, agroecology has evolved in meaning and in practice, and has seen tremendous growth in its scale of application and political and funding support. More recently defined as "a scientific field, a set of agricultural practices and a social movement" (Wezel et al., 2009), agroecology is multidimensional, encompassing environmental, social, economic, and cultural factors and practices. Agroecology now represents a transdisciplinary science, working in partnership with multiple stakeholders, embracing co-learning, local knowledge, and cultural values (HLPE, 2019).

Whilst agroecology lacks a definitive set of practices, broadly speaking, it is characterised by its attempt to harness, maintain, and enhance biological and ecological processes in agricultural production, attempts to reduce the use of purchased inputs (e.g. agrochemicals and fossil fuels), and to create more diverse, resilient, and productive agroecosystems. Food-related practices can be classified on a spectrum based on how agroecological they are, depending on their capacity to achieve these objectives.

However, the lack of concrete definition has posed a challenge to the movement, as growing calls have been made to see evidence of its contributions to food systems sustainability. Until recently, studies of agroecological performance have been incongruent, based on widely differing methods, time and spatial scales of assessment, and dimensions of analyses. This has hindered more systematic assessment of agroecological practice, and its ability to inform sustainable food policy. Responding to the need for more harmonised methods of measurement, the 26th Committee on Agriculture and High Level Panel of Experts of the multi-stakeholder Committee on Food Security made specific recommendations that the Food and Agriculture Organization of the United Nations (FAO) should support the development and use of comprehensive metrics, tools and protocols to monitor agroecology, and facilitate the adoption of agroecological practices (and other innovative practices) by member states.

In 2019, FAO responded to this mandate with the development of the Tool for Agroecology Performance Evaluation (TAPE). The development of TAPE was informed by existing frameworks of agroecology and involved consultation with hundreds of global participants from academia, government, private sector, and non-governmental sectors (FAO, 2019; Mottet et al., 2020). The aim of the consultation process was to develop a tool that can contribute to the assessment of the sustainability of diverse agricultural and food systems in a multidimensional manner and

can support the transition toward more sustainable food systems. Since its inception, TAPE has been endorsed on the global stage by the Committee on World Food Security and by prominent academicians in agroecology.

TAPE was selected for use in this study as a globally endorsed instrument that enables the characterisation of food systems, their agroecological status and outcomes. Agroecology, as a comprehensive and holistic approach to food systems' health, is reasonably well-aligned with Indigenous Peoples' philosophies and approaches to food.

1.1.2 The Stepwise Approach of TAPE

TAPE consists of several steps (Figure 2). Step 0 is a context-setting exercise, providing an overview of target territory and the key drivers that can foster a favourable environment for sustainable food systems. This step is completed at community/territorial level via desk-based study and/or participatory exercises, such as focus group discussions and key informant stakeholder interviews. Step 0 provides context for interpreting the results of subsequent performance assessments.

Steps 1 and 2 comprise the main analytic steps. Step 1 is completed at household/farm level and evaluates the level of "agroecological transition" of different food production systems. The step can be completed either as a survey with households/farmers or via self-assessment by farmers themselves. Step 1 is based upon the ten elements of agroecology, which were defined by FAO and member states in 2018 (Figure 2). These elements are (1) Diversity; (2) Synergies; (3) Efficiency; (4) Recycling; (5) Resilience; (6) Culture and Food Traditions; (7) Co-creation and sharing of knowledge; (8) Human and Social Values; (9) Circular and Solidarity Economy; (10) Responsible Governance (Figure 3).

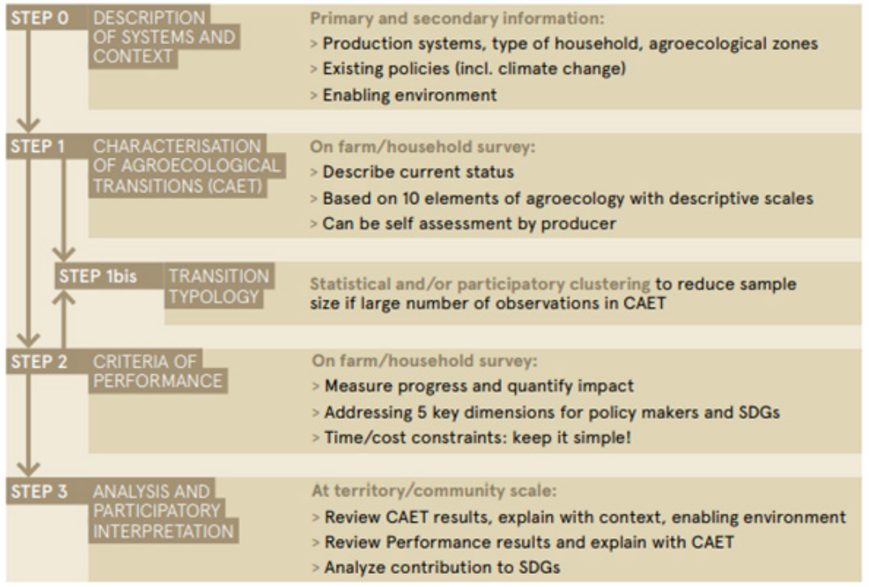


Figure 2: Stepwise approach to TAPE, from FA0 (2019).

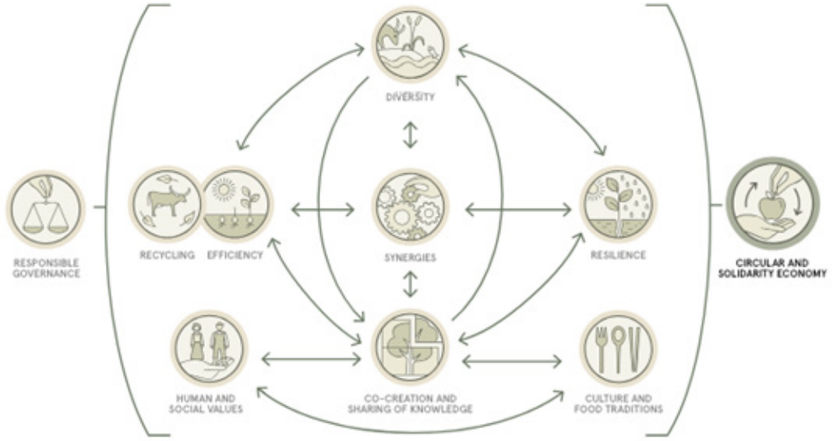


Figure 3: Mapping key interactions between agroecology elements. Source: FAO (2018).

Each element is represented by several sub-indicators. These sub-indicators are characterised semi-quantitatively from 0 to 4 on a Likert-type scale (where 4 = most agroecologically advanced). The scores of each indicator are summed to provide a percentage score for each of the ten elements. Higher percentage scores indicate that systems are more advanced in their "agroecological transition". The percentage value of each of the ten elements can be combined to calculate an aggregate "Characterisation of Agroecological Transition" (CAET) score. Household/farms and communities can then be ranked according to their CAET scores.

Whereas Step 1 of TAPE seeks to characterise food systems according to the multiple dimensions of agroecology, Step 2 seeks to assess food system performance based on a short list of core performance criteria. These criteria – which span economic, environmental, health, social and governance dimensions – are aligned with the Sustainable Development Goals, and thus seek to allow local actors to prioritise key areas for targeted improvement (Figure 4). Step 2 is also completed at household/farm level and is completed after Step 1

Step 3 is a crucial stage where stakeholders participate in interpreting the gathered data results. The aggregated insights provide invaluable perspectives, ensuring that the interpretation accurately represents the food systems under study. This participatory approach aims to validate the findings and ensures that the analysis reflects the specific priorities and nuances of the local context.

During this step, the strengths and weaknesses identified in the systems through the CAET results (Step 1) are reviewed, considering the contextual and enabling factors from Step 0 that may influence these outcomes. Stakeholders engage in discussions to determine aspects of the analysis that emphasise critical factors driving positive outcomes. This includes reviewing performance criteria results (Step 2), discussing how the data collected in Steps 1 and 0 contribute to these outcomes.

Furthermore, stakeholders collaborate to identify strategies for improving performance and advance agroecological transition.

1.1.3 Contextualisation of TAPE for Indigenous Peoples' Food Systems.

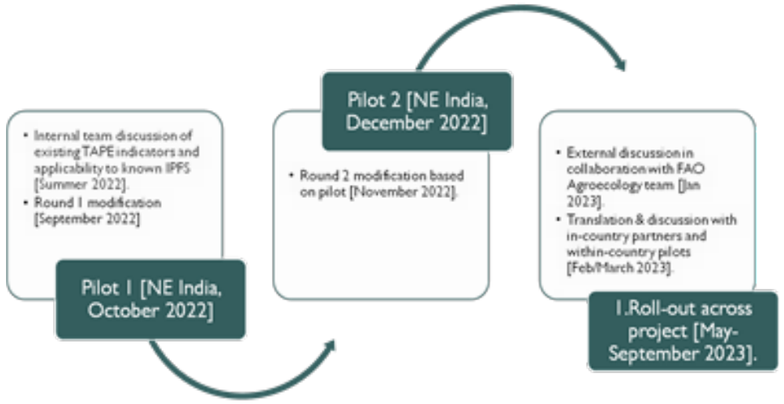
Whilst TAPE was designed to be applicable and relevant to diverse contexts, agroecological zones and production systems, the instrument was not considered adequate in its original form to capture the uniqueness of Indigenous Peoples' food systems. In particular, it struggled to capture the plurality of Indigenous Peoples' food systems, the multiple scales of management, and customary systems of governance and resilience-building.

MAIN DIMENSION	#	CORE CRITERIA OF PERFORMANCE	PROPOSED METHOD OF ASSESSMENT IN SURVEY	SDG	SDG INDICATORS
Governance	1	Secure land tenure (or mobility for pastoralists)	Type of tenure over land: property, lease + duration, verbal, not explicit (**SDG 1.4.2, 5.a.1 and 2.4.1 sub-indicator 11**) Existence and use of pastoral agreements and mobility corridors	1 2 5	1.4.2 2.4.1 5.a.1
Economy	2	Productivity	Farm output value per hectare (**SDG 2.4.1 sub-indicator 1**) Farm output value per person	2	2.3.1 2.4.1
	3	Income	Outputs – inputs – operating expenses – depreciation + other income (**SDG 2.4.1 sub-indicator 2**)	1 2 10	1.1.1, 1.2.1 and 1.2.2 2.3.2 2.4.1 10.2.1
	4	Added value	Net income +rents +taxes +interests – subsidies	10	10.1.1 10.2.1
Health & nutrition	5	Exposure to pesticides	Quantity applied, area, toxicity and existence of risk mitigation equipment and practices	3	3.9.1 3.9.2 3.9.3
	6	Dietary diversity	Minimum Dietary Diversity for Women (FAO and FHI 360, 2016)	2	2.1.1 2.1.2 2.2.1 2.2.2 2.4.1
Society & Culture	7	Women's empowerment	Abbreviated Women's Empowerment in Agriculture Index, A-WEAI (IFPRI, 2012)	2 5	2.4.1 5.a.1 5.a.2
	8	Youth employment opportunity	Access to jobs, training, education or migration (**SDG 8.6.1**)	8	8.6.1
Environment	9	Agricultural biodiversity	Relative importance of crops varieties, livestock breeds, trees and semi-natural environments on farm (**SDG 2.4.1 sub-indicator 8.1, 8.6 and 8.7**)	2 15	2.4.1 2.5.1
	10	Soil health	Adapted SOCLA rapid and farmer friendly agroecological method to assess soil health (Nicholls *et al.*, 2004)	2 15	2.4.1 15.3.1

Figure 4: Performance of criteria assessed within TAPE Step 2 and their links to the Sustainable Development Goal indicators.

Beginning in June 2022, TIP began a process of adaptation to the instrument, which was highly iterative and completed in multiple stages (Figure 4) and engaged a diverse group of Indigenous and non-indigenous experts. Based on initial, internal team discussions regarding existing TAPE indicators and their applicability to known Indigenous Peoples' food systems, a first draft of a modified TAPE was created and piloted in four Khasi Indigenous households in Northeast India in October 2022. The pilot sought to assess the instrument according to its ability to characterise the food systems, as well as consistency and ease of researcher and respondent understanding.

Based on feedback from the pilot implementation by field partners, TIP made further modifications to the instrument in November 2022 and re-piloted it at the same sites in December 2022. Only minor adjustments were necessary after this second pilot. In the third stage of adaptation, TIP met with the FAO Agroecology team in Rome in January 2023 to discuss and review the proposed modifications. The modifications were implemented with the concurrence of FAO.



The modifications made to TAPE sought to better capture key and unique attributes of Indigenous Peoples' food systems. Modifications centred on five key aspects of food systems, summarised in Table 1.

Of all the steps within TAPE, Step 0 saw the most significant adaptations, seeking to capture qualities relating to scale and diversity more adequately. As per the original format of TAPE, Step 0 comprised key informant interviews with Indigenous Peoples community Elders to glean detailed, information on the enabling (and limiting) factors within the food system, including factors relating to ecological environment, public policy context, participation within the food system of local actors and networks (Image 1). Information on the presence of customary norms around food production and natural resource use was also gathered.

The explicit addition of a "seasonal dependency matrix" (Choudhury, unpublished) (Annex 1) and a "seasonal calendar of gainful activities" allowed the seasonal use of diverse food systems, the seasonal diversity in the foods produced/gathered from within those systems, and seasonal change in food and non-food-related livelihood activities to be captured. It also sought to allow

the identification of any "lean" periods - when access to market-sourced alternatives becomes more critical which may not always be nutritious . These two matrices were compiled via participatory focus group discussions and Participatory Rural Appraisal (PRA) exercises with target communities.

Image 1: Step 0 being completed in Meghalaya, northeast India by partners, NESFAS.© NESFAS

Only small modifications were made at Step 1 (Table 1). These modifications comprised the addition of one indicator under the element of Diversity, to reflect the use of natural systems and wild food resources. Several questions were reworded to explicitly emphasise common attributes of Indigenous Peoples' food systems (e.g. customary norms, use of fallows).

Food System Attributes	**Comments on applicability to Indigenous Peoples' food systems.**	**Changes made to TAPE**
Diversity.	Indigenous Peoples' food systems often comprise the use of multiple food "sub"-systems (for example, a shifting agricultural system, gardens, forests, riverine systems), which do not figure in the original TAPE instrument. TAPE is also primarily designed for use on cultivated systems, whereas IPFS include use of uncultivated/wild food resources. Seasonal and interannual diversity was also not captured in the original TAPE, which is important in the context of mobile and rotational IPFS.	**Step 0** was amended to include a seasonal dependency matrix, which captures the diversity of food sub-systems used within the Indigenous Peoples' community/territory. The matrix also captures the variation in food produced at different times of year. Step 0 key informant interviews enabled inter-annual practices (e.g. in forest-fallow cycles) to be captured. An additional question at **Step 1** was added to capture the use of natural systems and wild food resources.
Resilience.	TAPE prioritises economic resilience, and formal systems of support (such as access to credit and insurance policies). In IPFS, while economic aspects are often increasingly important, resilience is primarily ensured through strong social networks and social capital, which are functional and effective because of the customary norms and of IP communities.	**Step 1** question on mechanisms to reduce vulnerability reworded to reflect customary systems and norms that reduce vulnerability and support resilience.

Food System Attributes	Comments on applicability to Indigenous Peoples' food systems.	Changes made to TAPE
Governance.	TAPE is based on the premise of private ownership of resources and emphasises formal institutions and governance frameworks that support natural resource access – but lacks recognition of the common property framework characterising most Indigenous Peoples customary mechanisms and norms that regulate access to natural resources. It also lacks specific attention to tenurial (in)security, which is a common threat to the integrity of Indigenous Peoples' food systems.	Key informant interviews at **Step 0** attempt to capture the customary norms that govern access and tenure over land and natural resources. **Step 1** question on the participation of producers in governance of land and natural resources was reworded to explicitly recognise the influence of customary norms and importance of mechanisms ensuring tenure security.
Natural resources management.	Management and conservation of natural resources - land, forests, water - is integral to IP food systems management and resource conservation. The original TAPE instrument fails to capture this important aspect and the focus is limited to the crop-farm level only	Key informant interviews at **Step 0** elucidated specific systems of natural resource management, including customary practices and landscape management approaches Several questions at **Step 1** were amended to recognise practices related to the use and management of natural resources, which are common to many Indigenous Peoples' food systems. These include specific recognition of the use of fallows (in Synergies), and use of water harvesting techniques (in Recycling) rather than on equipment.
Scalar focus	A fundamental difference between Indigenous Peoples' food systems and the rationale on which TAPE is based is that while TAPE has a plot or household-level focus, Indigenous Peoples' food systems are often managed at the broader landscape level (e.g., also comprising natural systems and fallow). Such landscapes are often under communal systems of management.	The additional seasonal dependency matrix at **Step 0** enabled the capture of diverse food systems used by communities across the territory. Key informant interviews at **Step 0** involved description of systems of landscape management. Questions at **Step 1** were answered with respect to multiple household-owned systems across the landscape (but excluding communal resources).

Table 1 Food system attributes as expressed by TAPE, and modifications made for Indigenous Peoples' food systems

A minor adaptation was also made at Step 2. TAPE in its original form measures productivity according to income revenues from crop/livestock production, however many Indigenous Peoples' communities are subsistence-oriented. Step 2 was worded in a way to ensure that even if produce was not sold, the equivalent cost of produced items was captured – thus ensuring that productivity was not underestimated. Step 3 does not follow a prescribed format, and so no modifications were needed here.

1.1.4 Sampling Methodology

The sampling methodology for the assessment of Indigenous Peoples' food systems was carefully designed to capture a representative snapshot of diverse Indigenous Peoples' food systems across four countries: Northern Thailand, Northeast India, Kenya and Mexico. A total of sixteen sites inhabited by Indigenous Peoples were identified, with four sites per country. Among the sites studied, the Karen, Garo and Khasi Peoples follow matrilineal customs, while the rest are patriarchal. TIP recognises that its assessment of Indigenous Peoples' food systems is not

exhaustive and cannot capture the full diversity of Indigenous food practices globally. With future funding opportunities, TIP aims to expand the number of sites investigated.

In each country, TIP has longstanding partnerships with on-the-ground Indigenous Peoples-led institutions with research capacity. Research partners in each country were asked to select four sites to showcase a diversity of Indigenous food systems. The primary criteria for sampling were: (1) the community must be a majority of Indigenous Peoples; (2) it must comprise at least 30 households; and (3) it must practise Indigenous Peoples' methods of food provisioning primarily. Teams were also instructed to consider practical implications for site selection, such as language, accessibility, and familiarity with the organisation/NGO. Within each community, thirty households were randomly selected to participate in the study resulting in a total sample size of 480 households. In Mexico, however, snowball sampling was used to identify these thirty households to effectively reach and include those that were otherwise difficult to access due to logistical and social barriers. The sample size of thirty was maintained across all sites to ensure consistency, enabling reliable statistical analysis while addressing practical constraints. This size strikes a balance between achieving meaningful insights into the Indigenous Peoples' food systems studied and remaining manageable within the study's resources and constraints. Between May and September 2023, TAPE was applied in the sixteen identified Indigenous Peoples' communities across the four countries.

1.1.5 Data Collection

Free, Prior and Informed (FPIC) consent was secured from the participating communities before initiation of the study. This involved conducting a general awareness to communicate the purpose, scope and potential impacts to the community members. This process ensured that the community and participants were aware of their rights and the confidentiality of their data. The consent process also included addressing any concerns from members to ensure that their participation was fully voluntary and informed.

1.1.5.1 Data collection of Background information

The background information for the sites studied in Step 0 was collected using a multifaceted approach to ensure a comprehensive understanding of the Indigenous Peoples' food systems. Data was gathered from various secondary sources, including open data repositories and existing literature on Indigenous food systems, agricultural practices, and socio-economic factors, providing a broad context for the sites under study. Participatory Rural Appraisal (PRA) methods were employed to engage directly with the communities, ensuring that their knowledge and experiences were accurately represented. These sessions included mapping and seasonal dependency matrix exercises to explore food practices, resource availability, and seasonal variations. Focus Group Discussions (FGDs) were held with key informants such as Elders, women, custodian farmers, and local governance representatives. The FGDs offered valuable insights into the factors that enable or constrain effective food systems, including social, environmental, and governance aspects. This data collection process was conducted between April and May 2023.

1.1.5.2 Household Survey

Data collection for the household survey was conducted using the Kobo Toolbox, an online tool that allows for offline data entry and secure storage in an online database. This tool facilitated the systematic collection of data from the participating households by enabling enumerators to input responses even in areas with limited connectivity. Between May and September 2023, the TAPE methodology was implemented across sixteen selected Indigenous Peoples' communities in four countries covering approximately 500 households, gathering information on various aspects of their food systems.

1.1.5.2 Training of Enumerators and Translation

Following the finalisation of the TAPE-IP version with FAO, TIP and its partners translated the instrument into relevant Indigenous Peoples' languages. This too was a challenge, with certain western and/or agroecological terms simply having no direct correlation in the Indigenous People language. The translated versions of TAPE were shared with FAO so that they could be uploaded to and made accessible to enumerators via the online data collection system, Kobo Toolbox.

In-depth enumerator training and further country pilots helped to refine locally relevant understandings of such terms. In February-March 2023, assigned leads within research partner organisations were provided with training on TAPE over several online sessions led by FAO. Following a "training of trainers" approach, each research partner subsequently trained their local Indigenous youth enumerators on how to complete TAPE (Image 2). In a series of group discussions, research partner leads discussed the ten elements with youth enumerators, looking for ideas, practices, words and/or expressions that exist (with relevant equivalence) in the Indigenous context and language. This prepared the ground for a common understanding amongst enumerators of the TAPE elements, and how they could be understood within the local context. Following this training, enumerators undertook a pilot study in a practice farm setting to test their understanding of TAPE, thus ensuring consistency in their application and scoring and

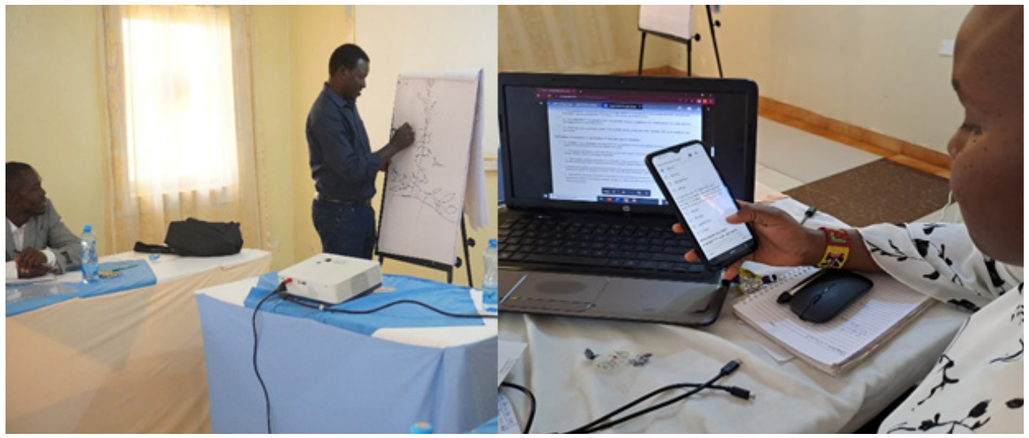


Image 2: Training of enumerators conducted in Kenya by partners, OPDP. ©OPDP

reducing variability due to researcher error. The pilot also provided an opportunity for enumerators to check their research skills, with the pilot even extending to how enumerators would introduce themselves to the farmers. In April 2023, initial Free, Prior and Informed Consent workshops were held in participating communities, in line with the mandate of the UN Declaration on the Rights of Indigenous Peoples, 2007. Further informed consent was obtained during 1:1 interactions, with the purpose of the survey reiterated by enumerators, and participating households given the opportunity to ask questions before consenting to participate.

1.1.6 Data Quality Assurance and Interpretation

To ensure the integrity and reliability of the data collected for the study, comprehensive quality control protocols were implemented throughout the study. Comprehensive training was provided to enumerators to minimise variability and measurement errors, ensuring adherence to data collection protocols and accuracy during data entry. Following data collection, the dataset were cleaned to correct errors, address missing data, and ensure completeness. Cross-country dialogues and participatory community validation and interpretation through Step 3 were conducted to validate findings, ensure they were contextually relevant, and refine the analysis based on community insights and feedback.

1.1.6.1 Cross- Country Review and Interpretation

From October-December 2023, TIP presented the results of the analysis to each country during in-person and online dialogues, providing opportunity to discuss the findings observed, assessing whether they were in line with expectations (given their local knowledge), and how results might be explained in the context of the enabling environment (Step 0). These discussions paved the way for TAPE Step 3.

In January 2024, TIP held an online "cross-country dialogue" in which all research partners were invited to share broad highlights from the TAPE surveys completed in their communities, offer insight into agroecological best practices or "model communities" as shown by the TAPE results, and to reflect on how the data generated might be used locally.

Research partners were also invited to reflect on the limitations of TAPE within the study communities and (if relevant) make recommendations for what might be included in TAPE in future. During a final roundtable, attendees were asked to reflect on the shared strengths of all the Indigenous Peoples' food systems discussed, and raise any other issues prompted by the discussion

1.1.6.2 Participatory Community Validation and Collaborative Interpretation

The process of data validation and interpretation was deeply embedded in community engagement, where results were shared with stakeholders who actively reviewed and discussed the findings. This participatory approach ensured that the data were validated and the interpretations were aligned with community perspectives, making the results relevant to their local context.

Step 3 involves the joint/participatory analysis of data from TAPE steps 1 and 2 within the community. The key objectives of TAPE Step 3 are to:

a. Verify the adequacy and performance of the framework.
b. Confirm/revise the analysis of steps 1 and 2.
c. Design possible ways forward in time, potentially utilising the tool to monitor progress, or identifying other future actions to support the community and/or the sustainability of the food system.

There is no firm protocol provided by FAO for the completion of Step 3, enabling flexibility in how it is applied to meet the needs and suitability of the local context. The research teams were supported by TIP to think carefully about how they design Step 3 process, particularly so that the results of TAPE will be meaningfully understood by the communities so as to enable their interpretation. Box 1 provides a summary of guiding questions, prepared by TIP, and inspired by Lucantoni et al., (2022) to support TAPE Step 3 implementation. These guiding questions were reworded to ensure that they are meaningful and well-understood by the community members. The final Step 3 protocol designed and followed by each country team are described in separate country reports (reports 2-5 of this collection).

Box 1: Guiding questions for Step 3

Confirm/revise the analysis.

- To what extent do the enabling and constraining elements of the system, as described in step 0, explain the transition levels characterised in step 1?
- To what extent do the enabling and constraining elements of the system, as described in step 0, explain the impact/outcomes of transitions, characterised in step 2?
- Do the results of step 1 explain the impact of step 2? How can we explain these?
- How would you rank the 36 indices (step 1) to best reflect your food system?

Verify the adequacy of the framework.

- Do you feel these TAPE results are representative of your food system? In what ways is it representative?
- Do you feel that aspects of your food system are not captured within these TAPE results? What do you feel is missing in these results?
- Do the principles/values identified in the stories better help to explain the results we have seen? How would you rank the values/themes identified? Do these values drive your actions?

Design possible ways forward in time.

- What are the elements of the system that you would value most highly and would like to prioritise?
- What are the best practices that we can identify? If we were to help you to enhance/scale these, which would you prioritise? What would you want "scaling" to look like for this practice?
- What are the challenges you face most and what do you need support with?
- Is there any action research that you would like to see relating to your food system?
- How would you like to use these TAPE & Storytelling results (e.g., in future interactions with agencies)? How can they be used to strengthen arguments/advocate for your rights?

1.1.7 Statistical Analysis Methods

From September 2023, data were cleaned and analysed with the support of the FAO TAPE team using the online statistical software, STATA (Version 17).

For analysis purposes, results were first pooled per country, across multiple communities, and summary statistics were provided. Results were then disaggregated by community and summary statistics presented.

To explore the relationships among the ten agroecological elements, Spearman correlation analyses were conducted. Spearman correlation coefficients were calculated to measure the strength and direction of the linear relationships between pairs of agroecological elements.

To further understand the dynamics within the agroecological systems, both simple and multiple linear regression analyses were employed.

The results from these analyses were used to draw conclusions about the effectiveness and sustainability of different agroecological practices across the studied communities. The findings were contextualised within each country's unique environmental, social, and cultural settings, offering actionable insights for enhancing the resilience and productivity of Indigenous Peoples' food systems.

1.1.8 Scope and Limitations

The TAPE (Tool for Agroecology Performance Evaluation) framework used in this study provided valuable insights into the sustainability, resilience, and unique practices of Indigenous Peoples' food systems. By assessing multiple dimensions—environmental, social, economic, and governance aspects—TAPE identified strengths and challenges within these systems. It highlighted well performing food systems, uncovering the practices, structures, and enabling factors that contribute to their resilience, while also identifying systems at risk and suggesting areas for targeted interventions to support their sustainability.

The inclusion of a seasonal dependency matrix added a deeper understanding of the landscape approach within Indigenous Peoples' food systems. This matrix captured the diversity of food systems and the community's dependency on particular systems across different seasons, illuminating how communities manage resources and adapt to seasonal changes. Additionally, TAPE generated data that could inform policy changes aimed at strengthening these food systems. Communities recognized the tool's potential to empower local producers by providing actionable insights to improve food system management.

However, community feedback indicated that while TAPE is a valuable tool, there is potential to simplify it for greater accessibility and ease of use by the communities themselves. The study's scope also suggests the possibility of expanding TAPE's application to different regions and contexts, thereby broadening its relevance and impact.

One key limitation of this study is that, while the sample size was diverse, it may not be fully representative of all Indigenous Peoples' food systems globally. The unique characteristics of food systems in different regions or communities may not have been entirely captured, thus limiting the generalisability of the findings.

The contextual adaptation of TAPE may not have fully captured the complexity of Indigenous Peoples' food systems, particularly those that rely heavily on uncultivated resources and communal land use. These aspects are central to many Indigenous food systems but are challenging to quantify within TAPE's existing framework, which is primarily designed around cultivated agricultural systems.

A significant challenge was the use of modern agroecological terms, which often do not have direct equivalents in Indigenous languages. Ensuring accurate translation and interpretation of these terms was crucial, as misunderstandings could lead to misrepresentation of the data. While efforts were made to find expressions closest to the intended meaning, translating agroecological concepts into Indigenous languages posed a complex challenge.

Indigenous Peoples' food systems are highly dynamic, with resource availability and food production varying significantly across seasons. Focusing on a snapshot of the food system at a specific point in time may have overlooked long-term trends and fluctuations that are essential for understanding the resilience of these systems.

1.2 : Generating evidence using participatory storytelling.

In recent years, increasing recognition has been given to approaches that integrate and elevate Indigenous wisdom to address emerging global environmental crises (FAO, 2021; Kimmerer & Artelle, 2024). At the UN Food Systems Summit in 2021, Indigenous Peoples were recognised as key allies in the pursuit of nature-positive food systems. And yet the worldviews and mindsets informing the design of existing high-level institutional forums have not evolved to enable meaningful participation by Indigenous Peoples. For example, Indigenous Peoples' worldviews operate across longer time horizons. Knowledge is rooted in inter-being and local intimacy. And food systems are nested within sharing economies and interdependent governance systems, which cannot be easily reconciled within Western enlightenment philosophies of scientific reason and individual liberty, nor late-stage capitalist paradigms of scarcity, competition, and wealth accumulation. The difficulty in bridging Indigenous Peoples and Western epistemologies has resulted in the historical exclusion of Indigenous Peoples' voices, knowledge, and skills in Western forms of data analysis, academic writing, and science-based policy (Maclean et al., 2022; Zurba et al., 2021).

The research project, *Demonstrating that People and Landscapes Thrive under Indigenous Peoples' food systems,* begins a conversation between Western and Indigenous epistemologies with an ancient practice familiar to us all: storytelling. Human beings have used stories as a way of generating and sharing knowledge since time immemorial. The telling of stories has served a number of purposes, including the transmission and reformulation of accumulated experience

and knowledge, values, and community identity. Within Western social science, storytelling is having a resurgence as a method that can help humans make sense of complex systems, and transform them (Collective Change Lab, 2022). As a method which values oral mechanisms of knowledge transfer - as much as the written word - storytelling has emerged in Western science as a research method that acknowledges Indigenous oral mechanisms of knowledge transfer, creates spaces for Indigenous Peoples to share holistic knowledge about food systems, and invites community involvement (Rieger et al., 2023). Storytelling methods – when appropriately grounded in Indigenous ways of knowing, being and doing, – thus offer a way to privilege Indigenous voices in efforts to pro-actively decolonise research, and a way of bridging Western and Indigenous epistemologies in science and policy (Chambers et al., 2017; Datta, 2017).

This research project started with the assumption that Indigenous Peoples' stories could be a rich source of knowledge about how Indigenous Peoples' communities have become intimate with landscapes to co-evolve food systems shaped by locally specific biosocial and biocultural contexts. Whilst recognising the inherent diversity of place-based stories, recent scholarship has identified several common features of Indigenous Peoples' stories. These features include their complexity, their invocation of heart and mind and their often-dramatic features (Archibald, 2009). Indigenous stories appeal to nature, and they represent situations and experiences holistically (MacDonald, 1998). Indigenous Peoples stories are dynamic and interactive, continually adaptive to new socio-cultural scenarios (Fernández et al., 2018).

The project worked across socio-cultural regions with Karen, Garo, Karbi, Khasi and Ogiek Peoples in Northern Thailand, Northeast India and Kenya respectively to co-design and implement the collection of stories from Indigenous Peoples about their food systems and food practices. Efforts were taken to understand the principles underpinning food practices, and the benefits that flow from them. Collective analysis of stories within communities, and between countries, created a process for forming new narratives about how people and landscapes thrive through Indigenous Peoples' food systems.

In the project, the process and outputs of storytelling supplement and complement data collected via the Tool for Agroecology Performance Evaluation (TAPE; FAO, 2019) method. Whilst a comprehensive instrument of assessment, the TAPE method is focused on outcomes for people and individual farms. The collection of stories enables the project to think about benefits more widely, as they are articulated and defined by different communities. It also facilitates consideration of the worldviews, values, interrelationships, community dynamics that explain the contribution of Indigenous Peoples' food systems to people and landscapes, catalysing learning about what to protect and promote in the context of a rapidly changing climate.

Efforts to encourage the interplay of Indigenous Peoples knowledge and Western Science were made via the intentional mapping of the stories onto the ten principles of agroecology explored via the TAPE method. This aimed to help audiences to view the TAPE framework through Indigenous Peoples paradigms, as well as enrich TAPE results with a deeper appreciation of the mechanisms by which Indigenous Peoples are achieving agroecology outcomes.

1.2.1 Co-designing a participatory approach to storytelling.

There are many different ways of approaching storytelling, with methods varying according to research needs, the time, and resources available. As a team made up of both Indigenous and Western researchers, TIP used a participatory approach to structure engagements between researchers, so we could dive into the questions we needed to consider together and co-produce the research design, implementation, and analysis. The following section of the report outlines how the teams worked together between January 2023 and November 2023 to strive for the respectful, reciprocal, and meaningful integration of Indigenous ways of knowing with previous practice on storytelling and project goals.

The storytelling approach for this project was carefully co-designed with the three partner organisations: Pgakenyaw Association for Sustainable Development (PASD) in Northern Thailand, and the Northeast Society for Agroecology Support (NESFAS) Northeast India and Ogiek Peoples' Development Programme (OPDP) in Kenya, representing the Karen Peoples, Garo, Karbi and Khasi and Ogiek Peoples Peoples respectively. Each partner organisation has longstanding and trusted relationships within the Indigenous Peoples communities in which they work, and deep knowledge of the conditions in which stories are cultivated and shared. The partners formed in-country research teams who could co-design the storytelling process. Early conversations with these partners indicated the importance of developing context-specific approaches to story identification and collection. The uniqueness, for example, of the settings in which stories are told, differed substantially by country and community, rendering a one-size fits all method inappropriate. All research teams used the same templates for story collection (Annex 2) but created individualised work plans for story selection and collection based on their rich knowledge of prevailing conditions and cultural norms.

To support the development of work plans, the research teams gathered for two half-day workshops online during March 2023. The first session brought all teams (including national leads and enumerators) together and sought to lay the groundwork for designing the work plans for story collection. The session was oriented around several key questions, which prompted researchers to reflect on storytelling within their respective cultures and contexts:

1. What stories do you tell most often about yourself?
2. What types of stories do we have in our cultures?
3. What do our cultures tell us about why humans tell stories?
4. Can you link the purpose of this project to story types in your culture?
5. When, where and how are these types of stories told?
6. What situation(s) will help us collect the best stories?

Using Zoom functionality, teams were put into breakout rooms to discuss and reflect on these questions internally. Following breakout discussions, all teams were brought back together and shared their insights with other country teams. These insights were visually mapped on a Zoom whiteboard/shared screen.

These questions/prompts from the first workshop session raised important points that could be factored into story collection work plans. For example, relating to the types of stories told (Figure 6), the team from Northern Thailand were able to reflect on how the Karen Peoples tell stories, folklore and share legends based on community history; "spirit stories'' that teach listeners of sharing/caring for others; love stories, creation stories (of the world and its natural constituents), children's stories (to teach children important lessons about the world), and stories whereby the powerless become empowered. Ogiek colleagues reflected on different types of stories that are told amongst their communities: creation stories explain how hunter-gatherer communities came into being; "survival stories" describe how ancestors got through times of hardship and tactics used to survive; stories of conservation pass on teachings about biodiversity, and the importance of maintaining it; and "naming stories" that relate how the species came to have their names.

Teams also reflected on the ways and conditions in which stories are told within their communities. In Northeast India, stories are shared in different forms (such as via song, chants, poetry, prayer, dance) and during different occasions, such as prior to sowing, or during the threshing of the millet. In Northern Thailand, there are two main periods of the year in which stories are typically told or transferred. A period in September, prior to harvest, was considered a particularly poignant time whereby over three nights, women of the community would be given a space to tell stories to their children and others in the community. The Kenyan team reflected on the importance of atmosphere prior to story sharing – a story cannot just be asked for but has to emerge from an organic process. These discussions enriched thinking about how country research teams would approach the collection of stories for the project. A second workshop session delved into the practicalities of story collection, using what had been learned in Session 1 to consider how to invite a story. We also discussed how to select stories for project inclusion in a participatory way with communities, and how to complete consent in a reciprocal exchange with storytellers, which made a project commitment to honour the story that was gifted. Given the length and emergent nature of a storytelling process, including the many iterations and evolutions that happen to stories through collection, translation, editing and re-telling, we extended the Free, Prior and Informed Consent (FPIC) process to include processes to kept the story safe and separate from the storyteller until it was ready to be retold. Within the Free Prior Informed Consent, we discussed the active involvement of storytellers and communities in the analysis of their stories and synthesis of the bigger narratives that emerge from the story collection. We also included regular dialogue and reciprocal exchange with storytellers so they could inform decisions about how the project shares the stories to a wider audience – locally, nationally, and internationally – at conferences, on social media, in reports etc. Session 2 also covered how to document stories to ensure the voices of the storytellers are centred, and their accounts are not paraphrased nor edited without their validation.

At the start of session 2, it was agreed as a group that stories would, at some stage, be mapped onto the ten principles of agroecology that are explored via the TAPE method. It was up to the teams to discuss whether this was brought into their initial criteria for story selection, or whether it would be brought in as a final filter. Participants were allocated Zoom breakout rooms per country and asked to consider what criteria and processes they would use to select stories for the project, how they would select storytellers, and how they would incorporate the ten agroecological principles

into their methods. Coming back to the whole group, each of the three teams described unique approaches that they would take to story selection and collection. These were later written up by research teams into country-specific work plans following the session.

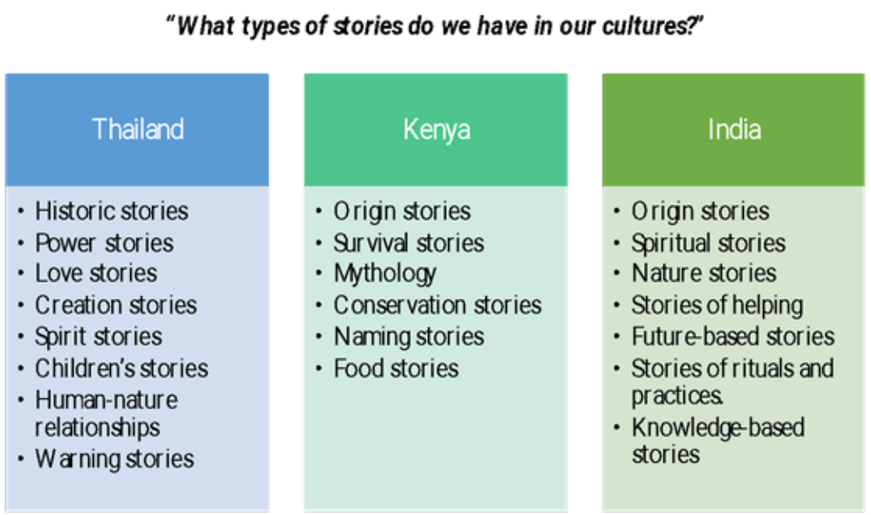


Figure 6: Results of breakout room discussions on the types of stories told within respective Indigenous Peoples' cultures.

Following the workshops, each country team went away and finalised their own context-specific work plans for story-collection. Based on a template/checklist designed by TIP (Annex 2), the work plans elaborated on chosen selection criteria, story collection methods, consent process and translation mechanisms. This took place during April 2023. An individual follow-up call was conducted with each country team to discuss their plans before work commenced. A summary of the work plans is described in Table 2.

1.2.2 Identifying stories

Based on their chosen methods of community engagement (Table 2), all country teams identified a "long-list" of up to 30 possible stories to be collected. During an online session in May 2023, all country teams came together to share summaries of a longlist of stories that they had identified with their communities. The objective of the cross-country dialogue that followed was to help each country team to shortlist ten stories that would closely relate to the aims of the research project.

To help the shortlisting process, the country teams reflected on how the stories they had collected related to the ten principles of agroecology they were measuring with TAPE. We also discussed stories that extended thinking about agroecology and food systems beyond TAPE's agroecology principles. The dialogue also prompted an interesting cross-cultural discussion about the different uses and interpretations of the stories within the communities, and how stories may have evolved alongside changing socio-ecological conditions. For example, the Thai team shared a story of two young girls, too lazy to work on their parents' fields, who are tricked by an evil spirit that offers to

	Northern Thailand	**Kenya**	**Northeast India**
Identifying stories [longlisting]	Focus group discussions were held with Elders in each of the four communities. Participants were asked to share the popular folktales that are often told in their communities that relate to their food system.	Through the TAPE survey, enumerators initially identified 24 storytellers from the four regions (9 men, 11 women and 4 youths). Storytellers selected were deemed eloquent in speech, practising, or involved in agroecology and are renowned story tellers. As the process evolved more stories were told and collected.	Stories and possible storytellers were identified during community awareness sessions and TAPE household surveys. Enumerators asked survey participants if they could think of stories that relate to the agroecological focus of the survey. Stories were invited that focused on specific solutions to unique problems in the community.
Shortlisting stories for collection.	Based on discussion with storytellers on which stories they felt most comfortable sharing; PASD ensured overlap with agroecology principles.	From a longlist of 30 stories, ten final stories were selected that were most relevant to agroecological practices. These were originally from the community of interest, has cultural significance, and were appropriate and ethical to share.	40 stories emerged from the initial listing. NESFAS met internally to group stories into 10-12 emergent themes. NESFAS organised a meeting with the community/storytellers to prioritise and finalise on the stories to document.
Story Collection Environment	Final stories were collected by enumerators in small groups in a communal village setting.	During a day-long session, storytellers were invited from all communities to share all stories on the longlist. The session was attended by 12 story tellers and 7 story listeners from two regions; 29 stories were collected, which included the final ten shortlisted.	Stories were collected by enumerators through interaction with storytellers within the villages..
Recording	The stories were audio-recorded in Karen and later transcribed into Thai.	Stories were video and audio recorded. During storytelling, one story listener made notes. Other listeners were invited to ask questions.	Stories were documented in a format that were agreed upon by project communities. This included audio recording and note taking.
Translation	Karen to Thai to English.	Ogiek to English.	Khasi/Garo/Karbi to English
Quality checking translations	Enumerator translations quality-checked by National team leads. Since youth enumerators may not understand many old terms used in stories, they were encouraged to ask for clarification during story collection to ensure full understanding.	Translator was recruited to translate all the stories. OPDP team collectively reviewed and edited translated stories for accuracy and checked that translated stories accurately conveyed meaning and intent of the original stories. Story listeners helped to validate the transcribed stories with original storytellers.	Transcriptions and translations completed by the NESFAS team were reviewed with storytellers and translations were verified by regional partners who speak both languages.

Table 2 Summary of story collection approaches co-designed by TIP and local partners in Northern Thailand, Kenya, and Northeast India.

help them in their labour, with dramatic consequences. The team noted that whilst this story is generations-old, it has been interpreted by one community as a cautionary tale about embracing new agricultural technologies without fully thinking through the possible repercussions. To situate a story within its cultural context and the project focus, it was collectively decided that as well as collecting stories research teams would also provide (1) a description of the storyteller (e.g., gender, approximate age, role within community); (2) the conditions in which the story is typically

told within the community (e.g., during harvest, by Elders to children); (3) the local interpretations or uses of the story; and (4) the story's relationship to TAPE's ten dimensions of agroecology.

Following these cross-cultural dialogues, teams were invited to finalise a shortlist of stories that they would collect and document.

1.2.3 Story Collection

From July-September 2023, shortlisted stories were collected via methods/activities devised by country teams. For example, Kenya opted to bring all storytellers – from all communities – together during one large session. Northeast India opted to collect stories in a more intimate setting, in or around participants' homes.

A partway peer-to-peer review of approach and quality was initially planned for after the first 1-2 stories had been collected. However, the remoteness of communities and the time demands of collection meant that stories ended up being collected in short succession. This made the midway review unfeasible. Instead, the reflexivity practised in cross-country conversations about how our story collections reflect the focus of communities and the focus of the project on agroecology principles prompted in-country revisions to story collections. Over the course of the TAPE and storytelling engagement the team in Kenya learned about new stories and they swapped out

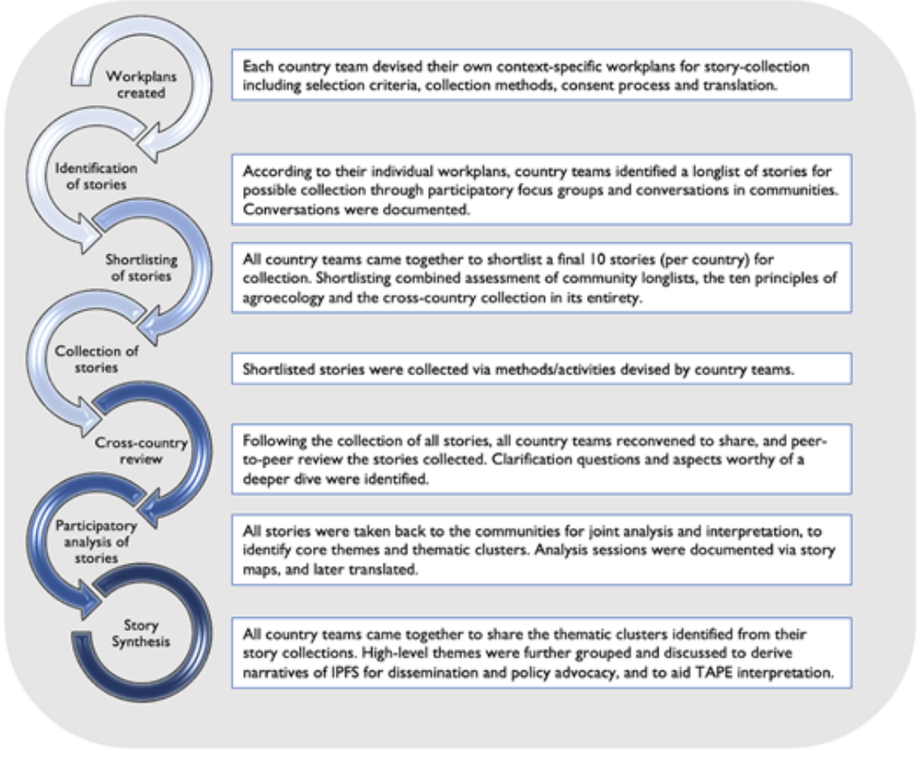


Figure 7: A stepwise approach to storytelling.

some of the mythological stories about ogres for stories about hunting practices along with the introduction of pumpkin into Ogiek territory and relationships between humans and animals. In Northeast India, the story about the importance of millet was replaced with an origin story because the narrative lays the foundation of the Khasi value system essential for maintaining peace and harmony. Another story about conservation efforts was replaced with a story about the discovery of traditional yeast to revive a fading tale in an era where use of synthetic yeasts is more common. All stories collected were translated into English to enable future cross-cultural review and collective analysis.

1.2.4 Story review, analysis and synthesis (local-to-global)

The analysis of the stories took place within Indigenous Peoples communities, within country programme teams and across country contexts. This multi-scale approach to analysis enabled validation, refinement and sensemaking across different perspectives and lived experience, which strengthened the process by which the project arrived at reflect on the bigger stories about Indigenous Peoples food systems emerging from the story collection (see Story synthesis section). This section explains the key steps of the story review and analysis process within Indigenous Peoples communities and within country programme teams.

Story review

Following the collection of all stories, all country teams reconvened in early September 2023 during an online review session. The objective of this session was to share and review the stories collected in a cross-cultural exchange. Teams were invited to ask questions about the other teams' stories so country teams could reflect on points of clarification and aspects of the stories they would like to learn more about from the storyteller. Country research teams went back to storytellers to seek clarification and amended English translations of the stories.

Learning how to facilitate participatory analysis of stories

To complete story analysis with Indigenous Peoples, the country research teams gathered to collectively learn a participatory process to facilitate story analysis among storytellers and their communities. Adapted from previous participatory efforts to collectively analyse over 800 children's life stories with groups of children in Bangladesh (Sayem et al., 2023) and Nepal (Hacker & Sharma, 2022) using causal analysis, the process was designed to:

(a) identify causal pathways linking worldviews, values, practices, and outcomes within individual stories;
(b) identify core themes and meanings with individual stories
(c) identify cross-cutting themes about Indigenous Peoples' food systems in the story collection.

In October-November 2023, researchers at TIP met with each country team to complete a pilot of the story review and collective analysis process using a sample of three stories from each

country's story collection. The story review and collective analysis process consisted of three main steps, which are described in brief below, supported by examples from analysis in Northern Thailand.

Step 1: Individual Story Mapping

For each story, we asked the following questions:

i. What is the practice the story refers to? (e.g. weeding in rotational farming).
ii. What are the outcomes/impact of the practice in the story?
iii. What are the series of events of actions that lead to the practice?
iv. What are the worldviews / values / principles / traditions that make the practice possible?
v. Are there any other significant points of change or contrasts within the story?

Answers to the questions were organised on a piece of paper, with the food practice in the middle, the outcomes/impact positioned to the right, and factors that lead to the practice on the left. Significant points of change and contrasting factors were interwoven into the map. Arrows denote a relationship. One-way arrows suggest casual relationships, illustrating how one thing leads to another in the story. See example story map for the Karen story, Miss Red-Eyed Frog and Miss Dear (Image 3).

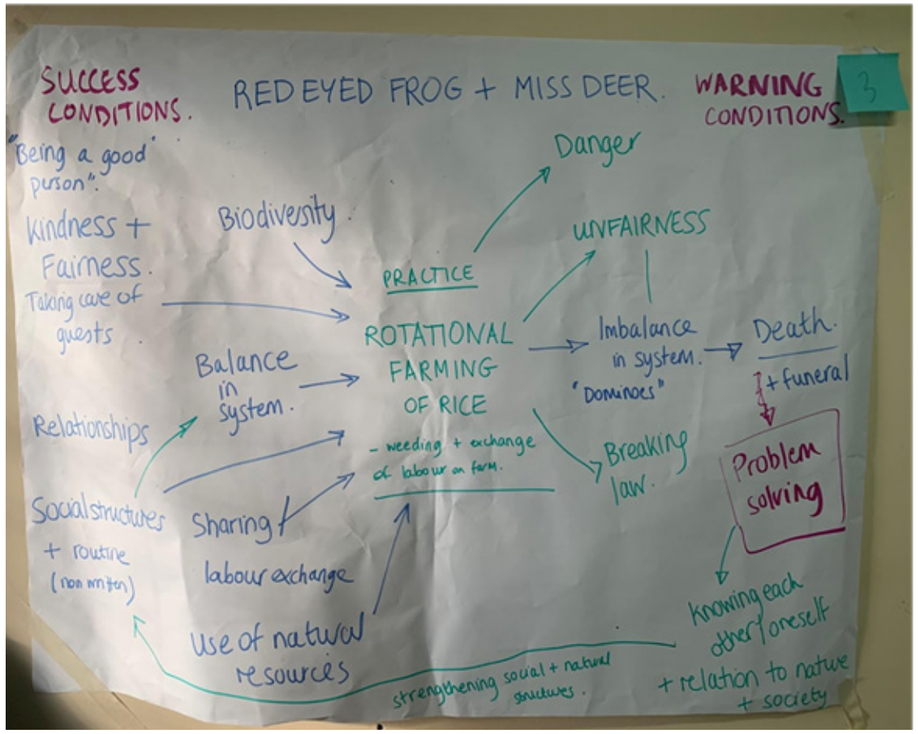


Image 3 Story "map" based on the Karen stor, Miss Red-Eyed Frog and Miss Dear, as completed by researchers in Northern Thailand during a pilot of the process.©PASD

Answers to the questions were organised on a piece of paper, with the food practice in the middle, the outcomes/impact positioned to the right, and factors that lead to the practice on the left. Significant points of change and contrasting factors were interwoven into the map. Arrows denote a relationship. One-way arrows suggest casual relationships, illustrating how

Following the pilot exercise, the facilitation process was simplified into the following questions which guided story analysis and causal mapping:

1. What is the practice the story refers to?
   (The practice is written in the centre of a piece of paper)
2. What are the outcomes/impact of the practice in the story?
   (Outcomes are written on the paper with arrows linking the practice to the outcome.
3. What factors lead to the practice or make it possible?
   (Factors are written on the paper with arrows linking factors to the practice and its outcomes).
4. Are there any other significant points of change or contrasts within the story?
   (These were noted on the story map).

Step 2: Identifying Story Themes

The next step of the analysis identified core themes and meanings within stories. A theme might be the most critical relationship between factors, or the key message that the story is conveying. For each story, the three most important themes were identified by a smaller group of 2-3 people. The final number of themes was kept small so that internal negotiation and discussion was required. Each group wrote the three final themes onto post-it notes and then placed them on the story map. For the story map, Miss Red-Eyed Frog and Miss Deer the main themes for the pilot group were (1) the importance of balance (2) respect for one another and (3) systemic and holistic thinking.

Image 4: Members from Khun Mae Yod village analysing the Karen story, in Northern Thailand.©PASD

Step 3: Thematic Clustering

The final step brought everyone together to look at the themes that emerged across the story collection. The process attempts to group the identified themes into similar and contrasting thematic clusters. In this dynamic exercise, one group of researchers called out a theme that had been written on a post-it note on a story map they had been part of analysing. Facilitators asked other groups for post-it notes that contained similar issues. Discussions to negotiate meanings and nuances were encouraged. Post-it notes that had similar themes were grouped together centrally for everyone to see. This process of calling out and grouping themes continued until all themes were mapped into distinctive clusters.

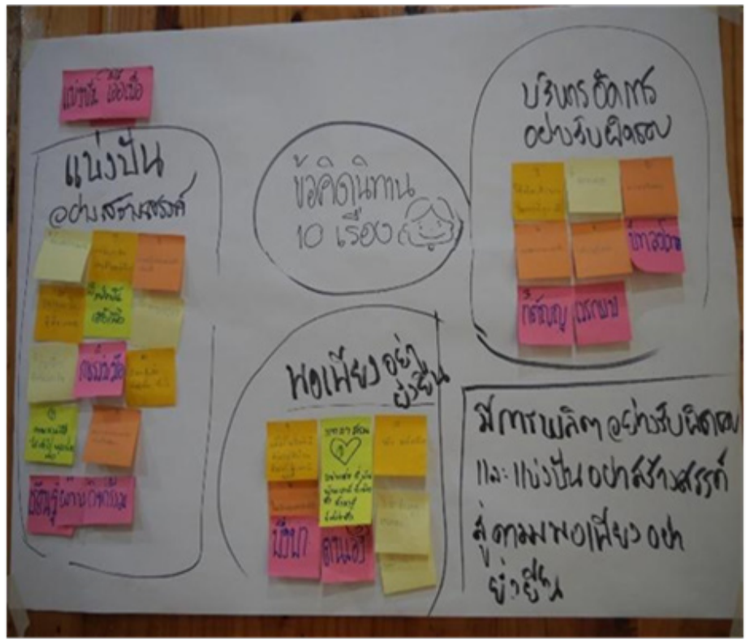


Image 5. Villagers thematically cluster the story themes into three main features of Karen food systems in Northern Thailand: creatively sharing; sufficiency and sustainability and responsible governance. ©PASD

Groups were then challenged to give the thematic clusters a name, giving a sense of the "high-level" messages about Indigenous Peoples' food systems that can be found within the story collection. The naming of clusters included discussions about whether particular themes should stay or move to different clusters.

Local-level analysis

Following the within-team pilot/practice, story review and collective analysis was then facilitated by country teams with 131 Indigenous Peoples storytellers and their communities between November 2023 and February 2024. Whilst the overall approach was consistent across countries, the format of meetings and the analytical process was adapted to the local context.

The research team in Northern Thailand invited fifteen members from five villages to come together over night. The group consisted of community Elders (male and female), youth and enumerators. The group was divided into five groups (based on community), each of which analysed two stories each.

The research team in Northeast India facilitated analysis with fifteen NESFAS staff and the enumerators on the TAPE project, creating a preliminary story map. The country research team ran analysis sessions in four communities, as language differences made it challenging to convene as one large group. In total, 66 people of all ages and genders in the communities participated in analysis. People gathered in outdoor spaces by a fire, in selected households, and in Mother Earth Cafes as well as community centres. In these environments and cultural contexts, it was more appropriate to use the questions to facilitate reflections and dialogue, and the maps were drawn later. The team felt that the community initially found it challenging to grapple with the deeper themes of stories. Therefore, rather than dividing the group up, steps 2 and 3 were completed as one large group. Higher level themes were identified by clustering key elements from story maps and asking each member of the community to derive lessons from the story. The lessons shared by individuals were then clustered to form a final set of messages.

The research team in Kenya brought 35 members of the Ogiek community in two community forums to complete the story analysis. One community forum in East Mau brought five women and nine men together. The group comprised of eight young people (male and female), and six community Elders (male and female). The second community forum in Nkareta brought six women and fifteen men together. The group comprised eight young people (male and female) and thirteen community Elders (male and female).

Overall, the country teams reported that communities responded positively to the story analysis. They reported that the exercise invited a sense of community bonding, with the analysis of stories providing a platform for celebrating collective identity through stories. The exercise also held value as a tool for knowledge and cultural preservation and amplified marginalised voices. For example, the research team in Northern Thailand reflected that the combination of Elders and young people was particularly good because the Elders could explain the wisdom in the story. In Northeast India the process led to recognition of the gap in stories representing Khasi and Garo identity, leading to the inclusion of new stories and storytellers.

National-level analysis

At the national level, country programme teams followed the same collective analysis process. In Kenya, the country research team used the same methodology in the community forum with OPDP staff during staff meetings. The objective was to complement community analysis with additional perspectives on the practices, outcomes, influencing factors and significant points of change within each narrative. The community and organisational analysis of the stories were combined into a set of story maps and lessons from each story. In Northern Thailand, the research team documented small group and large group sessions, also digitalising the analytical maps.

In Northeast India the research team facilitated adjustments to story maps through research team and community level assessments of the maps as artefacts that were representative of the relationships between elements in their stories.

Country teams did some additional analysis of story collections, mapping story content to TAPE dimensions and adding national context. Country research teams used a matrix to assess how ten agroecology dimensions of the TAPE tool were best represented by each story in their collection. It was possible – and typical – for stories to represent many dimensions within one story. This analysis prompted reflection on how TAPE dimensions are expressed in indigenous contexts and which principles of Indigenous Peoples' food system extend TAPE dimensions into different focal areas. One example of this is the prominence of sufficiency as an agroecological dimension of Indigenous Peoples' food systems not represented in the TAPE tool.

Global-level synthesis

The country research teams gathered for a story synthesis session online in January 2024. This involved all country teams, including team leads and any members involved in the story collection and analysis process. During the structured session, each country partner was invited to present on the final thematic clusters identified by communities during the participatory story analysis exercises. The clusters from all three countries were shared and clustered so those closest in meaning were positioned closer together and those that hold a unique space were positioned apart. This involved negotiating meaning about how different principles, practices, and values (outcomes) are expressed in different cultures to reach a shared understanding of commonalities across contexts, and unique characteristics/principles. The clustering exercise allowed the country-level themes to be synthesised into a final set of high-level (more global) narratives about Indigenous Peoples' food systems. The end of the session invited participants to reflect and share on the themes that spoke most strongly to them, given their knowledge of current local, national, and global policy contexts pertaining to Indigenous Peoples' food systems. Conversations were documented.

The synthesis process used final thematic clusters, the matrices that mapped stories to TAPE dimensions as well as individual story maps to identify meta-narratives that deepen and extend current understandings of Indigenous Peoples' food systems, and which counter dominant narratives about how food should be cultivated. As high-level themes were developed, stories that evidenced the theme were brought under that theme. The findings were tested with a small group of five individuals accustomed to researching and representing the role of Indigenous Peoples' food systems in global research and policy. Their awareness of global policy on agroecology added another layer of interpretation to stories, which informed the translation of story evidence into seven high level claims about how, when, why and in what ways Indigenous Peoples' food systems support people and landscapes to thrive. These narratives were tested and refined with country teams in May 2024, before being written up as a separate story synthesis report, which links off to the original stories on the TIP website (https://www.theindigenouspartnership.org/ipfsproject).

1.2.5 Free, Prior and Informed Consent (FPIC)

Given the duration of the storytelling process and the process of co-producing the stories and their analysis, consent was collected over four distinct stages of storytelling: making arrangements, collecting the story, story analysis and validation and communicating the stories (Figure 8).

Figure 8: Four stages of storytelling for consent.

Step 1: Making arrangements

An initial indication of consent was obtained from participating communities during Free, Prior and Informed Consent (FPIC) workshops. FPIC is a prerequisite for projects involving Indigenous Peoples (UNDRIP, 2007). Workshops were undertaken in all participating communities and involved community briefing on the project work proposed (including TAPE and storytelling). This gave communities the opportunity to ask questions about the project, before giving informed consent.

Step 2: Collecting the story

Consent was sought again from individual or group storytellers prior to the telling of stories. A two-way consent form was signed by both storyteller and enumerator, which indicated not only consent of the storyteller to participate in the project, but also indicated the researcher's commitment to using the story responsibly.

Step 3: Story analysis and validation

Community analysis sessions began with storytellers sharing their stories. Any missing details or gaps were discussed and incorporated, including linking to additional stories or folklore and clarifying unclear characters or events. This process also provided informal collective consent about the final version of the story to be used for analysis. Young people were invited into these sessions so they also heard and analysed the stories, which held local value as an activity that promoted cultural preservation and community belonging.

Step 4: Communicating the stories

Final consent was sought from individual or group storytellers prior to uploading stories on TIP's website and the inclusion of stories in project presentations and reports. This consent was explicit about how the stories were going to be shared, the reason we were sharing them (for learning purposes) and sought confirmation on how the storytellers would like to be identified in the sharing of the story.

1.2.5 Scope and limitations

The communities had many more stories than the project had resources to collect, translate and analyse. In some cases, an individual story was told in multiple different ways, with distinct local interpretations, emphasising how stories do not present one truth but are instructive about how people make sense of their worlds. There was strong interest in translating the stories into written forms of local language for further sharing and culture preservation, however the TIP project regrettably did not have funding for this component. Going forward, this seems like an important budget line for projects working with Indigenous people's stories.

Whilst necessary, language translation has its limitations (Smith, 1996): in translating away from the original tongue, original meanings and nuances of language can be lost. What may be one term in one language may not have a direct equivalent term in another. Conversely, some terms may have multiple meanings and associations in one language that cannot be captured in another, regardless of how well translated they may be. With Indigenous linguistic diversity recognised as tightly coupled with biological diversity, this potential loss of knowledge during translation is particularly concerning (Greenfly et al., 2012; Wilder et al., 2016). To mitigate these shortcomings of translation in this project, research partners were asked to leave certain words or phrases in the Indigenous language and footnote these with lengthier descriptions. This intended to capture the original meaning as much as possible without affecting story fluency. This was particularly used when describing local varieties of foods. Enumerator translations were cross-checked by country team leads (in consultation with Elders, where appropriate) to mitigate loss of meaning.

Collective analysis of stories at the community level required skilled researchers who could adapt training to local situations and context. The collection and analysis of stories were integrated into TAPE processes as much as possible to minimise travel. Cross-community analysis of stories was difficult in some contexts as different languages prevented collective and collaborative sensemaking. In this circumstance, the enumerators in the country research teams played an important knowledge weaving role, interlinking insights from one community analysis session to another.

It was the intention for storytellers to engage with global synthesis of the story collection but resource constraints in the project made it difficult for country teams to complete this step before publication milestones. However, the in-country research teams have a strong interest to translate and convey the key findings of the project at upcoming community level events.

1.3. Integrating TAPE and Storytelling

The results and insights on Indigenous Peoples' food systems that were gleaned from the Tool for Agroecology Performance Evaluation (TAPE) and from the participatory storytelling approach are quite different in format and scope. This section describes the way in which these two approaches were combined and used to enrich one another in the production of agroecological evidence on Indigenous Peoples' Food Systems, drawing upon the well-established "iceberg model".

1.3.1 The Iceberg Model

The Iceberg Model is a metaphorical tool commonly used within systems thinking (Figure 9). It is based on the idea that only a small portion of an iceberg is visible above the water, while the majority of it is hidden beneath the surface. In systems thinking, iceberg model is used to draw attention to four levels of reality:

(1) Events/behaviours: visible events, behaviours, or symptoms that we see (i.e. the tip of the iceberg).
(2) Patterns: patterns occurring over time that provide clues for understanding the systems' structures.
(3) Structures: the underlying structures, relationships and feedback within the system that influence the observed patterns. This might include physical things, organisations, policies, and rituals/habits/traditions.
(4) Paradigms of thought: the values, beliefs, worldviews that shape the system under observation.

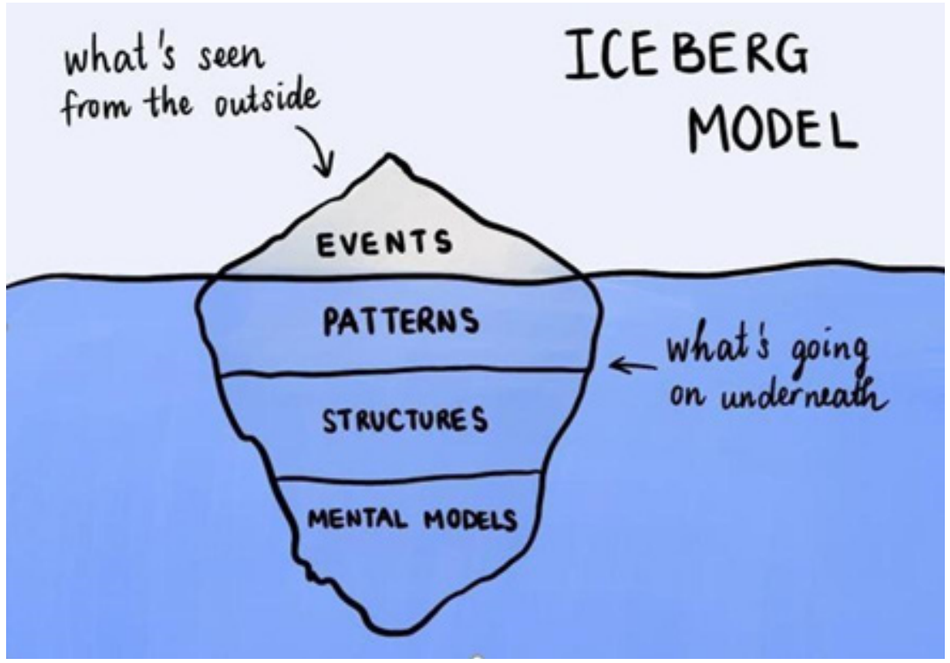


Figure 9: Iceberg model of reality (Source: Medium.com)

By conceptualising reality as layers of observable and underlying factors, the iceberg model emphasises the importance of understanding the underlying dynamics of visible outcomes. It allows one to gain a deeper understanding of why certain events/behaviours occur in certain contexts, and how they may be influenced. And it encourages engagement with mental models, paradigms of thought and worldviews to make sense of systems.

1.3.2 Application of the model

When describing the results of TAPE, we are effectively describing the visible elements of the Indigenous Peoples' food system, corresponding to the tip of the iceberg above the water. This is particularly the case for TAPE Step 2, which assesses the "outcomes" of the food system according to various dimensions of sustainability (economic, environmental, and social). In Step 1, TAPE goes a little deeper below the surface to discuss patterns and structures (governance, circular economy) that influence the observed events and behaviours.

Storytelling overlaps somewhat with TAPE on the structures that we do not see. However, more importantly, it uncovers the paradigms of thought that shape the agroecology system (well below the water). Storytelling thus, takes us deeper into our understanding of Indigenous Peoples' food systems as agroecological systems. In presenting the results, we first present TAPE results as visible events and outcomes, followed by discussion of the stories collected, and how they add to our knowledge of why certain outcomes are observed, including the paradigms of thought that underpin the structures, patterns, and behaviours within Indigenous Peoples' landscapes. A separate report reflects on the value of adding participatory storytelling to TAPE.

1.4. Summarising Remarks

The report has described above the process of adapting the TAPE instrument and its application in Indigenous Peoples' food systems. The report has also described the process of co-creating a method to collect Indigenous Peoples' stories, which help to convey the values and principles underlying the results obtained by TAPE. The report then describes the novel and innovative way in which these two approaches were combined and used to enrich one another in the production of agroecological evidence. In the five reports that follow, we present this evidence based on TAPE and storytelling results from Northeast India (Chapter 2), Northern Thailand (Chapter 3), Kenya (Chapter 4) Mexico (Chapter 5). In Chapter 6, we briefly summarise the findings from all countries, and conclude with a reflection on combining participatory storytelling and TAPE. We hope that these insights will prove useful for stakeholders undertaking research relating to Indigenous Peoples' food systems, and/or those interested in food systems policy.

CHAPTER
2

Evidence on the Multidimensional Performance of Agroecology in the Indigenous Peoples' Food Systems of Northeast India

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- **Khasi Peoples of Dewlieh and Umsawwar** villages, Meghalaya
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Summary

Aim: This study characterised the food systems of Indigenous Peoples' communities in Meghalaya, Northeast India, and presents evidence on the multidimensional performance of agroecology based on the use of the Tool for Agroecology Performance Evaluation (TAPE).

Methods: In 2023, TAPE was used to evaluate 120 households belonging to the Garo, Karbi and Khasi Peoples across four communities in Meghalaya, Northeast India.

Results: The food systems of Meghalaya is characterised by the diversity of systems that encompass cultivated, semi-domesticated and reliance on natural systems utilised across the seasonal calendar. Shifting cultivation remains central to many community food systems, alongside the use of fallows and forests, aquatic systems, and home gardens. A high diversity of crops is produced, and a further rich diversity of wild foods is sourced. The use of TAPE in this study showed that:

- The food systems studied in Meghalaya are mostly at moderate-high levels of agroecological transition, with only one community considered to be less agro ecologically advanced. Traditional food practices continue to be largely retained.
- Elements of Efficiency and Human and Social values received highest scores, reflecting the use of external inputs, management of soil fertility, pests and diseases, and women and youth empowerment and the quality of labour conditions and welfare.
- There was a strong positive link between producer participation in the governance of natural resources and land and overall agroecological status in the target territories. A strong link was seen between human and social values and resilience to climate change.
- Most advanced agroecological systems had higher productivity and farm revenues, suggesting that these traditional food systems can be economically viable.
- Most advanced agroecological food had higher quality soils, spent more on organic pesticides, and maintained higher agrobiodiversity.
- Most advanced agroecological systems had greater retention of youth within the community for agriculture.

2.1 Methods and research sites

TAPE was used to evaluate 120 households of the Garo, Karbi and Khasi Peoples in Meghalaya, Northeast India. Four communities that included Darechikgre, Dewlieh, Plasha and Umsawwar, were selected for this study. These communities, chosen by NESFAS, had long-standing, trusted relationships with the organisation. These communities are representative of the Indigenous Peoples' food systems and diverse food practices of the three tribes in the region. In each community, 30 households were randomly selected for participation. The random selection of households was designed to provide a comprehensive overview of the food systems within each community.

Free, Prior and Informed consent for the study was first obtained from the Nokma (village head) of Darechikgre and the Dorbar Shnong (village council) of Dewlieh, Plasha and Umsawwar and the village. To ensure that the communities were fully aware of the study's purpose and methods, the research team conducted a general awareness session. The team conducted a general awareness prior to the conduct of the study. Subsequently, verbal consent was confirmed with each participating household before the interviews began.

Data collection took place between May and September 2023, with seven enumerators from Northeast Society for Agroecology Support (NESFAS). These enumerators, being part of

NESFAS, had prior experience working within these communities, which facilitated smoother communication and data collection. The training and data collection activities were overseen by a lead from NESFAS, who had been trained on the TAPE instrument by the Food and Agriculture Organization (FAO).

The enumerators underwent comprehensive training, which included in-depth discussions on agroecological elements, the TAPE instrument and their application within the target communities. They were trained in the use of the seasonal dependency matrix and Participatory Rural Appraisal (PRA) exercise. The training also reviewed and clarified the meaning of TAPE items with examples relevant to the local context. Enumerators were trained in the use of the Kobo Toolbox, a digital application used for data collection.

Following the data analysis conducted by the FAO, the research team engaged in cross-country dialogues to discuss the results. The findings were shared with the participating communities to gather their feedback and facilitate joint interpretation of the results. This collaborative process allowed the communities to provide input on how the findings could be made more relevant and useful for their specific needs and contexts.

Study Sites

The four participating villages were Darechikgre (Garo Peoples), Dewlieh (Khasi Peoples), Plasha (Karbi Peoples), and Umsawwar (Khasi Peoples) (Figure 10). All of the communities in this study are agrarian communities that are predominantly subsistence-oriented, whilst exploring ways to diversify their income opportunities.

The following section provides descriptions of each community, their food systems, and enabling/constraining environments. This information was derived from the adapted TAPE Step 0, which integrates participatory rural appraisal and key informant interviews and insights from discussions with project field partners at NESFAS.

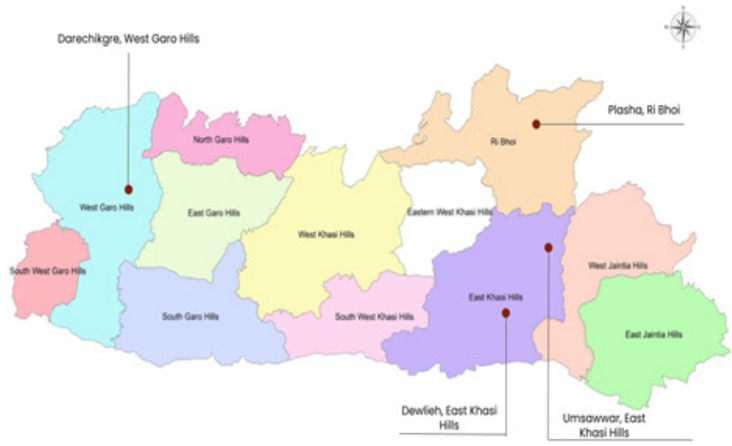


Figure 10: Map indicating locations of study communities within Meghalaya, Northeast India.

	Dewlieh	Umsawwar	Plasha	Darechikgre
IP Group	Khasi	Khasi	Karbi	Garo
Population (persons)	91	409	299	955
Land area (ha) ***Land per capita***	79 0.87	1319	449 1.50	480 0.50
Cultivated food systems	Jhum fields Jhum fallows Home gardens	Bun field Bun fallows Home gardens Non- Homestead garden Paddy fields Forest gardens Fishponds	Jhum fields Jhum fallows Paddy fields Paddy gardens Orchards Home gardens Fishponds	Jhum fields Jhum fallows Paddy fields Orchards Home gardens Plantation
Natural food systems	Forest River	Forest Grasslands Rivers/streams	Forest Rivers/streams	Forests Rivers
External food sources	Market PDS	Market PDS	Market PDS	Market PDS
Livelihood activities	Broom cultivation Bamboo weaving	Broom cultivation NFTP processing Livestock rearing	Pineapple and areca nut cultivation Eri Silk and cotton weaving Bamboo weaving	Areca nut plantation Orange and Chayote squash cultivation Beekeeping

Table 3. Summary characteristics of community population, land use and food systems use in sites in Meghalaya, Northeast India.

Dewlieh village is located in Khatarshnong Laitkroh block of East Khasi Hills district in Meghalaya and has a small area of 79ha. Dewlieh is located within a deep, steep canyon, accessible only by stairs on foot. As the village falls within the Sohra region, it receives one of the highest rainfalls in the world, with an average annual rainfall of more than 1000 cm. The village comprises a total of 34 families residing in the village with a total of 91 persons. The people belong to the Khasi tribe, which is one of the dominant Indigenous Peoples' groups in the state of Meghalaya and follows the matrilineal custom.

Food Systems use: In Dewlieh, the *jhum* system, a form of shifting cultivation, constitutes the dominant food source with additional resources sourced from the forest, river, fallows and home gardens. Apart from the diversity of food sources that are available in the village, people also have access to market food, and receive food welfare support through the Public Distribution System (PDS). From the *jhum* fields, food crops like millets, maize, beans, and a wide range of vegetables including green leafy wild edibles are harvested by the community. Tuberous crops like sweet potatoes and cassava are harvested in early years of *jhum* fallows; during the later years of fallow, wild edibles such as mushrooms are sourced. The surrounding forest offers wild fruits and vegetables, and during the winter, villagers hunt small animals such as mountain rats. Attached to the residence are home gardens where additional vegetable crops are grown with integration of a variety of fruit trees, particularly *Sohiong (Prunus nepalensis)* trees. A few households rear poultry and pigs in their home gardens for self consumption. The Wah Sohra River is an important source of fish and other aquatic animals, including frogs and crabs, especially during the rainy season.

Livelihood Opportunities: In Dewlieh, crops cultivated are primarily for household consumption, with only the surplus produce being sold to the nearby market in Sohra. The common crops sold include potatoes, cassava, black mustard and others. Among the fruits, *Sohiong* trees are particularly significant, as they constitute an important fruit crop sold in the market. *Sohiong,* known for its distinctive flavour and local value, is a key product that contributes to the household income and is highly sought after in the regional market. In recent years, broom grass cultivation has expanded significantly, driven by market demand, and has become an important cash crop grown in fallows. Households engage in wage work on non-family farms, including transporting produce from *jhum* fields to the village and market. Additionally, bamboo weaving, especially the creation of baskets for storing and transporting produce, is an important off-farm activity.

Enabling environment: In Dewlieh, the traditional village institution called the *Dorbar Shnong (Village Council)* led by an elected *Rangbah Shnong (village headman),* is the most important institution with significant authority and responsibilities. It plays a central role in equitable resource allocation, land use planning, and sustainable resource management within the community. Notably, *Dewlieh* is among the early villages to facilitate the inclusion of women into *Dorbar Shnong,* a practice that is traditionally uncommon. A strong sense of community in Dewlieh fosters mutual support, particularly in food production. Community members often exchange labour for sowing, weeding and harvesting enhancing their collective effort. This communal support sustains their agricultural practices.

The steep terrain in Dewlieh is not well-suited for raising livestock and transporting the animals or meat to the local market poses considerable challenges As a result, livestock integration into the food system is limited, with only a few households raising pigs and poultry. To address the difficulties of transporting pork to the market, the community has developed a unique practice called *khalai dohsngiang.* This system is organised within the village to facilitate the sale of pork meat through a lottery system. This manages the distribution and sale of pork locally supporting the local economy.

A notable constraint of Dewlieh is that the village does not own the land it cultivates but the land is leased from the Langstieh clan currently under a 15 year agreement. However, the close dialogue and relation that the communities have with the owning clan, allows this arrangement granting the community considerable responsibilities such as protecting the forests from wildfires. It allows the *Dorbar Shnong* to allocate land to its members for cultivation. Additionally, the *Dorbar Shnong* has designated a portion of the forest as *Lawadong* or restricted forest where set of rules are established for sustainable harvesting of resources such as timber and collection of firewood

Despite these responsibilities, the absence of a long-term, guaranteed lease agreement restricts the community's ability to make long-term decisions regarding land use and management. This lack of secure tenure limits their capacity to invest in and implement sustainable land practices effectively.

Dewlieh has also been particularly affected by Government concerns around the use of fire and land clearance associated with shifting cultivation. The community has received advice from

multiple government departments to reduce burning and deforestation associated with shifting cultivation. Additionally, the village has faced a marked lack of extension support for improving productivity of shifting cultivation and has not been recognised for inclusion in the Government organic farming mission.

Umsawwar village is situated in the Mawkynrew block of East Khasi Hills district in Meghalaya. Umsawwar is situated on the Shillong Plateau, experiencing warm summers and cool winters due to its elevation of over 1400 metres. The village receives heavy rainfall, with an average annual rainfall of more than 400 cm. This heavy rainfall and the geographical location contribute to the village's luscious vegetation, ranging from sub-tropical evergreen forests to temperate pine forests. The village has a population of 409 people residing in 71 families in the village (2011 Census). The people belong to the Khasi tribe, and follow the matrilineal custom, with matrilocality being widely practised.

Food Systems use: In Umsawwar, households rely on a diverse array of food systems that encompass cultivated, semi-domesticated, and natural sources. These systems provide 145 different food items, including a variety of plant and animal products, which are harvested and consumed throughout the year, as outlined in the seasonal calendar. Bun cultivation is the most significant food system in Umsawwar, particularly well-suited to the expansive grasslands in the area. This cultivation is practised on common property areas allocated by the *Dorbar Shnong.* Bun cultivation operates similarly to rotational cropping, where fields are farmed for several years before being left to fallow. The process begins with clodding the soil and overturning the clods to cover the vegetation. After drying, the vegetation is burned anaerobically, a method akin to biochar production that enriches the soil with nutrients before planting. While a variety of tubers, vegetables and oilseeds are grown in bun fields, millet and maize are the primary cereals grown and paddy is notably absent. Though some households still engage in traditional jhum cultivation, it has been largely replaced with bun cultivation due to its ability to support shorter fallow periods, better adapting landscape. Home gardens attached to homesteads also play a vital role in the community's food production. These gardens offer a steady supply of vegetables and fruits for household use, with surplus produce, particularly mustard greens and radishes, sold in local markets in Jatah and Smit. The surrounding forests and grasslands are rich in wild edibles, including green leafy vegetables, various mushrooms, bayberry, and wild berries. The grasslands of Umsawwar are also a source of unique foods like *Niangphlang,* an insect that is harvested and consumed as a traditional delicacy. The Umngot River and nearby streams are crucial sources of fishes and other aquatic fauna consumed. Fishing in these water bodies is tightly regulated by rules set by the village council ensuring sustainable management of these resources.

Livelihood Opportunities. In Umsawwar, livelihood opportunities encompasses agriculture, livestock rearing, small scale trade and sale of non-forest timber products. Potato takes precedence as the main crop cultivated in bun for subsistence and surplus sales. Other crops sold include radish, mustard leaves, and perilla seeds. Millet is also regaining prominence as an important crop cultivated in bun for consumption and income generation. Animal husbandry is practised in home gardens. Pigs, chickens, and goats are raised primarily for supplementary income, with sales typically occurring at the end of the year. Although cattle rearing was once widespread; it has declined over the years due to decrease in the number of available herders. The collection

and sale of Non-timber forest products (NTFPs) provide additional income opportunities. Wild edibles such as mushrooms, *Centella asiatica,* fish mint, water celery, and bayberry are gathered from the surrounding forests and grasslands. These products are either sold within the village or at local markets.

Over the years, driven by market demand, broom grass cultivation has expanded significantly. Typically introduced during the first year of fallows, broom grass has become an important cash crop. This shift has notably impacted fallow regeneration and contributed to a decline in traditional *jhum* cultivation, with an increasing number of fallow lands now dedicated to permanent broom grass cultivation.

Additionally, households with members over 18 years old engage in off-farm labour for about 60-100 days a year under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS). The schemes implement infrastructure projects like road construction, footpaths, and check dams.

Enabling environment. Traditional governance structures in Umsawwar are strongly upheld. The Dorbar Shnong, led by an elected *Sordar Shnong* (village headman), is the primary institution responsible for overseeing the allocation and management of land and resources. The land in Umsawwar is owned and managed collectively by the *Dorbar Shnong,* which plays a crucial role in designating areas for settlement, cultivation, and the management of various forest types. Each year, the *Dorbar Shnong* selects and allocates land to households for bun cultivation, ensuring an equitable distribution of resources. Although traditionally, women have not been part of the *Dorbar Shnong,* Umsawwar has taken progressive steps to include women in the decision-making process. The village has also established a separate women's council, known as the *Dorbar Kynthei,* where women gather to discuss issues ranging from social concerns to environmental matters. The *Dorbar Kynthei* operates independently but also contributes to the broader governance of the village by presenting its agenda at the general meetings of the Dorbar Shnong each year. In addition to the *Dorbar Kynthei,* Umsawwar has instituted the *Dorbar Khynnah,* or the Children's Dorbar, to promote intergenerational knowledge transfer. Modelled after the Dorbar Shnong, the *Dorbar Khynnah* allows children to engage in governance and learn about the cultural practices, farming methods, and community values of their elders.

Umsawwar's unique governance system, characterised by its inclusive and participatory approach, has played a crucial role in enabling the community to collectively address and respond to external challenges, particularly those that threaten their food systems and natural resources. One of the most notable examples of this collective resilience is the community's successful opposition to the proposed Umngot River Hydel Project. The deep-rooted sense of community in Umsawwar plays a crucial role in maintaining and perpetuating traditional farming practices. Villagers and clans actively participate in the exchange of labour, seeds, and resources, fostering strong social ties and ensuring the resilience and sustainability of their agricultural systems

The introduction of potato cultivation in Umsawwar, which became a dominant crop, brought about significant changes in farming practices, especially with the initial promotion of inorganic

inputs through Government subsidies. However, the Government's recent shift towards promoting organic and natural farming has led to the withdrawal of these subsidies, leaving farmers to procure inputs from local markets at their own expense. One of the major constraints is the limited support and the lack of adequate extension services available to farmers during this transition. Moreover, while farmers often save planting material from their own harvests, the crops, particularly potatoes, are increasingly susceptible to diseases and the impacts of climate change.

Plasha village situated in the Umling block of Ri Bhoi district in Meghalaya has a total area of 449 ha, with an area of 83.70 ha used by the community for agriculture. Plasha is located at an elevation of 600m and is characterised by low hills and small elongated valleys that lie between them. The dominant vegetation in the village is sub-tropical semi-evergreen and evergreen forest. The village comprises 55 households and 299 persons. The people belong to the Karbi tribe, which is a minor tribe of Meghalaya. Unlike the surrounding Khasi-Jaintia community, they are patrilineal.

Food Systems use: Households in Plasha depend on a diverse range of food sources to meet their dietary needs. Wet paddy cultivation in the lowlands and *jhum* cultivation in the hilly areas are the most predominant systems. In the wet paddy fields, various traditional rice varieties are grown, while the *jhum* fields are used to grow upland rice intercropped with crops such as beans, squash, oilseeds, and chillies. The village achieved self-sufficiency in staples through these diverse food systems reducing their dependency on markets. In the past, cotton was traditionally cultivated in these *jhum* fields, providing a locally sourced fibre used for weaving. However, the practice declined as easier access to market-supplied cotton became more prevalent, gradually replacing homegrown cotton. Recently, portions of the fallows have been converted into orchards for areca nut, orange, and pineapple, while other sections are left to regenerate naturally. Home gardens attached to residences play a crucial role in enhancing household food security. Crops cultivated include beans, maize, taro and several fruit trees are integrated in the kitchen garden. Pigs and poultry are commonly reared within these home gardens, although cattle farming has become less common. Additionally, some households have introduced beekeeping and silkworm rearing within their home gardens. The surrounding forest is an essential food source, providing wild edibles like mushrooms, banana stems, green leafy vegetables, jackfruit, and wild honey. It is also a source for harvesting insects and wild fowl, typically caught using traps. Aquatic foods such as fishes, crabs and shrimps are mainly sourced from the paddy fields and the streams that run through them, with fishing practices regulated to prevent overfishing.

The forest is also important for collection of several insects, wild fowl, usually captured using traps. Market food is also easily accessible from the shops in the village or the nearby town of Nongpoh.

Livelihood Opportunities: In Plasha, agriculture predominantly serves subsistence needs, with any surplus sold at local markets. Sticky rice is especially valued for its economic importance, while taro, pumpkin, beans, and various wild edibles from the surrounding forest are also sold in the village and at local markets in Umden and Nongpoh. Recently, there has been a notable shift towards cultivating horticultural crops, such as orange, pineapple, and areca nut. These crops,

once primarily grown in fallows and home gardens, are now commercially cultivated on a larger scale.The region's pineapples are particularly renowned for their exceptional flavour and aroma. Government initiatives aimed at promoting the cultivation, processing and marketing of pineapple in the region has contributed to this expansion. Additionally, the rising demand for bamboo driven by the booming real estate sector in nearby Guwahati, Assam, has led to expanded bamboo cultivation. While these developments provide economic opportunities, they have also impacted local biodiversity. Both the men and women in Plasha participate in off-farm activities. Women are skilled weavers of eri silk and cotton, working both at Eri Silk weaving centres in the neighbouring village of Umden. Many women have organised themselves into self-help groups to support and expand their weaving activities. Men are engaged in bamboo weaving and woodcrafting. Additionally, community members participate in infrastructural work under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), for 65 to 100 days annually.

Enabling environment: Plasha is also served by the traditional institution of the *Dorbar Shnong,* led by the *Rong kethe* (village headman) who is elected by community members Although the *Dorbar Shnong* includes women, their participation in these meetings is infrequent. Despite being a patrilineal society, Plasha exhibits matriarchal characteristics, with women being highly respected and often referred to as *"Lukhmi ka iing"* (Lukhmi = goddess of rice), acknowledging their role in sustaining the household. Land for cultivation and forests are privately owned by households, but the *Dorbar Shnong* oversees the management of the *Law Shnong,* a community forest regulating resource use. The *Dorbar Shnong* did not participate in the Payment for Ecosystem Services (PES) scheme due to concern that its requirements would hinder the practice of their traditional systems.The sale of land to outsiders is prohibited, and households with limited land for shifting cultivation are supported by those with additional land or regenerated fallows, through agreements that allow them to cultivate without rent.

The strong sense of community and active participation of youth in farming ensure the continuation of traditional farming activities in Plasha. The village was part of the state's Organic Mission, which supports farmers, especially pineapple growers, in obtaining organic certification under the Participatory Guarantee Systems (PGS)-India. Plasha along with six adjoining villages had established the Tomonpo Anglong Organic Producer Company Limited aimed at creating market linkages for their local produce. However, the full potential of this initiative has yet to be realised. The value chain, which includes steps such as processing, packaging, and distribution, remains underdeveloped. As a result, farmers often find themselves selling their products in their raw form, typically in local markets. Furthermore, the region's inadequate road infrastructure poses significant challenges.

Darechikgre village is located in the Rongram block of the West Garo Hills district in Meghalaya, within the Durama forest range, which also encompasses the Nokrek Biosphere Reserve and biodiversity hotspot preserved by the Garo people for generations. In the buffer zone of this reserve, a sanctuary has been established for the preservation of citrus germplasm.The village has a total area of 480ha and is characterised by low hills and small elongated valleys that lie between them. Whilst winters are cool, summers are hot, with the maximum temperature in 2023 touching almost 40 degrees Celsius. The village comprises a total of 174 households, with a total

population of 955 people. The village is inhabited by the Garo People, one of the major tribes of Meghalaya and follows the matrilineal system.

Food Systems use. The food system of Darechikgre is primarily based on *jhum* cultivation and wet paddy farming, complemented by the use of fallows, home gardens, forests, and rivers. Wet paddy fields are located in the narrow valleys between the hills, while *jhum* fields are spread across the hillsides. In the wet paddy fields, paddy serves as the main staple, while in the *jhum* fields, hill paddy is grown alongside a variety of crops, including vegetables, oilseeds, and condiments. In home gardens, crops like chayote and fruit trees like oranges are grown for household consumption and sale to the market. Some households have also integrated beekeeping into their home gardens. Pigs and poultry are commonly raised animals within the home gardens. Some Households also rear dairy cows. The surrounding forest is a vital source of wild edibles, including bamboo shoots, various green leafy vegetables, and fruits. *Citrus indica,* a rare wild citrus species locally known as *Memang Narang,* is also collected from the forest. The Ganol River that flows through the village is a source of aquatic resources such as fishes, crabs and others.

Livelihood Opportunities. Agricultural production in Darechikgre is primarily focused on self-consumption, with only surplus yields being sold at the local market in Rongram. The community's reputation for chemical free production enhances the market value of their produce. Chayote and oranges are particularly significant, not only providing crucial income through local sales but also through exports. The cultivation of these crops is complemented by the establishment of various plantations and orchards within the community. These plantations are mostly areca nut and betel leaf. While many of these plantations are situated close to residences for ease of management, there has been a recent expansion of areca nut cultivation into fallow areas due to growing market demand.

In addition to staple crops, the Darechikgre community harvests a variety of non-timber forest products (NTFPs) that contribute to their income. These include leaves from *Michinga (Zanthoxylum sp.)* and *Mebitchi (Rhynchotechus ellipticum),* as well as wild banana inflorescence, all of which are sold in local markets. Furthermore, value-added products like orange marmalade, jam, honey, and pickles contribute to the local economy.

Enabling environment. In Darechikgre, the traditional governance system is led by a female traditional head called *Nokma.* This position is typically hereditary, passing from one generation to the next within a family or clan.In Darechikgre, the land is governed by two *Nokma* representing two clans: *Bolwari* and *A·gitok*. Although she holds the primary responsibility for governance, duties are delegated to their husband and supported by her brothers and maternal uncles. The role of the *Nokma* is crucial to oversee various aspects of village life, including land management, conflict resolution, and the enforcement of traditional customs and laws. A crucial role of the *Nokma* is overseeing the selection and allocation of land for shifting cultivation and plantation. Under this traditional system, land is collectively owned by the community, with private ownership being prohibited. While land can be passed down to future generations, the *Nokma* retains the authority to reclaim land if it is misused. The community manages various types of forests, including Sacred Forests and community conserved forests. The community has also previously collaborated with the Wildlife and Forest department to support the protection of designated forest

areas surrounding the village. Additionally, an area of 35 hectares of community-managed forests, which is not suitable for shifting cultivation, was brought under the World Bank-led Payment for Ecosystem Services (PES) scheme. The increasing expansion of areca plantations in *jhum* fallows raises significant concerns due to its environmental and socio-economic impacts. This shift disrupts the traditional practice of shifting cultivation, reducing biodiversity and degrading soil health by converting diverse ecosystems into monoculture crops, creating economic dependency on a single cash crop.

2.2 Key Attributes of the Indigenous Peoples' food systems of Northeast India

Food source diversity and seasonal dependency

As exhibited in the study communities, the Indigenous Peoples' food systems in Meghalaya depend upon a diversity of sources for obtaining their food, including (1) cultivated systems and semi domesticated systems, (2) collection from natural systems and (3) food from external systems. These food sources span diverse landscapes and are managed and utilised according to different time-cycles. Whilst the exact nature of the food systems will vary between communities, several common systems can be identified. These include shifting *(jhum)* cultivation, paddy fields, use of forests, aquatic systems, home gardens, and the market. Of these, shifting cultivation is a particularly prominent and consistent feature of the traditional Indigenous food landscape of Meghalaya. The following section elaborates on diversity of food systems within the four communities examined in this study, including their seasonal importance. Information comes from the communities and the research partner, NESFAS.

(1) CULTIVATED SYSTEMS AND SEMI-DOMESTICATED

• ***Shifting Cultivation (jhum).*** Shifting cultivation or jhum cultivation remains an important agricultural practice in many Indigenous Peoples' communities in Meghalaya, including in three of the sites participating in this study (Darechikgre, Dewlieh and Plasha). Jhum cultivation involves the selective clearing of areas to create space for cultivation, followed by controlled burning of the resulting space to remove dry biomass and facilitate the release of nutrients into the soil. The resulting plot of land is planted with a diverse range of crops, including starchy staples, nuts, and seeds, which are intercropped using methods like seed broadcasting and dibbling This land is typically farmed for one year and is then left to "fallow" for 10-15 years in Dewlieh and Darechikgre, whereas in Plasha the fallows are left for 5-7 years. In Dewlieh, crops such as cassava and sweet potato are harvested from the fallows for at least three years. This extended fallow period is crucial for allowing the soil to rejuvenate and forest to regenerate and regain vitality. Shifting cultivation goes by different names in the three different communities studied, including *"rep shyrtie"* in the Khasi community of Dewlieh and as *"a·ba cha·a"* in Darechikgre. Shifting cultivation traditionally takes place on community land, which is leased to households wishing to cultivate.

This diverse crop cultivation contributes to communities' overall food security and ensures a well-rounded and nutritious diet for its members almost all year round. The dependence on the shifting fields is highest during the months from October to December, which coincides with the

seasonal harvesting of staple crops (e.g. rice, millet, taro), vegetables, pulses and oilseeds. Some of these staples are stored during this season to support the community during the lean months (January to March), when shifting fields are being prepared for sowing. From April/May onwards to October, these fields provide an array of green leafy and other vegetables.

• ***Bun Cultivation.*** In Umsawwar village, traditional jhum cultivation has been largely replaced by a modified jhum practice adapted for grasslands, known as bun, which is similar to rotational cropping. The bun cultivation process begins with clodding the soil using hand tools, followed by overturning the soil clods to cover the existing vegetation. Additional herbs, including ferns and grasses collected from around the plot, are also incorporated into the soil. The field is then left to dry, and once sufficiently dried, it is burned in a controlled manner. This burning occurs in an anaerobic environment, creating carbon-rich charred residues that enhance soil health.

Crops are planted either by direct sowing or broadcasting. Unlike other upland rainfed systems, bun cultivation does not involve paddy cultivation. Staples such as potatoes, maize, millet, and various types of taro are cultivated alongside other vegetables like garlic chives and perilla seeds. Sohplang (Flemingia vestita), a nitrogen-fixing herb with tuberous roots, is also cultivated in the bun. Crops are cultivated for two years.after which the land is allowed to fallow for 5-6 years to allow for natural regeneration. Bun cultivation follows a similar seasonal pattern to jhum, producing starchy staples such as tubers and cereals like millet and maize (October and December), which can be stored for consumption during the lean months (January to March).It also provides green leafy vegetables, vitamin-A rich vegetables, and other produce during the intervening monsoon period besides .

• ***Jhum and bun fallows.*** *Jhum* fallows, known as *A·jiri bolma,* in Darechikgre, and *syllai* in Dewlieh, also plays a crucial role in providing sustenance for the community. The fallows are also a source of a variety of wild edibles that include mushrooms and wild leafy vegetables. In the first year of fallow in Dewlieh, tubers like sweet potato and cassava are propagated and harvest continues for 1-3 years. Planting materials are also collected from these fallows to cultivate in the jhum fields. The fallows also serve as valuable repositories for storing planting materials, ensuring a consistent supply for upcoming sowing seasons. Thereafter the fields are left to naturally regenerate. In Plasha, upland paddy is rotated with ginger with minimal disturbance to the soil and thereafter, the land is left to fallows. Banana and pineapple often incorporated in the first year of *jhum* are harvested from the succeeding fallow years. However, in the expansion of monoculture in fallows, areca nut in Darechikgre, broom grass in Dewlieh, pineapple and areca nut in Plasha is disrupting the regenerative cycle. The bun fallows, known as *syllei bun,* crops that remain from the first year of cultivation, such as pumpkin, cucumber, taro and sweet potato can still be harvested. These bun fallows also provide wild edibles like *Centella* asiatica.

• ***Wet Paddy Cultivation.*** Lowland paddy cultivation constitutes an important component of some Indigenous Peoples' food systems in Meghalaya, including in Plasha, Umsawwar and Darechikgre, where the landscapes are well-suited to this form of agriculture. Wet paddy cultivation is not a traditional practice in these communities but has been adopted over generations through exchange with plain-dwelling communities. Farmers have adapted seeds, initially hill paddy, that

can thrive in wet conditions and also increase rice diversity through seed exchange, leading to a rich diversity of local rice varieties cultivated without chemical inputs. Particularly in Ri-Bhoi, paddy farmers have recently begun practising crop rotation, alternating paddy with winter crops like cole crops, carrots, peas, and beans. These paddy fields also yield a variety of wild edibles such as water colocasia, fish mint, and water celery, while fruit trees like guava are sometimes planted along the ridges. Additionally, these fields support the community's protein needs by fostering the growth of various aquatic species.

• ***Paddy gardens.*** In Plasha, the cultivation practice called Arsun a bari, (or paddy gardens) is a distinctive part of their food systems. It involves the maintenance of gardens similar to a kitchen garden but in close proximity to the paddy fields . These gardens are primarily dedicated to the cultivation of vegetables and herbs that can be harvested through the entire year. Varieties of fruit trees are also incorporated into these gardens. This practice is mainly motivated by the convenience it provides to households. With these gardens located near the paddy fields, farmers can easily access fresh vegetables, herbs, and fruits during the cultivation season, reducing the need to travel back home for meals and ensuring their food is supplemented with nutritious, homegrown produce.

• ***Home gardens.*** Home gardens constitute an essential part of the Indigenous Peoples' food system in Meghalaya, including in all of the study communities. Households commonly maintain gardens contiguous to, or near their residences. These gardens serve as a source of diverse vegetables, herbs, and are often integrated with livestock (predominantly pigs and poultry) and varieties of fruit trees. The integration of apiculture, or beekeeping, is also common practice among households in the Darechikgre. This involves domesticating local bee species to harvest honey, which both boosts the household's income and plays a crucial role in agricultural pollination. In Plasha, silkworms are reared in many home gardens. The silk cocoon produced by the silkworms is used for making eri silk yarn. Additionally, silkworm larvae are consumed as a source of protein. To support the silkworms, castor leaves, their primary feed, are cultivated in the vicinity of the home gardens. The home garden is utilised all year round for food but becomes particularly crucial during these lean winter months.

• ***Non-Homestead Gardens.*** In Umsawwar, several households maintain gardens that are distant from their place of residence and often near forests. These are called kper lum, similar to forest gardens. Households cultivate a variety of starchy and leafy vegetables and herbs in these gardens with high integration of trees particularly fruit trees also serving as live fences around the plot. In some cases sheds for cattles are kept in these gardens and provide access to manure. These gardens are particularly important sources of edible diversity during the lean winter months.

(2) NATURAL SYSTEMS

• ***Forest.*** The collection and capture of wild foods from the forest surrounding the villages constitute a significant and integral part of the local food culture in all the four villages studied. Forests offer a wide range of edible wild plants, mushrooms, fruits, nuts, and game for hunting,

contributing significantly to the community's food diversity. Indigenous Peoples possess deep traditional knowledge of the forest resources and practices that are crucial for sustainable foraging. Wild food harvesting is conducted with a deep understanding of the ecosystem, ensuring that resources are collected sustainably throughout the year, based on seasonal availability. Customary norms regulate the use of various types of forests. For instance, the collection of fuelwood and timber for construction is restricted to specific months and limited quantities from the Khlaw Shnong or Community Forest, while sacred groves are protected from any form of human intervention. In Umsawwar, the sale of timber and other forest resources is also prohibited, preserving the integrity of their natural resources.

• ***Rivers and streams.*** Natural rivers and streams serve as invaluable sources of edible biodiversity to the study communities, offering a wide variety of aquatic species that the local community relies upon for their sustenance. These aquatic systems provide food to communities all year round. Customary regulations are placed to ensure that the community practises sustainable fishing techniques, for example, restrictions on the use of nets or poison for catching fish, or seasonal restrictions on catches. In Plasha, some households also maintain fishponds. It is common for the fishponds to be used for fishing games, which is a recreational activity for the community.

(3) EXTERNAL SOURCES

• ***Food Welfare (PDS and ICDS).*** The Public Distribution System (PDS) provides subsidised rice all year round to low-income households that possess a valid ration card. Under this nationwide program, eligible households are able to acquire rice at subsidised rates, ensuring that this dietary staple remains affordable and within reach for those in need. Whilst an important cornerstone of India's food security policy, there are concerns that the introduction and widespread accessibility of rice through PDS have significantly influenced the dietary habits of the people and led to the substitution of millet – which is more nutritious - as the primary staple. In all communities, households with infants are also eligible for food support under the Integrated Child Development Services (ICDS) scheme, which provides fortified foods and rations. Like the PDS however, there are similar concerns that the provision of such foods to infants lacks local relevance and fails to align culturally with the community's dietary practices.

• ***Market sourcing and trading.*** All the participating communities depend on local markets to procure essential food items. In Dewlieh and Umsawwar, the dependence on the market is particularly high for the acquisition of rice, which has replaced millet as the predominant staple food. Besides rice, these markets serve as vital sources of protein, offering items such as pork, dried fish, and poultry. These local markets serve as important hubs for obtaining essential food items and supplies that may not be locally produced or readily available through their own agricultural and foraging practices and help to support communities' dietary and culinary needs. The procurement of food from markets is particularly important during "lean months" (December-March, dry season), during which time the diversity and quantity of food available from cultivated systems is reduced. Since most of the agricultural systems rely on rainfed irrigation, the communities face significant challenges in growing food during winters. These

months also coincide with the dry season, and the time of year in which the cultivated system is still being prepared for sowing and harvest. During these periods, markets are also utilised to source vegetables and fruits. Additionally, sourcing from forests and natural aquatic systems becomes crucial during times of scarcity. The communities have developed strategies to manage seasonal food shortages and maintain food security by storing staples and employing traditional food preservation methods, alongside relying on forest resources.

2.3 Results

2.3.1 Step 1: Characterisation of the Agroecological Transition

TAPE Step 1, comprising the Characterisation of the Agroecological Transition (CAET), was used to evaluate the level of "agroecological transition" in agroecosystem. For Indigenous Peoples' food systems in the four selected sites in Meghalaya, CAET was used to assess the agroecology outcomes of these systems. The spider web diagram presented in Figure 11 presents the combined average scores for each of the ten elements across all communities. The use of TAPE in this study shows that, overall, the surveyed Indigenous Peoples' food systems can be deemed as at moderate levels of agroecological outcomes with an overall CAET score of 64.8% (Table 4). The overall score across the 36 indices of CAET are presented in Figure 12. Combined results from all communities show "advanced" (score >70) scores on two elements – Efficiency (74.9; SD=10.9) and Human and Social Values (73.2; SD=16.6). These elements are captured through relevant indices that measure the use of external inputs, management of soil fertility, pests and diseases, and women's and youth empowerment and the quality of labour conditions and welfare. The lowest scores were observed in the elements of Diversity (56.5; SD=16.4) which asses the diversity of crops, animals, collection from natural systems, and livelihood activities), and Recycling (55.4; SD=16.4) which evaluates the reuse of biomass, water saving, seed management and energy use).

However, disaggregated by sites, the CAET results reveal notable differences (Table 4), which may reflect important variation in food practices and enabling environment. The highest overall CAET score was received in Plasha (CAET = 71.7), indicating an"advanced" agroecological system. The community of Dewlieh received a comparatively low CAET score, at 51.6. The details of the descriptive scales for all 36 indices in the four sites are provided in Annex 4. The following section elaborates on scores received for 10 elements, highlighting community differences and exploring how the variation in the enabling environment may account for the observed results.

Figure 11: Radar plot showing the results of the CAET score for the Darechikgre, Dewlieh, Umsawwar and Plasha in Northeast India.

Communities	Darechikgre	Dewlieh	Plasha	Umsawwar	Combined
CAET Score	68.8	51.9	71.5	67.4	64.9
Diversity	59.8	52.1	41.7	67.6	55.3
Synergies	58.7	40.6	58.7	70.8	57.2
Efficiency	79.2	77.9	78.6	65.6	75.3
Recycling	57.1	45	53.8	64.5	55.1
Resilience	61.2	48.4	64.5	73.5	61.9
Culture and Food Traditions	76.2	48.9	89	46.8	65.2
Co-creation and Sharing of Knowledge	70.5	49.2	81.8	60.8	65.6
Human and Social values	73.6	51.3	78.1	88.1	72.8
Circular and solidarity Economy	70.8	64.4	81	62.3	69.6
Responsible Governance	79.2	38.9	86	70.8	68.7

Table 4: Summary table of the CAET results per element and overall for whole sample (N=120) from Darechikgre, Dewlieh, Umsawwar and Plasha in North East India

Advanced >70%

The element of **Efficiency** received the highest score of all agroecological elements assessed in this TAPE study (74.9). This high score reflects that most inputs are either produced on the farm or sourced from within the agroecosystem, with exchanges also occurring among community members. High scales in the sub-indicator of soil fertility management and pest and diseases control underscore the focus of these systems on nature-based practices (Figure 12). As a subsistence system, production and natural resources primarily meet household food needs, supplemented by seasonal harvesting from natural ecosystems.

Darechikgre (79.2), Dewlieh (77.9), and Plasha (78.6) achieved advanced scores, reflecting their strong adherence to non-chemical farming practices. These communities avoid synthetic fertilisers and manage soil fertility through organic methods. In contrast, Umsawwar (65.6) had a slightly lower efficiency score indicating the use of synthetic inputs for soil and crop management. This is partly due to the introduction of potato cultivation supported by previous state subsidies for chemical inputs, and the expansion of broom grass cultivation driving the use of weedicides.

Human and Social Values, which assesses youth and female empowerment and quality of labour conditions, also received a high overall score. Advanced scores were recorded in Darechikgre (73.6), Plasha (78.1) and Umsawwar (88.1). In these communities, agriculture is predominantly family-based, with both men and women having access to capital and decision-making processes. Youth engagement in farming is also high, and most young people (both boys and girls) do not want to emigrate. Youth involvement in farming is strong, with most young people (both boys and girls) showing a preference to remain in their communities rather than migrate. Although youth may migrate seasonally for work or education, they return to assist their families during the sowing and

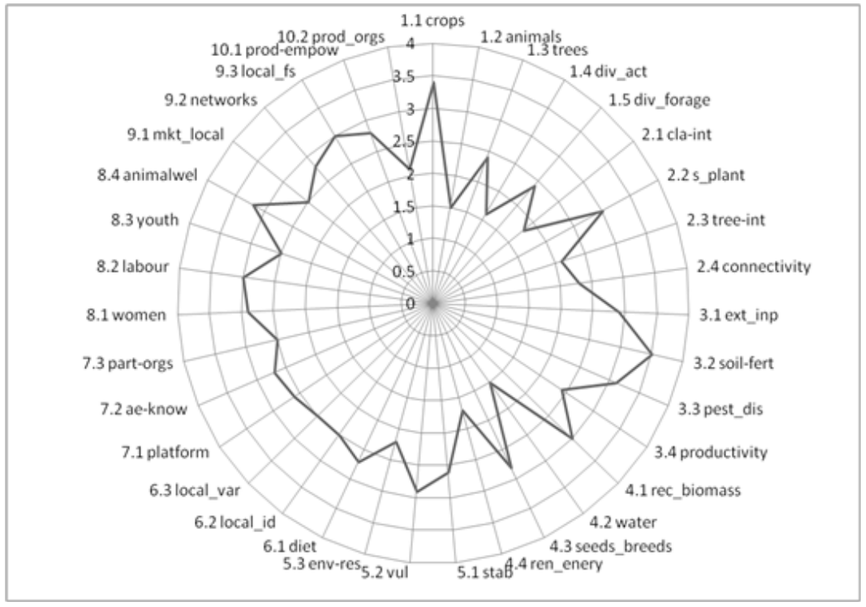


Figure 12: Radar plot of the 36 CAET indicators across the 4 sites in Northeast India.

harvest period. In Darechikgre and Umsawwar – both matrilineal communities - women have full access to resources and have equal opportunities to influence or participate in decision making.In Dewlieh, despite women's active role in decision making, their access to resources is limited due to tenure insecurity, and youth engagement in farming is lower. In Plasha, a patrilineal community, women are involved in decision-making and are active in women-focused organisations. Across all four sites, traditional governance structures incorporate women and youth groups who play crucial roles in overseeing community affairs supporting the Dorbar Shnong or the Nokma. This inclusive approach ensures that both women's and youth's perspectives and needs are addressed in community management and development.

Moderate-High Scores (60-70%)

The element of **Circular and Solidarity Economy,** which assesses local marketing practices, producer-consumer relationships, and community self-sufficiency, received a score of 69.2, just below the threshold for an advanced agroecological score. This element reflects the extent of local product and service exchange, as well as community-driven economic activities. In Darechikgre (70.8) and Plasha (81.0), where scores were notably higher, communities demonstrate a high degree of self-sufficiency and local trade. In these areas, agricultural and food production is almost entirely self-sustained, with significant trade and product exchange occurring among local households. In Plasha, key cash crops such as pineapple, bamboo, and areca nut are marketed through local intermediaries, while Darechikgre's major cash crops include chayote and areca nut, similarly sold through local intermediaries. In contrast, Umsawwar and Dewlieh primarily grow crops for self-consumption, with only occasional sales of potatoes and sale of livestock in Umsawwar. In these two villages, broom grass serves as a principal cash crop, although the intermediaries involved in its sale are not always local to the community, impacting the local economic benefit.

Overall, the scores for **Responsible Governance,** which measures the participation of producers in land and natural resource decisions were relatively high (68.3). Advanced scores are achieved in Plasha (79.8), Darechikgre (86.0) and Umsawwar (70.8), where producers are actively involved in decision making processes related to land and resource management, and producers' rights are largely recognized and respected for both men and women. In Umsawwar, traditional governance systems that oversee community land ownership remain in place, with the Dorbar Shnong managing the allocation of farming land. Similarly, Darechikgre maintains its traditional governance system, where the Nokma designates suitable forest areas for jhum cultivation. In Plasha, although the majority of land is privately owned by villagers, there are restrictions on selling property to outsiders, which fosters a strong sense of community ownership and control over land and resource decisions. Overall, the scores for responsible governance, which measures producer participation in land and natural resource management, were relatively high at 68.3. Advanced scores were achieved in Plasha (79.8), Darechikgre (86.0), and Umsawwar (70.8), where producers are actively involved in decision-making processes related to land and resource management, and both men's and women's rights are generally respected. In Umsawwar, traditional governance systems that oversee community land ownership remain in place, with the Dorbar Shnong managing the allocation of farming land. Similarly, Darechikgre maintains its traditional governance system, where the Nokma designates suitable forest areas for jhum cultivation. In

Plasha, although the majority of land is privately owned by villagers, there are restrictions on selling property to outsiders, which fosters a strong sense of community ownership and control over land and resource decisions. In contrast, Dewlieh received a notably lower score of 38.9 for Responsible Governance. This lower score reflects the fact that land in Dewlieh is leased to the community, limiting producers' ability to participate fully in the governance of land and natural resources and reducing their influence over decision making processes.

The element of Co-creation and Sharing of Knowledge, which assess the effectiveness of mechanism for knowledge transfer show an overall score of 65.1. Among the four communities, Plasha (81.8) and Darechikgre (81.8) achieved high scores for this element. In these communities, multiple mechanisms are in place for sharing agroecological knowledge, with a strong focus on engaging young people. They also benefit from being part of broader networks of producers that facilitate knowledge exchange. Additionally, they are connected with networks of producers for exchange of knowledge. Umsawwar (60.8) received a moderate score, and reflects on intergenerational and horizontal knowledge exchange, supported by structures like the Children's Dorbar and youth club. However, Dewlieh (49.2) scored the lowest relying primarily on informal methods like parental teaching or labour exchange for knowledge transfer. Dewlieh faces significant challenges in maintaining the continuity of Traditional Knowledge due to its demographic composition. The community has a relatively young population, which, combined with a declining number of Elders, creates a gap in the transmission of knowledge, especially in agroecological practices and cultural traditions. Additionally, both Dewlieh and Umsawwar lack producer associations or networks that could play a crucial role in enhancing knowledge exchange and agricultural practices, particularly in adapting to changing environmental conditions.

The element of Culture and Food Tradition, which assesses aspects such as diet, nutritional awareness, local identity, and the use of local resources, scored an overall 64.0. Plasha (89.0) and Darechikgre (76.2) achieved advanced scores, reflecting a strong sense of local and traditional identity. In these communities, respect for traditions and rituals remains deeply ingrained, significantly influencing food production and helping to preserve a diverse and traditional diet. Conversely, the Khasi communities of Dewlieh and Umsawwar received lower scores (<50) for this element. Although customary norms are observed in both communities, they lack the rituals or practices common to other Khasi groups. Additionally, there has been a shift away from traditional diets, with rice increasingly dominating as the staple food, replacing millets.

Resilience that measures the stability of income, production, social safety nets and environmental resilience showed moderate score (62.3). Umsawwar (76.6) received an advanced score, particularly high in the social mechanisms to reduce vulnerability. Umsawwar's resilience is bolstered by a strong sense of community, deeply rooted in the Dorbar Shnong, which ensures equitable resource sharing and robust social support networks that mitigate vulnerabilities. Plasha (66.1) and Darechikgre (62.4) both received moderate resilience scores, underpinned by strong social support systems within their communities. In Plasha, the adaptability to climate change is particularly noteworthy; the community has developed effective strategies to cope with shifting weather patterns, ensuring that agricultural practices remain viable despite environmental fluctuations. In contrast, Darechikgre, while also benefiting from strong social cohesion, exhibits

lower adaptability to climate changes. Dewlieh (50.6) received the lowest score with environmental resilience particularly low due to unpredictable rainfall patterns, which disrupt traditional farming cycles and reduce crop yields.

Moderate-low scores (50-60%)

The overall score for the element of Synergies (57.6) that assesses the synergies between crops, plants, animals, trees and the connectivity between landscape elements received a moderate-low score. The highest indicator within this element was soil-plant integration, reflecting practices such as intercropping, minimal tillage, and effective weed management, which are prevalent in all the villages. However, the integration of livestock into these systems scored the lowest, largely due to the limited presence of livestock and the absence of widespread aquaculture. Umsawwar (70.8) recorded a high score with strong soil-plant integration and integration of trees within the agricultural systems. Within the diverse systems cultivated, crops are rotated regularly; intercropping is common and crop combination and bun fallow regeneration practices are applied systematically. Dewlieh (40.6) received a lower synergies score with lowest due to the very limited presence of animal agriculture, which is constrained by geographical factors, leading to minimal crop-livestock integration.

In Umsawwar, all the soil is covered with residues or cover crops. Within the community's varied systems, crops are rotated regularly; intercropping is common and crop combination and bun fallow regeneration practices are applied systematically. Dewlieh (40.6) has a low score where livestock raising is limited due to geographical limitations, there is little crop-livestock integration. In all the four sites, systems are reasonably well-connected, with several elements adjacent to crops and/or pastures. Plasha (71.7) recorded an advanced score while Darechikgre (68.7) and Umsawwar (67.9) had moderate scores whereas Dewlieh (51.6) had the lowest score.

The element of Diversity (56.7) received the lowest score. This element measures the diversity of crops, animals , trees, economic activities and collection from natural systems. Across all four sites studied, crop diversity is relatively high, with more than three crops occupying significant cultivated areas, each adapted to local and changing climatic conditions. However, animal diversity was notably the lowest across the sites. Across all the four sites studies, crop diversity with more than three crops with significant cultivated area adapted to local and changing climatic conditions. Animal diversity was lowest. Plasha (71.7) scored the advance score while Darechikgre (68.7) and Umsawwar (67.9) had moderate scores whereas Dewlieh (51.6) had the lowest score. The communities, being primarily subsistence-focused, typically engage in two to three productive activities, mainly centred around food production and related services. Natural systems play a crucial role in these communities, providing a variety of food items that are collected or harvested from diverse systems. Additionally, strong customary norms guide the management of these natural systems, ensuring sustainable harvesting practices are maintained. Being subsistence focussed, communities engage in two-three productive activities that are mostly associated with food production and related services. The natural systems constitute an important part of the system with a variety of food items collected or harvested from diverse natural systems, and strong customary norms promoting management of natural systems and sustainable harvesting. Whilst the element of Recycling (55.4) scored relatively low, it can still be considered "moderately

agroecological". The indicator of recycling biomass and nutrients score highest. The recycling of biomass and nutrients is particularly strong across the communities, with most residues and by-products being effectively recycled. All communities also score highly in the recycling of seeds and breeds. Seed sharing is a common practice, promoting biodiversity and ensuring that a variety of crops, adaptive to changing conditions, are grown. While some specific seeds are purchased from the market, the majority are locally sourced and exchanged within the community. Animal genetic material, however, is primarily obtained from the market. Energy use in these communities reflects a mix of traditional and modern practices, with both electricity and firewood being used. Water harvesting, on the other hand, is not widely practised or deemed essential. This is largely due to the region's climate, as Northeast India is one of the wettest areas in the world, with agricultural systems predominantly rainfed.

Correlations Among the 10 elements of Agroecology

The matrix of correlations between the ten elements of agroecology across four sites in Meghalaya, North East India, is detailed in Table 5. There is a strong positive correlation between Human and Social Values and Resilience (0.73), indicating that communities with strong social structures and values tend to be more resilient. Human and social Values also show moderate positive correlation with Synergies (0.52). The Indigenous Peoples' food systems are often community-driven, where resilience is built not only through farming practices but also through strong social connections and shared values. The positive correlation between Synergies and Resilience (0.66) implies that practices enhancing synergies within the system, such as crop-livestock integration or soil-plant interactions, significantly contribute to community resilience.This finding suggests that social cohesion, equity, and support systems within the community play a critical role in their ability to adapt

	div	syn	eff	rec	res	cultf	cocr	human	circ	respg
div	1	0.55	0.08	0.41	0.54	0.38	0.09	0.36	0.2	0.08
syn	0.55	1	0.2	0.33	0.66	0.03	0.3	0.52	0.09	0.48
eff	0.08	0.2	1	0.43	0.18	0.47	0.21	0.4	0.39	0.23
rec	0.33	0.43	0.08	1	0.54	0.01	0	0.32	0.09	0.09
res	0.54	0.66	0.18	0.08	1	0.02	0.32	0.73	0.02	0.44
cultf	0.38	0.03	0.47	0.54	0.02	1	0.58	0.08	0.63	0.65
cocr	0.09	0.3	0.21	0.01	0.32	0.58	1	0.24	0.58	0.66
human	0.36	0.52	0.4	0	0.73	0.08	0.24	1	0.09	0.29
circ	0.2	0.09	0.39	0.32	0.002	0.63	0.58	0.09	1	0.54
respg	0.08	0.48	0.23	0.09	0.44	0.65	0.66	0.39	0.54	1

Table 5: Matrix of correlation between the 10 elements of agroecology in Meghalaya, Northeast India across 120 household food systems

to and recover from challenges. Responsible Governance positively correlates with Co-creation and Sharing of Knowledge (0.66) and Culture and Food Traditions (0.65), suggesting that effective governance is a key driver of successful agroecological outcomes. These systems foster innovation and flexibility through collaborative knowledge sharing which are key to adapting to changes.

The Circular and Solidarity Economy is strongly correlated to Culture and Food Traditions (0.63). Traditional practices often align with these principles, as Indigenous Peoples communities tend to use locally available resources in a sustainable and circular manner, reducing waste and making the most of every resource.

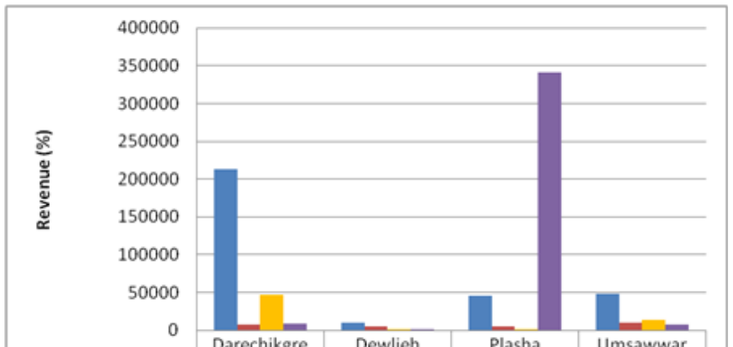
Diversity (0.42) shows moderate correlation with Synergies (0.55), Resilience (0.54) and Recycling (0.41). This suggests that greater diversity within the agroecological system improves the overall success of agroecological success and greater adoption of recycling practices.

3.3.2 Step 2: Core Criteria of Performance: Multidimensional Performance of Agroecology

The following section presents the relationship between agroecology and core criteria of performance on some sustainable indicators. These indicators span five dimensions of sustainability and are aligned with the indicators and targets of the Sustainable Development Goals (see Chapter 1: Methodological Report).

Economic Dimension

Assessment of the economic variables indicate variation in productivity across the four sites (Figure 13). Darechikgre records the highest productivity per capita largely contributed by revenue from a diverse range of crops such as chayote, oranges, and areca nut, alongside significant earnings from animal products. In contrast, Plasha shows considerable revenue from forest resources, primarily through the sale of bamboo and wild edibles. Dewlieh, on the other hand, records the lowest



	Darechikgre	Dewlieh	Plasha	Umsawwar
Crop only	213542	10606	45944	48341
Animals only	7286	4557	5582	10194
Animal products	46903	15	1343	13293
Forest only	9374	443	341172	7588

Figure 13: Summary of key economic variables, disaggregated by community, Northeast India

annual productivity per capita and minimal agricultural revenue. While the total annual productivity is high, the net revenue from agriculture is low. This is indicative of the food systems highly focused on subsistence and only sale of surplus. Additionally, the sale of cash crops is also seasonal.

There is a positive correlation between CAET scores and the value added in agriculture, which represents the monetary value generated after accounting for various expenditures (Figure 14). This positive trend is seen in all the four communities where implementation of agroecological practices support economic output. Similarly, the value added per capita, calculated by dividing the value added among the household members, shows a positive trend (Figure 15). As many of the farms are managed by family members, the economic contributions of agroecological practices extend to provide financial benefits for each individual involved.

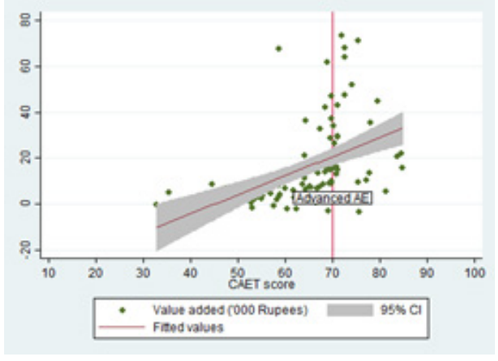


Figure 14: Relationship between the level of agroecology performance and added value across 4 communities in Northeast India.

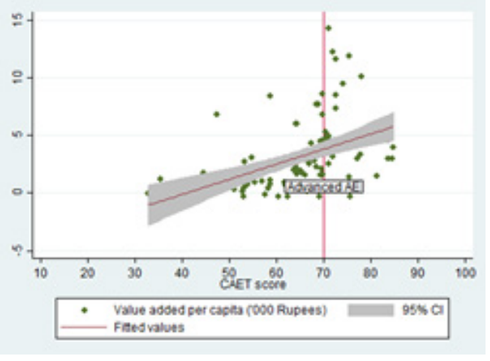


Figure 15: Relationship between the level of agroecology performance and added value per capita across 4 communities in Northeast India.

Dewlieh, with its strong reliance on shifting cultivation and the use of self-produced or exchanged resources, demonstrates a positive relationship between agroecological advancements and crop production per hectare. In Darechikgre, Plasha and Umsawwar this relationship is weak with households emphasising on crop diversity rather than few high yielding mono-culture crops.The

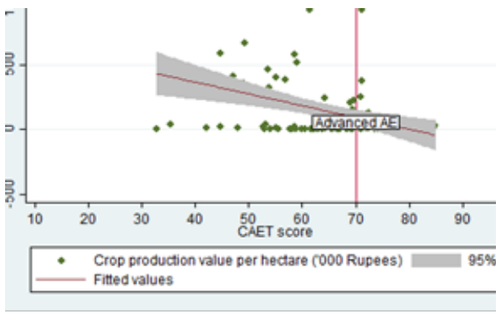


Figure 16: Relationship between the level of agroecology performance and crop production value per hectare across 4 communities in Northeast India.

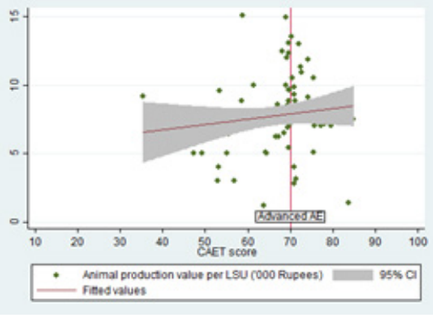


Figure 17: Relationship between the level of agroecology performance and animal production value per LSU across 4 communities in Northeast India.

aggregated results indicate that the overall CAET score is inversely related to crop production per hectare (Figure 16). This could be due to these systems prioritising crop production for self sufficiency, while non-farm activities contribute to additional income.

The CAET score is positively associated with the value of animal production per Livestock Unit (LSU) (Figure 17). Livestock, particularly pigs and poultry, play a significant role in household income. However, this contribution is less noticeable in Dewlieh, where livestock numbers are limited.

In all four communities,the total value of production shows a positive relationship with CAET, though this correlation is less pronounced in Dewlieh. The overall results indicate that farms that employ more advanced agroecological practices tend to generate a higher overall value from their production (Figure 18). Although this total value divided by household members still reflects a positive relationship with CAET, it is somewhat weaker (Figure 19).

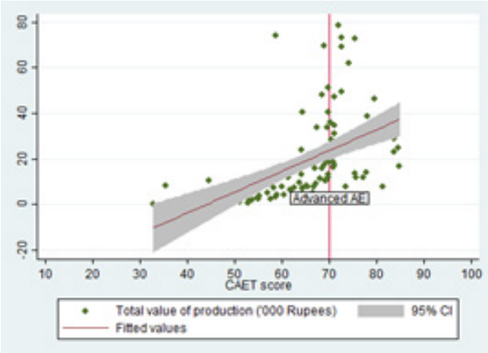


Figure 18: Relationship between the level of agroecology performance and total value of production across 4 countries in Northeast India.

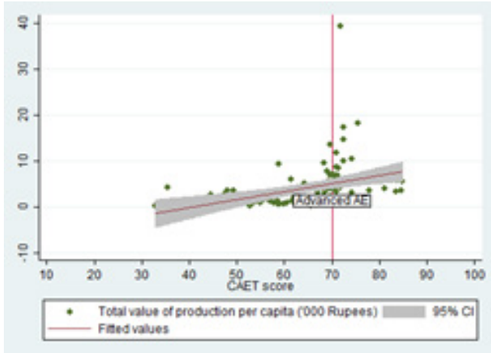


Figure 19: Relationship between the level of agroecology performance and total value of production per capita across 4 communities in Northeast India.

The four sites in Meghalaya, Northeast India reveal an upward trend in net revenue for households that implement agroecological practices. Though primarily oriented towards self consumption, the economic viability of these systems are highlighted. In each community included in the study, households cultivate traditional crops with substantial economic value, in addition to selling surplus production. This practice significantly contributes to their overall income. The relationship between overall CAET, net revenue and net revenue per capita, although moderate, remains positive (Figure 20 and Figure 21).

Food Security, Human Health and Nutrition dimension

The Food Insecurity Experience Scale (FIES) results indicate that food insecurity is almost non-existent within the food systems analysed (Figure 22). Dewlieh, Darechikgre, and Plasha achieved the highest food security scores among the sites surveyed, with Umsawwar showing a slightly lower score. The annual food expenditures per capita were notably low across all these

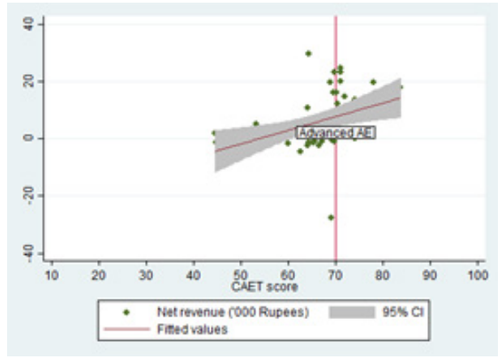


Figure 20: Relationship between the level of agroecology performance and Net revenue across 4 communities in Northeast India

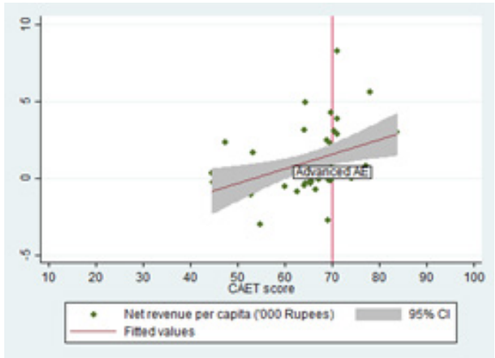


Figure 21: Relationship between the level of agroecology performance and Net revenue per capita across 4 communities in Northeast India.

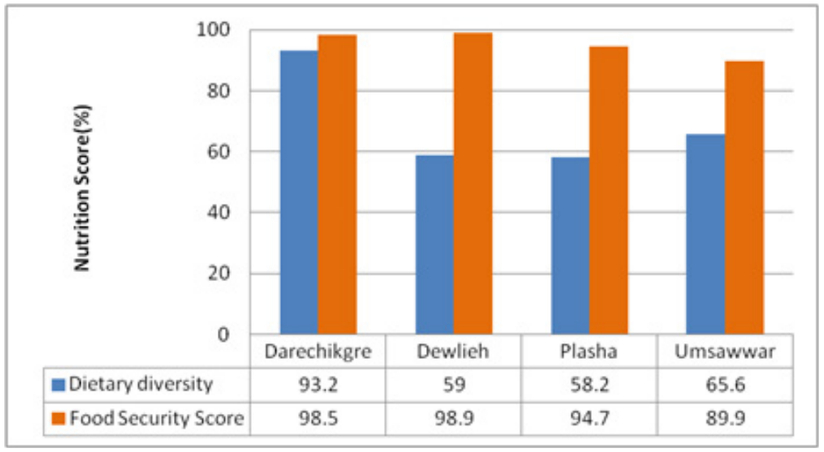


Figure 22: Summary of key nutrition variables, disaggregated by community, Northeast India

communities, reflecting a significant degree of self-sufficiency and internal exchange. The strong food security in these areas is underpinned by their diverse support systems, which contribute to their resilience and stability. In Dewlieh, Darechikgre, and Plasha, the practice of shifting cultivation allowed for the cultivation of a variety of crops including cereals like upland paddy and millet and collection from natural systems support in enhancing the food security.

In Dewlieh, Plasha, and Darechikgre, higher CAET scores are associated with lower levels of food insecurity. Strong community sharing practices, combined with the cultivation of diverse crop varieties, contribute to this positive trend. However, Umsawwar displays a negative trend in terms of food security, but the FIES is still high. The village predominant grassland landscape and frequent exposure to unpredictable weather conditions negatively impact food security outcomes.The aggregated results, although show a slight decrease in the FIES (measures food security) score as the CAET increases (Figure 23), this reduction in food security is minimal. Despite variations in CAET scores, most households cluster around a high FIES score of 100, demonstrating strong resilience to food insecurity.

An assessment of the relationship between CAET and the probability of moderate food insecurity (figure 24) reveals a weak positive association, suggesting that while food security remains high overall, there may be an increased likelihood of moderate food insecurity with more advanced agroecological practices. However, this trend is primarily driven by Umsawwar, where the probability of moderate food insecurity increases with higher CAET. In the other communities, Dewlieh, Plasha and Modynagar, show a declining trend.

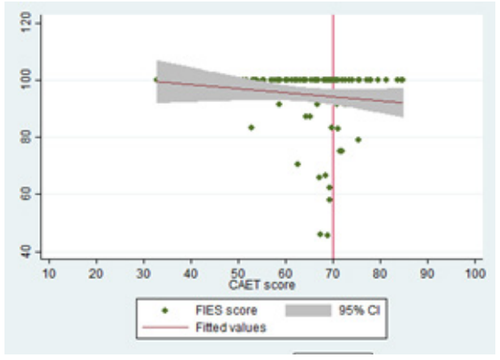


Figure 23: Relationship between the level of agroecology performance and FIES across 4 communities in Northeast India

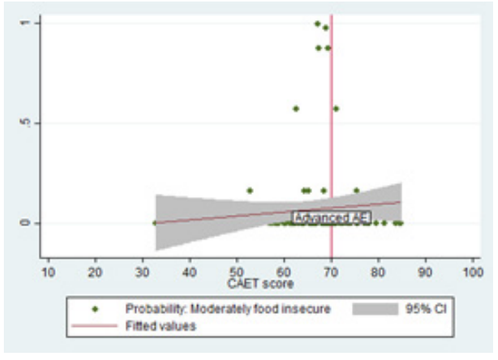


Figure 24: Relationship between the level of agroecology performance and probability of moderately food insecurity across 4 communities in Northeast India

A positive trend is observed in Dewlieh, Umsawwar and Darechikgre between households' dietary diversity and the agroecological advancement. In these communities, households focus on cultivating a variety of food crops and gathering seasonal wild foods to enhance their dietary options. A weak downward trend is observed in Plasha, which may be reflective of short-term conditions, such as seasonal variability. Aggregated results indicate a positive relation between CAET scores and dietary diversity, where households with more advanced agroecological practices are linked to having a more varied diet (Figure 25).

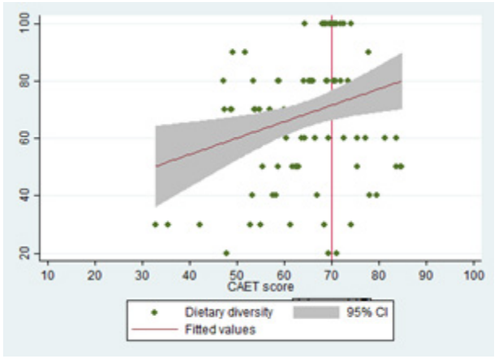


Figure 25: Relationship between the level of agroecology performance and Dietary Diversity across 4 communities in Northeast India

There is a negative association between the share of food to total expenditure and CAET score in Dewlieh, Umsawwar and Darechikgre. Notably, while households in Dewlieh and Umsawwar still depend on the market and the Public Distribution System (PDS) for rice, they are able to diversify

their diets through the variety of non-cereal crops supported by the diverse food systems. In contrast, Plasha presents a slightly different trend. This likely reflects economic empowerment based on the food systems in Plasha allowing for a broader consumption of both self-produced and market-sourced foods, often from local farmers, leading to higher expenditure on food.

When aggregated across the communities, the overall trend reveals a negative association between CAET scores and percent share of food expenditure to total expenditure (Figure 26). This includes a negative relationship between CAET scores and food expenditure per capita (Figure 27), suggesting that households with higher CAET scores tend to spend less on food and produce much of their food locally. This reduced need to purchase food helps in saving income.

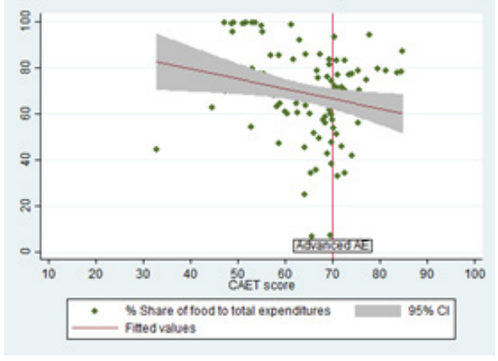


Figure 26: Relationship between the level of agroecology performance and % share of food to total expenditures across 4 communities in Northeast India.

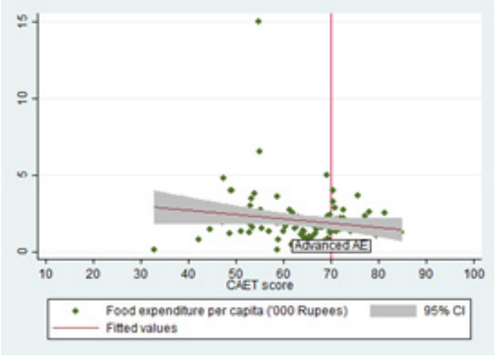


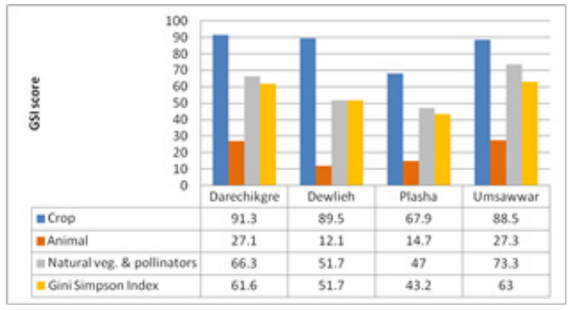
Figure 27: Relationship between the level of agroecology performance and food expenditure per capita across 4 communities in Northeast India.

Environment Dimension

The study highlights several important aspects of the environmental dimension associated with agroecological practice. The study reveals that the food systems studied adopt advanced agroecological practices generally lead to improved soil health and greater overall agrobiodiversity.

Umsawwar scored the highest Gini-Simpson Index (63) followed by Darechikgre (61.6) suggesting substantial ecological diversity. This diversity is supported by maintenance of rich crop diversity and effective community management promoting conservation of natural resources. In Darechikgre, beekeeping is also commonly integrated into home gardens in Darechikgre. Dewlieh has a moderate score of 51.7, reflecting a balanced environment with high crop diversity. Plasha has the lowest score (43.2). Dewlieh scores moderately at 51.7, indicating a balanced environment with high crop diversity. In contrast, Plasha has the lowest score at 43.2. Both these villages exhibit low animal diversity, with limited integration of animals into their systems.

There is a positive relationship between CAET score and the Gini-Simpson Agrobiodiversity Index (Figure 29) indicating that households with more advanced agroecological practices tend to have higher levels of agrobiodiversity on their farms. This encompasses a diverse range of crops, animals,



	Darechikgre	Dewlieh	Plasha	Umsawwar
Crop	91.3	89.5	67.9	88.5
Animal	27.1	12.1	14.7	27.3
Natural veg. & pollinators	66.3	51.7	47	73.3
Gini Simpson Index	61.6	51.7	43.2	63

Figure 28: Summary of key environmental variables, disaggregated by community, Northeast India

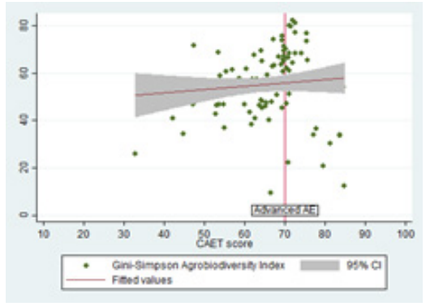


Figure 29: Relationship between the level of agroecology performance and Gini-Simpson agrobiodiversity index across 4 communities in Northeast India.

natural vegetation, trees, and pollinators. This positive trend is consistent in Dewlieh, Darechikgre and Umsawwar where these communities also show a positive association between CAET and crop agrobiodiversity. In contrast, Plasha displays an inverse relationship between CAET and both Gini Simpson index and crop agrobiodiversity. This decline can be attributed to the rising cultivation of a limited number of crops, such as pineapple and bamboo, spurred by the real estate boom in the neighbouring state. The aggregated results show an inverse relationship between CAET and crop agrobiodiversity (Figure 30). It is also notable that in the four communities, market pressure is driving a greater emphasis on cash crop cultivation on larger areas of land, including fallows.

CAET and animal agrobiodiversity shows a positive trend, with higher CAET scores associated with greater animal diversity (Figure 31). However, the diversity within livestock is relatively limited, with households typically keeping one or two breeds of poultry or pigs.

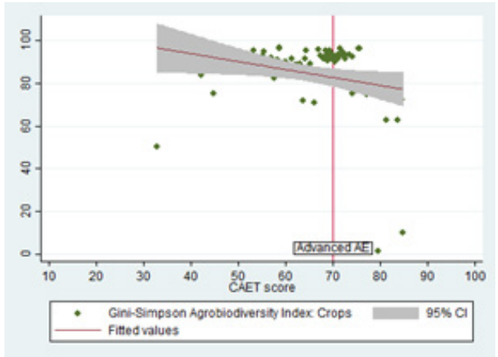


Figure 30: Relationship between the level of agroecology performance and crop agrobiodiversity index across 4 communities in Northeast India.

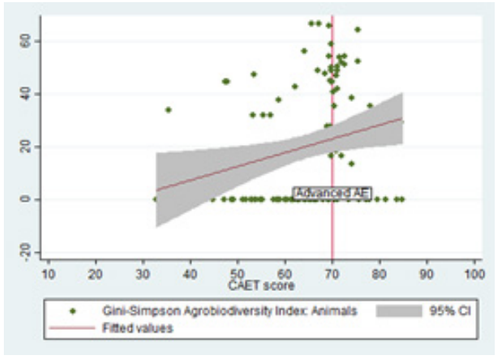


Figure 31: Relationship between the level of agroecology performance and animal agrobiodiversity index across 4 communities in Northeast India.

Concerning soil health, all sites recorded soil health values considered healthy (>3.5) and show positive association between CAET and soil health. The aggregated results indicate that

households with higher CAET scores report better soil health.(Figure 32). In all the four sites studied, there is widespread adoption of soil management practices such as recycling of biomass, intercropping and crop rotation that contribute to overall soil health.

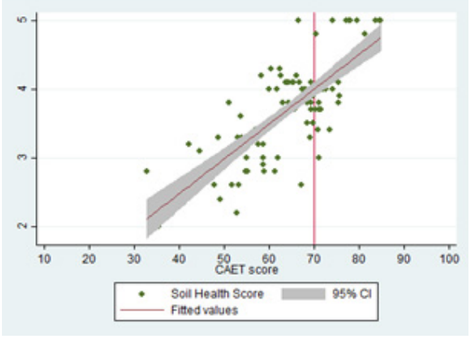
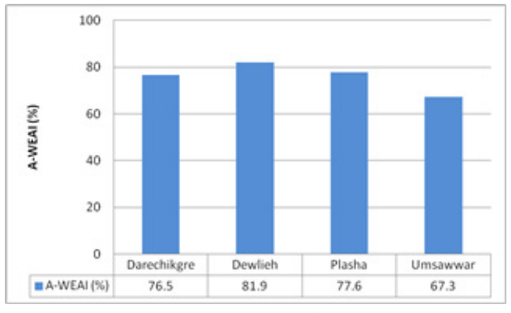


Figure 32: Relationship between the level of agroecology performance and soil health across 4 communities in Northeast India.

Social Dimension

The social dimension of the agroecological practice measures the empowerment of women and youth employment in the agroecosystem. The study revealed that gender parity across the sites studied is high indicating that women are involved in decision making.

The A-WEAI (the Abbreviated Women's Empowerment in Agriculture Index) score across the four sites indicate that there is high empowerment of women in the food system (Figure 33). Dewlieh has the highest A-WEAI score suggesting that despite the lack of tenure security, women can influence decisions over household production and community resources. This is followed by Plasha and Darechikgre (>75%) whereas Umsawwar Women in all the sites jointly make decisions related to agricultural production such as selection of crops species, livestock and production species.



	Darechikgre	Dewlieh	Plasha	Umsawwar
A-WEAI (%)	76.5	81.9	77.6	67.3

Figure33:SummaryofA-WEAI(%)disaggregated into communities, Northeast India

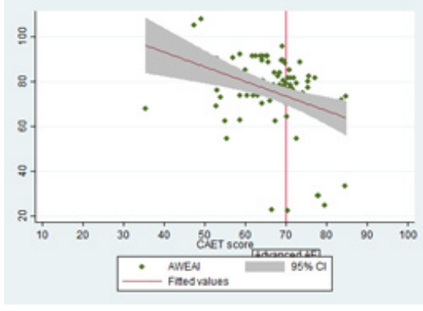
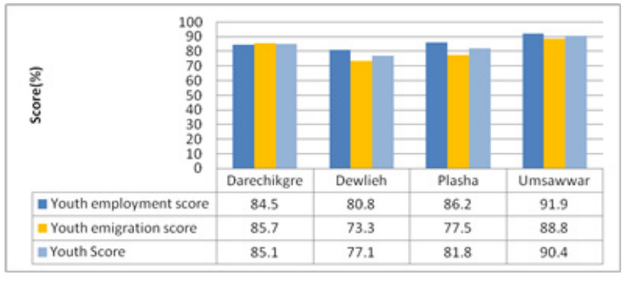


Figure 34: Relationship between the level of agroecology performance and A-WEAI across 4 communities in Northeast India.

The aggregated CAET score with A-WEAI was shown to be inversely associated. (Figure 34). However, A-WEAI in these systems remains relatively high at around 70 per cent. Despite this inverse relation, women in these systems have critical roles within food systems and have access to resources.

The high youth scores across the four sites highlight the strong potential of their food system in supporting and retaining youth within the community (Figure 35). Umsawwar, Plasha, and Darechikgre, with their emphasis on engaging youth in the food system, have successfully encouraged youth participation and economic involvement, contributing to their high retention rates. In contrast, Dewlieh is experiencing youth migration. The primary factors driving this migration are the pursuit of higher education and changing aspirations among the youth, leading them to move away from traditional food systems.



	Darechikgre	Dewlieh	Plasha	Umsawwar
Youth employment score	84.5	80.8	86.2	91.9
Youth emigration score	85.7	73.3	77.5	88.8
Youth Score	85.1	77.1	81.8	90.4

Figure 35: Summary of key social variables, disaggregated by community, Northeast India

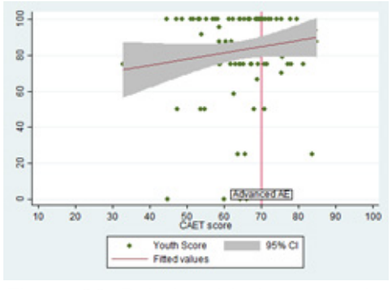


Figure 36: Relationship between the level of agroecology performance and Youth score across 4 communities in Northeast India.

There is a positive relationship between CAET scores and youth involvement in agriculture, where higher implementation of agroecological practices encourage greater youth participation in agriculture (Figure 36). Although there is seasonal migration of youth in all four communities, their engagement remains strong, largely due to the prevalence of family farms. The gender dimension reveals that higher agroecology performance encouraged higher participation of male youth (Figure 37). In the matrilineal and matrilocal societies of Darechikgre, Dewlieh, and Umsawwar, female youth demonstrate a strong engagement in food production, with many expressing a desire not to migrate. The overall relationship between female youth scores and the CAET remains stable at a high level (Figure 38)

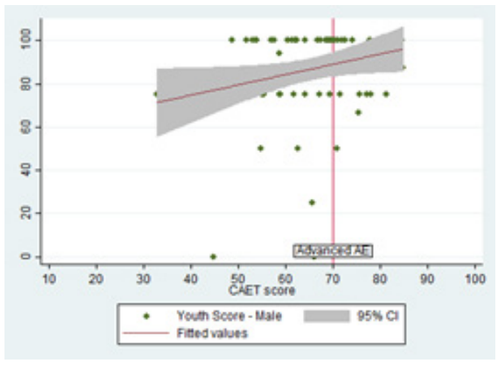


Figure 37: Relationship between the level of agroecology performance and Youth score-male, across 4 communities in Northeast India.

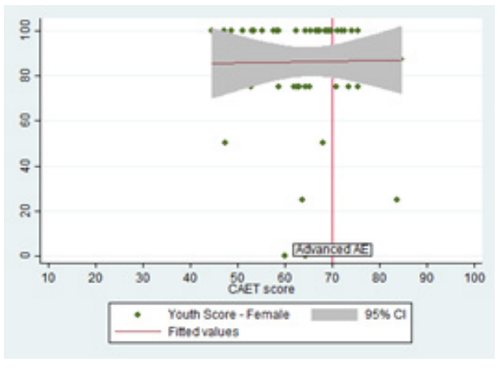
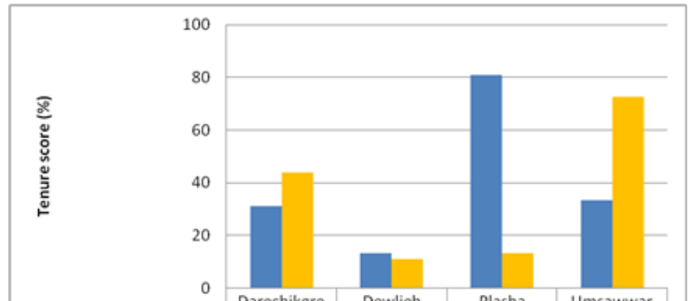


Figure 38: Relationship between the level of agroecology performance and Youth score-female across 4 communities in Northeast India

Governance Dimension

While there is significant gender parity in tenure systems across the studied communities, notable variations in tenure security are observed across the four sites. In Darechikgre and Umsawwar females have higher tenure security (Figure 39). These villages follow a matrilineal system where the land is inherited by the youngest daughter, giving women stronger land rights. However, land in these communities is collectively owned, and the sale or transfer of land to non-residents is restricted to maintain communal ownership and preserve local resources.



	Darechikgre	Dewlieh	Plasha	Umsawwar
Tenure Score (Male)	31	13.3	81	33.3
Tenure Score (Female)	44	11.1	13.1	72.5

Figure 39 : Summary of key governance variables, disaggregated by community, Northeast India

In Plasha, males have higher tenure security as compared to females. The Karbi People are patrilineal, where property and cultivation rights are typically held by men, though women have access to the use of all resources. Dewlieh presents a different challenge where both genders have low tenure security. The village is reliant on the leased land from the Langstieh clan. While are *Dorbar Shnong* are in good terms and through dialogues with the landowner, 15 years of lease was negotiated, however, there will be need for long term sustainability

Additionally, formal land deeds are uncommon among the Karbi, Khasi and Grao Peoples and the use of common property resources is prevalent, emphasising the informal nature of the tenure systems in the communities.The results suggest that collective governance ensures better land tenure security because it fosters inclusivity, shared responsibility, and long-term sustainability.

2.3.3 Step 3: Joint Interpretation and Reflection on Results

TAPE Step 3 enabled the confirmation of analysis with the study communities, and the verification of the adequacy of the TAPE framework. The protocols for Step 3 were co-designed by NESFAS and are summarised in Box 2.

Confirming the TAPE results and analysis

The presentation and subsequent discussion of the TAPE results with the Khasi, Karbi, and Garo Peoples of Dewlieh, Umsawwar, Plasha, and Darechikgre offered profound insights into the approaches these communities have developed, grounded in their understanding of local ecosystems.

Box 2: Protocol for Step 3 in Meghalaya

Identify Stakeholders: Relevant stakeholders involved in the study are identified and invited This includes farmers, community members, Elders, member of the Village Council, enumerators and researchers.
Communication Channel : Focus group discussion was conducted in all the four study sites. Discussion Framework: Guiding questions are outlined to create a framework for facilitating the discussion, ensuring that open dialogue and diverse perspectives are encouraged.
Setting objective of Discussion : The objectives for Step 3 are outlined, focussing on the validation and reflection process to deepen understanding of the agroecological practices within the IPFS.
Review of CAET Results considering contextual factors: CAET results from Step 1 is shared., Participants are encouraged to share insights,discuss how contextual and enabling factors identified in Step 0 may influence the CAET results. Elders contributed deeper insights in interpreting the results.
Review Performance Criteria Results: The results from Step 2 was presented and understand the relationship
Reflection of the framework: A reflection exercise, with Elders to identify concept within the IPFS that align with the 10 elements of agroecology, elements and indices ranked based on their significance for the sustainability. Discussion is facilitated to seek feedbacks on the strength and weakness of the framework in capturing the complexities of IPFS.
Identify Strategies for Improvement: Participants discussed potential use of the gathered data by the community.
Documentation: Detailed documentation was undertaken to record discussions, insights

Emphasis on self sufficiency over profit: The communities confirmed that their primary goal for food production is self-consumption, with any surplus sold in local markets that contribute to the overall low net revenue. Although the income generation from subsistence farming is modest, it ensures household food security, which was considered more important. Households strategically plan their food production to maintain reserves of crops with longer shelf lives for emergencies, such as paddy in Plasha and Darechikgre, and cassava and millet in Umsawwar and Dewlieh, alongside vegetables like pumpkin. The cultivation of diverse crops and preserving food through fermentation or dehydration, especially common in Plasha and Darechikgre, food sharing and exchange are attributes of the food systems that support high food security recorded across the four sites. Food sharing and exchange are widespread practices among families and community members. Traditional economies were based on a barter system for goods and services, including education and a close relationship with producers and consumers. However, changing policies and the influence of the market economy have led to increased monetization of goods and services. Efforts to improve the economic conditions of these communities have prompted the introduction or expansion of high-value crops such as pineapple, bamboo, and areca nut in Plasha, areca nut in Darechikgre, and broom grass in Dewlieh and Umsawwar to supplement household income. Despite these efforts, the lack of proper regulation and limited market linkages for these products leave producers vulnerable, with most sales occurring through intermediaries. Often, these intermediaries are from the village and help with aggregation and keeping producers informed about market dynamics.

Communities were surprised by the negative net revenue findings, suggesting that if such a deficit existed, household food security would have been compromised. This could be due to the tools

not fully capturing the food consumed or an outlier in the dataset. It was also shared that there are tendencies of respondents to overestimate expenditures and underestimate revenues, a common issue in economic surveys, where there is reluctance to disclose income due to fears of exclusion from welfare programs and the lack of documenting their economic returns.

Local food systems harmonised with environmental stewardship: Cultivated systems such as jhum, wet paddy cultivation, and home gardens demonstrate highly efficient resource use, utilising various traditional seeds that are saved or exchanged among farmers. Soil health is prioritised and biomass from these systems is recycled as mulch or compost, supplemented by weed management practices. Weeding is a crucial farming activity in these systems. It pulled manually or with the use of hand tools. Customary norms are deeply ingrained in the community, serve as effective guidelines for land use and ensure that designated forest areas surrounding cultivated systems are safeguarded in carrying out food production. While communities depend on food foraging and collection, regulations on use of these resources ensures sustainable and seasonal harvesting. This supports the high biodiversity index in these food systems.

Crop diversity leverage to manage risks : These systems maintain high levels of crop diversity, incorporating both intra- and inter-species varieties, and are supplemented by foraging, which effectively support their dietary diversity. In Plasha and Darechikgre, where rice is a major staple cultivated in hill or wet paddy, food security is relatively stable and has strongly maintained its food and culture traditions. In Umsawwar and Dewlieh, changes in dietary habits have led to a shift from traditional staples to a reliance on rice. Although these communities are not fully self-sufficient in cereals and depend on the market and Public Distribution System (PDS), the rich crop diversity and varieties of non-cereal starchy foods that are cultivated within their agricultural systems support their food security. These systems favours the optimisation of land through extensive intercropping over growing large volumes of a few crops. This approach, which involves cultivating multiple crop species, helps protect against unpredictable weather and reduces pest vulnerability, thereby preventing total crop loss that could occur if only a single variety were planted.

Community Centric Food System: The food systems studied are characterised by a collaborative approach where gender specific roles and collective support are essential. For example, women play a crucial role in nurturing crops, selecting and saving seeds, and foraging for wild edibles, all of which are vital for maintaining biodiversity and ensuring food security. Meanwhile, men focus on land preparation, fire management, beekeeping contributing to effective resource management. The communities emphasise collective support through shared labour in land preparation, joint sowing and harvesting, and the exchange of resources such as seeds and tools. This mutual assistance strengthens social ties, ensures equitable distribution of labour, and enhances the overall resilience and efficiency of the food system. This supports horizontal and intergenerational knowledge exchange ensuring the sustenance of the agroecological practices in these systems.

The elements and indicators from the perspective of Indigenous Peoples: Across the four sites, in depth discussions were conducted with Elders and knowledge holders to understand the presence and relevance of the ten elements in the Indigenous Peoples' food systems of Meghalaya. These conversations revealed a consensus on the critical important elements and

perspectives that sustain and enhance sustainable practices in these systems. The elements of **Human and Social Values** were ranked as the most critical, and serve as the foundation for the Indigenous Peoples, guiding their interactions with man and nature. This enables the persistence of traditional practices fostering a sense of collective responsibility and mutual support. This communal ethos maintains cultural and social cohesion within these communities. Closely tied to this element is the **Responsible Governance** ensuring framework that prioritises well-being of the community and common responsibility for equitable resource distribution involving all gender in the decision making process. The continuous **Co-creation and Sharing of Knowledge** among community members fostered through this strong social cohesion helps maintain **Culture and Local Food Traditions.** This is a dynamic process and is instrumental in adapting to changes and challenges thereby enhancing community's **Resilience.**

Diversity and synergies within the food systems were recognised as key to resilience building, supporting food security and strengthening ability to withstand shocks. These communities do not explicitly integrate trees into their cultivated systems as seen in agroforestry models, they prioritise the sustainable management of surrounding forests, including the careful use of forest resources around paddy fields. These systems achieve resource optimisation by **Recycling,** enhancing the **Efficiency** of the food systems. Being rainfed, they don't depend on water-saving techniques; instead, farming practices are guided by a deep understanding of the ecosystem Communities stress that controlled burning is a vital component of Indigenous Peoples' food systems, enhancing soil fertility by releasing nutrients, especially when cultivating in rocky or poor-quality soil, and efficiently reducing weeds and pests. They argue the negative perception of burning fails to recognize its benefits and misinterprets its role in their farming practices.

The elements of **Circular and Solidarity Economy** were perceived differently by Indigenous Peoples. Rather than the primary driver of agroecology transition, it is seen as an outcome of a resilient and well-functioning food system.

2.3.4 Lessons from Storytelling

Khasi, Karbi and Garo Peoples stories provide further insight into key interrelationships between agroecology elements and food system performance. Some of the stories talk to the agroecology elements that Khasi, Karbi and Garo food systems score highest on, contributing to existing knowledge on when, how, why and in what ways indigenous food systems support people and landscapes to thrive. In this section, we draw the reader's attention to some of the worldviews and value systems that underpin the design of food systems and determine their outcomes.

The reciprocity underpinning resilience

TAPE articulates resilience in terms of the stability of income and food production, and the ability of these to recover after shocks and climate change. It also talks about mechanisms to reduce vulnerability. Whilst the original TAPE was focused on access to insurance and credit, the adapted version of TAPE to encompass Indigenous Peoples' food systems also included social/customary support mechanisms that can be drawn upon in times of need. These social support mechanisms are particularly apparent in the stories from Northeast India, showing ways in which traditional

community support systems allow the collective community to thrive. In Khasi stories success is understood to follow hard work within a supportive relational context. No-one can manage a rotational farming system alone. Instead the labour exchange practices of Jar and Cheirne and Lei Ram Sngei in the Karbi and Khasi story Types of Labour Exchange celebrate clan and community cooperation which relies on solidarity, empathy and collaborative effort among equal participants, rather than the hire of external labour.

The stories from Northeast India expand the concept of resilience further, showing how it grows from humankind's reciprocal relationship with nature. The stories consider the way resilient food systems are contingent on the resilience of the landscape and natural systems too. Rituals, gestures and practices underscore this important interrelationship. In the Karbi peoples story Rituals before sowing one member from every household gathers at a plot designated as the sacred garden in the ritual Arnam A Bari. Divine blessings are made followed by joyous dances before members of the community are granted permission to commence the sowing of crops. In Shad Domahi cows are bathed and blessed with water as "a gesture of gratitude for their indispensable role in supporting mankind through food and labour". These rituals, along with others that practise reverence for crops like rice, millet and maize are reenacted seasonally to underscore the importance of human belonging and nurturing of a healthy inter-species collective.

In Relationship Of Fire With Man And The Use Of Fire the Khasi community write: "We regard "ram-ew," our mother earth, as a living entity with the capacity to rejuvenate itself. Like a living being, it can teem with a multitude of life forms. To honour this innate vitality, we deliberately allow our fallow lands to regenerate". The story describes how fire is a force for renewal, not destruction, which ensures that the ecosystem can recover from disturbances and adapt to changing conditions. The Khasi people's story Natural Cues for Time Keeping and Weather Forecasting shows the myriad conversations farmers and traditional knowledge holders have with natural systems to make agroecological decisions. The story Placenta and Umbilical Cord Ceremony describes how the placing of the placenta and umbilical cord on the tops of trees roots a new born baby into its home. The ceremony celebrates humans as part of the natural world and begins a human life with the act of giving to nature.

Considered together, the stories show how Indigenous Peoples' food systems in Northeast India are intentional about reciprocity. The stories teach that advanced agroecological systems are contingent on the reciprocal quality of interactions humans have with one another and with the natural world. They show how reciprocal qualities can be designed into rules, norms, practices, rituals and ceremonies. They make the case that resilience relies on relational capacities to be in reciprocal relationships within and across clans, communities, species and living systems.

The morality of responsible governance

In the story Origin of the Khasi wisdom about food cultivation has a moral underpinning, purposefully connecting decisions about the cultivation of crops and gathering of food to a deeper sense of what it means to be a Khasi and a human contributing to the health of Earth's ecosystem. The selection of caretakers for the Earth is told in great detail. While initial choices led to conflict and exploitation, the Seven Clans represent an important shift towards ethical leadership,

participatory decision making, environmental stewardship, shared accountability and respect for cultural heritage. These decision-making principles are interwoven with the Khasi value system "Ka Tip Briew Tip Blei, Ka Tip Kur Tip Kha and Ka Kamai ia ka Hok" which highlight social cohesion, mutual aid, respect for nature and fairness and justice in the pursuit of the common good. In Folk Hunting Traditions the intention of the hunt must be pure and the hunters must stay focused. The hunters are strictly prohibited from picking or consuming any fruits or crops they see in the fields or surroundings. Stealing places the hunters in peril because it empowers the bear who steals millet, maize and cucumber from them. Sufficiency or a worldview of "enoughness" is a major moral underpinning of food systems, which support the health of the whole.

The co-creation and sharing of knowledge for agroecological efficiencies

The Garo story Weeding in Jhum Fields shows how co-creation and sharing of knowledge is prioritised over the use of chemical fertilisers. The story shows how responsible governance brings other benefits – by using waste sweet potato leaves for mulch, flavour and nutritional value is increased and reliance on external inputs is reduced. Another example is the Khasi story Types of Labour Exchange which explains how knowledge exchange on agriculture is not just a practice but a way of life. Wisdom on seed keeping, soil improvement, and pest management strategies is collectively generated over generations and collectively enriching into the future. These sorts of practices, along with those on collaborative use of fire in the story Relationship of Fire with Man and the Use of Fire explain the high TAPE scores on efficiency - the use of external inputs is low, soil fertility is high and reliance on chemical pesticides to manage pests and diseases is low.

The importance of sacred connections for biodiversity

The stories point to the importance of the sacred for explaining high and moderate scores on principles including human and social values, culture and food traditions and responsible governance. For example, interlinkages between sustaining food traditions, responsible governance and biodiversity are expressed in The Garo People's story Discovery of Wanchi – Traditional Yeast. The discovery of Wanchi in fermentation processes led to the incorporation of a wide variety of natural elements to enhance the flavour and nutritional complexity of rice beer, which also promoted biodiversity. As the practice of brewing rice beer is declining, humans are participating less in the everyday conversation between diverse terrestrial and aquatic life forms. Without a revival of cultural heritage the worry is biodiversity will be lost. Key to its revival is a rekindling of the sacred.

Some of the stories describe the sacred in religious terms. For example, The Origin of the Khasi describes divine covenant and moral principles guiding human behaviour to ensure prosperity. It explores the importance of kinship and humility in maintaining a harmonious relationship with nature. In other stories the sacred is expressed as the fullness of human experience. Harvest rituals and ceremonies create space for finding a deep sense of connection to our shared humanity and to connect to something bigger than ourselves, to access intuitive faculties and unseen wisdom. Through this deep and intimate biocultural knowledge of a locality, human capacities to govern responsibly are enhanced.

In the Khasi story Seed Dialogue farmers maintain communication with seeds through sowing and

harvest. Seeds are described as "part of the family, possessing life ... and believed to understand human words". When seeds are shared with different clans an exchange always takes place to prevent the seeds from feeling neglected by the household giving them away. The consumption of seeds by birds, rodents and animals is not stopped. Instead, a request is made for the seeds to return "to fill the baskets once more". These traditions are considered important for imbuing food practices with respect for all life. The story Relationship of Fire with Man and the Use of Fire details the creation of firebreaks and the use of controlled burning to prevent wildfires and regenerate land are described as time-honoured traditions, involving designated Elders with ancestral wisdom to communicate with fire. Both stories illustrate sacred connections to nature in practices that allow natural elements to play a vital role in shaping human lives and futures. Recognition and respect for the interconnectedness of all living beings underpins a holistic approach to agriculture that integrates spiritual, cultural and ecological elements.

2.4 Discussion

2.4.1 Summary of results.

The application of TAPE (Tool for Agroecology Performance Evaluation) to 120 Indigenous households across four sites in Meghalaya has provided valuable insights into the agroecological outcomes and overall sustainability of the surveyed food systems. It also sheds light on how the level of agroecological transition, measured using the 10 Elements of Agroecology (FAO, 2018), relates to multidimensional performance. This provides crucial information into the outcomes of Indigenous Peoples' food systems and the challenges faced

Summary of the key results obtained with the use of TAPE in Darechikgre, Dewlieh , Plasha and Umsawwar:

- The food systems studied are characterised by a mosaic landscape comprising cultivated, semi-domesticated, and natural systems. Among the cultivated systems, shifting cultivation is predominant in Dewlieh and Darechikgre, bun cultivation in Umsawwar, and a combination of both in Plasha. These food systems are also supported by food welfare programmes and market access.

- The overall performance of these food systems indicates a moderate level of agroecological practice implementation, with average CAET scores falling within the transition range. In Northeast India, production systems generally achieve moderate to high scores on the 10 Elements of Agroecology. However, across all four sites, market forces and policy shifts have led to a departure from traditional farming practices.

- Disaggregated results reveal that Plasha has achieved an advanced score, reflecting a high level of agroecological practices and principles. The community's strong preservation of rich cultural and food traditions, combined with the integration of modern practices, contributed to this high score. In contrast, Darechikgre (68.7) and Umsawwar (67.9) show moderate levels of agroecological implementation. While traditional food systems are retained to a large extent, these communities face challenges arising from the expansion

of cash cropping into traditional systems driven by market demand. Dewlieh, which has the lowest CAET score (50.7), faces significant challenges, including geographical limitations. The absence of supportive environments for promotion of their shifting fields and the lack of security of tenure further exacerbates these challenges.

- Across all communities, particularly high scores on two elements – Efficiency and Human and Social values. Practices supporting the element of efficiency are evident in the traditional food practices of the Khasi, Garo and Karbi. Most notably, under traditional methods of shifting cultivation, no synthetic inputs are used. Instead, soil fertility is maintained via the continued rotation of plots and through the controlled, periodic burning of plant biomass. In all communities, the majority of seeds remain self-produced or internally exchanged, and traditional practices of seed sharing remain strong. The fact that the element of efficiency most strongly correlated with the element of culture and food traditions supports that traditional food practices are strongly aligned with low chemical dependency and practices that enhance soil health.

- Although the element of diversity shows overall low scores, these systems exhibit high crop diversity across the sites and high score soil-plant integration. Intercropping and mixed cropping is extensively adopted in these systems supporting high biodiversity. In the context of the surveyed communities, the integration of livestock into the agricultural systems is notably limited. This low level of livestock incorporation reflects traditional practices where crop cultivation has been the primary focus, with less emphasis on animal husbandry

- Responsible governance plays a crucial role in the successful implementation of agroecological practices and principles. Across the sites surveyed, the traditional governance systems are strong and encourage collaborative decision making.This element also has strong links with Co-creation and Sharing of knowledge and Culture and Food Traditions

- In the economic dimension of sustainability, the results showed a strong link between agroecological status in Meghalaya and their economic performance: more advanced agroecological food systems had higher productivity and farm revenues, particularly crop revenue. Given that traditional food practices are strongly retained in the most agroecologically advanced farms, this suggests that traditional food systems can be economically viable.

- Pertaining to the environmental dimension of sustainability, more advanced agroecological household food systems in our sample had higher quality soils and spent more on organic pesticides. More advanced agroecological systems also maintained higher agrobiodiversity.

- The nutrition dimension of sustainability revealed that these food systems strongly support high dietary diversity. Food insecurity is low in all the communities.The maintenance of diverse production systems and high crop diversity ensures that communities have access to a wide variety of food items, effectively meeting their nutritional needs.

- Human and social values continue to underpin these food systems, with the empowerment of women and retention of youth being particularly prominent. Results regarding the social dimension of sustainability showed that more advanced agroecological systems had greater retention of youth within the community for agriculture. Youth constitute not only an important source of agricultural labour but are critical for the transmission and promotion of traditional values and food practices aimed at sustainability and systems' regeneration. Gender parity was also highest in the most agro ecologically advanced food systems.

- The stories and folktales collected from the Khasi, Karbi, and Garo Peoples in North East India highlight how their Indigenous Peoples' food systems are deeply interconnected and reciprocal relationships between humans and the natural world underpin resilience and sustainability. Their stories reveal that successful agroecological systems are built on communal cooperation, sacred rituals, and ethical governance. Practices such as shifting cultivation, ritual blessings before sowing, and the use of fire for ecosystem renewal demonstrate how cultural and spiritual values guide sustainable food production. The emphasis on mutual aid, respect for nature, and the sacredness of life illustrates how these systems maintain soil fertility, promote biodiversity, and ensure food security while nurturing a profound sense of belonging and stewardship towards the environment.

2.4.1 Models for agroecological best practice

The TAPE study conducted across four sites in Meghalaya, Northeast India, has provided valuable insights into practical implementation and identified successful models of agroecological practices These practices and innovative strategies demonstrate how context specific approaches can effectively address local challenges and leverage opportunities, providing a framework for promoting sustainability.

1. ***Land optimisation:*** In the four sites studied, traditional farming systems demonstrate a model of agroecology characterised by effective land optimization managed by smallholder farmers. Typically, these farmers operate on plots of less than 1 acre, where they cultivate 15-30 different crops either simultaneously (shifting cultivation) or in succession (bun and homegardens). This practice includes intercropping and crop rotation, integration of trees and management of surrounding forest.This approach maximises land productivity while preserving biodiversity and supporting soil health. Management practises in these local food systems further reveal that these management practices have evolved to adapt to changing environmental conditions, showcasing a dynamic agroecological model.

2. ***Value Driven Governance:*** Traditional governance structures in Darechikgre, Dewlieh, Umsawwar, and Plasha promote principles of equity, community participation, and collective responsibility. In Dewlieh, Plasha, and Umsawwar, the *Dorbar Shnong* is led by an elected headman *(Rangbah Shnong, Sordar Shnong, or Rong Kethe).* Darechikgre follows a matrilineal system governed by the Nokma, a traditional female leader whose duties are often executed by her husband. Both governance systems are grounded in cultural values and traditions, fostering local administration and resource management. This is exemplified by their community-based conservation practices and diverse types

of forests, which have been evolved and preserved through generations, reflecting a deep commitment to environmental stewardship (Box 3)

Box 3: Customary Classification of Forest and Management Practices among the Khasi Peoples of Meghalaya, North East India

Under Khasi customary law, forest lands are classified into several types based on their intended use and management practices (Tiwari, 2010). Each type has its own set of regulations and purposes, reflecting the diverse needs of the community and the environment. Here are the common types of forests managed by the Khasi people:

1. Law Kyntang (Sacred forest): Reserved for religious purposes, these forests are managed by religious leaders and are typically well-preserved. No resources are extracted except for religious ceremonies, and they provide important ecosystem services such as water.
2. Law Shnong (Village forest): Owned by a single village, these forests are managed by the village council. They are used for both timber and non-timber forest products (NTFPs), with collection restricted to personal use and regulated to ensure sustainability.l purposes.
3. Law Adong (Village restricted forest): This is similar to village forests but with stricter protection, these forests are reserved for poorer families and occasional village needs. Timber extraction is limited to critical situations, while NTFP collection is permitted if it doesn't harm the forest.
4. Law Raid (Forests belonging to a group of villages): These forests are jointly managed by multiple contiguous village under a council led by the head of the group of the village (Syiem Raid).All people within the territory (Raid) have access to the forest, primarily benefiting the poor and can be allocated for shifting and other livelihood needs
5. Law Ri-Kynti (private forest on private land) :Owned by individuals, these small, scattered forests are managed according to the owner's needs and often converted to other uses like agriculture. They are a major source of timber and forest products.
6. Law Kur (clan forest): Belonging to clans, these forests are managed collectively by clan members. Access is restricted to clan members, with decisions made by a clan council. They are well-protected and preserved for future generations.
7. Law Balang (Church Forest): These are forests managed by the different church denominations. These forests reflect the intersection of religious and traditional land management practices. Access is typically restricted to church members for church-related purposes, with resource collection limited to necessities for church operations. Some areas may also be used for farming to raise funds for the church.

3. *Dorbar Khynnah (Children's Dorbar)*

The *Dorbar Khynnah,* initiated by the *Dorbar Shnong* of Umsawwar village, is an innovative model designed to empower children and adolescents by involving them in local governance and decision-making processes. This innovative platform nurtures leadership and environmental stewardship from a young age, while also serving as a space for intergenerational knowledge transfer. Elders and community members actively impart wisdom on food systems, cultural heritage, traditional values, and environmental conservation, ensuring that essential knowledge is passed down and that future generations are equipped to lead with responsibility and respect for their environment. (Box 4)

Box 4: Dorbar Khynnah or Children's Dorbar in Umsawwar

The Dorbar Kynnah, also known as the Children's Dorbar, is a unique and innovative institution established by the Dorbar Shnong in Umsawwar. Its primary objective is to facilitate the transfer of traditional knowledge across generations, ensuring that the younger members of the community are well-versed in their cultural heritage, farming practices, food traditions, and the principles of good governance. This institution plays a crucial role in preserving and perpetuating the community's way of life.

The structure of the Children's Dorbar mirrors that of the Dorbar Shnong. It is led by a Sordar, who is often the oldest child in the group and is nominated for the role. The Sordar's role is to lead the group, much like the head of the adult Dorbar, ensuring that the voices of the children are heard and that they are actively involved in community life.

The Children's Dorbar is guided and supported by designated members of the Dorbar Shnong, who mentor the children and help them develop leadership skills. Each year, the Sordar of the Children's Dorbar presents a report at the general meeting of the Dorbar Shnong, which includes updates on their activities and any issues they wish to address.

In recent years, the Children's Dorbar has played a key role in the Indigenous Peoples' Biocentric Restoration Initiative, actively involved in preparing planting materials and planting of saplings in identified areas for restoration.

4. *Linking School with Local Agrobiodiversity through Local Procurement*

Dewlieh is one of five villages pioneering a community-driven school feeding initiative that complements the PM-POSHAN (Pradhan Mantri Poshan Shakti Nirman) meals under the project, *"Linking Schools to Agrobiodiversity for Improved Diets, Nutrition, and Livelihoods,"* supported by TIP. This project focuses on improving children's access to healthy, nutritious, and diverse meals by sourcing at least one-third of the ingredients from the local food systems or from school gardens, while also creating income opportunities for local farmers. Tailored strategies have been implemented to enhance dietary diversity and promote a circular economy through local procurement. A key innovation is the inclusion of wild edibles in the school meals, with active involvement from parents, farmers, and the wider community, creating a collaborative approach to improving children's nutrition and overall well-being.

2.4.2 Recommendations and Policy consideration

The use of TAPE can provide entry points to inform evidence-based policy change to support communities in the region and empower communities to accelerate their process of transition to agroecology. Using the framework of the ten elements of agroecology, the following recommended activities may help to support communities to build and maintain their agroecological status:

1. ***Diversity.*** Diversity was not a strong predictor of the overall agroecological status of systems, but TAPE Step 1 highlighted that enhancing income diversification could benefit target communities. Leveraging the strengths of local food systems to create livelihoods can promote sustainable practices and offer an alternative to the expansive monocultures driven by current market and policy trends. This approach could enhance income, safeguard against market fluctuations, and support biodiversity conservation.

2. ***Efficiency.*** TAPE results indicate that past government subsidies for chemical fertilisers and cash cropping have created dependencies on external inputs that producers find difficult to overcome. The state's Organic Mission and Natural Farming initiatives, while promising, are geographically limited and not well-adapted to local contexts. Greater inclusivity of Indigenous and local food systems could facilitate a more effective transition. Additionally, more research into rainfed agriculture could help address seasonal variations in food diversity.
3. ***Co-creation and Knowledge Sharing.*** The study highlighted that communities with younger populations or younger-headed households benefit from creating and supporting knowledge transfer avenues to preserve traditional values and agroecological knowledge. Successful models for intergenerational and cross-generational knowledge sharing were observed in Umsawwar and could be replicated or expanded in other areas to enhance knowledge exchange.
4. ***Circular and Solidarity Economy.*** Communities focused on subsistence have the potential to increase income by establishing direct consumer relationships, which can enhance economic resilience and value capture from their food systems. Embracing green livelihoods—such as ecotourism, sustainable handicraft production, farm produce certification, and renewable energy projects—can diversify income sources while promoting environmental conservation.
5. ***Responsible Governance.*** The study revealed a strong link between responsible governance and overall agroecological status, underscoring the critical role of inclusive decision making and capacity building. Effective governance, driven by values such as equity and transparency, is crucial for fostering environmental stewardship and sustainable practices. By strengthening traditional governance systems, which are often rooted in community values and local knowledge, and integrating these with supportive legal frameworks, communities can ensure more effective management of their natural resources. This approach not only secures land tenure and promotes sustainability but also enhances the resilience and health of agroecological systems, paving the way for a more sustainable future.

Policy Recommendation

Insights from the TAPE study highlight the strengths of Indigenous Peoples' food systems and their potential to contribute significantly to achieving SDG goals. However, the study also identifies challenges related to market and policy impacts on the sustainability of these systems. Current development policies largely overlook these systems with no targeted policies to protect and promote them. Incorporating Indigenous Peoples' food system practices and values into existing policies, alongside fostering knowledge co-creation and supporting community-led initiatives, can substantially improve food and nutrition security, biodiversity, and climate adaptation.

1. ***Recognise and support role of IPFS in food security:*** Agricultural development is currently centred on settled, intensive farming and market-oriented approaches, resulting in the homogenisation of agricultural production. Similarly, food security efforts focus predominantly on ensuring the availability of a few staple cereals. These approaches

contradict with the philosophies of Indigenous Peoples' Food Systems, which emphasise biodiversity, cultural practices, and resilience in food production. Shifting policies to recognise and support the unique characteristics of IPFS can expand the scope of food security and strengthen their role in promoting sustainable food systems.

2.
3. ***Support for collective land ownership:*** The land tenure system favours private ownership and overlooks the collective ownership models central to Indigenous Peoples' communities. The absence of formal land titles restricts their access to credit, subsidies, and extension support. To address these challenges, it is crucial to formalise Indigenous Peoples' collective land rights, enabling them to fully benefit from available resources and preserve their traditional practices.
4. ***Promote market linkages of Indigenous Peoples crops:*** Programmes aimed at creating market linkages for agricultural producers typically focus on a few high-demand cash crops or mainstream agricultural products, providing limited support for crops cultivated by Indigenous Peoples. As a result, Indigenous communities face challenges in integrating their traditional crops into wider markets, diminishing their cultural and nutritional significance. It is essential to actively promote, incentivise, and support the cultivation, consumption, and marketing of these indigenous crops to strengthen local economies and preserve cultural heritage.
5. ***Enhance research and support for rainfed agriculture:*** Indigenous Peoples' food systems are predominantly rainfed, deeply connected to their rich traditional ecological knowledge. At present, there is inadequate investment and limited research into rainfed agriculture, making it vulnerable to climate variability. Strengthening support and advancing research in this area is essential for improving the resilience and sustainability of IPFS.

CHAPTER
3

Evidence on the Multidimensional Performance of Agroecology in the Indigenous Peoples' food systems of Northern Thailand

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Summary

Aim: This study characterised the food systems of Karen Indigenous Peoples' communities in Northern Thailand, and presents evidence on the multidimensional performance of agroecology based on the use of the Tool for Agroecology Performance Evaluation (TAPE).

Methods: In 2023, TAPE was used to evaluate 124 households in four Karen Peoples' communities in Northern Thailand, providing a characterization of the level of agroecological transition of local farms and an assessment of their performance across the economic, environmental, and social dimensions of sustainability.

Results:

- Rotational farming and the maintenance and use of forests for food are particularly critical attributes of the Karen food systems, alongside the use of fallows and forests, aquatic systems, and home gardens. A high diversity of crops is produced, and a further rich diversity of wild foods are sourced.
- The food systems studied in Northern Thailand are at varying levels of agroecological transition. The food systems reliant on the traditional method of rotational farming – alongside the use of other cultivated and natural systems - are the most agroecologically advanced, and perform strongly against multidimensional indicators of economic, environmental, social, and nutritional performance.
- Despite the move to cash cropping, values integral to Karen culture remain intact and supportive of agroecology in food systems. Deep respect for nature and the importance of human solidarity is repeatedly expressed in Karen folktales and informs governance systems. The most advanced agroecological systems also tend to be the systems with the greatest capacity to withstand and recover from shocks.
- A clear and positive link was seen between agroecological status and farm revenue, and particularly revenue from forest products.
- More advanced agroecological food systems spent less on chemical inputs and fertilisers and spent more on organic pesticides and maintained higher quality soils.
- Food insecurity was virtually non-existent in the study communities. The most advanced agroecological systems experience greater food security.

3.1 Methods and research sites

TAPE was used to evaluate 124 households of Karen Peoples in Northern Thailand. The data collection took place between May and September 2023, with eight enumerators involved in the process who were recruited from the study communities. The training of enumerators and data collection activities was overseen by members of Pgakenyaw Association for Sustainable Development (PASD), University of Chiang Mai and ECHO International, who had received training on the TAPE instrument directly from FAO. Training of enumerators involved the in-depth discussion of agroecological principles (including their meaning and analogous practices in the target communities), clarification of enumerator understanding of TAPE item meaning, and familiarisation with the Kobo Toolbox instrument.

Figure 40: Map indicating locations of study sites in Northern Thailand

Four villages were selected for this study, all of which PASD has previously engaged with and has trusted, longstanding relations. The communities were selected by the research team to represent a diversity of food

practices. Two of the communities – Mae Paw Khee and Hin Lad Nai- represent "closed" communities, retaining many aspects of the traditional Karen food system; the other two communities can be considered more "open" to the extent that they have adopted mainstream agricultural practices. Within each village, approximately 31 households were selected at random to participate by the enumerators. Informed consent for community involvement in the study was sought through the village council, and a second confirmation of consent was obtained from the participating households themselves prior to interview.

Study Sites

The four villages were Mae Paw Khee, Hin Lad Nai, Khun Mae Yod, Huay E Kha. All of the communities in this study are agrarian communities and remain predominantly oriented to production for self consumption, whilst exploring ways to expand their income opportunities.

The following section provides descriptions of each community, their food systems, and enabling and constraining environments. This information was derived from the adapted TAPE Step 0 (including the added participatory rural appraisal and key informant interviews) and based on discussions with project field partners, PASD, University of Chiang Mai and ECHO International.

	Mae Paw Khee	**Hin Lad Nai**	**Khun Mae Yod**	**Huay E Kha**
IP Group	Sgaw Karen	Pgaz K' Nyau/Karen	Sgaw Karen	P'Kayaw/Karen
Population (persons)	269	112	260	516
Land area (ha)	1341.8	1752.6	5043	1561.9
Per capita	5	15.7	19.4	3
Residential & garden	4.8 (0.4%)	196.5 (11.3%)	52.5 (1.0%)	16 (1.0%)
Forest (inc. fallows)	639.7 (47.7%)	1503.4 (85.8%)	4356 (86.3%)	1210 (77.4%)
Food production area	697.3 (51.9%)	28.6 (1.6%)	633.6 (12.5%)	224 (14.3%)
Per capita	2.6	0.3	2.8	0.4

Table 6: Summary characteristics of community population and land use, Northern Thailand

Community	**Cultivated Systems**					**Natural Systems**		**External sources**	
	Rotational farming	Fallow	Paddy fields	Home gardens	Forest gardens	Forest	Aquatic	Market	Food subsidy
Mae Paw Khee	X (37)	X		X (16)		X (13)	X (9)	X (14)	
Hin Lad Nai	X (11)	X (8)		X (18)	X (4)	X (37)	X (6)	X (3)	X (5)
Huay E Kang	-- (23)	X (12)	X (20)			X (32)	X (14)	X (13)	X (2)
Khun Mae Yod	-- (18)	X (11)	X (9)	X (10)	X (10)	X (12)	X (7)	X (3)	

Table7. Summary of food sub-systems utilised by each community, Northern Thailand. X denotes usage; -- denotes usage by a limited number of families. Numbered brackets indicate the number of edible species produced within the sub-system.

Mae Paw Khee village is located in Tha Song Yang district, in Tak province, near to the Thailand-Myanmar border and the Mae Moei National Park. The village covers just over 1,340 hectares, of which almost half (47.7%) is forest. Mae Paw Khee village is S'gaw Karen, and comprises 41 households with a population of 269 peoples.

Food Systems Use: Mae Paw Khee continues to rely heavily on the traditional practice of rotational farming, from which they derive most of their food. The village has over 670 hectares of land designated for rotational farming: a cycle of five years means the village needs 135 hectares of land per yearly cycle (3.2 hectares of land per family). The rotational farming system in Mae Paw Khee supports a high level of agrobiodiversity, particularly in winter months. Since the Government has claimed some of Mae Paw Khee's forest area as conservation area (non-rotational land) in recent years, the villagers have been forced to shorten the rotational cycle to five years. Villagers also source food in home gardens and gather a variety of wild food plants and hunting animals from the forest and rivers. Villagers purchase some dried or canned foods, salt, and sugar from the market.

Livelihood opportunities: The community has not taken up cash cropping. Year-round, people work on their rotational farms or with livestock. Labour exchange (on neighbour's farms) for free or for an agreed wage generates some income. Handicrafts and arts, such as wickerwork and weaving, are an additional occupation for women and children that has been practised and passed down for generations. Handicrafts are often produced during spare time around agricultural work. The villagers also process some unique products, including coffee and tea from a local Karen herb called "Haw Wor" found on rotational farms, and animal products. Food processing occurs in three periods: January to February, April to May, and July to September. Transportation and delivery is a new career linked to the increasing development of marketed products, pioneered by younger members of the community. Transportation of goods occurs from March to May and August to October.

Hin Lad Nai village is located in Wiang Pa Pao district, Chiang Rai province, and covers over 1750 hectares of land. The village is located in a mountainous area, on a plain between two mountains, linking it to a natural stream, which brings flowing water through the village year-round. Village residents are able to use this water for community and household consumption and agriculture. The small residential area is located approximately 800-900 metres above sea level. Residential space covers just over 11% of total village territory, with the rest being forested. The forest is a humid evergreen forest that benefits from cool weather year-round. Hin Lad Nai is a small community, home to 112 people in 23 households, all of whom are Pgaz K' Nyau Karen.

Food Systems Use. Food production in the community takes place all year round. The community retains rotational farming on a 7- to 10-year cycle, alongside other food systems, including home gardens, wild harvesting from fallows and forests. Labour exchange is still common and facilitates the ongoing retention of rotational farming practices.

Livelihood opportunities. The Hin Lad Nai community made an explicit decision to not welcome chemical cash cropping and has devised several other livelihood opportunities based

on the abundance of rich and locally available natural resources. These include the cultivation of food products for income generation within certain areas of the forest – such as the keeping of stingless bees for honey, and growth of tea plants. These products are an important part of the village economy and generate substantial income for households in the village. The village has also started to welcome eco-tourists and students in homestays, generating further income, with little impact on the surrounding environment and food system.

Huay E Kha village is located in Mae Wang district, in Chiang Mai province, at 500-1400 metres above sea level. The village spans an area of over 1560 hectares, of which over 1200 hectares is forested and just 16 hectares is residential space. The forest is a mix of dry evergreen and dry deciduous dipterocarp forest. A number of streams and rivers run through community land and are the primary source for households and food (paddy) production. The village is just over 50 kilometres from Chiangmai City, with a paved road to the community, which serves as the primary transport route for agricultural products. The village comprises a population of 516 people. Huay E Kha is a P'Kayaw Karen village; most villagers are Buddhist.

Food Systems Use. Huay E Kha derives its food primarily from paddy fields, which are used to cultivate foods for household consumption and to grow cash crops, as well as gardens. The community also uses the public service and market for food. The traditional use of some natural systems has been retained: the community territory remains rich in biodiversity, allowing the community to source a huge diversity of wild foods from nearby forests and rivers. Small areas of land are still used for rotational farming. The only remaining forest is community-managed forest (rather than fallow forest or agroforestry), which continues to be used for the collection of wild foods.

Livelihood opportunities. Huay E Kha has not strongly retained rotational farming (with only a few households still practising it) and has taken up cash cropping, supported by the Pang Ung Royal Project. The project promotes temperate fruit trees and other cash crops, providing agricultural inputs and supplies and purchasing crops directly from villages. The crops grown include coffee, persimmon, Japanese apricot, pear, beans, avocado and passion fruit. Huay E Kha also undertakes some food processing (45 days/year), including drying of vegetables, herbs for massage, and production of crab paste. The villagers produce handicrafts during off-farm time and have established a brand called "Che Su Hmo". Other off-farm work includes carpentry, construction, collecting waste, driving (taxi) and transportation of agricultural produce.

Khun Mae Yod village is situated in Mae Chaem District of Chiang Mai Province. At the time of the study, there were 65 households with 260 people within the community. The total area of Khun Mae Yod community (including another two clusters of households: Mae Rajee and Pa Kluay) is 5,043 hectares. The area of farmland and forest is roughly equal, whilst the living area is only 1%.

Food Systems Use. In Khun Mae Yod, the community maintains a balance of both traditional rotational farming and cash cropping, alongside food production in paddy fields and gardens, and the tending of livestock. Forty-five households continue rotational cultivation – with one plot used for rice cultivation at a time, and twelve plots left to fallow, in a rotational system. Sixty-

six households grow cash crops such as corn, beans, cabbages, passionfruit and potatoes. The hilly terrain of the region has hindered the wider establishment of irrigated paddy fields, although the paddy provides an important source of vegetables. People also hunt small animals and aquaculture from paddy fields and from the stream which is more abundant during dry season. Markets and grocery stores in the community are also sources of protein as villagers tend to buy pork, chicken, and fish from there.

Livelihood opportunities. Transport of goods is an activity of cash crop growers including the transportation by car to the Royal Project which buys some of the products and to distant markets. Members of some households work in non-farm sectors such as handicrafts, manual labour in construction. and government services.

3.2 Key attributes of the Karen Peoples' food system of Northern Thailand

Food source diversity and seasonal dependency

Traditionally, the Karen IPFS comprises several systems, which span diverse landscapes and are managed according to different time-cycles. These sub-systems can be classified into three main groups: (1) Cultivated systems and semi domesticated systems; (2) Natural Systems; and (3) External food sources. Whilst the exact nature of the Karen IPFS will vary between communities, several common systems within the Karen IPFS. These include rotational farming, fallows, use of forests, aquatic systems, home gardens, and the market. Food production takes place throughout all three seasons (hot season from March to May; rainy season from May to October; and cool season from November to February).

Of these systems, rotational farming and forest use for food are particularly prominent features of the Karen IPFS. The following section elaborates on food sub-systems within the four communities examined in this study, including the seasonal dependency on such systems. Information comes from the communities and local Indigenous partner institutions.

(1) CULTIVATED AND SEMI-DOMESTICATED SYSTEMS

- ***Rotational farming.*** The rotational farming system feeds the community continuously throughout the year and has been passed down through Karen communities for generations. In a rotational farming system, only one plot is cultivated by a given household within one year, with the remaining plots left to "fallow". The short cultivation period (1 year) and long fallow period (7-10yrs) is symbolic of the Karen rotational farming system, and optimises farming and conservation, and contributes to ecosystem restoration. The long rotational cycle allows the soil and pre-existing plants within the fallow to recover from the disturbance induced by agriculture. Each cycle uses land that is owned by the community, with each family/household having tenurial access to their plots that is inherited.

  Supporting the interannual rotations of land is an intricate pattern of seasonal activities across the year (Figure 41). The annual calendar begins in February, with the selection of a new plot for cultivation and clearing of trees. In April, when plant biomass is as dry as possible and

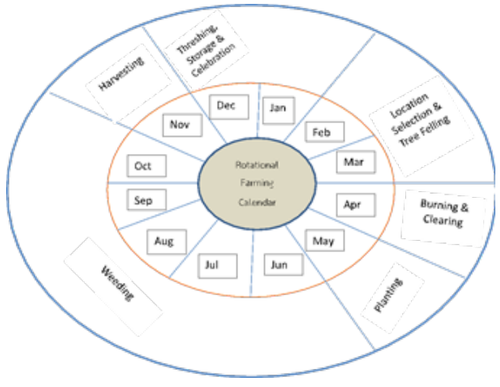


Figure 41 . Seasonal calendar of rotational farming activities conceptualised and created by PASD

after useful biomass has been removed from the cleared fields, the plot is burned and cleared, followed by the planting of crops in May. The heat from burning helps eliminate disease and insect pests. Burning also breaks down biomass for plant uptake, reducing the need for synthetic fertilisers and herbicides. Villages may plant up to seventy crops within the cultivated area. From June to October, the area is managed for weeds until the main harvest in November. Aside from this main harvest, several other crops are sequentially harvested throughout the year. In December and January, the annual cycle is completed with the separation of crops, food storage and festivities.

Rotational farming is managed according to customary norms about where and how farming can take place. Specific natural signs indicate that a location is appropriate for farming (e.g., if a sheet of cotton becomes damp when you place it in the soil) or unsuitable, which reflect ways of knowing a maturing ecosystem that are not "scientific".

- ***Fallow lands,*** found within rotational farms, are plots that are not cultivated within that year. Fallow land is crucial as it serves as a source of diverse wild edibles and animal products. The regenerating fallows of different ages and young forests, each at different successional stages, create a mosaic of habitat types, thus supporting rich biodiversity. Each of the interannual periods within the cycle has a specific name, which may vary between villages. For instance (in Hin Lad Nai village), *hsgif wa* refers to plots that are one-year into the cycle, *hsgif bauf* for plots 2-3 years into the cycle, *hsgif loov htauf* for 5-6 years, *hsgif yauv ploj* for plots 6-7 years, and *Doo Lax/La* for 7-10 years.

- ***Paddy cultivation.*** Whilst rotational farming is the traditional farming system of the Karens, paddy cultivation has been adopted by some communities, where geography allows. Land under paddy cultivation is formally recognised, so many communities view it as a more sustainable, secure option. Some upslope communities have attempted to terrace land to enable paddy cultivation, but there have been several instances where this has led to landslides. Only one of four of the communities surveyed in this study uses wet paddy cultivation, with fields irrigated using water from nearby streams. Rice is planted during the rainy season, and vegetables, garlic, and herbs in the dry season. The food grown supports household consumption, with the surplus used to generate income. Besides cultivated crops, community members also hunt small animals, rodents and catch fish within the paddy fields and water channels.

- ***Home gardens.*** Home gardens are a near ubiquitous feature of the Karen food system, which are used for food production for community and household consumption, as well as items to sell for a necessary income. Foods grown include fruits (e.g., banana, mango, papaya,

guava), vegetables (onion, edible ferns). Some villagers also keep livestock, including cows, pigs, buffalos, chickens, and ducks. Some also keep bees within their gardens.

- ***Forest Gardens.*** Some communities also cultivate trees (including tea plants), vegetables and keep bees in "forest gardens". Trees, vegetables, fruits and tea plants are planted in small plots within forest areas. Pollinator species, such as Apis dorsata, A. cerana and stingless bees, are also commonly raised in these spaces. Integrated within the forest, these gardens benefit from the ecosystem services that forests provide.

(1) NATURAL SYSTEMS

- Forest. Forests comprise an important part of the village food production system, and make up a significant proportion of community land, even where communities have transitioned to cash cropping. Rich in biodiversity, the forests give villagers access to wild animals, insects, aquatic species, fruits, mushrooms, and vegetables that are available throughout the year. Besides the provision of wild foods, the villagers use timber products when constructing their houses and as agricultural tools. Different parts of the forest are recognised for providing different types of food. There is deep-rooted value for forests within Karen culture, captured in poems, psalms, folklore and customary norms.

- Aquatic systems. The Karen Peoples surveyed use rivers and streams as a natural food system, harvesting fish, shellfish (crabs, shrimps), frogs and tadpoles, snails and dragonflies for household and community consumption. Communities have established a system of rules and regulations regarding the use and conservation of these water sources in order to prevent damage to the water ecosystem and to prevent overharvesting of resources – thus ensuring long term sustainability of the food source.

(1) EXTERNAL SOURCES

- Public Assistance. From 2017, the Thai Government established a social assistance programme to combat food insecurity and hunger in Thailand, providing up to 500 Thai baht allowance to low-income households to spend on food at given retailers at subsidised prices (amongst other benefits). Eligible persons must be a Thai citizen aged over 18yrs, must own no financial assets over 100,000 Bahts, must be unemployed or have an annual income of below $3055, and have no real estate. The system is known as the "state welfare card" (SWC) programme and is the country's primary safety net programme. Not all households within the study were eligible for this (including households in Hin Lad Nai), being over the income threshold. Households that were eligible used the SWC cards to purchase foods such as instant noodles, canned fish, fish sauce, eggs, salt.

- Market sourcing and trading. All communities relied on the market to some extent as a food source. Local and urban markets provide villagers access to fresh food and meats, processed foods, dried foods, and ready-to-eat foods. With the hot season (March to May) the least productive period of the year for cultivated food crops, market reliance may be

higher at this time. The market systems in and outside of the community are also important sources of income for village residents that they can use throughout the year. A number of unprocessed and processed food products are sold to consumers outside the community. The community is also equipped with an online marketing system, which members of the younger generation are helping to manage and maintain.

Constraining environment for the Indigenous Peoples' food system

Factors relating to public policy, environment and local networks/actors can be identified as supporting or limiting the Indigenous Peoples' food system for the target Karen communities. Several government policies have significantly impacted the traditional food system and practices – and rotational farming has been particularly threatened by government policy, undermining the sustainability of the system. Most significant amongst these is the non-recognition of customary law by the Thai Government means that rotational farming land is not officially recognised. This results in tenure insecurity for rotational farmers and means that the Government can reclaim the land of rotational farmers at any time.

New provincial and local regulations that attempt to reduce levels of the pollutant PM2.5 have been introduced, placing extreme restrictions on traditional burning practices. The Government has designated March-April, which is the traditional time of year for burning, as the "no burning season". This threatens the integrity and sustainability of the rotational farming system: the land will not be completely cleared if the biomass is not burned during this time. The farmer must manually remove the plant cover, a task that is difficult and time-consuming, often performed in hot weather. Burning is now only allowed on one pre-selected day for a total of one hour each year. Successful burning relies on their being the right burning conditions on the day/hour selected by the Government. The prohibition of burning in the suitable period affects the fertility of the land and thus reduces the growth and yield of upland rice.

The forest lands of Karen communities are threatened by the establishment of National Parks. The National Park Act of 2019, places considerable restrictions on the use of forest resources, and threatens to further destabilise the community food system. The Act states that settlement and activities to be conducted in the area, therefore rendering community members illegal forest encroachers in the eyes of the law. People living in the community are unable to hold or occupy land for construction, to clear or burn the forest for shifting agriculture, or to do anything to deteriorate or completely change the condition of the area from its original state. Processes to exempt communities from these have started but have been very slow.

Other government appropriation of healthy forest land also remains a problem. A nationwide policy to increase forest area to 40% land area may be further fuelling such attempts. Whilst the excellent preservation of forest lands within territories has (in some cases) help communities to increase its credibility with the authorities as responsible managers of land, it has also brought in the risk of their forests being declared as Protected Areas, thus depriving the villagers of their ancestral rights of ownership over these resources. This is further accentuated by the fact that rotational farming is not recognised by the authorities in Thailand as a legitimate agricultural system and hence, no land titling is issued by the authorities.

Cash cropping involves the permanent establishment of land for cropping and has been incentivised through various means by the government in recent years. Whilst rotational farming lands are not recognised by the Government, settled agriculture is recognised – the promise of tenurial security is an incentive for cash crop adoption. Another governmental organisation which plays a major role in supporting the village in many aspects is the Pang Ung Royal Project. The project promotes temperate fruit trees and other cash crops and buys some produce from the villages. The Royal Project has also set up the rice bank and cooperative fund to secure the food and agricultural inputs supplies. The project also supports the infrastructure development such as road and bridge construction to facilitate transportation and marketing of agricultural produce, and the well making to keep water for cultivation.

Informants in all villages commented on the various ways that climate change is impacting their food system and practices. In the past, most villagers had completed their planting by May. But this year, the planting was completed in June. This delay contributes to greater weed competition. Also, lower seed germination rates force the need for re-planting, leading to more seed use and increased labour. Late planting can encourage more significant insect infestation and diseases and less plant growth time. Overall, this can mean lower yields. Hail and heavy winds have made a devastating impact, damaging community farmlands, and also creating immense emotional distress for villagers. Communities are being forced to adapt their homes and farming areas to protect against damage. Flooding is a common annual phenomenon, due to overflow from canals. The floods often cause damage to nearby plantations and farmlands. Some villages have also experienced landslides due to heavy rainfall, and wildfire haze from the cities and neighbouring countries affects the daily lives and health of residents.

3.3 Results

3.3.1 Step 1: Characterisation of the agroecological transition

TAPE Step 1, comprising the Characterisation of the Agroecological Transition (CAET), was used to evaluate the level of agroecological performance in the four selected Karen communities. The radar diagram (Figure 42) presents the combined average scores for each of the ten elements across all communities. The use of CAET in the surveyed communities indicates that the communities can largely be considered "advanced" agroecological systems, with an average CAET score of 76.6%. Across all communities, high average scores were received on almost all the 10 elements, with 8 out of 10 elements of agroecology scoring more than 70%, and only two elements scoring between 60-70%. In particular, the Karen communities are most advanced in the elements of **Culture and Food Traditions** (mean= 82.3; SD=11.3), **Human and Social Values** (mean=86.7; SD=10.2), and Responsible governance (mean= 83.6). These elements reflect traditional identity and the extent to which traditional food practices are maintained; quality of labour conditions and welfare; and the ability of local producers to participate in decisions over land and natural resources (Table 8). Lowest scores were received for the elements of **Recycling** (69.9), which reflects reuse of biomass, water saving, seed management and energy use, and for **Circular and Solidarity Economy** (68.5), which measures the tendency to market their agricultural production in local circuits and territorial markets with a strong connection between producers

and consumers. It should be noted that these scores are only comparatively low against the other elements; in terms of the CAET, these scores are on the cusp of demonstrating high levels of agroecological transition.

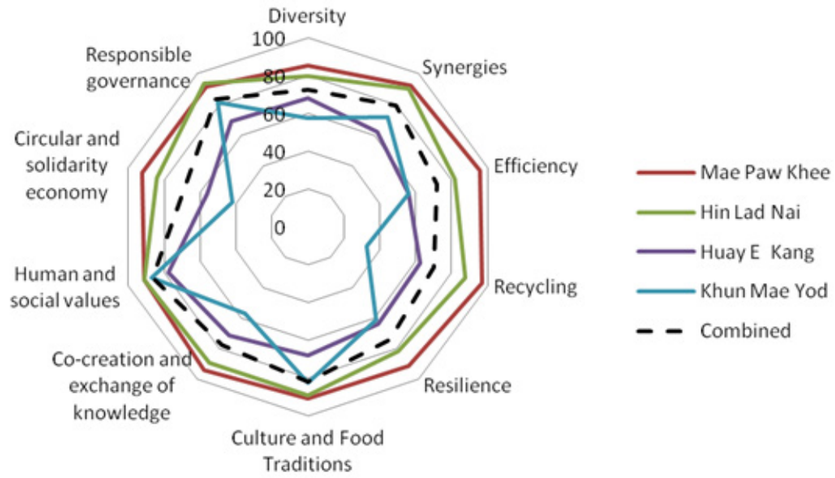


Figure 42: Radar plot showing the results of the CAET score for Maw Paw Khee, Hin Lad Nai, Huay E Kang and Khun Mae Yod in Northern Thailand

Communities	Mae Paw Khee	Hin Lad Nai	Huay E Kha	Khun Mae Yod	Combined
CAET Score	92.2	86.8	65.4	62.9	76.6
Diversity	85.2	79.8	67.8	57.5	72.5
Synergies	92.5	90.5	62.3	71.9	79
Efficiency	96	81.7	55.9	56.3	72.1
Recycling	97.1	87.5	62.5	32.5	69.9
Resilience	90.8	81.6	63.7	61.1	74.1
Culture and Food Traditions	90.8	89	67.9	82.8	82.3
-creation and Sharing of Knowledge	93.9	88.7	71	56.9	77.6
Human and Social values	91.5	91.3	77.7	86.9	86.7
Circular and solidarity Economy	92.5	84.1	56.1	42.2	68.5
Responsible Governance	91.9	93.5	68.9	81.1	83.6

Table 8 : Summary table of the CAET results per element and overall for whole sample (N=124) from Mae Paw Khee, Hin Lad Nai, Huay E Kha and Khun Mae Yod in Northern Thailand

Average results for the ten elements of agroecology for each community are presented in Table 8. CAET results disaggregated for the four communities indicate some differences, which may reflect important variation in food practices and enabling environment. The radar plot (Figure 43) illustrates the overall performance score of the system across the 36 CAET indicators. The highest overall CAET scores were received in Mae Paw Khee and Hin Lad Nai. In these communities,

traditional practices of rotational farming remain the predominant source of food, and the communities have actively rejected cash cropping practices. The communities of Huay E Kha and Khun Mae Yod received comparatively lower scores, at 65.4% and 62.9% respectively. Unlike Mae Paw Khee and Hin Lad Nai, these communities have not strongly retained rotational farming - with only a few households still practising it - and have moved towards a reliance on cash cropping. Despite the uptake of cash cropping, the differences in overall CAET scores between Huay E Kha and Khun Mae Yod compared to Mae Paw Khee and Hin Lad Nai are not significant/large – suggesting that strengths in other agroecological principles remain upheld. The following section elaborates on scores received for individual elements, reflecting on community differences and the ways that differences in the enabling environment might help to explain the results seen.

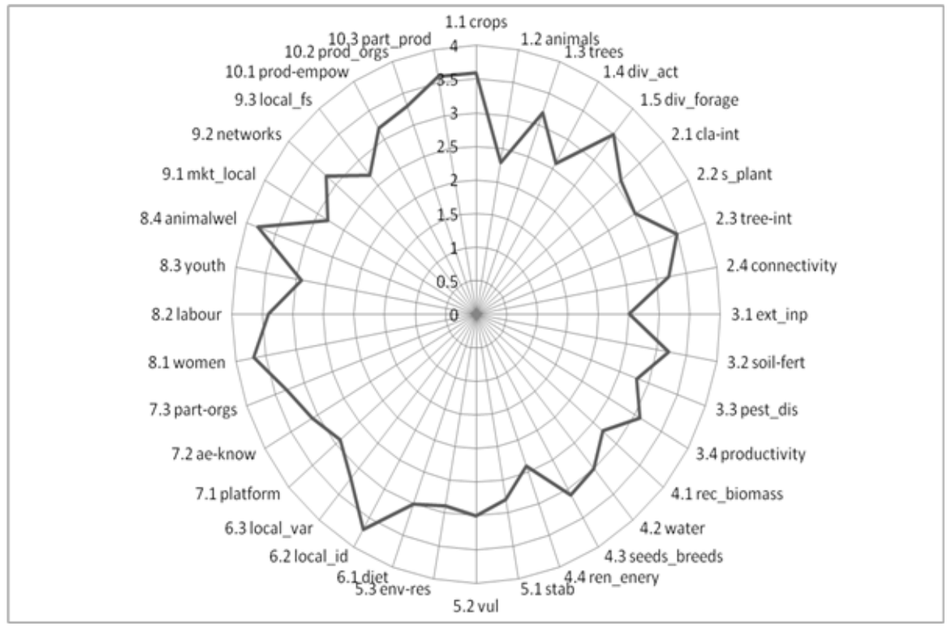


Figure 43: Radar plot of the 36 CAET indicators across the 4 sites in Northern Thailand

Very Advanced (>80%)

Human and social values received the highest score of all agroecological elements, and universally high scores across all indicators and communities. With the Karen systems being matriarchal, high scores for women's empowerment are as expected. A high score on human and social values also reflects that households feel that working conditions in agriculture are good. Agriculture is mostly based on family farming and producers (both men and women) have access to capital and decision-making processes. Workers have decent labour conditions. This is true of all communities, despite engagement within contract farming and cash cropping within Khun Mae Yod and Huay E Kha. Most young people (both boys and girls) do not want to emigrate. This was felt particularly strongly in Hin Lad Nai, where youth see a future in their food systems. Khun Mae Yod shows lower scores, reflecting some dissatisfaction among the youth with agricultural working conditions, which involve a mix of traditional (rotational) farming practices, highly labour intensive- and cash cropping.

Responsible governance, which measures producers' empowerment, their participation in the governance of land and natural resources, and participation in producers' organisations, was high (>80%) in three of four communities. In Mae Paw Khee, Hin Lad Nai, and Khun Mae Yod, mechanisms allowing producers to participate in the governance of land and natural resources exist and are fully operational, aimed at ensuring equitable access to resources and security of tenure. These communities have retained traditional agricultural practices, through which land allocation is overseen fairly by the village council, and communal management of lands remains the norm. The lower score in Huay E Kha (68.9%) suggests that producers feel less empowered in their recognition of rights and possess limited bargaining power. For example, the establishment of contract farming in Huay E Kha supports producers in terms of product marketing and supply of inputs, but it may also trap producers into relationships in which they have limited means to negotiate. This is in contrast with customary regimes, in which community members have greater capacity and means to adapt and improve their livelihoods and modes of production. In Khun Mae Yod, where traditional farming practice is balanced with cash cropping/contract farming, scores for responsible governance were also not as high.

Culture and food traditions is amongst the highest scoring elements (82.3%), with three of four communities receiving advanced agroecological scores for this element. Scores suggest in particular that Mae Paw Khee, Khun Mae Yod and Hin Lad Nai, - where traditional farming practices have been retained - still feel a strong sense of traditional identity and have high respect for traditions and/ or rituals. In Huay E Kha, traditional identity and rituals were less strongly felt. In all communities, the majority of the food consumed comes from local varieties/breeds and traditional knowledge and practices for food preparation are implemented, although this was less strong within Huay E Kha and Khun Mae Yod. In these communities, some new seed varieties and breeds have been introduced and new ways of farming are being practised to generate income. Increased purchasing of food products from markets is also resulting in a change in dietary habits, away from traditional consumption patterns.

Advanced >70%

The scores received for **Synergies** were high (79%), implying strong integrative management of the different components of the agroecosystem to generate positive ecosystem services. As outlined in earlier sections, the traditional Karen food system, comprising multiple sub-systems, is carefully managed to ensure synergistic relations across systems. This is particularly true of the integration of trees, which provide several products and services and for which practices aimed at regeneration are actively maintained (e.g. through fallow management). Even in communities that have moved towards a more cash-crop-centred economy, there is strong emphasis on maintaining forest and tree health. The Karen people further recognise the ecosystem services that forests provide – including the provision of high-quality water and pollinator health. Forest health is equated with "good life/living" for humans. Customary norms that protect the forest remain strong, with Elders responsible for forest management. Communities maintain different types of forest, which serve different purposes. Common designations include a "forbidden" or sacred forest area (in which even community use is restricted); a conservation or watershed forest, in which farming activities are curbed; a cultivation or community forest area, where rotational farming and other planting is permitted.

Soil-plant synergies saw the highest scores in Mae Paw Khee and Hin Lad Nai, supported by the strong retention of traditional crop and plot rotation practices, intercropping, and weed management. In the traditional rotational farming system, soil-plant synergies are optimised as land is cycled between cultivation (1yr) and a long fallow period (7-10yrs). The long fallow period enables the soil to sustain further cycles of rotational farming. Over time, regrowth of plants and trees in the fallow lands supports increased biomass and soil fertility. Proximity of cultivated fields to primary or late-successional forests supports agricultural productivity and hastens the regeneration of a plot back to forest once fallowed. Burning to clear a new plot for cultivation each year also breaks down biomass for plant uptake, so there is less need for synthetic fertilisers and herbicides. In Huay E Kha, where cash cropping is dominant, the lowest (but still moderate at 62.3%) score for synergies was recorded. The prioritisation of cash cropping, and associated dependency on external inputs and technologies, may result in the de-prioritisation of synergies within and between other systems.

The element of **Co-creation and Sharing of Knowledge** assesses the level of and access to knowledge on agroecology and traditional organic practices. The overall score for this element can be considered advanced (77.6%). All communities except for Khun Mae Yod exceeded the 70% threshold for this element, indicating that households generally have sound knowledge of agroecological practices and principles, and networks exist for the horizontal creation and transfer of knowledge and good practices. Several formal and informal channels for knowledge exchange are present within the communities: a cultural education curriculum is supported in local schools; and labour exchange – particularly on rotational farms – supports the interaction of elders with youths and provides opportunity to share knowledge.

A high overall score (74.1%) was received for the element of **Resilience,** which is described as an "emerging property" of agroecological systems (Lucantoni et al 2022). This can be interpreted in the context of social support systems within the Karen Indigenous Peoples' communities, where (despite the evolution of food practices) customary social systems that reduce vulnerability, such as the sharing of food and natural resources, remain active and generally well-functioning in communities. Some community variation was seen however: in Huay E Kha, whilst such supportive systems and mechanisms exist, they may have only limited capacity to support recovery from shocks. Income was perceived to be generally stable in all communities, however production was perceived to be more variable within Huay E Kha. Cash cropping here introduces increased instability of production as the system is more vulnerable to external shocks, market volatility and climate change. However, the establishment of contract farming in the area, supported by the Government-based "Royal Project", may protect cash croppers from severe income and production crashes.

The element of **Efficiency** saw a high overall score (72.1%), but with large differences seen across communities. The two communities of Huay E Kha and Khun Mae Yod recorded scores of <60%. These communities reported particularly high reliance on market-purchased inputs. In both villages, organic practices to manage soil fertility and pests and disease are used, however synthetic inputs (chemical pesticides and fertilisers) are applied to specific cash crops. Perhaps in recognition of the risks of cash cropping, Huay E Kha is also trying to innovate and develop organic

farming opportunities. In Hin Lad Nai and Mae Paw Khee, where efficiency scores were over 80%, most households self-produce their inputs from rotational farming, and do not depend on chemical fertilisers and pesticides. These communities predominantly derive their food from the rotational farming system, supplemented by food from home gardens, and wild foods from forests and aquatic systems. In Khun Mae Yod, whilst most of the food for subsistence is still cultivated within the rotational farming system, households also undertake cash cropping of beans, potato, and corn. Results from the sub-indicator on productivity and household needs suggest that in Hin Lad Nai, Khun Mae Yod and Huay E Kha, food production and utilisation of natural systems is sufficient to cover household needs for food and generate cash for essentials, however, it does not enable regular savings.

Overall results on **Diversity** indicate an advanced average score of 72.5%, suggesting that the average farm in the surveyed communities can be considered diverse in terms of their crop, livestock, and natural vegetation – as well as in their livelihood activities and use of natural systems for food. Karen food systems are traditionally based on a variety of systems (including cultivated and natural) within each of which a variety of edible plants and animals are harvested. Some community differences are notable. All communities received high scores on crop diversity, indicating a high number of different varieties adapted to local conditions and spatially diversified farms with multi-, poly- or inter-cropping. The rotational farming system in particular supports a rich diversity of animal and plant (wild and cultivated) life within cultivated plots and fallows. Over 70 varieties of crop are grown in rotational farming systems. However, animal diversity was comparatively low. Whilst some households may keep poultry and a few livestock animals, animal husbandry is not a key feature of Karen food systems. Diversity in economic activities was particularly low in Khun Mae Yod and Huay E Kha, perhaps reflecting the prioritisation of cash cropping within these communities (at the expense of other livelihood activities).

Moderate/"In transition" (50-70%)

The element of **Recycling** saw a lower overall score, just below the threshold for advanced agroecological transition (69.9%). This element saw greatest divergence across the communities, with scores of over 85% in Mae Paw Khee and Hin Lad Nai, and a score of 32.5% in Khun Mae Yod. Differences can particularly be attributed to the rankings assigned for the recycling of biomass, water saving and use of renewable energy. The results indicate that Khun Mae Yod and Huay E Kha recycle a lesser proportion of agricultural residues and discharge or burn more of their waste; and that households have minimal techniques through which to harvest or save water. These communities also rely more on externally purchased energy sources, which tend to be non-renewable. By contrast Hin Lad Nai relies on solar power rather than (fossil fuel) electricity – another active decision made by the community.

Circular and Solidarity Economy scored less than 70%. This indicator reflects the extent to which products and services are locally marketed, the existence of direct relationships with consumers (as opposed to via unknown intermediaries). It also reflects whether food supply and inputs are locally available and purchased, including via producer-producer/within-village exchanges. Sizable differences in scores were seen in scores between communities. Khun Mae Yod received a score of less than 50%, compared to >80% in Mae Paw Khee and Hin Lad Nai,

reflecting differences in the local marketing of produce. In Mae Paw Khee, marketing networks are – by geographical necessity – more local. The cash crops produced in Huay E Kha and Khun Mae Yod often reach more distant, urban centres, with a greater number of non-community actors often involved in these value/trade chains. In Mae Paw Khee and Hin Lad Nai, the community is almost completely self-sufficient for agriculture and food production. This is in contrast with Khun Mae Yod and Huay E Kha, where food and agricultural inputs are more commonly sourced from outside sources/markets.

Correlations Among the 10 elements of Agroecology

The correlational analysis indicates the relative importance of the different elements of agroecology in determining the overall assessment of agro-ecological "transition" in the communities (Table 9). To improve statistical power, correlation results are calculated using the pooled results from all communities.

The element of resilience is strongly correlated with all the 10 elements indicating their vital role in supporting resilience of the communities studied. Notably, Resilience shows strongest correlation with Circular and Solidarity Economy (0.89), Recycling (0.88), Efficiency (0.87), and Co-creation and Sharing of Knowledge (0.83) highlighting the importance of resource management, collaboration and self-sufficiency in enhancing resilience.

The element of Diversity shows the highest correlation with Resilience (0.71), indicating that greater diversity within the system significantly enhances the ability to withstand and adapt to challenges. For example, the diversity of crops and systems used by the Karen Peoples serves as an important risk aversion and management strategy, and thus forms a foundation for building resilience.

	div	syn	eff	rec	res	cultf	cocr	human	circ	respg
div	1	0.62	0.64	0.69	0.71	0.43	0.62	0.45	0.65	0.51
syn	0.62	1	0.74	0.73	0.74	0.7	0.67	0.66	0.72	0.72
eff	0.64	0.74	1	0.88	0.87	0.71	0.78	0.53	0.88	0.65
rec	0.69	0.73	0.88	1	0.88	0.63	0.87	0.51	0.89	0.62
res	0.71	0.74	0.87	0.88	1	0.74	0.83	0.59	0.89	0.72
cultf	0.43	0.7	0.71	0.63	0.74	1	0.57	0.66	0.65	0.72
cocr	0.62	0.67	0.78	0.87	0.83	0.57	1	0.62	0.81	0.6
human	0.45	0.66	0.53	0.51	0.59	0.66	0.62	1	0.54	0.72
circ	0.65	0.72	0.88	0.89	0.89	0.65	0.81	0.54	1	0.64
respg	0.51	0.72	0.65	0.62	0.72	0.72	0.6	0.72	0.64	1

Table 9: Matrix of correlation between the 10 elements of agroecology in Northern Thailand across 124 household food systems

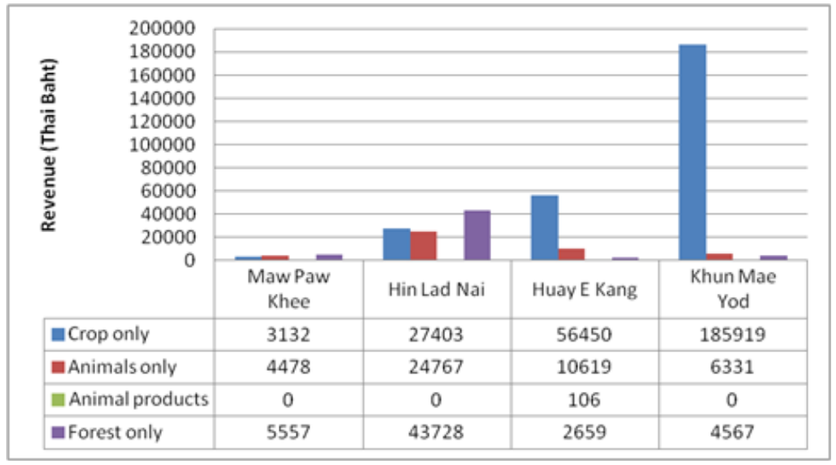
Human and Social Values is highly correlated with the element of Responsible Governance (0.72), suggesting that governance systems prioritising social values are more likely to be responsive to community needs and lead to more inclusive decision making. Additionally, Responsible Governance is also correlated with Efficiency (0.72) and Culture and Food Traditions (0.72), indicating that governance practices that respect local traditions strengthens community identity and ensures effective use of resources.

4.3.2 Step 2: Core Criteria of Performance: Multidimensional Performance of Agroecology

The following section presents the average results of indicators of performance for the four communities. These indicators span five dimensions of sustainability and are aligned with the indicators and targets of the Sustainable Development Goals (see Report 2: Methodology).

Economic Dimension

Assessment on the economic performance of the system shows variation in the revenues stream across the four sites in Northern Thailand (Figure 44). Khun Mae Yod village outperforms the other communities in terms of overall productivity per capita, by virtue of its high crop revenues, and moderate income from animals and forest products In Huay E Kha, crop revenue was also relatively high, with sizable income from animals and less from forest products. Hin Lad Nai saw the majority of its revenue from forest products, with less emphasis on crop and animal revenue streams. Mae Paw Khee had the lowest overall productivity: its revenues were fairly evenly balanced between crop, animal, and forest.



	Maw Paw Khee	Hin Lad Nai	Huay E Kang	Khun Mae Yod
Crop only	3132	27403	56450	185919
Animals only	4478	24767	10619	6331
Animal products	0	0	106	0
Forest only	5557	43728	2659	4567

Figure 44: Summary of key economic variables, disaggregated by community, Northern Thailand

The economic indicators of the value added (Figure 45) which represent the net revenue generated from all activities as well as the value added per capita (Figure 46) show a positive association with the CAET score across the communities. Khun Mae Yod and Huay E Kang where almost all households are in transition showed stronger correlation. In contrast, Mae Paw Khee and Hin Lad Nai, which are agroecologically advanced, show a weak positive correlation. These communities rely on self produced resources, reducing external cost.

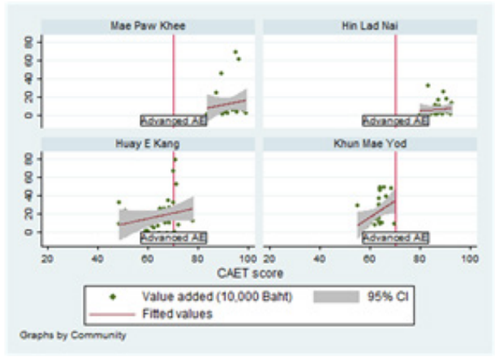


Figure 45: Relationship between the level of agroecology performance and added value across 4 communities in Northern Thailand.

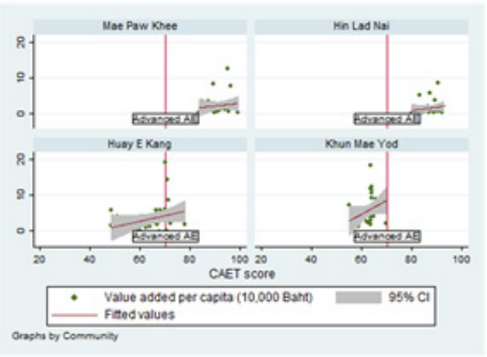


Figure 46: Relationship between the level of agroecology performance and added value per capita across 4 communities in Northern Thailand.

In Mae Paw Khee and Hin Lad Nai, where only agroecologically advanced households are present, crop production value per hectare remains consistent across households, showing no strong correlation with CAET. Conversely, in Huay E Kang and Khun Mae Yod, there is a strong positive relationship. Many households in these communities engage in paddy cultivation, and an increase in paddy productivity is likely driving the rise in crop production value per hectare (figure 47).

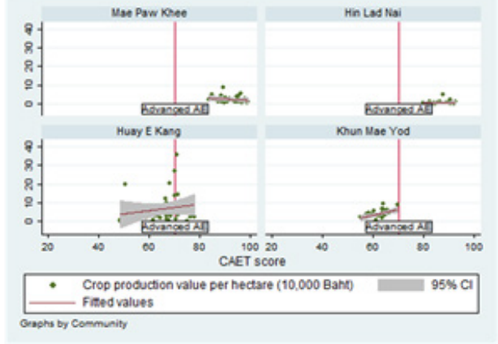


Figure 47: Relationship between the level of agroecology performance and crop production value per hectare across 4 communities in Northern Thailand.

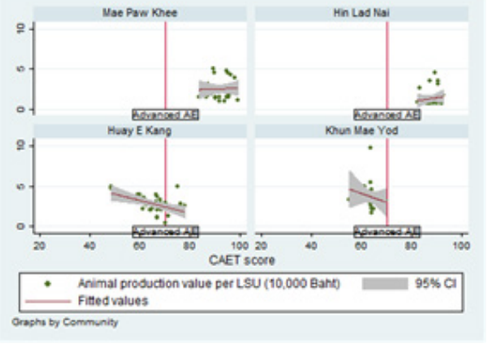


Figure 48: Relationship between the level of agroecology performance and animal production value per LSU across 4 communities in Northern Thailand.

There is a negative relationship between CAET and animal production value per LSU across individual communities (Figure 48). Agroecologically advanced households generate less animal production value compared to those with lower CAET scores, as Karen farmers tend to prioritise crops. In HuayE Kang, less advanced households achieve higher animal production value, while in Khun Mae Yod, less advanced households show a negative relationship. In Hin Lad Nai, where households focus on piggery and poultry for market sale, there is a weak positive relationship between CAET and animal production value.

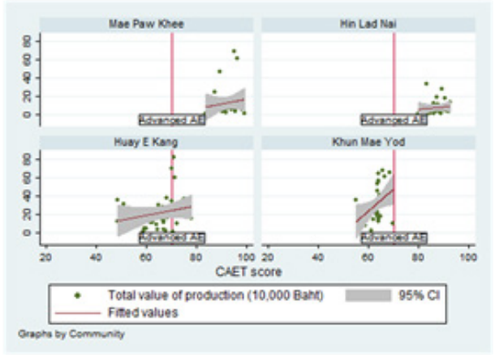


Figure 49: Relationship between the level of agroecology performance and total value of production across 4 communities in Northern Thailand.

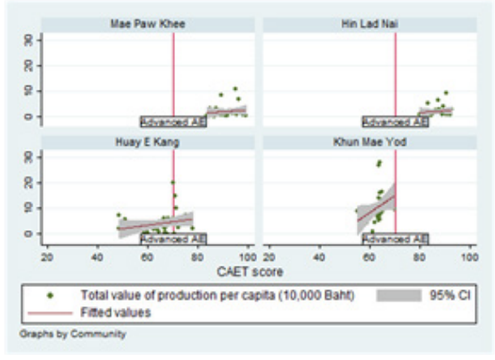


Figure 50: Relationship between the level of agroecology performance and total value of production per capita across 4 communities in Northern Thailand.

The relationship between CAET and total production value (Figure 49), as well as production value per capita (Figure 50) show positive relation. The relationship between Huay E Kang and Khun Mae Yod shows a stronger relationship where all households show moderate levels of agroecology performance. In Hin Lad Nai and Mae Paw Khee, though, this relationship is weaker, with households already showing high agroecology outcomes.

The relationship between CAET score and net revenue and net revenue per capita in Huay E Kha and Khun Mae Yod show a positive trend (Figure 51 and 52). In these specific communities, higher CAET scores are associated with increased net revenue. This positive relationship can be attributed to their agricultural practices, particularly the successful cultivation and sale of paddy and other crops during the off-season, which enhances their financial outcomes despite the broader negative trend. In Mae Paw Khee there is a weak and Hin Lad Nai, there is a weak relation, with focus more on production for self consumption.

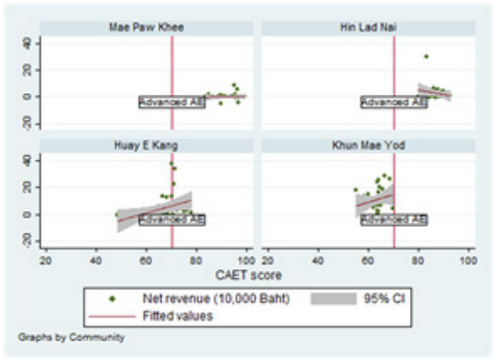


Figure 51: Relationship between the level of agroecology performance and Net revenue, across 4 communities in Northern Thailand.

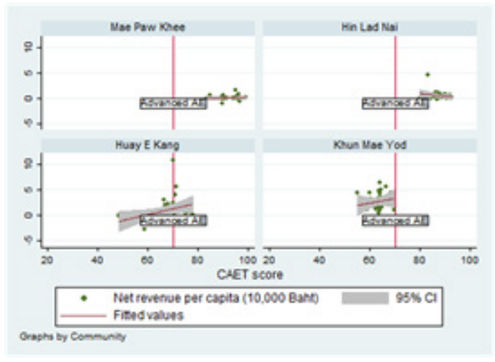


Figure 52: .Relationship between the level of agroecology performance and Net revenue per capita,across 4 communities in Northern Thailand.

Food Security, Human Health and Nutrition dimension

Food insecurity is virtually non-existent within the food systems examined with agroecology advanced communities of Hin Lad Nai and Mae Paw Khee scoring the highest. Even in Huay E Kha, where scores were lowest, levels were still considered "highly food secure" (Figure 53).

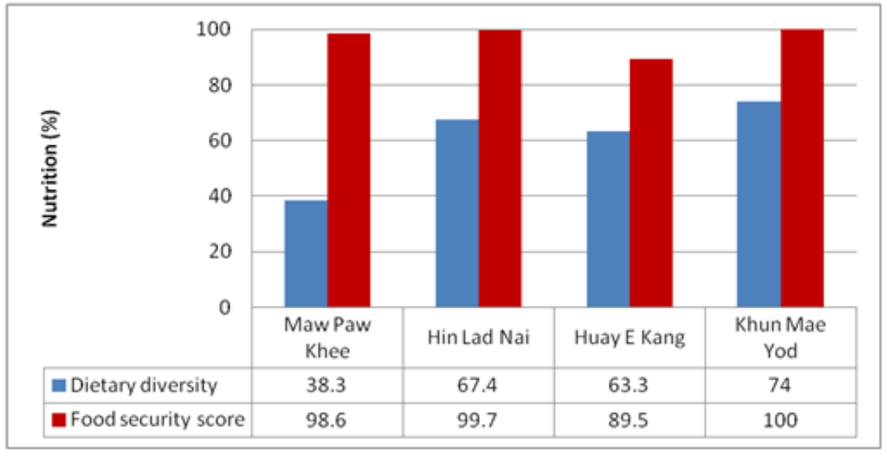


Figure 53: Summary of key nutrition variables, disaggregated by community in Northern Thailand

The aggregated results as well as at community level, the Food Insecurity Experience Scale (FIES) is correlated with CAET, indicating that more advanced agroecological systems tend to experience greater food security (Figure 54). This enhanced food security results from the integration of diverse food sources, including not only those from cultivated systems—such as rotational fields, paddy fields, and home gardens—but also from natural landscapes like forests and aquatic systems. Thus, adopting agroecological practices helps reduce household food insecurity by broadening and securing the sources of food available to these households. This trend is more pronounced in Huay E Kang.This suggests that the adoption of agroecological practices contributes to reducing household food insecurity, which also depends on food welfare.

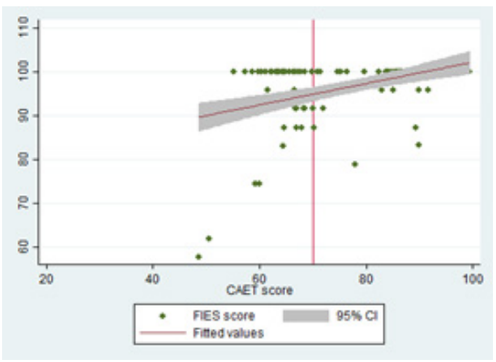


Figure 54: Relationship between the level of agroecology performance and FIES across 4 communities in Northern Thailand.

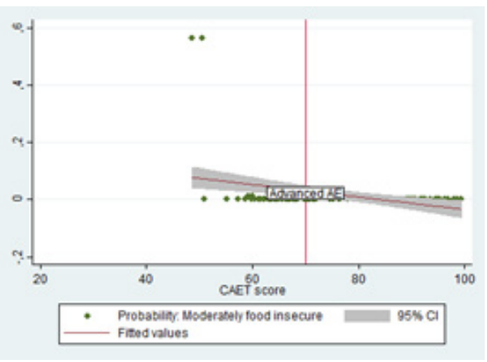


Figure 55: Relationship between the level of agroecology performance and probability of moderately food insecurity across 4 communities in Northern Thailand.

There is a negative correlation between CAET scores and the probability of moderate food insecurity across all communities. This indicates that higher CAET scores are associated with a higher likelihood of food security (Figure 55). This suggests that more advanced agroecological practices improve food security by enhancing resource management and diversifying food sources, which reduces the risk of experiencing moderate food insecurity.

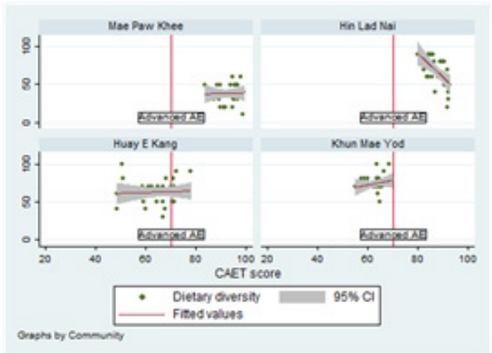


Figure 56: Relationship between the level of agroecology performance and Dietary Diversity across 4 communities in Northern Thailand.

There is a weak positive correlation between CAET scores and dietary diversity, except in Hin Lad Nai (Figure 56). In Hin Lad Nai, although dietary diversity declines with increasing CAET scores, it remains above the 50 threshold necessary for a healthy diet. Despite the community's advanced agroecological performance, this trend suggests potential seasonal variability impacting dietary diversity. In contrast, in Mae Paw Khee, although the correlation between CAET scores and the probability of moderate food insecurity is weak, the dietary diversity falls well below the threshold. This indicates the strongest disconnect between food insecurity and dietary diversity in this community. Meanwhile, in Huay E Kang and Khun Mae Yod, there is a weak but positive association between CAET scores and dietary diversity, suggesting that as CAET scores increase, dietary diversity slightly improves in these communities.

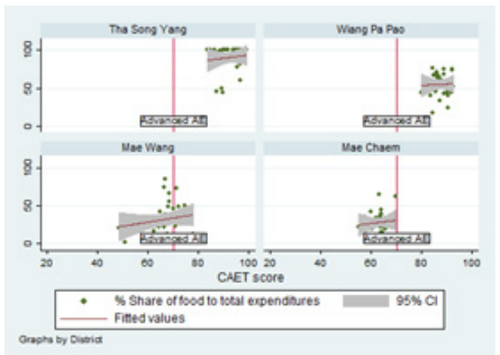


Figure 57: Relationship between the level of agroecology performance and % share of food to total expenditures across 4 communities in Northern Thailand.

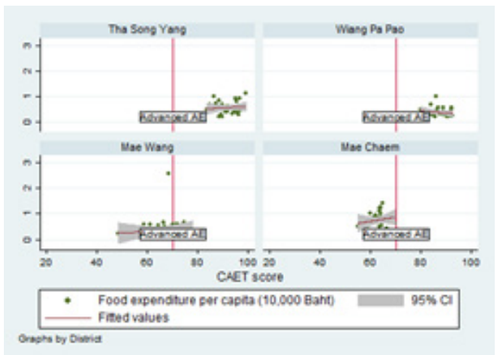


Figure 58 .Relationship between the level of agroecology performance and food expenditure per capita across 4 communities in Northern Thailand.

The relationship between overall CAET scores and food expenditure and % share of food to total expenditure shows varying relationships across the four communities (Figure 58). In Huay E Kha, where monocropping is prevalent, the relationship is particularly strong, indicating higher food expenditures. Other communities also exhibit a weak but positive correlation. This increase in food expenditure may reflect a greater reliance on external markets for food. Conversely, in Hin Lad Nai, which is also agroecologically advanced, the trend is negative, indicating that higher CAET scores are associated with lower food expenditure in this community.

Environment Dimension

This section explores key aspects of the environmental dimension associated with agroecological practices, focusing on the use of pesticides and fertilisers, soil health, and agrobiodiversity. The study reveals notable variations in how different communities manage agricultural inputs and the subsequent effects on ecological indicators.

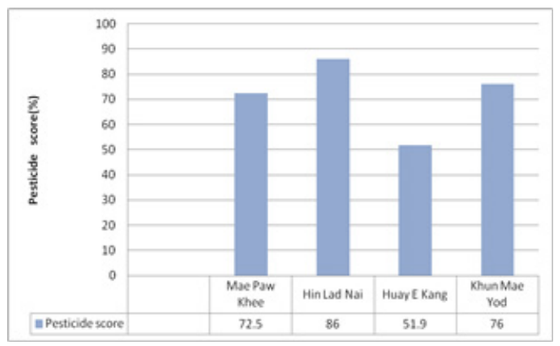


Figure 59: Summary of pesticide score disaggregated by community in Northern Thailand

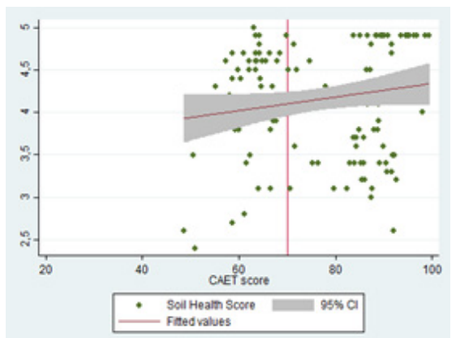


Figure 60: Relationship between the level of agroecology performance and soil health across 4 communities in Northern Thailand.

The study indicates a significant difference in pesticide and fertiliser use among the communities (Figure 59). In terms of pesticide use, Huay E Kha spent the most on chemical pesticides and only a minimal amount on organic alternatives, whereas Hin Lad Nai showed very low pesticide use overall and relatively low fertiliser expenditure. This higher score indicates lower use of chemical pesticides, greater use of mitigation techniques, and more implementation of non-chemical pest management practices. Hin Lad Nai achieved the highest pesticide score, suggesting minimal reliance on chemical inputs, while Huay E Kha had the lowest score.

Concerning soil health, all communities recorded soil health values considered healthy (>3.5), of which the highest values were recorded in Mae Paw Khee. Soil health index is positively correlated with CAET, indicating that more advanced agroecological farms maintain higher quality soils (Figure 60). Khun Mae Yod recorded the highest annual expenditure on chemical fertilisers with its focus on commercial production of rice while Mae Paw Khee reported almost zero spending on these inputs as it is predominantly reliant on their traditional farming practices.

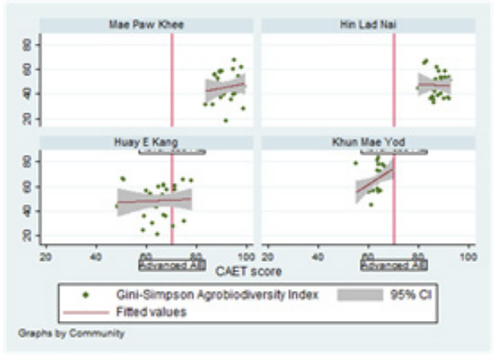


Figure 61: Relationship between the level of agroecology performance and Gini-Simpson agrobiodiversity index across 4 communities in Northern Thailand.

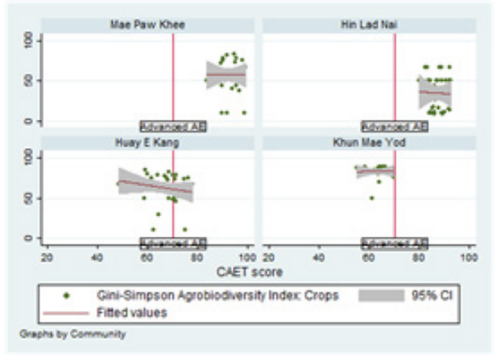


Figure 62: Relationship between the level of agroecology performance and Gini-Simpson agrobiodiversity index Crops across 4 communities in Northern Thailand.

The relationship between CAET and Gini-Simpson agrobiodiversity index among the communities is a positive one (Figure 61). In Khun Mae Yod it is an especially strong one. Although the community does not have any advanced households, the trend of increasing agrobiodiversity with rise in CAET score is unmistakable.

Analysis of communities reveal that except in Huay E Kang, there is a positive relation between crop diversity and CAET score (Figure 62).This is attributed to farmers in Huay E Kang focusing more on improving rice productivity through wet paddy cultivation, which involves mono-cropping, thereby reducing crop diversity.

Social Dimension

In all communities, there is high gender parity indicating female experiences, indicating that females experience greater empowerment/decision-making ability in the dimensions examined (involvement in productive decision-making, time use, control over income, leadership within the community, asset ownership and credit) than their male counterparts. The Abbreviated Women's

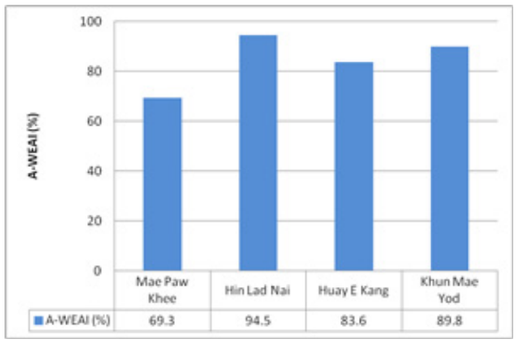


Figure 63: Summary of A-WAEI (%) disaggregated into communities in Northern Thailand

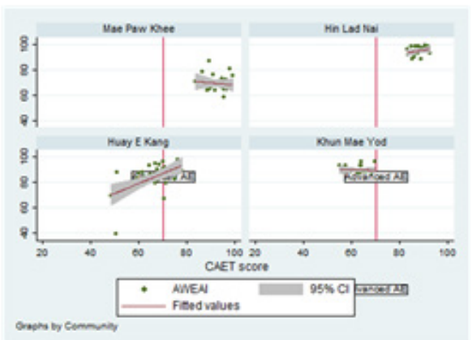


Figure 64: Relationship between the level of agroecology performance and A-WEAI across 4 communities in Northern Thailand.

Empowerment in Agriculture Index (A-WEAI)showed high scores (>70%)with the highest score in Hin Lad Nai (Figure 63).

Excepting Mae Paw Khee, the relationship between CAET and A-WEAI shows a of positive association, i.e., women empowerment improves as households become more advanced in adopting agroecological principles. This is most clearly seen in Huay E Kang where the positive relationship of CAET with AWEAI is very strong. Even in Mae Paw Khee the A-WEAI values are more than 80 which is very high, and the decline is very minor.

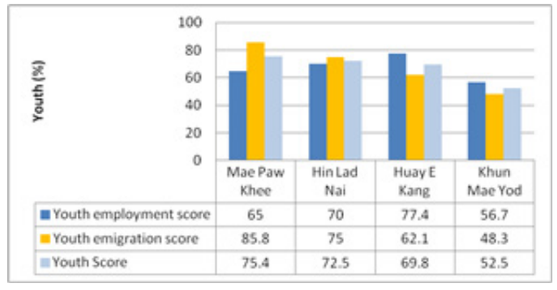


Figure 65 : Summary of key social variables, disaggregated by community in Northern Thailand

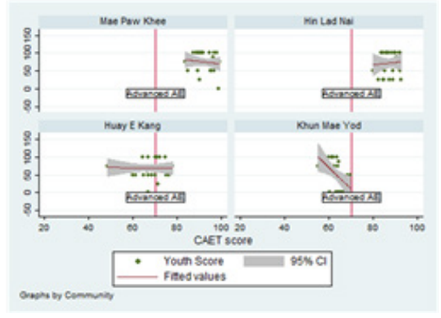


Figure 66: Relationship between the level of agroecology performance and Youth score across 4 communities in Northern Thailand

Youth employment and youth emigration scores (0-100) reflect respectively the proportion of youths within households working in agricultural production or education in the system assessed, and the proportion of youths that want to remain in the community and continue in agriculture. High scores (>70%) for both indices were seen in Hin Lad Nai (Figure 65), where youths are actively involved in creating value chains for products from their rotational farms The youth score is positively associated with CAET score suggesting that participation of youth is higher with more advanced agroecological systems except in Khun Mae Yod (Figure 66). Khun Mae Yod appears to face the most challenges in terms of employing and retaining its youth in agriculture. Youth emigration score is positively but weakly correlated with CAET, suggesting that young people may have more agricultural job opportunities and be less inclined to migrate within most advanced agroecological systems.

When the relationship between CAET and male youth score is analysed, it is found to be a positive one except in Khun Mae Yod and Mae Paw Khee (Figure 67). This means that the motivation to continue in farming and the local food system is higher for youths that belong to agroecologically advanced households, as compared to those who are less advanced. In Khun Mae Yod, where the pressure to move out is very high as represented by a very strong negative relationship between CAET and male youth scores. Male youth from agroecolologically advanced households from Mae Paw Khee also show some tendency to move out but the youth participation figures are still very high. Except in Khun Mae Yod, the general pattern is of female youth staying back and

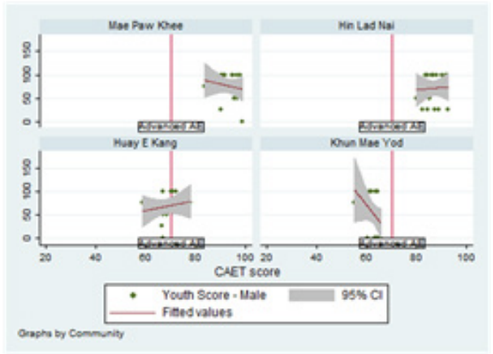


Figure 67: Relationship between the level of agroecology performance and Youth score-male across 4 communities in Northern Thailand

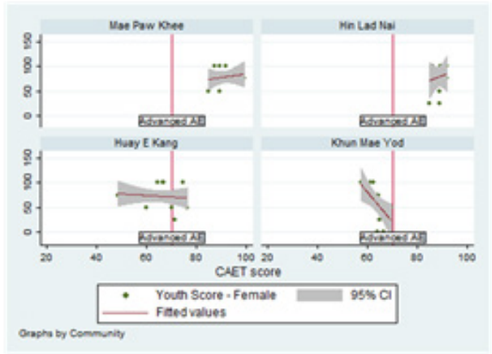


Figure 68: Relationship between the level of agroecology performance and Youth score-female across 4 communities in Northern Thailand.

continuing with the local food system provided households also adopt agroecological principles in their food production system, i.e., a positive relationship between CAET and youth score-female (Figure 69)

Governance Dimension

The governance dimension of sustainability measures tenure score which considers (with equal weight) the existence of legal recognition of access to land, the perception of security of access to land, the existence of the right to sell, bequeath or inherit land. The study reveals significant variations in tenure security across different communities (Figure 69). Hin Lad Nai has the lowest tenure score due to substantial uncertainty regarding land rights, particularly with limited formal legal recognition of land access. In contrast, Khun Mae Yod has the highest tenure score, as the community relies on cash cropping within settled wet paddy systems, which provides greater security of tenure.

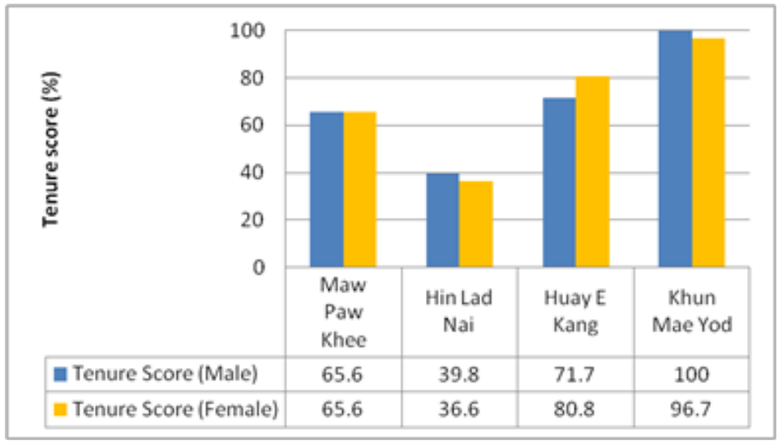


Figure 69: Summary of key governance variables, disaggregated by community In Northern Thailand

3.3.3 Step 3: Joint Interpretation and Reflection on Results

TAPE Step 3 enabled the confirmation of analysis with the study communities, and the verification of the adequacy of the TAPE framework. The protocol for Step 3 was co-designed with the Thai research team and is summarised in Box 5.

Box 5: Protocol for Step 3 in Northern Thailand.

Identify Stakeholders: The participants invited to the participate in the Step 3 for joint interpretation included enumerators, youth leaders and knowledge holders.

Communication Channel : The team leading the study organised a focus group discussion with 15 participants representing the four study sites.

Outlining Roles of team members: The facilitator for each discussion of each step are assigned among the team members. Dr. Prasert, Dr. Kwanchewan and Dr. Boongsong led discussion on Step 0, Step 1 and Step 2 respectively.

Contextual Factors: Participants from each community are engaged in detailed discussions on the various factors that either enable or limit the agroecology outcomes of their respective food systems. These discussion are comprehensive, covering aspects such as local resources, traditional knowledge, socio –economic conditions. The dialogue extended to explore the opportunities arising from these factors. Conversely, participants shared challenges that pose threats to the sustainability of their food systems encompassing issues such as climate change impacts.

Review of CAET Results: The CAET results were presented, with a detailed explanation of the key findings. Participants then engaged into a review of the results, considering contextual factors, and discussing the reasons behind the scores. This step also involved identifying any discrepancies among the results of different communities and necessary clarification sought where needed.

Review Performance Criteria Results: The results from Step 2 are presented, after which the facilitator guided the participants to verify if the CAET score led to the impact in Step 2. This process was further supported by the contextual information gathered in Step 0.

Ranking of indices: Participants from each community were guided to rank the indices, prioritising those that best reflect the food systems within their community..

Adequacy of the framework: Community members together with the team delved into the intricacies of the Karen People food systems that were not adequately represented by the TAPE. This discussion shed light on indicators that were incongruent with the local context, resulting in lower scores.

Identify Strategies for Improvement: Participants explored potential ways to use the collected data within the community. The team also recognized the findings as instrumental in supporting policy advocacy initiative.

Feedbacks: Participants shared their perspectives on the effectiveness of the tool, highlighting both successful aspects and areas for improvement. They also offered valuable suggestions to enhance the process for future use of the tool.

Confirming the TAPE results and analysis

The feedback provided by each community during the Step 3 meeting illuminates the intricacies of their respective food systems, confirming the insights gleaned from the TAPE analysis.

Seasonal variation on food diversity: In the context of rainfed agriculture, communities experience limitations in accessing diverse food options during winter and hot seasons, leading to heightened dependency on external markets. Notably, a significant portion of meat products is acquired from external sources. Despite maintaining food security within their localities, the communities acknowledge the necessity of addressing seasonal food variations to lessen reliance on external supplies during lean periods. While cultural and food traditions persist, there is a noticeable decline in children's knowledge of edible vegetables, indicating a need for knowledge preservation efforts.

Generational Knowledge gap: The communities emphasise the significance of human social values in their food systems, highlighting the essential roles of labour exchange and youth engagement in preserving traditional farming practices. Concerns regarding youth migration for education or work are prevalent across all villages, with Khun Mae Yod experiencing severe labour shortages as a result, leading to heightened reliance on chemical inputs and diminished diversity. Notably, Hin Lad Nai demonstrates higher youth retention rates, attributed to the availability of sustainable livelihood opportunities such as value addition, sale of honey, and promoting eco-tours. To address knowledge gaps, innovative strategies such as establishing online groups between university students and young community members have been implemented in Hin Lad Nai, fostering collaboration and knowledge exchange during semester breaks.

Retention of traditional food systems for environmental health: The retention of traditional food systems is vital for environmental health, as highlighted by Elders expressing concerns about the expanding cash cropping, particularly notable in Khun Mae Yod. Communities like Huay E Kha and Khun Mae Yod, which have shifted towards cash cropping, witness a surge in the usage of agricultural inputs such as seeds, fertilisers, and pesticides, even within rotational rice fields. This sustained reliance on chemicals poses significant risks to soil health and water availability, consequently leading to a departure from traditional food systems. Such challenges underscore the intricacy of maintaining sustainable food systems amidst evolving environmental conditions and socio-economic pressures. However, Hin Lad Nai, where traditional farming systems are intact, has made a conscious decision to not promote cash crops. Instead, well-managed fallow management and the integration of beekeeping, complemented with diversified economic activities, highlight the economic viability of these systems.

Additionally, shared concerns about climate change and its adverse effects on crop yields are prevalent across all communities, highlighting the urgent need for resilience-building strategies like preserving agrobiodiversity. Despite these challenges, agrobiodiversity remains relatively high across all four communities, acting as a crucial strategy to mitigate the impacts of climate change and ensure long-term food security.

Limited policy support for Karen People food system: Forests are a crucial element of the Karen people's culture, yet policies and regulations, such as national park restrictions and bans

on burning in rotational farms, threaten this relationship. Adaptive strategies have emerged within communities like Hin Lad Nai, where, despite the negative impacts of national park regulations, close relationships with foresters have been established, facilitating mutual activities and discussions on cultural conservation. The community has also successfully negotiated understanding and permissions regarding the burning policy for farming areas, demonstrating proactive engagement in local governance processes. Although forest encroachment has decreased following joint meetings and clear demarcation efforts, challenges persist with new and uncooperative members.

In Huay E Kha, the community's opposition to the recategorisation of land by the NLPC showcases their resistance to external land management initiatives. Meanwhile, Mae Paw Khee's location within a national conservation forest underscores impending stricter regulations, raising concerns about future governance dynamics. Furthermore, issues of encroachment by non-Indigenous persons, coupled with government policies like national park expansion and strict burning regulations, present complex governance challenges across all communities.

However, strong leadership in each community has been instrumental in navigating these challenges and maintaining sustainable agroecological practices. This resilience in local governance highlights the importance of adaptive strategies and proactive engagement in ensuring the sustainability of their traditional food systems and cultural heritage.

Elements of Agroecology and Perspective of Karen People Food Systems: The Karen Peoples Food System deeply reflects their cultural values and commitment to sustainability. Elements of agroecology, particularly **Human and Social Values, Co-Creation and Sharing of Knowledge, Diversity,** and **Culture and Food Tradition,** are uniquely expressed in Karen culture in the following ways.

Karen People prioritise **Human and Social Values** within their communities, fostering an environment of equality and mutual respect. In Hin Lad Nai, the principle of equality is upheld, allowing the younger generation to express their ideas freely. This inclusion helps maintain a cohesive community structure and supports innovation in their agricultural practices. Similarly, Huay E Kha emphasises the empowerment and freedom of expression for youth, encouraging active participation in community activities and decision-making processes. These values are crucial in sustaining traditional farming practices and ensuring the community's resilience.

Co-creation and the sharing of knowledge are fundamental to the Karen People approach to maintaining their food systems. Huay E Kha regularly organises learning forums on traditional culture, herbal knowledge, and natural dyeing techniques. These forums not only preserve valuable cultural knowledge but also adapt it for contemporary use. The youth in Huay E Khang are actively involved in these processes, cultivating a 1-rai rotational farm and learning from elders. In Hin Lad Nai, strategies have been developed to bridge the knowledge gap and foster continuous learning.

Diversity is a cornerstone of the Karen Peoples food Systems, though its implementation varies among communities. Khun Mae Yod showcases a mix of traditional rotational farming and cash

crop monocultures. They emphasise the synergies between animals, farms, and forests, and practice seed saving, including medicinal herbs, to maintain agricultural biodiversity.

Culture and Food Tradition: The preservation of cultural traditions and food practices is integral to the Karen People's identity and sustainability. In Hin Lad Nai, traditional rituals like the au khae (ancestral cult) are still followed, and the community consumes a seasonal diet, promoting biodiversity and cultural continuity. Mae Paw Khee and Khun Mae Yod also maintain cultural practices within their farming systems. However, the shift towards cash cropping in some areas, such as Khun Mae Yod, poses challenges to these traditions.

Responsible governance plays a crucial role in ensuring tenure security within Karen communities, particularly regarding land management and conservation efforts. Strong leadership is pivotal in navigating complex governance challenges and maintaining sustainable agroecological practices. By establishing close relationships with relevant authorities and stakeholders, community leaders facilitate mutual understanding and cooperation, thus mitigating conflicts over land ownership and access. They also advocate for the recognition of customary land rights and negotiate permissions regarding land use policies and regulations. Through proactive engagement in local governance processes and effective decision-making, these leaders uphold tenure security, preserving the cultural and environmental integrity of their food systems.

3.3.4 Lessons from Storytelling

Karen peoples stories provide further insight into key interrelationships between agroecology elements and food system performance. Some of the stories talk to the agroecology elements that Karen food systems score highest on, contributing to existing knowledge on when, how, why and in what ways indigenous food systems support people and landscapes to thrive. In this section, we draw the reader's attention to some of the worldviews and value systems that underpin the design of food systems, and determine their outcomes.

Reconceptualising human and social values and responsible governance in agroecology

The stories shared by the Karen People emphasise the central importance of human and social values for ensuring the integrity and sustainability of the agroecosystem. In alignment with the way the TAPE tool expresses human and social values, the Karen stories explicitly showcase women and youth involvement, and the importance of fostering fair labour conditions. As a practice, labour exchange helps to ensure sufficiency of labour with due environmental diligence – e.g., careful burning of land. The tradition also helps to foster inter- and intragenerational community cohesion, knowledge transfers and responsible governance of shared natural resources.

Karen stories deepen concepts of human and social values and responsible governance as they are currently defined and measured by TAPE. Karen People's stories convey important lessons about how certain worldviews and values underpin the sustainability of the ecological system. Greed disrupts important interrelationships where as sufficiency, sharing, solidarity, respect and an ethic of care towards other humans and living beings promotes socio-ecological balance. The Karen story of **The Beast Wedding** is a tale of two young girls who dream of an easier life

away from agriculture, and the challenges that befall them as their ambition begets disharmony in the socio-ecological system. In the story **Miss Red Eye Frog and Miss Deer,** the frog treats a fellow farmer (the deer) with disrespect when the deer comes to help on the frog's farm. The story elaborates on the runaway ecological effects that follow the mistreatment.

Karen stories also extend the concept of human and social values and responsible governance beyond the human sphere, into natural and spiritual spheres of being. TAPE includes a measure of animal welfare, which is about respecting and protecting animals from pain, but the Karen stories encourage the agroecologist to see the entire food system as reliant on the inter-dependent behaviour of humans, animals and the natural world. A lot of the stories reinforce the point that if you grow your food with deep respect and reverence of other beings you will have success. In the folktales it is the intention behind the design of food systems that is awarded particular attention. In **Phu Maw Taw** the success of a rotational farmer is linked to his love, patience, forgiveness and understanding of other beings. His experience leads to diligence and humility. But these capacities are not noticed by a greedy onlooker who tries to copy his success. In the story **Orphan and the Bird** the bird defecates silver in response to the orphan's care of the bird. When a corrupt king captures the bird, it turns into a giant and the country floods. Only the orphan and his grandmother survive. The stories encourage the reader to pay attention to the qualities and capacities an agroecologist needs to develop.

The human capacity to see humanity as one interacting member of an inter-species collective shifts responsibility and accountability in the stories. Human beings cannot conquer and neither can they fix. They can respect their talents alongside the talents of their co-collaborators, noticing how talents co-exist with responsibilities. In the Karen peoples story **Orphan and the Pond** the water-bailing system to catch fish has the ability to naturally recover itself provided no more water resources are taken than are necessary for subsistence. The humans are required to exercise restraint and this respectful gesture creates the space for the water to sustain its own health. In stories Naw Pha Do and **Banana Blossom,** orphans are protected by spirits and rewarded for virtuosity, good characters and doing the right thing, while kings and misguided parents are punished for mistreating them.

The importance of diversified knowledge systems to the agroecologist

Karen People's stories emphasise the importance of knowledge co-creation and exchange within the agroecological system, which the TAPE assessment showed to be particularly advanced in two of the Karen communities. In the stories, we hear of characters sharing tacit ecological knowledge (skills, ideas and experiences) with each other to facilitate successful food production, illustrating the importance of informal knowledge exchange between people.

The stories provide guidance on sources of knowledge and how knowledge should be applied. In the story **Mother Fish,** culture and identity are celebrated as important sources of knowledge. The mother bestows this knowledge on her children at the beginning of the story and the elder brother provides a diversity of wild foods to his younger brother. In time he gives a lot of seeds which make survival possible and ultimately help the boy thrive. In the story **Rice Spirit Bird,** an orphan is able to use local knowledge about rotational farming to convert poor soil into rich soil.

The qualities the orphan displays are kindness, innovation, patience and respect for nature and the Rice Goddess.

Rice fills his granary, even during "starving season".

There is an appreciation of innovation, but this is nested in stories that make the listener aware of the pitfalls of sudden change and which encourage the mixing of old and new knowledge with a careful and patient approach. In **The Beast Wedding** – a story about knowledge, insight and wisdom – it is about a young girl who trusts in the old practices when the older people are blind. In other stories, **Phu MawTaw** and **Naw Pha Do,** knowledge on traditional farming is shared by wise individuals - a fortune teller and an Elder – to help others in the village grow food. The stories make the point that knowing things is different to being wise. They emphasise how new knowledge needs to be interpreted holistically, contextually and systemically for it to be applied wisely. The Karen People's stories celebrate the power of discerning whether a solution today will create problems for tomorrow. Instead of short-termism, the stories encourage agroecology practitioners to diversify their knowledge systems. Spirit knowledge, which comes from nature, is another form of wisdom, which is especially used as a tool for survival, and to withstand hardship. For example, in the story of **The Rice Spirit Bird,** the spirit imparts her wisdom on rice farming to the farmer. Despite being allocated poor quality land, this ecological knowledge allows the farmer to cultivate an excellent crop. The receipt and use of spirit knowledge is contingent on a strong relationship with the natural world, which pays close attention to other species.

Reflecting on circularity, efficiency and wealth generation

Within TAPE the agroecology element of circularity and solidarity economy is primarily viewed through the lens of market transactions, but in the stories about Karen food systems the importance of circularity and solidarity was emphasised as working together, sharing resources, and helping one another in times of need. Its basis was in expressions of care, especially for those who had less, like orphans. Stories did not talk about the marketing and trading of food and instead illustrated the role and value of non-monetary transactions which looked after others.

In **Rice and Money** there is a debate between rice and money about who better looks after people. After trying money, which resulted in hungry children who could not stop crying, the villagers reverted to rice, distributing seeds so everyone has enough food to support themselves and their children. The lesson is clear: if you value money more than food you are always at risk of being hungry. Money can get you food, but without food your money means nothing. In **Naw Pha Do** the king, who had been sitting above the people, gets down from his high seat to sit on the ground. On eating the kind of rice planted on rotational farms and feeling his hunger stop, he understands why the farmers have been reluctant to give up rotational farming the same way their ancestors had done. There is more nutritional value in older systems than cash-dependent systems, reminding readers that food is a source of life and more important than money. Similarly, resilience is not depicted as being contingent on the stability of income and food production, but rather contingent on community support systems. Many of the stories contain moral messages about supporting community members who are less fortunate – widows and orphans are often the protagonists of these stories.

The TAPE element of efficiency assesses the extent to which a food system relies upon internal (self-produced or self-exchanged) inputs, the use of organic practices to manage soil fertility, pests, and diseases. It also asks whether the household needs are met by self-production and whether this also enables monetary savings. The stories collected refer to explicit organic practices that ensure soil fertility and the management of pests -for example, **Phu Maw Taw** refers to how bird pests can be managed through natural means. An important difference to TAPE relates to its mention of "monetary savings". In the stories, food surpluses are not used to derive monetary savings – but are shared with others or stored to provide future resilience. Indeed, to gain surplus wealth is cautioned against.

Together, the stories explore the interrelationships between circularity, efficiency and wealth generation. They pose questions about the origins and maintenance of wealth generation in food systems – perhaps suggesting that non-market forms of circularity and solidarity which emphasise sufficiency are important for agroecological transitions.

3.4 Discussion

3.4.1 Summary of results.

The application of TAPE (Tool for Agroecology Performance Evaluation) to 124 Indigenous households across four sites in Northern Thailand has offered valuable insights into the agroecological outcomes and overall sustainability of these food systems.

Summary of the key results obtained with the use of TAPE in Mae Paw Khee, Hin Lad Nai, Khun Mae Yod and Huay E Kha:

- The food systems of the Karen Peoples consist of varied systems that include cultivated, semi-domesticated and natural systems. Rotational farming is predominant systems complemented with sustainable use and management of fallows and forests. However, wet paddy cultivation predominates in Huay E Kha, whereas Khun Mae Yod has retained rotational farming along with paddy cultivation.
- The studied food systems are considered **advanced agroecological systems,** with varying levels of agroecological performance among communities. Hin Lad Nai and Mae Paw Khee demonstrated advanced performance, while Huay E Kha and Khun Mae Yod showed moderate implementation of agroecological principles. The variation is linked to the adoption of cash cropping in Khun Mae Yod and Huay E Kha. This shift not only altered agricultural practices, such as the use of non-native seed varieties and synthetic inputs, but also disrupted traditional norms and structures by creating new dependencies on external sources.
- **Eight out of the ten elements of agroecology showed advanced score,** with human and **social values receiving the highest overall score.** These values, along with respect for traditional identity, food cultivation, preparation, and dietary customs, have remained intact even in communities that have transitioned to cash cropping.
- The strongest correlations with agroecological status were with elements of **Resilience,**

Recycling, Efficiency, and Circular and Solidarity Economy. Strengthening these attributes (e.g., promoting organic practices, internal inputs, and direct consumer links) is important for advancing agroecological transition

- **Responsible governance is strongly correlated with Resilience, Synergies, Culture and food traditions, and Human and Social Values.** In all the communities, village councils uphold customary norms to ensure the sustainable use of resources. These norms include prohibiting tree cutting and hunting within conservation and community forests, preventing encroachment or destruction of watershed forests, restricting forest burning except for regulated rotational farming, and banning harmful tools like bird nets or glue traps for capturing wildlife in water sources within community forests.s.
- In the **economic dimension of sustainability,** the findings revealed a significant relationship between agroecological status and farm revenue: farms with more advanced agroecological practices tend to achieve higher and/or more profitable agricultural outputs. Additionally, forest product revenue showed a strong correlation with the CAET, indicating that increasing income through the sustainable utilisation of forest resources could contribute to improving agroecological status in the target regions.
- Pertaining to the environmental **dimension of sustainability** indicated that more advanced agroecological household food systems in our sample spent less on chemical inputs and fertilisers More advanced agroecological systems also had **higher quality soils.**
- Regarding **nutrition,** the results suggested that the most advanced agroecological systems experience greater food security. However, in general, food insecurity was low in study communities.
- The results related to the **social dimension of sustainability** revealed that more **advanced agroecological systems had a higher retention of youth** within the community for agricultural activities. Youth not only serve as a vital source of agricultural labour, but they also play a crucial role in preserving and promoting traditional values and food practices that support sustainability and the regeneration of these systems.
- In our study, the most advanced agroecological systems faced the **greatest insecurity in land tenure.** This can be related to the political situation in Thailand, where the systems in our sample depend on rotational agriculture, a practice not recognized by the Thai Government for land tenure rights. Despite these challenges, it is important to highlight that the Karen people remain remarkably committed to their traditional agricultural practices and the preservation of their natural resources.
- Karen stories offer deep insights into the **relationship between human values, responsible governance, and agroecological sustainability.** They underscore the importance of values such as solidarity, respect, and care in maintaining ecological balance and fostering community cohesion. The narratives emphasise the integration of diverse knowledge systems, blending traditional wisdom with new practices, and highlight the value of non-monetary transactions like sharing and mutual aid. They illustrate how respect for nature, responsible resource management, and community support contribute to food system resilience and sustainability. Overall, the stories suggest that prioritising sufficiency and interdependence over monetary gain is crucial for achieving sustainable agroecological transitions.

3.4.1 Models for agroecological best practice

The results strongly support that food systems based on traditional rotational farming—alongside the integration of other cultivated and natural systems—are the most agroecologically advanced and excel across multiple dimensions of economic, environmental, social, and nutritional performance. Two communities in the study serve as exemplary "agroecological lighthouses" (Nicholls and Altieri, 2018), representing best practices in agroecology. These lighthouses provide valuable lessons to guide communities and policymakers in the region towards achieving more advanced agroecological status.

Among these communities, Hin Lad Nai stands out as a "model" village, demonstrating traditional agriculture that integrates environmental stewardship with community-based economic development without resorting to cash cropping. Several key factors contribute to this recognition:

- **Strong Economic Outcomes from Forest-Based Livelihoods:** The village's "forest garden" combines the cultivation of vegetables, fruits, tea, and coffee within small plots alongside the forest, with beekeeping, providing diversified income sources and crucial ecosystem services. This forest-based economy is both lucrative and environmentally friendly, reducing reliance on harmful cash crops.
- **Commitment to Renewable Energy:** The community has embraced renewable solar energy, aligning its energy use with sustainable principles.
- **Youth Engagement and Retention:** The social enterprise model employed by Huay Hin Lad Nai has effectively engaged and retained its youth by involving them in expanding markets for their produce, particularly from rotational farms. Young community members are actively participating in identifying and developing new market opportunities while also raising awareness about the benefits of their food systems. This involvement not only provides them with meaningful roles but also strengthens their connection to their cultural heritage and supports the sustainability of the community's agricultural practices.
- **Knowledge Transmission Between Generations:** Strong relationships between Elders and youth are fostered through both formal institutions and informal practices, such as labour exchange. These interactions ensure the ongoing transfer of traditional knowledge and values, creating a dynamic bi-cultural curriculum that blends ancestral wisdom with contemporary insights.
- **Strong Governance Customary Laws and Support Systems:** The community is governed by strong customary laws upheld by Elders, focusing on mutual respect and restorative practices ensuring high levels of community compliance and cohesion.The community uses innovative and collaborative approach to governance, encouraging voluntary amends for breaches of norms, reflecting a departure from conventional policing methods and fostering a culture of shared values and mutual respect.
- **Effective Land Zonation and Resource Management:** Land in the village is meticulously zoned to ensure sustainable use of cultivated and natural resources. Sacred forests on the ridge are strictly protected, and no tree-felling is allowed, while forests on the ridge shoulders are sustainably managed for household use only, with no extraction allowed for commercial purposes.

- **Holistic Approach to Agroecology:** Hin Lad Nai demonstrates that agroecological success relies not just on sustainable farming practices, but also on a supportive social and cultural environment that nurtures and sustains these practices.

3.4.2 Recommendations and Policy consideration

The use of TAPE is helpful to identify, provide entry points and recommendations for intervention design and empower communities to accelerate their process of transition to agroecology. Using the framework of the ten elements of agroecology, the following recommended activities may help to support communities to build and maintain their agroecological status:

1. ***Diversity.*** The results of this study suggested that the diversity of economic activities could be improved. Given that forest product revenue was particularly strongly associated with overall agroecological status, supporting market development for NFTP sale could be one way to support income diversification through sustainable means. Lessons can be learned from Hin Lad Nai village in this regard, where the harvesting and sale of forest products continues to operate sustainably due to the strength of customary norms.
2. ***Efficiency.*** This study showed that many Karen households have been pushed into cash cropping, and introduced new dependencies on external inputs. Our study showed that this is associated with poorer agroecological outcomes. Some households (for example in Huay E Kha) are now trying to move towards organic cash cropping. This is not an easy transition, and households would benefit from support – for example in the form of training, provision of inputs, financial credit - to aid this transition.
3. ***Co-creation.*** Continuing to support avenues for continued transmission will play an important role in ensuring the preservation of traditional values and practices that nurture the local agroecosystem. Bringing together elders and youth may also support retention and interest of youth in agriculture.
4. ***Circular and Solidarity Economy.*** This study showed that strengthening aspects of the circular and solidarity economy can help to support the agroecological transition in study communities. In particular, we noted that the cash crops produced in Huay E Kha and Khun Mae Yod often reach more distant, urban centres, with a greater number of non-community actors often involved in these value/trade chains. Supporting communities to develop more local and direct relationships with consumers may give farmers more agency in market decisions, ensure a fair price for produce, and reduce risk of exploitative market relations.
5. ***Responsible Governance.*** All communities included in this study have previously or currently face challenges to their tenurial security. Lack of tenure recognition over rotational farmland has pushed some Karen households away from this sustainable practice and into input-heavy commercial agriculture. Supporting improved security of land tenure has the potential to enhance agroecological status.

Policy Recommendation

1. Establish legal frameworks to recognise and protect rotational farming practices and secure land titles for communities practising them, while also safeguarding Indigenous customary rights and promoting sustainability.
2. Revise environmental regulations to accommodate controlled burning schedules crucial for traditional agriculture and support community-led forest management over restrictive measures like those in the National Park Act.
3. Design development projects collaboratively with local communities to ensure they align with their needs and values, and support market access for sustainable income sources, including Non-Timber Forest Products (NTFPs).

Agroecology Assessment of Indigenous Peoples' Food Systems Report

CHAPTER
4

Evidence on the Multidimensional Performance of Agroecology in the Indigenous Peoples' Food Systems of Mau Forest, Kenya

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Summary

Aim: This study characterised the food systems of Ogiek Peoples' communities in the Mau Forest, Kenya and presents evidence on the multidimensional performance of agroecology based on the use of the Tool for Agroecology Performance Evaluation (TAPE).

Methods: In 2023, TAPE was used to evaluate 120 Ogiek Peoples' households in four communities in Kenya. Through a standardised survey filled during household visits, TAPE provides a characterisation of the level of agroecological transition of local farms and an assessment of their performance across the economic, environmental, and social dimensions of sustainability.

Results: The food systems of the Ogiek are traditionally based on hunting and gathering activities from the forest, alongside the keeping of bees, and use of home gardens. However, changing government policy and market pressures have increasingly pushed the Ogiek to adopt sedentary and cash-oriented food practices, with curtailed access and use of forest resources. The TAPE results highlight the stress facing these systems. In particular, the use of TAPE in this study showed that:

- The food systems studied in Mau Forest are mostly at low levels of agroecological transition, with only one community considered to be more agroecologically advanced.
- Six out of ten elements of agroecology received scores were deemed "non-agroecological" in TAPE Step 1.
- Higher scores for the agroecological elements of human and social values and culture and food traditions reflect that the communities still retain some of the traditional attributes of their food systems.
- There appears to be a link between agroecological status and economic revenue, and agrobiodiversity and dietary diversity. By supporting communities in the region to adopt agroecological practice, incomes could be increased whilst promoting ecological health and household nutrition.

Agroecology Assessment of Indigenous Peoples' Food Systems Report

4.1 Methods and research sites

TAPE was used to evaluate the agroecological outcomes of 120 households of Ogiek Peoples in Kenya. The data collection took place between May and September 2023, with eight enumerators involved in the process who belonged to the local community. The training of enumerators and data collection activities was overseen by an assigned lead from OPDP, who had received training from FAO on the TAPE instrument. Training of enumerators involved the in-depth discussion of agroecological principles (including their meaning and analogous practices in the target communities), clarification of enumerator understanding of TAPE item meaning, and familiarisation with the Kobo Toolbox instrument.

The study focused on four Ogiek communities that were previously engaged by OPDP. These communities were chosen due to their representativeness of the broader Ogiek population and the established trust between OPDP and the community members. The Ogiek people, traditionally known as hunter-gatherers, are currently experiencing significant shifts in their food systems due to various political, social, and environmental changes. This study seeks to capture and analyse these changes through the TAPE framework to understand how they impact the agroecological practices and overall well-being of the Ogiek communities. The findings are intended to provide insights that could guide future interventions and support the preservation of traditional practices while adapting to modern challenges. From each community, 30 households were selected randomly to participate in the study, ensuring a representative sample across the four communities.or to the data collection, consent was obtained through a multi-step process. Initial

consent for involving the community in the study was sought. Following the community consent, each participating household was individually approached to obtain their explicit consent.

Study Sites

The four participating villages were Nessuit, Mariashoni, Nkareta and Keneti (Figure 69). The following section provides descriptions of each community, their food systems, and enabling/ constraining environments. This information was derived from the adapted TAPE Step 0 (including the added participatory rural appraisal and key informant interviews) and based on discussions with project field partners at OPDP.

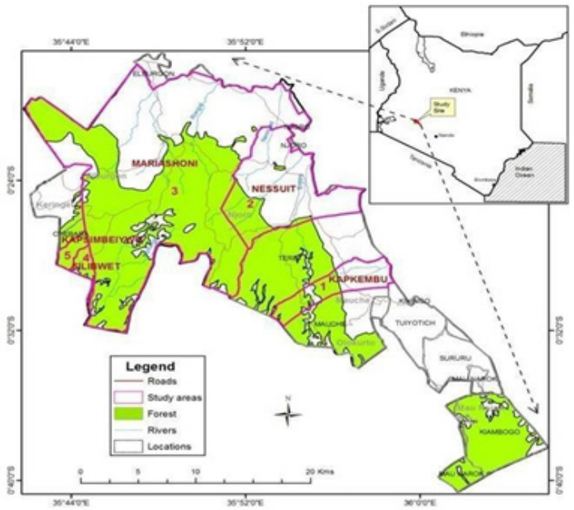

Figure 69: Map indicating locations of study communities within Kenya.

	Nessuit	**Mariashoni**	**Nkareta**	**Keneti**
	Chepkurerek and Marioshonik Ogiek	Marioshonik and Kipchorgwnonik Ogiek	Kaplelach Ogiek	Kaplelach Ogiek
Population (per-sons)	6104	4750	200	1800
Land area (ha)	25000	30225	4400	40000
Cultivated food systems	Home gardens Cash cropping	Home gardens Cash cropping	Home gardens Cash cropping	Homegardens, Cash cropping Pastoralism
Natural food systems	Forest Rivers/ponds	Forests Rivers/ponds	Forests	Forests Rivers
External food sources	Market Food welfare	Market	Market	Market
Livelihood activities	Cash-cropping. NFTP sale Manual labour Transportation	Cash cropping. Honey sale Manual labour Transportation	Cash cropping Livestock rearing Wild edibles sale Manual labour Transportation	Cash cropping Livestock rearing Wild edibles sale Medicinal herbs Honey sale Manual labour Transportation

Table 10. Summary characteristics of community population, land use and food systems use in sites in Kenya.

Nessuit is located in Njoro district, Rift Valley province in Kenya in the highlands of the Mau Forest Complex. It is predominantly inhabited by the Ogiek people, along with the Kipsigis and Kikuyu. Known for its cultural diversity, Nessuit practises subsistence farming, livestock keeping, small-scale trading, and large-scale potato farming. The region's temperate climate, due to its elevation of 2,200 to 3,000 metres, features significant rainfall during the long (March-June) and short (October-December) rainy seasons, and a cooler dry season in January and February. The landscape, dominated by the Mau Forest's dense cover and fertile soils, supports diverse flora and fauna, making Nessuit a vital and distinctive area within Kenya.

Food Systems use. The community draws upon a variety of food sources. Amongst these, home gardens provide potatoes and onions from January-March, and pumpkin and sweet potatoes from October-December. The forest is used to source a variety of wild fruits, mushrooms across the year; honey is harvested from the forest during October-December. From water bodies, manage and other wild vegetables are sourced throughout the year. The community relies on the market for many products, including potatoes, cabbages, peas, dried maize, and beans. Maize, beans, rice, and cooking oil are supplied through the food welfare system.

Livelihood Opportunities. The community is primarily engaged in agriculture, working on both their own farms and non-family farms for 120-180 days per year. This includes subsistence farming and the cultivation of cash crops, such as potatoes, maize, and beans, on newly established plantation land. In addition to agriculture, community members generate income from selling forest products, including spider-weed and nightshade. Some villages also participate in manual labour and transportation, moving agricultural inputs like fertilisers and seeds into the community, as well as transporting food crops like potatoes, beans, and maize to markets.

Mariashoni is located in Molo district, Nakuru County in Kenya, in the low highlands of the Mau Forest complex. The region experiences a warm and wet climate, with long rains experienced in months of March-June and short rains in August and December. The months of January to February are hot and dry. The area is relatively hilly with several rivers and water pools, and natural forest, especially in areas of higher-altitude. The population of Ogiek Peoples living in Mariashoni is approximately 6000, with over 2000 being adults. The community territory covers 60% of the East Mau Forest, spanning approximately 18000 hectares. Ogiek People have communal ownership of about 15000 hectares worth of this land.. The vast majority (95%) of the population are involved in agriculture and traditional gathering activities, while the remaining 5% engage in other livelihood activities.

Food Systems use. About 95% of the community's land area is used for food production. The Ogiek people of Mariashoni grow crops for both household consumption and cash sale. Food is sourced from a variety of places. From the forest, they gather products such as honey, wild fruits, wild vegetables, and herbs. In their kitchen gardens, they cultivate a mix of traditional and exotic vegetables. Over the past few decades, the community has established cash crops such as maize, potatoes, beans, peas, and other crops. The entire system of production has shifted from one based primarily on gathering from natural ecosystems and low-intensity farming to one focused on intensive and extensive cultivation. The goal of this new production system is to increase staple

crop yields by using inorganic substances. This shift aims to generate income to support activities like education.

Livelihood Opportunities. Most farmers produce food for their own consumption, with the surplus sold to middlemen who come directly to the farms to purchase primarily potatoes, maize, beans, and peas. However, the prices farmers receive are low due to exploitation by the middlemen and a lack of accountability mechanisms in the local market system. Some villagers sell vegetables themselves at local markets, often travelling on foot or by donkey. Other livelihood activities include the sale of honey, manual labour, and transportation services

Nkareta is located in the sub-county of Narok North. The village comprises around 200 households and is situated at the edge of the Mau Forest. The area is hot and cool with a mix of arid and semi-arid land. The dry season runs from December-February; March to August is the wet season; and June to July is the cold season. Nkareta location is dominated by two Indigenous communities - the Ogiek (specifically the Kaplelach sub-tribe) and the Maasai.

Food Systems use. The Ogiek Peoples, originally hunter-gatherers, now practise sedentary farming and livestock rearing to sustain their livelihoods. Plantation land supports the cultivation of potatoes, beans, peas, maize, wheat, and barley, which are used for both subsistence and sale. Despite the diversification of livelihood activities, much of the community still relies on the forest for gathering wild honey, berries, and herbal plants. Indigenous vegetable varieties are also grown in home gardens.

Livelihood Activities. Agriculture, including cash cropping, livestock rearing, and subsistence farming, is the main livelihood activity in Nkareta, with communities dedicating more than 200 days per year to agricultural work. The sale of wild edibles, such as manama, saga, and mrenda, is also a significant livelihood activity, engaging community members for approximately 150 days a year. Additionally, many community members earn income through transportation services and by working on non-family farms.

Keneti is located in Narok county, Lemek zone in Kenya. Keneti is situated in a lowland area, which experiences very little and unreliable rainfall. The Keneti region is occupied by the Ogiek community of a semi-mobile population that ranges from 2000-3000 with about 100 households and farms. The Keneti region covers about 2890 hectares of land with approximately 1630 hectares set aside for pastoralism, 900 hectares for agriculture and 250 hectares covered by natural forest. Keneti landscape is formed of both plains and hills with low rainfall forming seasonal rainfall. The residents rely upon a local dam for water.

Food Systems Use: The community is characterised as a mix of pastoralist, (sedentary) farmers, and honey producers. During rainy months (June, August and December) the community harvests a variety of food like maize, beans, potatoes and vegetables, which are used for both subsistence and sale. The community does have moderate access to the forest (due to geographical location). Honey and some wild berries are collected from the forest seasonally, particularly during the dry seasons in April and June. Home gardens are used across the year to grow seasonal vegetables,

including carrot, spinach, kale, onions, tomatoes, and some Indigenous vegetables. Some (non-pastoralist) households rear livestock within home gardens, from which meat and milk are sourced. In March, May and June, the community is most dependent on the market, from which it sources fruits and vegetables. Modern innovations have been integrated with traditional practices; for instance, crop rotation and polyculture are used to determine the best crop combinations for soil health and pest control. Solar energy is also used in the area to facilitate small-scale irrigation, particularly among the Ogiek Peoples.

Livelihood activities: The community comprises a mix of cash cropping households, and livestock keeping households. The most commonly marketed products include maize, beans, honey, livestock products, and herbal medicines. Road access to the market in Mulot town is poor, so agricultural products and livestock are mainly transported during the dry season when road conditions improve. Keneti frequently experiences severe droughts, so unsold products are stored for times of need.

4.2 Key attributes of the Ogiek Peoples' food system

Food source diversity and seasonal dependency
Whilst traditionally, the Ogiek predominantly relied upon hunting and gathering activities for food, they increasingly relied upon a diversity of sources for obtaining their food. These include (1) cultivated systems, (2) collection from natural systems and (3) food from external systems.

The following section elaborates on food sub-systems within the four communities examined in this study, including their seasonal importance. Information comes from the communities and the research partner, OPDP.

(1) CULTIVATED SYSTEMS

- ***Home gardens:*** Home gardens have become an important component of the food system for the Ogiek People across the four sites studied, following the transition to more settled agricultural practices. These gardens, characterised by a cultivation of varieties of vegetable crops, ensure a supply of fresh produce, essential for the community's diet. Furthermore, trees are often incorporated into these gardens.
- ***Livestock raising:*** Households often integrate livestock into their home garden. The animals raised include cows, goats, sheep, poultry, donkey and rabbits. These animals and animal products are consumed as well as support household income. Milk, meat and hides are the common animal products sold to the market.
- ***Cash cropping (Commercial Agriculture):*** Farmlands are predominantly dedicated to cultivating cash crops, focussing primarily on staples like maize and potatoes, and legumes like peas and beans, often grown as monocrops. Farmers rely on inorganic farming practices to increase productivity, which involve use of external inputs such as hybrid seeds, chemical fertilisers and pesticides. The crops serve as a vital source of income for the households, as a substantial portion of the harvest is sold for cash.

(2) PASTORAL SYSTEM: Among the four sites studied, the Ogiek People of Keneti practice both pastoralism and sedentary farming. They have designated specific areas for pastoral activities. Residing in a semi-arid region, the community builds rainwater ponds to ensure water availability

for both irrigation and livestock. The Ogiek still retain large tracts of land, allowing them to engage in a mix of pastoralism and farming. The absence of eviction and minimal government pressure has enabled them to continue this system without disruption.

(3) NATURAL SYSTEMS

- ***Forests.*** The natural forest holds profound cultural and spiritual significance for the Qgiek Peoples, serving as a religious site where important cultural practices are carried out. This reverence for the forest drives the community's commitment to conserving and protecting these vital systems. The forest also plays a critical role in the traditional food systems and livelihoods of the Ogiek People across the four sites. Historically, the forest has been a vital source of sustenance, providing a diverse array of wild foods such as honey, wild fruits, wild vegetables, mushrooms, and medicinal herbs throughout the year. Honey, in particular, is harvested during specific seasons, typically from October to December, contributing significantly to both dietary diversity and income generation for the community. Additionally, the forest serves as a rich repository of biodiversity, offering valuable resources for traditional practices and cultural significance. However, access to the forest has been increasingly restricted due to government policies and environmental changes, posing significant challenges to the maintenance of traditional livelihoods such as honey collection, gathering of medicinal plants, and hunting. Furthermore, climate change exacerbates these challenges, with erratic rainfall patterns, increased droughts, and rising temperatures affecting forest ecosystems
- ***Water Ponds:*** The regions being characterised by minimal and intermittent rainfall, communities like Keneti have ingeniously established low cost water ponds to harvest rainwater. These ponds serve as crucial reservoirs, ensuring water availability during the dry seasons. Additionally, these water bodies harbour stinging nettle, wild berries, managu often collected as food by residents.

(4) EXTERNAL SOURCES

- Food Welfare: Among the four communities studied, Nessuit was the singular beneficiary of food provisions facilitated by welfare initiatives. This provision included food products like maize, beans, rice and cooking oil to support the community's nutritional needs.
- Market:The Ogiek Peoples across the four sites are dependent on the market for various products especially in the months of March, May and June. Residents rely on the market to acquire items such as potato, cabbages, peas, dried maize and beans amongst others. Additionally, communities would sell their produce including honey at these local markets.

4.3 Results

4.3.1 Step 1: Characterisation of the agroecological transition

Step 1: Characterisation of the Agroecological Transition

TAPE Step 1, comprising the Characterisation of the Agroecological Transition (CAET), was used

to evaluate the level of "agroecological transition" in the four selected Ogiek Peoples' communities in Kenya. The radar diagram presented in Figure 70 presents the average scores for each of the ten elements across all communities.

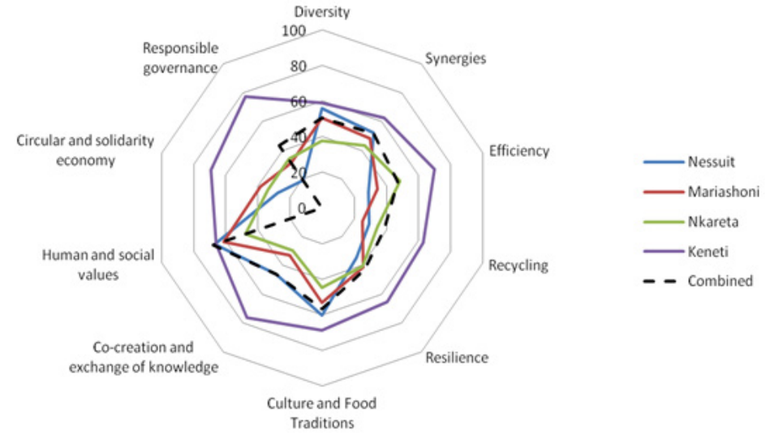

Figure 70 : Radar plot showing the results of the CAET score for Nessuit, Mariashoni and Keneti in the Mau Forest Complex, Kenya.

Communities	Keneti	Mariashoni	Nessuit	Nkareta	Combined
CAET Score	67.5	41.6	41.6	39.4	48
Diversity	55.5	49.5	52	37.5	48
Synergies	62.7	48.4	51.9	43.1	51.7
Efficiency	70	34.6	28.8	48.5	47.1
Recycling	63	25.1	29.3	34.3	38.6
Resilience	65.5	41	34.5	40.8	42.8
Culture and Food Traditions	69	53.2	60.2	44.8	56.7
Co-creation and Sharing of Knowledge	76.2	33	46.2	29.9	46.1
Human and Social values	65.9	61.5	66.8	47.7	60.2
Circular and solidarity Economy	69.4	38.4	27.6	33.6	44.8
Responsible Governance	77.5	31.2	19.2	33.9	43.6

Table 11: Summary table of the CAET results per element and overall for the whole sample (N=120) from Nessuit, Mariashoni and Keneti in the Mau Forest Complex, Kenya.

The use of TAPE in this study shows that, overall, the surveyed Ogiek Indigenous Peoples' food systems can be deemed as at low levels of agroecological transition, with a total score of 48% (Table 11). Results from all communities show moderate average scores (50-70%) for 4 out of 10 elements of agroecology. Six elements received average scores of less than 50%. Highest scores were seen for Human and Social Values (60.2), and Culture and Food Traditions (56.7), with particularly high scores received on sub-indicators on youth empowerment and local identity. Lowest scores were received for Recycling (38.6), which reflects reuse of biomass, water saving, seed management and energy use, and for Resilience (42.8), which reflects the capacity of the community to recover from shocks to income and production, and climate change vulnerability. The overall score across the 36 sub-indicators of CAET is presented in Figure 71.

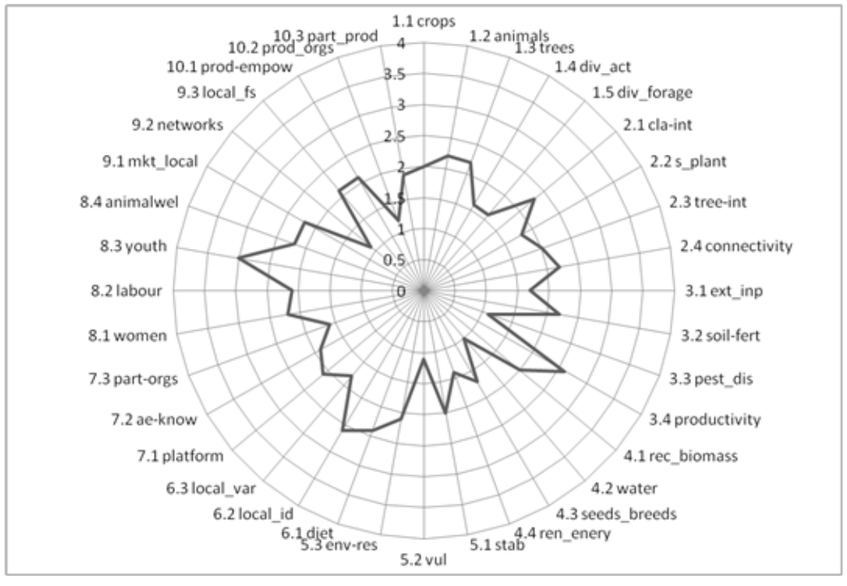

Figure 71 : Radar plot of the 36 CAET indicators across the 4 sites in Kenya

However, disaggregated for the four communities, CAET results indicate some differences, which may reflect important variation in food practices and enabling environment. The highest overall CAET score was received in Keneti (CAET=67.5), which represents a moderate-advanced agroecological system. The communities of Nessuit, Mariashoni and Nkareta all scored much lower, with overall CAET scores around 40, deemed to be "non-agroecological". The following section elaborates on scores received for individual elements, reflecting on community differences and the ways that differences in the enabling environment – in particular, the challenges confronting these hunter-gatherer communities transitioning to sedentary agriculture - might help to explain the results seen.

Moderate-Advanced (>60%)

The element of **Human and Social Values** received the highest score of all agroecological principles in the Ogiek Peoples' communities. With the exception of Nkareta, all communities received scores of over 60% for this element. In all communities, sub-indicators on youth empowerment and emigration were particularly high, indicating that most young people do not want to emigrate. The research team at OPDP agreed that youth appeared interested in farming – however, the team also suggested that opportunities to migrate to urban centres were limited due to high levels of urban unemployment and the high cost of living within urban centres.

Women here are increasingly able to take part and influence decisions made in the councils of Elders, but do not have full access to resources since household land titles remain traditionally held by men. In every community, women-centred co-operatives aimed at traditional livelihood activities exist, but women often struggle to access financial resources to support such work. This issue is manifest throughout the region. Keneti scored lower in terms of animal welfare, largely due to its arid conditions, which make animals more vulnerable to periodic hunger and thirst. The

lack of government support for livestock farming, such as funding for vaccinations and veterinary services, exacerbates the problem. Many farmers cannot afford immunisation or veterinary care, leading to higher rates of animals suffering from disease. In contrast, Mariashoni and Nessuit, both situated in more humid climates, received higher animal welfare scores.

Moderate/In Transition (50-60%)

Culture and Food Traditions, which reflects awareness of traditional identity, healthy nutritional practices, and use of local varieties and breeds, received a relatively high overall score. Scores for this element were highest in Keneti (69.0) and Nessuit (60.9), and lowest in Nkareta (44.8). Despite all influences from neighbouring cultures, the Ogiek Peoples have proven to be resilient in protecting their culture - and there remains good awareness of traditional identity and respect for traditional practice and rituals. Even in Keneti, where there is a stronger Maasai influence (particularly linguistically) and pastoralism is practised, the community retains a strong sense of Ogiek identity.

In Keneti, both Indigenous and exotic crop varieties are produced and consumed, whereas in the other communities, the majority of varieties and breeds produced (for consumption and sale) are introduced. In Keneti and Nessuit, particularly high scores were seen for appropriate diets, which may indicate that diverse, nutritious foods are produced and consumed and/or that sufficient income is generated to allow households to purchase nutritious diets. In Nessuit and Mariashoni, some community members will produce agricultural commodities (e.g. buy chickens to produce eggs, or cows for milk) purely to sell them, rather than saving products to support household nutrition. Thus, whilst farms may not be lacking in edible agrobiodiversity, not all food groups will be consumed, or not consumed regularly or in the quantity required for a healthy diet.

The element of **Synergies** also received a moderate overall score (51.7), with the highest score seen in Keneti (62.7) and lowest in Nkareta (43.1). The synergies principle reflects the on-farm integration of crops and livestock, of soils and plants, of trees and agriculture, and of different parts of the landscape. All communities scored similarly on the sub-indicator on crop and livestock: animals are mostly fed with feed produced on the farm and/or grazing, their manure is used as fertiliser. Communities also exhibited similar scores on tree integration, indicating that a significant number of trees provide multiple services and products, including for edible fruits, as well as for honey harvesting. Differences were seen between communities in soil-plant integration and landscape connectivity, for which Keneti saw the highest scores. Scores suggest that in Nkareta, Nessuit and Mariashoni, less than half percent of the arable land is covered with residues or cover crops, no crop or weed combination arrangements are practised, and more than 80 percent of the crops are produced in monocropping and continuous cropping. In these three communities, growing maize and potato as cash crops are now common and are not intercropped. Intercropping is limited to relatively small homesteads, where crop diversity remains high, and cover cropping is practised.

Low-moderate (40-50%)

Diversity received a low-moderate score of 48. **Diversity** scores were highest in Keneti (55.5) and Nessuit (52.0) and lowest in Nkareta (37.5). Crop diversity was similar in all communities, with two or three crops grown on significant cultivated areas. This score does not capture the diversity of crops grown in traditional home gardens, on small plots - rather, it captures the dominant plots

and crops kept. Animal diversity was highest in Keneti and Nessuit, with most households keeping more than three species with a significant number of animals. Keneti in particular is located close to the Maasai lands and is strongly influenced by their livestock keeping practices.

Tree diversity was greatest in Mariashoni, with a significant number of trees (and/or other perennials) of different species kept but was lower in the other communities. This score only captures the trees located within holdings akin to "private land" – most of which are fruit trees - and not trees and forests within communal land, within which diversity remains rich.

Keneti and Nessuit exhibit the greatest diversity in economic activities, engaging in two or three productive pursuits. These activities include cash cropping, beekeeping, and the sale of livestock, milk, meat, and hides. Keneti has adopted modern beekeeping practices to preserve and enjoy their traditional foods, and the presence of herbal specialists ensures access to herbal medicine. In contrast, Mariashoni and Nkareta mainly rely on a combination of subsistence and cash cropping, with only surplus produce being sold. While some households continue to practise traditional beekeeping in the forest, this alone does not generate enough income to sustain a sufficient livelihood. Despite their historical roots as hunter-gatherer communities, their use of natural systems is relatively minimal. This is also evident in Nessuit and Mariashoni, where communities maintain close proximity to the forest and retain access rights. These observations may indicate a swift shift from traditional practices towards intensive, sedentary agriculture. Additionally, traditional hunting has been restricted by new laws prohibiting it. Households in Keneti, which is situated much farther from the forest, have limited access and rights to natural resources within the protected area of the Maasai Mara National Park.

The overall **Efficiency** score of 47.1 hides large discrepancies in scores between the four communities. An "advanced" efficiency score of 70.0 in Keneti is in contrast with a score of 28.8 for Nessuit. These discrepancies reflect Nessuit's relatively widespread cultivation of potatoes and maize, using chemical fertilisers and pesticides to increase their yields. In Keneti, local regulation limits the use of excessive fertilisers, so most households use none or minimal fertilisers. Instead, the community also has adopted crop rotation to maintain soil fertility. The limited road access (lack of access to chemicals and introduced crops), and more secure land tenure (greater incentive to protect soil and land quality) may also explain its higher scores.

The overall score for **Co-creation and Sharing of Knowledge** across all communities is 46.1, with significant variation between Keneti (76.2) and Nkareta (29.9). In Ogiek communities, Traditional Knowledge transfer occurs during evenings or major events, facilitated by Elders (both men and women) who allocate time specifically for sharing knowledge. Although this practice still takes place, it is less frequent than in the past. December, during the festive season, remains a key period for knowledge sharing, as households gather for celebrations and lessons. Mentorship continues in the form of Elders teaching about wild edibles and honey to those interested in foraging. Additionally, when honey and forest products are sold at markets, sellers often share their knowledge with buyers during these interactions. As communities shift away from traditional hunter-gatherer lifestyles, "new" knowledge about sedentary agriculture is increasingly shared within community-based groups or co-operatives, especially when Elders are involved.

The differences in scores suggest that knowledge-sharing mechanisms are particularly strong in Keneti and Nessuit. Efforts to introduce agroecological knowledge from outside the communities have been limited, with only a few NGOs providing sporadic agricultural training. Government agricultural extension services, once available, are now largely confined to urban areas and are costly to access. As a result, farmers primarily learn from each other, relying on the expertise of experienced farmers who may have received some previous training.

The communities received a score of 44.8 for the agroecological element of **Circular and Solidarity Economy,** which reflects the extent to which products and services are marketed locally, relationships with consumers are direct, and extent to which foods consumed are locally sourced. Nessuit and Mariashoni received particularly low scores for consumer relationships, reflecting the absence of direct relationships with consumers of agricultural products and the exclusive management of market exchanges via intermediaries. In these two communities, once cash crops are mature, traders come from towns/urban centres and directly to peoples' farms to buy their produce. Many of the households in these communities are growing the same crops: supply is thus high relative to demand, and prices are reduced, and distress sales are made to middlemen. These intermediaries take the produce to market, further limiting producers' ability to get a good price at market. Attempts to form cooperatives to sell market products have often failed, as a member or two might decide to sell their produce to middlemen and so the whole process disintegrates. In contrast, in Keneti, more products are sold directly relationships with consumers, and less frequent involvement with intermediaries.

Scores received for the element of **Responsible Governance** were highly variable, from an advanced score of 77.5 in Keneti to 19.2 in Nessuit. The element reflects the ability for producers to participate in the governance of land and natural resources – and there are real differences in villages' ability to do so due to variation in land tenure rights. In Keneti, which is located on grasslands, land tenure is reasonably secure. Tenure is far less secure in the forest-proximate communities of Nessuit and Mariashoni because they are situated within Government-owned land. They are frequently subjected to forceful evictions, which the government justifies as necessary for environmental conservation. These continual evictions have resulted in the loss of their culture and traditions.

The score for the element of **Resilience** was relatively low overall (42.8) in the participating communities. In all communities, income is overall stable, but production is variable from year to year, and there is limited recovery of income and production recover after shocks/ perturbations. The scores reflect that the local food environment can suffer from climatic shocks, but the ecological system has a good capacity to adapt to climate change. However, there were differences in responses between communities in their ability to respond to other shocks. In Nessuit, Mariashoni and Nkareta, there was a sense that the community – whilst supportive – had little capacity to help one another after shocks. Access to credit is non-existent and people are not insured in any way. Customary social mechanisms are the only form of protection there is, however, it may be that whilst the intention and values to help those in need remains, producers may not be in a position to help. OPDP reflected that the infiltration of mainstream agriculture was disrupting the social fabric of communities and introducing individualist tendencies. The remote location of Keneti may help preserve the traditional food system more effectively.

Low <40%

The agroecological element of **Recycling** received the lowest score of all, reflecting overall minimal practice of recycling of biomass, water harvesting and saving techniques, seed self-production and/or renewable energy use. Once again, Keneti scored highest (63.0) compared to Nessuit (30), Nkareta and Mariashoni. With good access to urban markets and wider-spread cash crop cultivation, these latter three communities purchase far more of their seeds from outside sources, as opposed to within community seed selection and exchange. The three communities are also located in regions that receive more precipitation - in contrast, Keneti is more arid and so the community have to devise many ways to conserve and store water. In Keneti, compared to the other communities, a greater proportion of energy was renewable – the village is a pilot location for the development of solar power, with households provided solar kits. However, OPDP felt that enumerators may have misunderstood the question. They believe that the three other communities continue to rely primarily on local energy sources, such as biomass and animals for farming, and that many households are not connected to the electricity grid.

Correlations Among the 10 Elements of Agroecology

The matrix of correlation among the 10 elements of agroecology in Kenya is presented in Table 12. The analysis highlights that Resilience has the highest correlation with Circular and Solidarity economy (0.75), Responsible Governance (0.7), Recycling (0.72), Co-creation and Sharing of knowledge (0.72), and Efficiency (0.69). This suggests that fostering resilience can lead to effective agroecological transitions. Ogiek Peoples with their deep ecological knowledge emphasises on the sustainable uses of forest resources and community cooperation that enhance their capacity to adapt to environmental changes. Efficiency is notably linked with Recycling (0.72) suggesting

	div	Syn	eff	rec	res	cultf	cocr	human	circ	resp
div	1	0.52	0.35	0.4	0.41	0.48	0.42	0.41	0.27	0.21
Syn	0.52	1	0.45	0.53	0.43	0.31	0.53	0.2	0.33	0.23
eff	0.35	0.45	1	0.72	0.69	0.3	0.53	0.09	0.53	0.56
rec	0.4	0.53	0.72	1	0.72	0.44	0.68	0.22	0.61	0.57
res	0.41	0.43	0.69	0.72	1	0.52	0.7	0.3	0.75	0.73
cultf	0.48	0.31	0.3	0.44	0.52	1	0.5	0.51	0.27	0.37
cocr	0.42	0.53	0.53	0.68	0.7	0.5	1	0.42	0.57	0.48
human	0.41	0.2	0.09	0.22	0.3	0.51	0.42	1	0.26	0.15
circ	0.27	0.33	0.53	0.61	0.75	0.27	0.57	0.26	1	0.74
resp	0.21	0.23	0.56	0.57	0.73	0.37	0.48	0.15	0.74	1

Table 12 Matrix of correlation between the 10 elements of agroecology and the overall agroecological transition (CAET) in Kenya, across 120 household food systems.

that efficient operation involves enhanced recycling within the systems. In contrast, Elements of Diversity, Synergies, and Culture and food traditions contribute moderately to resilience. Human and Social Values show the weakest correlation with the elements but they remain essential for community cohesion. Strengthening these values along with enhancing resilience will lead to collective efforts towards sustainable food practices and preserve cultural traditions.

4.3.2 Step 2: Core Criteria of Performance: Multidimensional Performance of Agroecology

The following section presents the average results of indicators of performance for the four communities, as well as their correlation with agroecological status (CAET) scores. These indicators span five dimensions of sustainability and are aligned with the indicators and targets of the Sustainable Development Goals (see Chapter 1: Methodology).

Economic Dimension

An analysis of various economic indicators — such as value added, production values of crops and animals, and net revenue — in the four communities indicates that Keneti, which combines pastoralism and sedentary farming, has higher productivity per capita and gross revenue (Figure 72). This high performance is supported by better outcomes in both crop and animal production, reflecting the community's advanced adoption of agroecological practices. In contrast, Mariashoni, often at risk of eviction, struggles with low productivity. Nkareta achieves high net revenue due to lower expenditures.

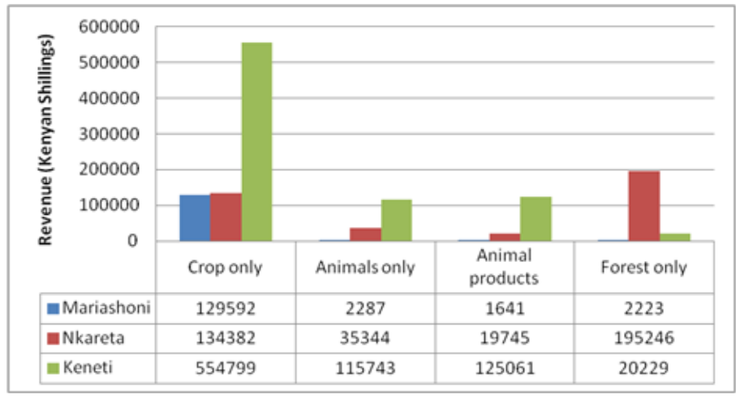

Figure 72: Summary of key economic variables, disaggregated by community, Kenya

The relationship between CAET and value added has been found to be positive and strong in Keneti, Mariashoni and Nkareta but a weak negative trend in Nessuit. One distinctive feature of this community is it high dependence on food welfare and regularly faced forced eviction.The aggregated results shows a positive and strong relationship between value added (Figure 73) and value added per capita (Figure 74), where households with higher agroecological performance generate higher total and per capita value added supported by reduced dependency on external inputs.

When productivity of crops and animals are combined, there is an upward rise in total value of production as households' CAET scores increase in all the communities. Keneti, Mariashoni,

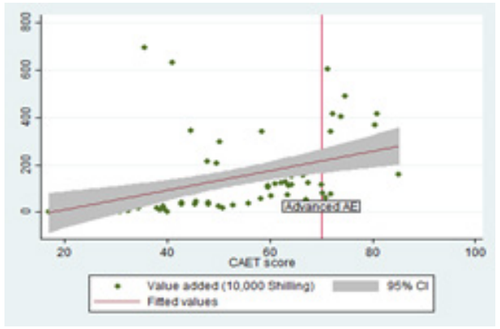

Figure 73: Relationship between the level of agroecology performance and added value across 4 communities in Kenya.

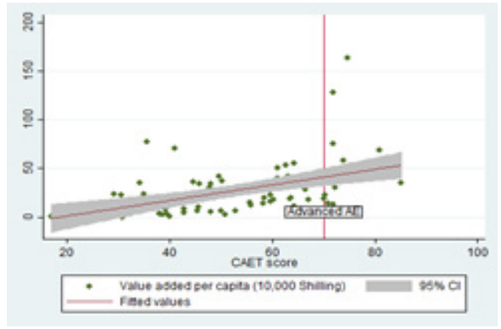

Figure 74: Relationship between the level of agroecology performance and added value per capita across 4 communities in Kenya.

also have the same trend. The case of Keneti is very important because it is the only community that has households that are agroecologically advanced as well as those who are in transition. Nessuit, and Nkareta, have a weak negative relationship and have no agroecologically advanced households. The total value of production (crops and animals) shows a positive relationship with CAET (Figure 75). Agroecologically advanced households are able to generate more total value of production per capita compared to those who are still in transition showing an overall positive trend (Figure 76).

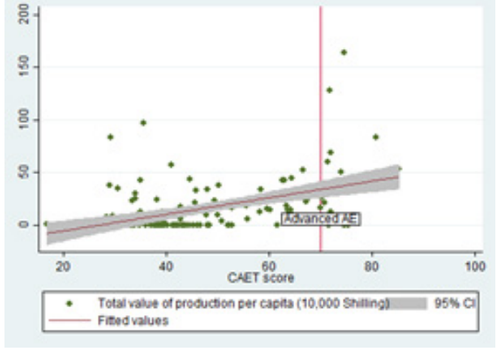

Figure 75: Relationship between the level of agroecology performance and total value of production in Kenya

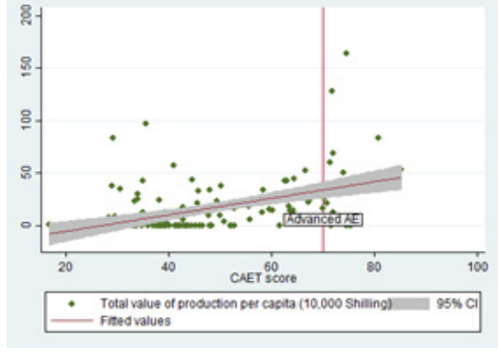

Figure 76: Relationship between the level of agroecology performance and total value of production per capita in Kenya

The communities that show a negative relationship of CAET with crop production value per hectare, namely, Nessuit, Mariashoni, and Nkareta, are those that do not have any households that are agroecologically advanced. This negative relationship may indicate the challenges these communities face in increasing crop productivity, likely due to their recent adoption of farming and lack of expertise. However, Keneti shows a positive correlation, indicating the community's ability to blend traditional pastoralism with modern agricultural practices.When it comes to animal production value per LSU, except for Nessuit, all the communities show a positive relationship with CAET with stronger correlation in Keneti that still practise pastoralism. The aggregated results shows that while animal production value per livestock unit (LSU) in most communities is

positively correlated with CAET (Figure 77), the crop production value per hectare (Figure 78) in most communities shows a negative relationship.

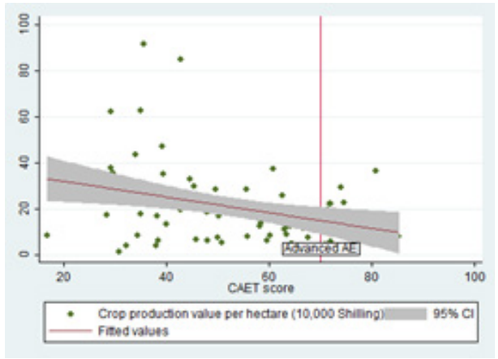

Figure 77: Relationship between the level of agroecology performance and crop production value per hectare in Kenya

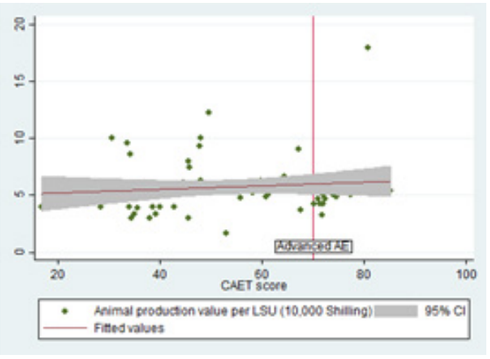

Figure 78: Relationship between the level of agroecology performance and animal production value per LSU in Kenya

Net revenue and net revenue per capita shows a positive association with the CAET score in Kenti, Mariashoni and Nkareta. In these communities, maximum income is earned from cash crops. This trend is particularly strong in Keneti, which is more agroecologically advanced, whereas other communities show weaker relationships due to their transitional state.The aggregated results also show that net revenue and net revenue per capita has a positive relationship with CAET (Figure 79 and Figure 80). The analysis highlights that adopting agroecological practices, as seen in Keneti, where pastoralism is combined with sedentary farming can contribute significantly to economic benefits.

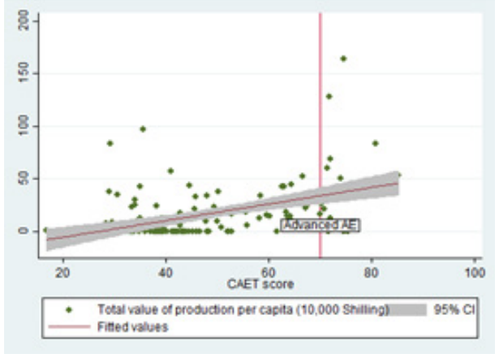

Figure 79: Relationship between the level of agroecology performance and Net revenue across 4 communities in Kenya.

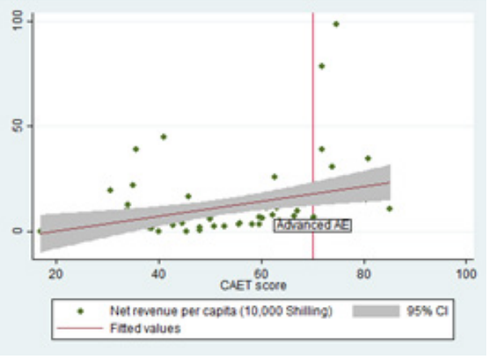

Figure 80: Relationship between the level of agroecology performance and Net revenue per capita across 4 communities in Kenya.

Food Security, Human Health and Nutrition dimension

The Food Insecurity Experience Scale (FIES) results indicate that food insecurity is generally moderate across the communities with the lowest levels of food insecurity are found in Mariashoni (Figure 81). At the same time, annual food expenditures per capita are highest in Nkareta

and Mariashoni, highlighting their greater reliance on market-purchased foods rather than subsistence production, as compared to Keneti. Dietary diversity scores are within the acceptable range (40-70%) only in the Keneti community, where self sufficiency is prioritised over the cash sale of produce. In contrast, dietary diversity in Nkareta and Mariashoni falls below the minimum threshold levels. In these communities, high-value nutritious products such as eggs and milk are produced but are often sold for cash instead of being consumed, with the income reinvested in agricultural inputs. As a result, low-value food products like cabbage and potatoes are purchased for household subsistence, leading to poorer nutritional outcomes.

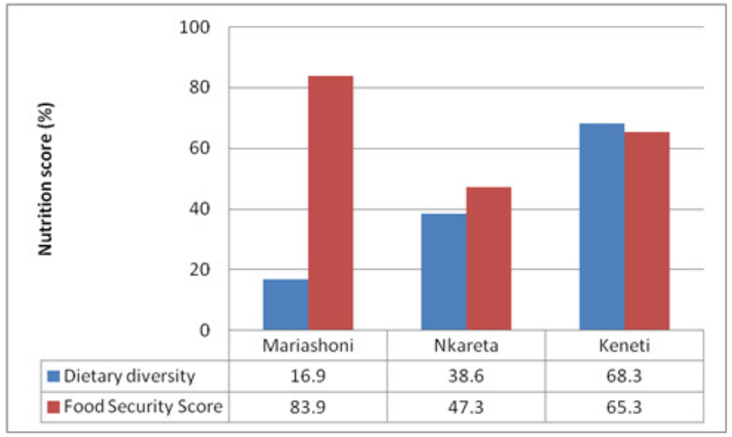

Figure 81: Summary of key nutrition and food security variables, disaggregated by community, Kenya.

Communities such as Keneti and Nkareta demonstrated that households with higher CAET scores experience lower levels of food insecurity. However, Nessuit and Mariashoni with no household with advanced agroecological performance show negative correlation. The overall results reveal that food insecurity decreases as households progress towards agroecology (Figure 82). Contrary

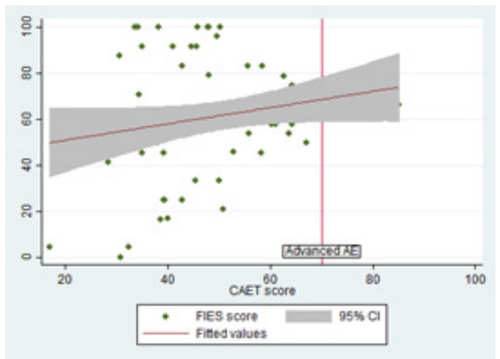

Figure 82: Relationship between the level of agroecology performance and FIES across 4 communities in Kenya.

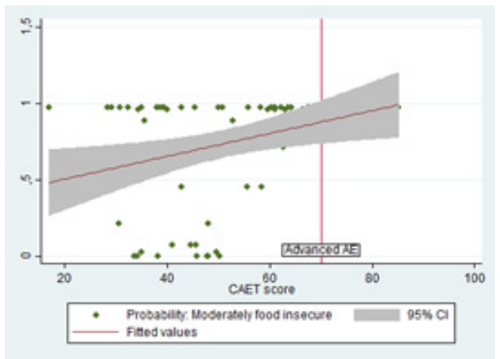

Figure 83: Relationship between the level of agroecology performance and probability of moderately food insecurity across 4 communities in Kenya

to expectations, the overall results indicate that the probability of moderate food insecurity increases as households become more agroecologically advanced (Figure 83). This may be due to these communities having no agroecologically advanced households due to the transition from traditional lifestyles to farming. Keneti, with both advanced and non-advanced households, shows a slightly negative but weak trend in moderate food insecurity.

Households with lower CAET scores, especially in Nkareta and Nessuit, show low dietary diversity, which could lead to nutritional deficiencies. While food insecurity may not be highly prevalent but the lack of dietary diversity particularly among those who are less agroecologically advanced. Keneti with households both in advanced and transition level show higher dietary diversity. Keneti, particularly, benefits from the dietary influence of the Maasai, which includes a high intake of animal flesh and dairy. The aggregated results indicate that dietary diversity improves significantly with increased CAET scores (Figure 84), with agroecologically advanced households enjoying a more diverse diet from both home production and market purchases

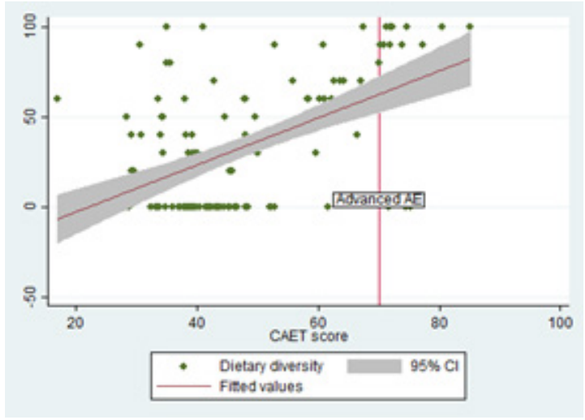

Figure 84: Relationship between the level of agroecology performance and Dietary Diversity across 4 communities in Kenya.

Increase in overall total income lowers the proportion of money spent on food, as observed in Keneti and Nessuit, both showing a decline in % share of food to total expenditures. Mariashoni and Nkareta showed a rising trend but none of these two communities had any households that are agroecologically advanced. The aggregated results show that as households move towards higher agroecological advancement, the % share of food to total expenditure also decreases (Figure 85).

Three communities, Nessuit, Mariashoni, Keneti, show that food expenditure per capita decreases with increase in the CAET score. In Nkareta, food expenditure per capita increases with higher CAET scores. However, none of the households in the community are considered agroecologically advanced. The overall relationship between CAET and food expenditure per capita shows a decline as households are in agroecological transition (Figure 86). This reduction could likely be contributed by an increase in overall income and increase in self consumption from heir own production.

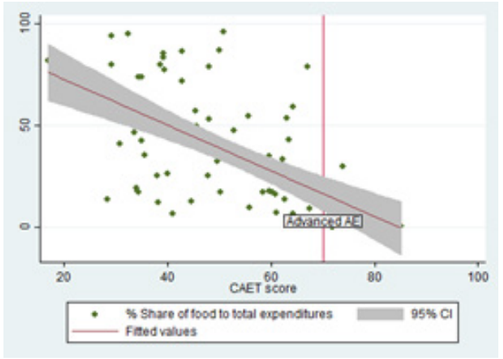

Figure 85: Relationship between the level of agroecology performance and % share of food to total expenditures across 4 communities in Kenya.

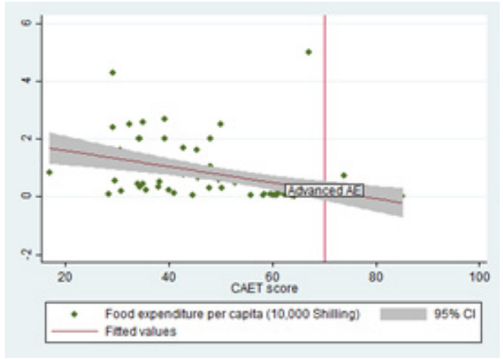

Figure 86: .Relationship between the level of agroecology performance and food expenditure per capita across 4 communities in Kenya.

Environment Dimension

Agrobiodiversity scores, as measured by the Gini-Simpson index, were considered "low" in Mariashoni and Nkareta, with both communities showing low agrobiodiversity scores for crops and animals (Figure 87). In contrast, Keneti exhibited particularly high biodiversity among pollinators and natural vegetation, along with a moderate overall biodiversity score. Keneti also had a higher pesticide score, whereas Mariashoni had the lowest pesticide score, indicating greater pesticide use but lower adoption of safety mitigations.

Out of the four communities, Mariashoni, and Nkareta exhibit a positive relationship between CAET and Gini-Simpson agrobiodiversity index. Keneti though shows a negative trend is still at a very high agrobiodiversity values. There is an overall positive association between CAET and the Gini-Simpson agrobiodiversity index, with households in agroecological transition associated with greater biodiversity (Figure 88).

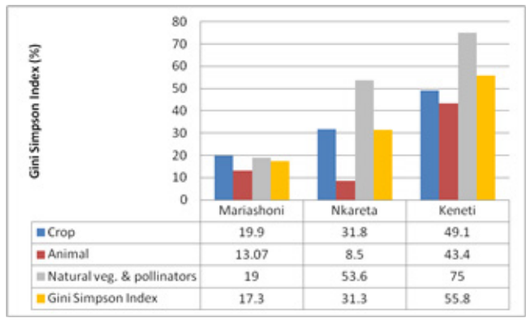

Figure 87: Summary of key environmental variables, disaggregated by community in Kenya .

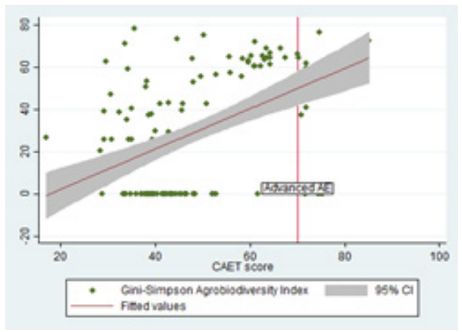

Figure 88: Relationship between the level of agroecology performance and Gini-Simpson agrobiodiversity index across 4 communities in Kenya

Out of the four communities, Keneti, Nessuit and Nkareta demonstrate a weak negative relationship between CAET and crop agrobiodiversity index with only Mariashoni showing positive trend. Mariashoni and Nkareta also show higher animal agrobiodiversity with rise in CAET score. This appears to be due to the fact that apart from home garden and cash cropping livestock rearing is also an important strategy adopted by households. The overall positive correlation between crop agrobiodiversity and the CAET score indicates that improved agroecology performance enhances crop diversity (Figure 89). A more consistent positive relationship is observed between animal agrobiodiversity and CAET (Figure 90). This suggests that animal diversity plays a more significant role in agroecological advancement.

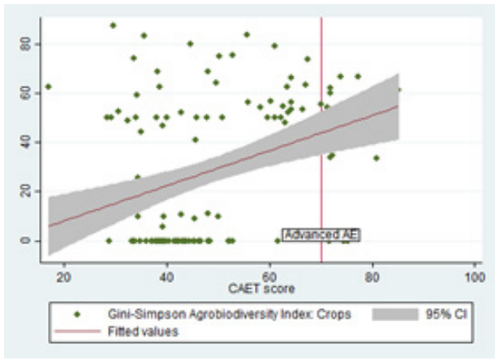

Figure 89: Relationship between the level of agroecology performance and crop agrobiodiversity index across 4 communities in Kenya.

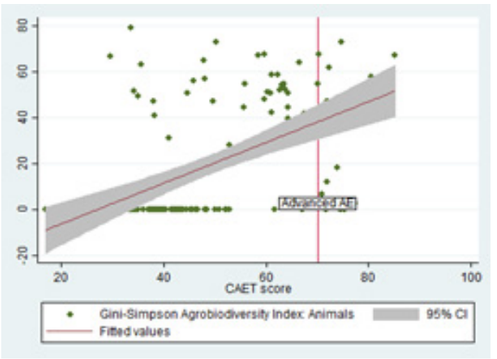

Figure 90: Relationship between the level of agroecology performance and animal agrobiodiversity index across 4 communities in Kenya.

In terms of soil health, all communities recorded values considered healthy (>3.5), with the highest values recorded in Nkareta. The largest annual expenditure on chemical fertilisers was in Mariashoni, while Nkareta had the lowest. Fertiliser expenditure was particularly high in Mariashoni but low in Keneti, where local rules restrict excessive fertiliser use. Overall, the relationship between CAET and soil health is positive, though weak (Figure 91). This is likely

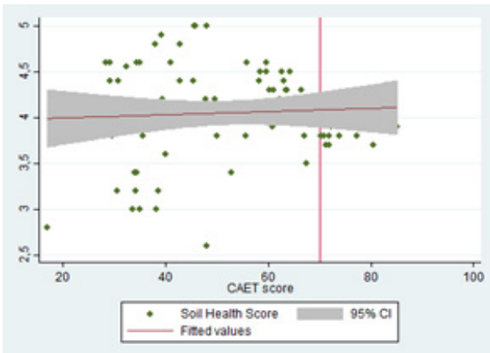

Figure 91: Relationship between the level of agroecology performance and soil health across 4 communities in Kenya.

because, the adoption of settled farming being very recent, agroecological practices for soil regeneration is a gradual process in the agroecological transition. Additionally, climate variability influences the strength of the relationship.

Social Dimension

In three communities, high gender equity is evident, indicating that females experience greater empowerment and decision-making ability in the examined dimensions (involvement in productive decision-making, time use, control over income, leadership within the community, asset ownership, and access to credit) compared to their male counterparts. The abbreviated version of the Women's Empowerment in Agriculture Index (A-WEAI) showed high scores (>70%) in all communities (Figure 92)

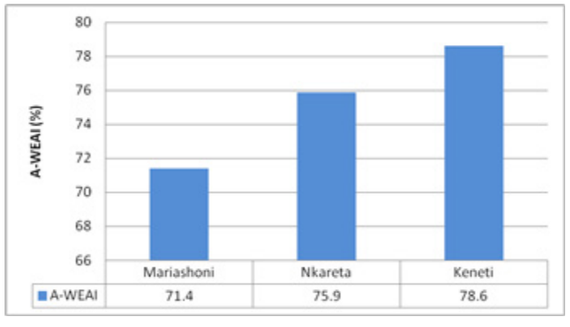

Figure 92: Summary of A-WAEI (%) disaggregated into communities in Kenya

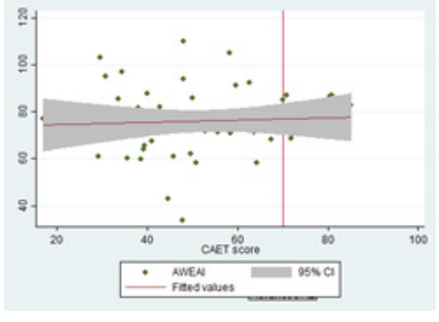

Figure 93:. Relationship between the level of agroecology performance and A-WEAI across 4 communities in Kenya.

In Keneti, which has agroecologically advanced and non-advanced households, the relationship between CAET and AWEAI is a weak positive whereas Nessuit and Nkareta shows a negative relationship. However, the overall A-WEAI values are high across the communities suggesting that women are not highly disadvantaged. The overall relationship between agroecology performance (CAET) and A-WEAI is positive (Figure 93), suggesting that as households adopt more advanced agroecological practices, women gain influence over land tenure, decision-making, and other

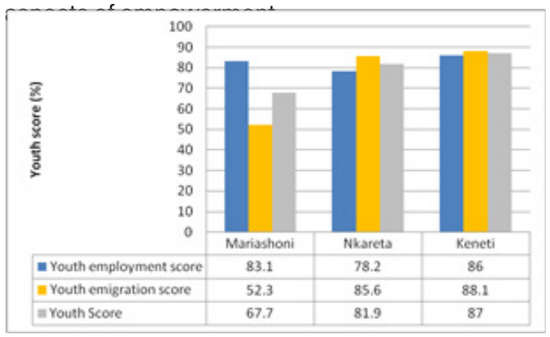

Figure: 94: Summary of key social variables, disaggregated by community in Kenya

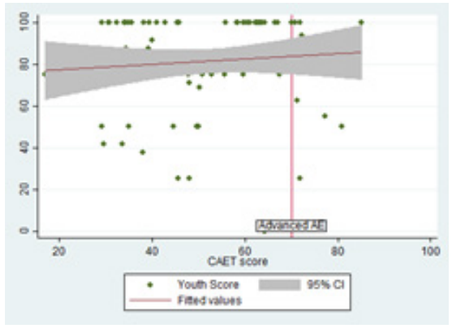

Figure 95. Relationship between the level of agroecology performance and Youth score across 4 communities in Kenya.

On discussion on youth, score from, Nessuit was omitted as there were only a few valid observations for analysis. Youth employment and youth emigration scores (ranging from 0 to 100) respectively indicate the proportion of youths engaged in agricultural production or education within the community, and the proportion of youths who wish to stay in the community and continue working in agriculture. High youth employment scores (>70%) were observed in all communities (Figure 94). In Mariashoni, however, a greater proportion of youths have migrated away or would like to migrate if given the opportunity.

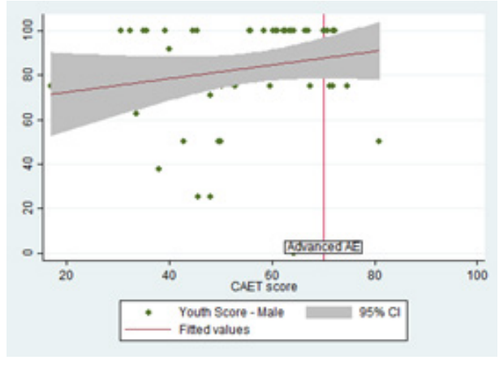

Figure 96. Relationship between the level of agroecology performance and Youth score-male across 4 communities in Kenya.

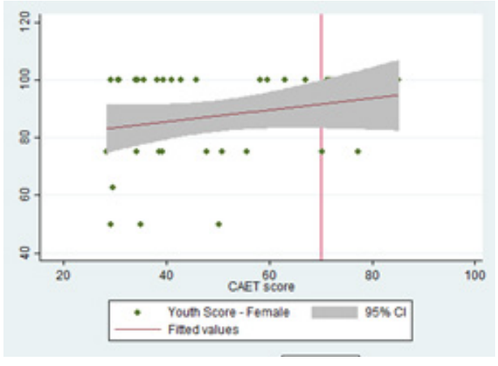

Figure 97.Relationship between the level of agroecology performance and Youth score-female across 4 communities in Kenya.

Although the overall youth score is high, trends across communities indicate a declining relationship. The shifts in cultural priorities and the influence of market and policy pressure may reduce their engagement time. However, the aggregated results show a weak positive relationship between CAET and youth score, with youth scores being relatively similar across the different categories of households (Figure 95). There is a gender specific difference in relation to participation and desire to stay and continue with the system. Among the three communities, only Mariashoni has a positive trend with the other two showing a trend of declining male youth score in relation to a rise in CAET score. The trend in Nkareta and Keneti, though negative, is not very strong which means that the decline is not very significant. Compared to males, female youth are generally more likely to remain in the community and continue engaging with the system. Both the overall male youth score (Figure 96) and female youth score (Figure 97) show positive relation with CAET but females showed higher engagement in the system largely due to existing gender roles and the benefits they receive from agroecological practices.

Governance Sustainability

The tenure score, which equally considers legal recognition of land access, perceived security of land access, and the right to sell, bequeath, or inherit land, reflects the traditional practice where Ogiek men typically hold land titles. As a result, men consistently have more secure tenure than women. However, even among men, tenure recognition varies significantly across communities. In Mariashoni, both men and women have very low tenure scores. The Ogiek community faces significant land tenure challenges, including historical displacement and the lack of legal recognition for their customary land rights. Additionally land conflicts with other groups, restrictive

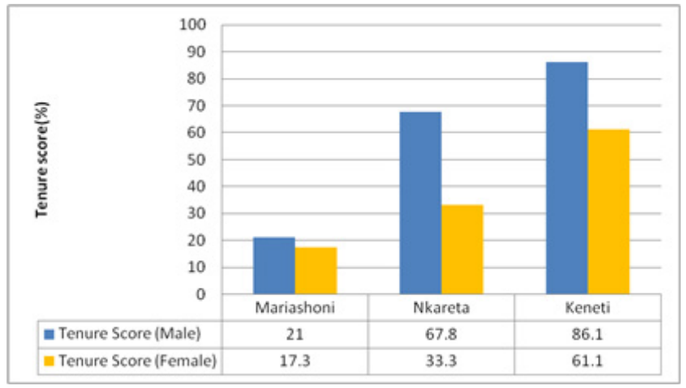

Figure 98: Summary of key governance variables, disaggregated by community across four sites in Kenya

government policies, and weak legal enforcement further undermine their land security. These issues limit the Ogiek's control over their ancestral lands, affecting both their livelihoods and cultural preservation.

In contrast, Keneti shows relatively high tenure security for both genders, with men scoring 86.1% and women 61.1%, indicating more secure land tenure compared to other communities (Figure 94). The continued practice of both pastoralism and farming, along with the preservation of collective community rights over land, contribute to this enhanced land tenure security.

4.3.3 Step 3: Joint Interpretation and Reflection on Results

TAPE Step 3 enabled the confirmation of analysis with the study communities, and the verification of the adequacy of the TAPE framework. The protocol for Step 3 was co-designed by OPDP and is summarised in Box 6

Box 6: Protocol for Step 3 in Kenya

Identify Stakeholders: Community members from the studied area actively engaged in Step 3 to collectively interpret the survey results. These included participation of elders and women. A total of 21+ members from four communities participated in Step 3 conducted in a cluster of two villages.

Communication Channel : Two group meetings are facilitated, each combining two communities for comprehensive participation and collaboration.

Review CAET and Performance Criteria in local context.: The enumerators were invited to share their insights and community-specific context, which contributed to the CAET results. The team facilitated discussion with the community members to review the results and delve into understanding their implications on the performance indicator. During this process, the community identified indices that did not accurately represent their practices. The process highlighted disparities between the data and community context, with community members expressing concerns that scores in some indices are perceived as too low compared to their practices. It also identified the challenges that threaten the food systems.

Box 6: Protocol for Step 3 in Kenya

Adequacy of the framework: Community members, along with the team, engaged in a thorough review of the intricacies of Ogiek Peoples food systems that were not adequately captured by the TAPE methodology. This discussion highlighted indicators that did not align with the local context.

Identify Strategies for Improvement: With the results indicating low level of agroecology, the team along with the community members identified a list of recommendations to support the agroecological transition.

Image 6 Participatory analysis undertaken in the communities at Step 3, Kenya.©OPDP

Confirming the TAPE results and analysis –

The TAPE results and analysis done in Nkareta, Keneti, Nessuit and Mariashoni showed varying scores on the ten elements of agroecology and multi-dimensional performance which were confirmed by participants at the Step 3 discussion.

Economic Viability of the food systems

Community members confirmed that the high annual productivity of Nkareta and Mariashoni primarily relies on cultivating a few cash crops such as maize, potatoes, and beans. Only a small variety of vegetables are grown in home gardens, with planting materials mostly sourced from external suppliers. Mobility restrictions have led these communities to raise animals on their farms, often using external feeds. They commonly sell animal products like milk, meat, and hides, which contribute to their revenue. Additionally, honey and wild vegetables gathered from the forest are important sources of income. However, limited market infrastructure forces farmers to travel long distances during the dry months to sell their produce , often through intermediaries who exploit them, explaining a lower score in the element **Circular and Solidarity Economy.**

In contrast, Keneti attributes the adoption of agroecological approaches and maintaining traditional food systems to providing diverse sources for generation of the substantial income. They also have a higher **Diversity** of crops and animals in their food system. Producers in Keneti

sell directly to the market, which strengthens their relationships with consumers. This direct feedback from consumers enables producers to continuously improve their products.

Environmental impacts of food systems

Community members from Nkareta, Mariashoni, and Nessuit emphasised that their current food production is primarily focused on increasing the yield of monocrops, in contrast to the traditional food systems that prioritised self-consumption. The shift to an unfamiliar system, pushes them to rely heavily on external inputs including high yielding seeds, chemical fertilisers and pesticides. This contributes to the low score in the element of Efficiency. Limited access to traditional seeds was raised as a concern that increases external dependency. Communities reported improvement in recycling practices, such as using maize crop residue as feed or manure. However, their capacity and interest to improve their farms are limited as they often fear eviction and concentrate on maximising yield so long as they are able to farm. Keneti was noted for imposing restrictions on excessive use of chemical fertilisers and pesticides and adopting more sustainable practices of farming. Water-saving practices are more common in Keneti than in the other sites, which have wetter climates and are closer to forests.

Participants highlighted the detrimental effects of climate change, including decreased rainfall and prolonged dry spells, which have had adverse impacts on both food production and forest ecosystems. The erratic weather patterns have disrupted farming schedules, leading to reduced crop and honey yields, compromised animal health, and heightened vulnerability to drought. Furthermore, deforestation for agricultural purposes, coupled with restricted forest access, has negatively affected honey producers.

To mitigate these challenges, various approaches have been adopted by farmers. These include implementing contour hedgerows to minimise soil erosion caused by heavy rainfall, adopting agroforestry techniques to mitigate the effects of extreme weather events, and promoting diversification in farming practices. Additionally, regulating the use of chemical inputs like pesticides is emphasised to enhance productivity while minimising environmental harm. These strategies are viewed as vital steps towards addressing the impacts of climate change on food systems.

Changing diets and impact on nutrition

The shift from traditional lifestyle has led to changes in dietary patterns with communities relying more on market-purchased produce. While severe food insecurity is not reported from the sites accessed, the dietary diversity remains relatively low. This was attributed to the lesser diversity of crops grown in the farm and most of the crops are produced for market rather than self-consumption. Kineti with their reliance on both traditional food systems and farms are able to access higher food diversity. There have been efforts to diversify farms to improve dietary diversity, especially for women and children. However, with the systems being rainfed, the seasonal production patterns influence eating habits.

Social Dynamics

The role of women in agriculture and in daily family consumption was acknowledged and this can be noted in the high A-WEAI score. Young people are highly engaged in food systems,

with many choosing to remain in their villages due to urban unemployment and living costs. In Keneti where traditional food systems are retained, the generational transmission of knowledge is high, but this aspect is in communities that have lost their traditional systems or shift to new systems.Despite these hardships, the human and social values remain strong in most of the communities.The communities highlighted the need for further empowerment and support to the youth and women for the critical role they play in the sustainability of their food culture and traditions.

Security of Land Tenure

Land tenure insecurity poses a significant challenge, particularly for communities residing in areas adjacent to forests like Nessuit, Mariashoni, and Nkareta. These regions frequently encounter issues such as evictions and unfair land subdivisions, which exacerbate the vulnerability of local residents. Alternatively, the limited size of the plots available to residents restricts their ability to increase diversity within their systems. In contrast, Keneti benefits from comparatively greater land tenure security, offering residents a more stable environment.

Traditional land laws in these areas allow male land ownership, although there are instances where women possess ownership and decision-making rights. Despite this, participants often express reluctance to openly discuss their land holdings due to the complexities and uncertainties surrounding land tenure. The communities recognise the necessity to advocate for more equitable land tenure practices to ensure fair access and utilisation of land resources for all community members as this is essential for building resilience of the communities. .

Feedback : Both the OPDP team and the Ogiek Peoples across the four sites recognise the significance of traditional food production in preserving community health and protecting ecosystems. The traditional practices of honey production, hunting, and gathering rely on ancestral knowledge passed down through generations, providing profound insights into forests, landscapes, and seasonal patterns. Maintaining these traditional systems is crucial for ensuring food security throughout the year. Elder Mr. Salanton Nadunguenkao from Nkareta expresses gratitude for the OPDP's efforts in conducting the TAPE study to enrich research and documentation on Ogiek culture, alongside their advocacy for land rights.

4.3.4 Lessons from Storytelling

Stories from Ogiek Peoples living in the Mau Forest provide further insight into key interrelationships between agroecology elements and between agroecology elements and food systems performance. The interrelationships reveal new things about how the elements strengthen one another, and they provide a window into Ogiek worldviews and value systems. Some of the stories relate to the agroecology elements that Ogiek food systems score highest on, including human and social values and culture and food traditions. The stories also relate to elements of agroecology which Ogiek food systems score lowest on. For example, resilience is strongly emphasised in Ogiek stories. Given the extreme market and policy pressures eroding traditional food systems customary support systems, Ogiek Peoples' stories prove to be a repository of insight and wisdom on the factors underpinning resilience and sustainability.

How biodiversity underpins resilience

Ogiek Peoples' stories demonstrate a deep understanding of the interconnectedness of the ecosystems in which humans are embedded. In many of the stories, including **Harmony of Nature: The Ogiek Journey through Pregnancy and Birth,** it is appreciation and respect of different plants, elements, spirits and animals interacting which is linked to human health and resilience. By selectively harvesting plants and maintaining the integrity of their natural habitats, Ogiek women contribute to the conservation of biodiversity of forest ecosystems. Nutrient-rich diets from local sources support pregnant and nursing mothers. Herbal remedies and sacred baths infused with forest energies centre Ogiek women's connection to nature in maternal and infant care practices.

The stories reveal how Ogiek Peoples see ecosystems as interconnected whole. Nurturing the interconnectedness between biodiversity, ecosystem health and human well-being underpins human health and resilience. In **Ogiek Ecological Zones** Ogiek peoples recognized the diverse ecological zones they encountered, each with its own advantages and challenges. They considered climatic conditions and used landscape features to shape decisions about food cultivation and use of natural resources, to harness ecological diversity for sustainable living. Sub-systems, including food systems, are encouraged to co-exist within the overall system. This is why the story **Turot: The Ogiek Hunting Practices** emphasises how hunters take careful measures to avoid the killing of pregnant mammals or their young. In a story about environmental stewardship **Sacrifice for the Rains** ends by saying:

> *"As the seasons cycled and the land thrived, the villagers celebrated the interconnectedness of all life and the resilience of their Indigenous food systems. Through their wise utilisation of the rains and their steadfast commitment to conserving their natural heritage, they forged a sustainable path forward, rooted in harmony with the land and guided by the wisdom of their ancestors".*

By being able to appreciate the diversity of identities and behaviours in the natural world, Ogiek peoples mimic natural processes in the design of their food systems. In **Discovery of Honey,** the woman carefully observed the natural behaviour of bees before designing logs to make and store honey, which saved the family from drought. In **Life in Trees the tree** is a central figure providing a multitude of ecosystem services to many different species. When human food systems mimic natural processes, the growing of food protects and nurtures this interdependence.

In the TAPE assessment tool, agroecological diversity is measured by the quantity of crops, animals, trees, economic activities and natural systems enriching a food system. In the Ogiek stories, agroecological diversity is expressed in the relational qualities of human-environment interactions. The Ogiek stories teach that biodiversity flows from an appreciation and respect of nature's abundance, reciprocal relations between humans and environment in agroecological practices and awareness of the interconnectedness of sub-systems (e.g., soil; forests, water, carbon sequestration), food systems (e.g., crop cultivation, hunting) and ecosystem services (e.g., shelter, habitat).

Combining cultural continuity and openness to new experiences

The TAPE element **Culture and Food Traditions** is one of the highest scoring for Ogiek Peoples' food systems and was strongly reflected in the Ogiek Peoples story collection. Interestingly, the stories highlight the role cultural identities and traditions play in decision making about food cultivation. Traditions are infused with innovations and it is Ogiek Peoples worldviews and values systems that anchor decisions about how to blend old and new. Importance is placed on good judgement, not on the existence and continuation of agroecological practices that no longer serve.

Ogiek Peoples stories celebrate both tradition and innovation. Cultural continuity is identified as being particularly important for knowing which food growing traditions to sustain and when to demonstrate flexibility. Traditional values of prudence, environmental stewardship and cooperation serve as a foundation of decision-making. For example, in **The Brave Man** prudence is celebrated in the wise friend who dried his meat, hung up his fruits and saved food. He exercises good judgement in the use of resources, and as a result everyone benefits because he has food to share. In the story Sacrifice for the Rains the villagers "wasted no time in planting their native crops, such as millet, sorghum and traditional varieties of beans and vegetables known for their resilience in the face of fluctuating weather patterns." In the story **Harmony of Nature: The Ogiek Journey through Pregnancy and Birth** it is the "gentle hands and knowing eyes" of the experienced herbalists who "understood the language of the forest" who are trusted to be guided by the wisdom of nature to select healing plants and craft remedies tailored to the specific needs of mother and child.

The cultural continuity of Ogiek values also anchors adaptability. **In The Hare and the Elephant,** a period of adversity demands the protagonists try something new. The Elephant has success with yields after using organic manure, demonstrating that he adapted in alignment with the Ogiek value of environmental stewardship. In **Turot: The Ogiek Hunting Practices,** the Ogiek hunter's ability to adapt to changing circumstances by dividing themselves into groups to gather wild edibles is a demonstration of resilience in the face of adversity.

Reciprocal relations between humans and the environment

The TAPE element of **Human and Social Values** does not explicitly mention human relationships with nature, but the importance of being in reciprocal relationship with the natural world is emphasised strongly in Ogiek Peoples stories. In the Ogiek story **Life in Trees** community resilience is linked with the mutual support between man and tree. The tree offers resources in times of need and later in life the man reciprocates by caring for the tree and the environment.

In these reciprocal relationships, human responsibilities to nurture nature are interconnected with deep respect for nature and natural processes. Cultural and spiritual connections to the land reinforce reverence for nature's gifts. Such a profound respect of the natural world underpins how protagonists in Ogiek stories strive for harmonious relationships with forest ecosystems. **In Bribe for a Monkey,** Sekeiyan's willingness to share maize, which she grows using organic manure, reinforces the point that reciprocity is the foundation of environmental health and long-term food security. The hard-working mother and the monkey become a formidable team, roaming the forest together gathering food. The co-creation and exchange of knowledge is inter-species, extending

TAPE principles which are focused on human-to-human knowledge transfer and equity in human-to-human participation.

Community support systems and resilience

Few of the Ogiek Peoples stories resonated with the TAPE articulation of **Circular and Solidarity Economy,** which considers producer-consumer networks and relationships with local intermediaries. There was much greater focus on the power of solidarity in community support systems to reduce vulnerability, with a strong emphasis on resilience as an emergent property of community support systems.

Important features of Ogiek Peoples community support systems include cooperation, knowledge sharing and co-learning. These behaviours are turning points in the stories. For example, in the story **Discovery of Honey,** the woman shared her knowledge with the man, which in turn was shared with subsequent generations. In **Introduction of Pumpkin** in Ogiek territory, a travelling woman shares seeds well suited to the local climate, requiring minimal input beyond natural processes of seed dispersal and germination. In **The Hare and the Elephant** one farmer shares what he has learned with another, demonstrating the synergistic effects of intercropping maize and beans. At the end of the story, both farmers have enough food to eat.

The relationship between governance, ethical stewardship, efficiencies and sustainability

The TAPE elements of **Responsible Governance** measures producers' empowerment, promotion of producers' organisations / associations and participation of producers in governance of land and natural resources. This latter attribute focusing on participation was particularly emphasised in Ogiek peoples stories – as was the interlinkages between governance, ethical stewardship, efficiencies and sustainability.

In the stories, governance and ethical stewardship is a process everyone contributes to, including women and young people so there is a lot of overlap in the stories in how TAPE elements "responsible governance" and "human and social values" are measured. The involvement of everyone is of moral importance, but it also generates efficiencies.

In the story **Ogiek Ecological Zones,** the council of Elders teach the community about how to use the land, and where to sustainably access the resources they need in different seasons. They have lived experience of food growing in the locality which has important utility, making the council of elders a choice that generates efficiencies. The division of tasks between men (hunting) and women (water collection) makes visible the contributions of different actors, with some roles fulfilled by both men and women including the preparation of honey and the collection of herbal medicine. Recognising and respecting these roles contributes to more efficient resource management and utilisation. In **Turot: The Ogiek Hunting Practices** young people and women have specific roles in gathering, hunting and cooking. The outcomes are healthy and delicious food, sustainable utilisation of natural resources and the love that comes from sharing talents and resources.

The stories repeatedly emphasise that the relationship between responsible governance and efficiency cannot be upheld without environmental stewardship being a core value underpinning

agroecological practices. In **The Brave Man** it is the careful stewardship of food and the land that helps the community prepare for unforeseen challenges and ensure resource abundance continues for future generations. In **Turot: The Ogiek Hunting Practices** a deep understanding of ecological dynamics and rhythms and a reverence for nature's gifts is essential for guiding agroecological practices that prioritise resourcefulness and long-term sustainability.

4.4 Discussion

4.4.1 Summary of results.

The application of TAPE to 120 Indigenous households within the Mau Forest Complex, Kenya, provided a comprehensive assessment of their agroecological transition. These findings reveal significant insights into the level of agroecological performance of the communities and the challenges they face. These data must be interpreted in the context of the immense pressures confronting the Ogiek Peoples and their food systems.

The Ogiek Peoples communities are undergoing a rapid transition in agricultural practices due to a combination of market forces and government policies. The increasing promotion of contemporary farming methods, such as monocropping and the use of chemical inputs to control pests and weeds, has led to increased reliance on synthetic chemicals and introduced exotic crop varieties. This has also exposed farmers to exploitative market relations and financial volatility. These challenges are compounded by an evolving government that imposes growing restrictions on community access to and use of forest lands. At the time of writing this report, the Ogiek face ongoing threat of eviction and there are Government plans to encircle the whole Mau Forest with an electric fence. For the Ogiek Peoples, traditionally hunter-gatherers who view the forest as their motherland and a vital source of nutrition and cultural identity, these mounting market and policy pressures have forced them into an unfamiliar lifestyle that are not conducive to sustainable, nourishing food systems or livelihoods.

- The Ogiek Peoples' food system, which predominantly relied on hunting and gathering, has shifted toward more sedentary farming, including home gardens, cash cropping, and livestock raising. However, as government restrictions increasingly limit access to their forest lands, the community has adapted by continuing seasonal activities such as gathering wild honey, berries, and herbal plants, which remain integral components of their traditional food systems. Notably, the Keneti community practises a mix of pastoralism, sedentary farming, and honey production, highlighting the diversity of food practices among the Ogiek.
- The food systems studied in Mau Forest are mostly at low levels of agroecological transition. The TAPE assessment indicates that six out of ten agroecological elements were deemed 'non-agroecological,' reflecting a low integration of sustainable farming practices. Only Keneti showed a moderate level of agroecological performance, with many of their traditional food practices still intact.
- Despite the pressures faced, the Ogiek communities have retained core attributes of their traditional food systems. Higher scores for the agroecological elements of **Human and**

Social Values and **Culture and Food Traditions** reflect the empowerment of women and youth and a continued strong sense of Indigenous identity. However, it was noted that departures from the traditional food system have increased individualism. With traditional values and structures retained, policy changes in favour of the Ogiek could help revitalise their food systems and the benefits they offer to people and the planet.

- In the **economic dimension of sustainability,** the results reveal a strong link between agroecological practices in Kenya and economic performance: more advanced agroecological food systems show higher productivity and greater farm revenues from crops, animals, and forest products. These agroecologically advanced farms, which retain traditional food systems while combining them with sustainable food production practices, demonstrate economic viability.
- Pertaining to the **environmental dimension of sustainability,** more advanced agroecological household food systems demonstrated higher soil quality and spent less on chemical pesticides. Additionally, these advanced agroecological systems maintained higher agrobiodiversity, particularly in terms of animal biodiversity.
- Regarding **nutrition,** the results suggested that dietary diversity was higher in the more advanced agroecological systems. Food insecurity was low in all communities.
- Results regarding the **social dimension of sustainability** showed that more advanced agroecological systems had significant female empowerment in agriculture. Similarly, the retention of youth in these communities and their engagement in agriculture is also higher.
- The **governance dimension of sustainability** indicates that advanced agroecological systems have higher land tenure security. This is also linked to the preservation of customary norms which enable communities to effectively manage their land and natural resources.
- Stories from the Ogiek Peoples living in the Mau Forest highlight the intricate connections between agroecology elements and food systems performance, offering valuable insights into their worldviews and values. These narratives reveal how biodiversity supports resilience by illustrating the Ogiek's deep respect for the interconnectedness of ecosystems, such as their selective harvesting practices that preserve forest biodiversity and support human health. They also demonstrate how **cultural continuity and openness to innovation** shape food systems, as traditions blend with new practices to enhance sustainability. The stories further underscore the importance of r**eciprocal relationships between humans and nature,** showcasing how mutual support between people and the environment underpins community resilience. **Community support systems,** characterised by cooperation and knowledge sharing, are pivotal in fostering resilience, while **responsible governance and ethical stewardship** are essential for sustainable resource management. Overall, these stories reflect the Ogiek Peoples' holistic approach to agroecology.

5.4.1 Models for agroecological best practice

In evaluating the agroecological outcomes of the Ogiek Peoples' food systems, which have traditionally relied on hunting and gathering and are now shifting toward a more sedentary lifestyle, Kineti stands out as a community that successfully integrates traditional practices with modern farming techniques to promote sustainability. Kineti serves as a model for how traditional methods can be preserved while embracing contemporary agricultural practices. The successful strategies

implemented by Kineti could offer a valuable template for other villages seeking to harmonise traditional and modern approaches to achieve better environmental and agricultural results.

1. **Blending Traditional and Modern Agroecological Practices:** Keneti serves as a model of successfully integrating traditional practices of hunting and gathering, pastoralism with modern farming innovations to achieve sustainability and food sovereignty. It has been notable in its ability to navigate market and policy challenges (more so) on its own terms – and thus may offer lessons that can be applied to other communities in the region. In Keneti, community members continue to ensure that subsistence needs (for a healthy diet) are met ahead of income. Unlike the other communities, Keneti's local food system is able to provide a sufficiently diverse diet to its community members, and community members spend far less on market-sourced food than their counterparts. Keneti village has imposed regulation that limits the use of excessive fertilisers: most households use no or minimal fertiliser for agricultural production, instead relying on crop rotation to maintain soil fertility. Despite lower use of fertilisers, TAPE Step 2 revealed that producers in Keneti are generating average crop revenues that far exceed those of fertiliser using communities (Mariashoni and Nkareta). The community is also maintaining higher levels of agrobiodiversity and high soil health scores. Other communities could be supported to transition to organic practices through the appropriate and accessible provision of agroecological training and resources. Unfortunately, such services and knowledge are currently lacking.

   Keneti also shows how the risk of exploitative market transactions can be mitigated through bypassing intermediaries. In Keneti, livestock producers are increasingly banding together to bring livestock to a common place, where consumers will come to purchase animals and animal products directly. Such co-operatives in other communities should be supported to empower producers and facilitate stronger, direct linkages between producers and consumers, enabling producers to get fair prices for their products.

2. **Honey Production of the Ogiek Peoples:** The Ogiek Peoples of Kenya, particularly those living in the Mau Forest Complex have a long-standing tradition of honey production that blends agroecological principles with cultural practices. The Ogiek Peoples honey production practices are based on sustainable harvesting methods that support biodiversity conservation and provide a sustainable source of livelihood.The Ogiek Peoples practise traditional beekeeping, using hollowed-out logs as hives placed high in the forest trees. These hives mimic natural bee habitats, encouraging wild bees to inhabit them. This method is ecologically sustainable as it does not disrupt the forest ecosystem and allows bees to thrive naturally.

   Ogiek Peoples' honey production is intimately linked to the health of the forest ecosystem. The Ogiek Peoples understand that a thriving forest supports diverse plant life, which in turn sustains bee populations. By safeguarding the forest, the Ogiek ensure the sustainability of both bees and local plant species, making their honey production a crucial driver of forest conservation. Despite the success of the Ogiek honey production, they face challenges related to land rights, evictions and deforestation. Supporting the Ogiek through policy and

legal frameworks that secure their land tenure and protect the Mau Forest would enable them to continue their sustainable honey production and forest conservation efforts.

4.4.2 Recommendations and Policy consideration

The use of TAPE can provide entry points to inform evidence-based policy change to support communities in the region and empower communities to accelerate their process of transition to agroecology. Using the framework of the ten elements of agroecology, the following recommended activities may help to support communities to build and maintain their agroecological status:

1. ***Diversity:*** TAPE Step 1 reveals low diversity in the system. Enhancing crop diversity, particularly within commercial systems, is crucial for promoting resilience and sustainability in agriculture. This can be achieved by supporting farmers to maintain diverse crops in their home gardens, thereby ensuring a varied and nutritious food supply.
2. ***Efficiency:***There is high dependence on external inputs. Capacity building of farmers to adopt practices that encourage recycling, soil-crop and livestock-crop synergies and sustainable pest management practices can help optimise agricultural productivity. Local seed banks can be established and supported to safeguard and increase access to traditional African Indigenous seeds
3. ***Resilience:*** Access to credit and support for community cohesion are vital for building resilience in agricultural communities. By providing financial resources and fostering strong social networks, communities can better withstand and recover from external shocks such as climate change.
4. ***Culture and Food Traditions:*** Result shows traditional culture is still maintained in these communities but is also impacted by changing societal shifts. The promotion of integrating scientific knowledge with traditional wisdom regarding food sovereignty and security is essential for promoting culturally appropriate and sustainable food systems. Recognising and valuing Indigenous food traditions helps preserve cultural heritage while promoting resilience in food production.
5. ***Human and Social Values:*** With women and youth participation still high, supporting women's institutions and creating opportunities to attract and retain youth in rural areas are critical for ensuring inclusive and equitable agricultural development. Improving agricultural labour conditions and providing youth with meaningful opportunities can help revitalise rural communities.
6. ***Co-creation and knowledge exchange:*** The study showed that a shift from the traditional food system also threatens the loss of critical ecological knowledge. Facilitating access to agroecological knowledge and promoting intergenerational knowledge sharing are key for fostering innovation and sustainability in agriculture. Similarly, local training initiatives can empower community members with the skills and knowledge needed to adapt to changing climatic conditions.
7. ***Circular and Solidarity Economy:*** The presence of intermediaries has been identified as a hindrance to economic resilience and sustainability. Establishing sustainable market linkages that foster direct producer-consumer relationships will enhance both economic stability and environmental sustainability.

8. ***Responsible Governance:*** The lack of secure land tenure and the disruption of traditional governance and customary norms have limited the community's ability to achieve sustainable food systems. By strengthening governance structures and upholding the rights of Indigenous Peoples, policymakers can help preserve natural ecosystems and biodiversity.

Policy Recommendation

1. **Legal Recognition of Land Rights:** The Ogiek communities in Mariashoni, Nkareta, and Nessuit face significant challenges related to land rights, affecting their access to forest resources essential for cultural and spiritual practices. These resources, which are crucial for ceremonies and initiation rites, are under threat from ongoing land disputes and encroachments. To address this issue, it is vital that the government officially recognises and legally affirms the land rights of these communities. This should include formalising their land tenure and safeguarding their rights to access and utilise forest products. Legal measures need to be established to prevent land grabbing and encroachment, ensuring that the Ogiek can sustainably manage and benefit from their traditional lands without facing threats to their cultural practices.

2. **Support for Sustainable Livelihoods:** The Ogiek rely heavily on traditional practices such as beekeeping and pastoralism for their livelihoods, but deforestation and environmental degradation have increasingly jeopardised these activities. The reduction in access to essential resources not only impacts their economic stability but also undermines their traditional practices. To support these communities, policies should be introduced that promote sustainable beekeeping and pastoralism. This includes providing financial assistance, technical support, and training for adopting eco-friendly practices. Additionally, integrating traditional practices into broader conservation strategies will help balance economic development with environmental protection, ensuring the long-term viability of Ogiek livelihoods.

3. **Enhanced Protections Against Land Grabbing:** Land grabbing presents a serious threat to the Ogiek, particularly affecting widowed women who are key providers and caregivers within their families. This issue exacerbates their vulnerability and restricts their access to essential resources. To address this, it is crucial to implement and enforce legal protections specifically designed to prevent land grabbing. These protections should include secure land tenure arrangements for widowed women and other vulnerable groups, along with mechanisms for reporting and addressing land disputes. By safeguarding the rights of these individuals, the policy will help ensure they have the stability and resources necessary to support their families and maintain their traditional practices.
4. **Legal Support for Herbal Practices:** Ogiek herbalists face numerous challenges, including a lack of legal recognition and support for their traditional medicine practices, which affects their ability to provide services and sustain their practices. To address these challenges, it is essential to develop and implement legal frameworks that support Ogiek herbal clinics and practitioners. This involves establishing formal recognition and certification for traditional medicine practices, creating regulatory guidelines, and offering

support for the documentation and preservation of Traditional Knowledge. Providing these resources and training will enable herbalists to continue their vital work within the community and integrate their practices into the broader healthcare system.

5. **Promote Social Inclusion:** The Ogiek experience social exclusion and discrimination, which hinders their integration into the national social and economic framework and limits their access to opportunities and resources. To address this, social inclusion policies must be advanced and enforced to promote equality and prevent discrimination against the Ogiek. This includes creating programmes that integrate Ogiek communities into national development plans, ensuring their active participation in decision-making processes, and addressing systemic biases. By enhancing representation and participation, these policies will help ensure that the Ogiek's rights and contributions are fully recognised and valued, fostering a more inclusive and equitable society.

CHAPTER
5

Evidence on the Multidimensional Performance of Agroecology in the Indigenous Peoples' food systems of Mexico

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Summary

Aim: Based on the use of the Tool for Agroecology Performance Evaluation (TAPE), adapted for Indigenous Peoples' food systems, this study evaluated the agroecological performance of the food system of Indigenous Peoples' communities in the Yucatan Peninsula, Mexico.

Methods: In 2023, TAPE was used to evaluate 120 Yucatec Maya households in four communities in the Yucatan peninsula, Mexico. Through a standardised survey filled during household and field visits, the agroecological performance of their food system was determined. The results are helpful in designing a process of agroecological transition to those farmers who would like to turn their systems into more sustainable ones.

Results:

- The Yucatec Maya food system of Mexico is composed of several subsystems. The most conspicuous one is the milpa, followed by the home garden. Other components are the use of food sources from the forest through hunting and wild food harvesting, bee keeping, livestock, mechanised plots, and a local one known as Ka'anche' (similar to a raised bed). Most of the food produced or collected is for the family's self-food sufficiency use and sharing.
- The use of TAPE in this study showed that the Yucatec Maya food system studied in four Yucatec Maya communities in Mexico, are considered between moderate to high levels of agroecological performance.
- The most agroecologically advanced food systems are in places in which traditional food practices were most well-maintained.
- The element of culture and food traditions achieved the highest scoring in all communities, reflecting strong sense of local or traditional identity and respect of traditions or rituals, even in sites where traditional practices have not remained as completely intact.
- Communities in which traditional practices remained most intact generally saw higher farm revenues.
- Expenditure on chemical inputs was highest in communities where traditional practices were least intact.
- Whilst youth employment in agriculture was high, a high proportion of youth have emigrated or would like to emigrate away from the community.
- Food insecurity was virtually non-existent and, in all communities, dietary diversity was adequate.
- Formal tenure recognition was consistently higher for men than women. Generally, the perceived tenure security was higher than formal recognition.

5.1 Methods and research sites

TAPE was used to evaluate 120 households of Yucatec Maya communities. The data collection took place between May and September 2023, undertaken by staff and students at the Universidad Intercultural Maya de Quintana Roo – all of whom had experience in doing surveys. The training of enumerators and data collection activities was overseen by an assigned lead from Universidad Intercultural Maya de Quintana Roo (UIMQRoo), who had received training from FAO on the TAPE instrument. Training of enumerators involved several steps:

(1) The in-depth discussion of ten agroecological elements, as expressed in TAPE.
(2) In-depth discussions of the closest correlates of the ten elements, their meaning, analogous practices, and words in Yucatec Maya. The idea was that by learning words in the local language that carry the same concept as in each of the 10 elements the possibilities of effective communication increase, thus reducing the possibilities of misunderstandings.
(3) On-campus training on TAPE items meaning and measurement.
(4) Pilot within the team leader's small farm to give enumerators confidence to ask questions related to understanding concepts, deciding how to measure and score each of the items in the instrument, make practical decisions for potential scenarios in the field, etc., before the actual use of TAPE in the field.
(5) On-farm pilot, in which all enumerators assessed the same farm to clarify consistency in enumerators' understanding of TAPE scores.
(6) After each day of field work, before leaving the community, the team gathered to discuss doubts or clarify questions. When needed the team visited the farm under questions and decided on-site the score for the item under discussion.
(7) A database was created, and preliminary results were obtained, the team gathered and looked for inconsistencies or contradictions. When needed, in order to check or confirm data, new field visits were scheduled for the farms and families that presented those inconsistencies.

In completing these steps, the research team sought to minimise variability in TAPE scores due to measurement error – and thus provide confidence that variability in TAPE scores reflects real differences in food systems and enabling environment.

Four communities were selected for this study – José Marìa Morelos, X'Pichil, Tabasco and Chacsinkin (Figure). These were selected by the research team to represent sites in different states of transition away from the traditional food systems of the Yucatec Maya

Figure 99: Map indicating locations of study communities within Mexico.

in José María Morelos; such practices are the least intact, and most intact in X'Pichil. The four communities are of varying size. The largest community of José María Morelos comprises approximately 13,500 people, compared to just 350 persons in Tabasco (Table 13). Within each community, snowball sampling was used to identify 30 households to participate. Informed consent for community involvement in the study was sought from participating households prior to interview.The following section provides descriptions of the study setting, their food systems,

and enabling/constraining environments. This information was derived from the adapted TAPE Step 0 (including the added participatory rural appraisal and key informant interviews) and TIP field partners at UIMQRoo.

Community:	José María Morelos	X'Pichil	Tabasco	Chacsinkin
Population	13,500	1,300	350	3,200
Land area (ha) Land per capita	23,500 1.74	27,300 21	6,500 18.57	20,000 6.25
Cultivated food subsystems	Milpa Home garden Parcela/Orchard Apiary	Milpa Home garden Parcela/Orchard Apiary	Milpa Home garden Parcela/Orchard	Milpa Home garden Parcela/Orchard
Natural food subsystem	Forest	Forest	Forest	Forest
External food sources	Market	Market	Market	Market

Table 13: Summary characteristics of community population, land use and food subsystems use in the sites in Mexico

Ecological Environment

The low-lying Yucatan peninsula is located in a tropical zone, spanning elevations of 2-50 metres above sea level. The region has an average annual temperature of 26C. Annual rainfall is between 1000-1200mm, with high relative humidity. Two main seasons are experienced in the region: a rainy season from June to November, and a dry season, from December to June. The region experiences erratic storms and hurricanes, which can have catastrophic effects on agriculture. The dominant karstic soils, which are shallow, thin, and stony, are a major constraint to the agriculture of the region - but have also contributed to its unique characteristics and resilience. Most agricultural areas are rainfed, with the *milpa* system (slash/burn) as the most conspicuous subsystem along with home gardens.

Food Systems and Market Context

The Maya milpa subsystem is part of a broader productive food system that also comprises hunting, beekeeping, home gardens, and wild food harvesting from forests. In the traditional Yucatec Maya system, almost 100% of the food produced or collected is for self-consumption by family and extended family. Recent estimates of contemporary Maya food systems place this estimate at 64% (Barrientos & Magaña, 2015).

Milpa farm sizes range from 0.5 to 5.0 hectares. An average farmer would work on 2-4 hectares a year for milpa, in addition to their home garden and use of natural systems. Intra and interspecific diversity are present in all systems. This means not only different species are farmed but also different varieties of the same species. Maize is the staple crop within the Yucatec Maya food system, followed by beans. All systems are rainfed, and the clouds are considered water containers by producers. Unfortunately, with climate change, the timing and volume of rains have become increasingly uncertain and unpredictable.

The focus is on family food self-sufficiency, followed by sharing surplus with the community. Small volumes of produce may be sold when income is needed. When products are sold, they are sold

mostly within the community. There is thus little need for producer organisations to help bring products to (say) urban markets. Farmers who do travel to urban markets (e.g. to sell citrus fruits) tend to have a network of direct contacts to whom they sell their products, avoiding the potential exploitation associated with use of intermediaries. Generally, farmers have found a good balance between how much they produce and how much money they need to cover their needs and are therefore somewhat buffered against market price volatility.

Unfortunately, this is not the case for beekeeping and the sale of honey, for which market regulation is lacking and fair prices are rarely achieved. Furthermore, beekeepers have struggled to maintain healthy apiaries with the increasing use of pesticides by the surrounding farmers in recent years. Some beekeepers have successfully organised themselves and have been able to export their products abroad; however, their struggles to maintain local production have not received due attention from the local government.

Customary norms

Customary norms, value systems and practices govern the use of cultivated spaces and natural resources and constitute an important – albeit usually hidden - element of the food system of the Yucatec Maya. At present, all four study sites have the following formal platforms that support responsible governance of the food systems and permit the exchange of knowledge: (1) the *ejidos,* and (2) the learning communities created by Sembrando Vida, SV, (sowing life), a federal government program subsidising 2.5has/farmer to implement two systems: one is called *Milpa* with fruit trees (acronym in Spanish is MIAF) and the other one is called agroforestry (fruit trees with forest trees).

The ejido is a designated/agreed area of land that is communally owned, but which can be individually used and yet not considered to be private property. Ejidatarios are registered members of the ejidos, and through monthly meetings, ejidatarios meet and discuss and collectively decide how to manage their resources. The customary and communal ejido system has been recognised as an important governance system through which the communities have been able to protect customary practices and ensure the conservation of natural resources in the face of contemporary pressures.

Mexico's Sembrando Vida, or "Sowing Life" program was launched by President Andrés Manuel López Obrador in 2019 as his signature program under the Secretary of Welfare. While often referred to as a "reforestation" program, Sembrando Vida actually seeks to address two problems: rural poverty and environmental degradation. The goals of Sembrando Vida include planting a million hectares of fruit and timber trees in agroforestry systems, supported by trained technicians, state-supervised nurseries, and "peasant learning communities." Participants of SV are not necessarily ejidatarios, but they must have the ejido permit. It is through the learning communities that SV transmits the techniques used to substitute fertilisers or pesticides. Whilst this farmer-farmer learning fosters knowledge transmission, very little of the knowledge exchanged comes from the actual local community or culture.

Another important local platform developed by the Yucatec Maya communities is called "iknal", which allows both the exchange, learning, creation, passing on, and innovating knowledge.

Innovation is a key feature of Indigenous ways of learning, individuals and communities generating knowledge. Iknal is being eroded rapidly, formal schooling has substituted it without offering something better. Only if there is research that could measure the speed of transmitting knowledge related to local food systems, and measure innovations, will it be possible to detect the rate of loss of the iknal system.

Enabling environment

Two key challenges facing the food systems were identified amongst producers in the four communities: first, the loss of predictability of rain, changes in the rain pattern, which make very difficult to plan their farming; and second, the disinterest of younger generations to learn conventional farming and much less for traditional knowledge and ways of farming. As a result, knowledge on how to produce food in alignment with the protection of natural resources is being rapidly lost. Producers expressed their concern for the future.

Aside from these two key concerns, aspects of the public policy environment can be identified as affecting the Yucatec Maya food system, both positively and negatively. The milpa has very little support from public policy, and the use of fire is over regulated. Although there is research regarding the Maya food system, the work has not been organised in a systematic manner to enable discussion of how the milpa can contribute much more to both food production, biodiversity conservation, carbon sequestration, and sustainable livelihoods. Despite these conditions, the milpa is now recognised as a Globally Important Agricultural Heritage System. This recognition has come mainly from actions of civil society and milpa farmers themselves throughout the Yucatan peninsula.

The free provision of fertilisers (e.g. Urea & DAP, two common fertilisers in Mexico) and implementation of agricultural extension programmes that are based on non-native species has further undermined the traditional food system. The state and federal government implemented about four years ago a program which offered technical assistance to farmers, with an agroecological approach (Sembrando Vida). Unfortunately, extension workers did not have a solid agroecological training and were unsatisfied with their salary, as a result the program did not have the desired impact. Inadequate planning and lack of consultation of Indigenous farmers have been identified by the farmers as the two main issues of many agricultural programs from the state and federal government.

It is urgent to promote the interface between knowledge (local and scientific) and public policies, otherwise the Yucatec Maya Food System will be eroded so much that the only source of food would be the conventional way of food production, with all the problems that it carries. In this process, it will be critical to incorporate elements of the local governance, modify the normativity that considers shifting cultivation harmful to the environment, and create academic programs (both undergraduate and graduate levels) and research to support decisions aiming at recuperating local knowledge and creating new ways of designing and managing sustainable local food systems, and still have important levels of production.

In the area of study, there are three networks (NGO's) with relevant work on food systems in Maya communities. Two are in Jose Maria Morelos, REPSERAM (Red de Productores de Servicios

Ambientales), a network of farmers who farm according to environmental services, and whose mission is to revive both the knowledge and old varieties of seeds that are planted in a milpa, with emphasis on maize and beans. The other is GLOCAL BEJ which carried out the TAPE project in the Yucatan peninsula.

6.2 Key attributes of the Yucatec Maya Peoples' Food system of Mexico

Food source diversity and seasonal dependency

As exhibited in the study communities, the Indigenous Peoples' food systems in Yucatan Peninsula depend upon a diversity of sources for obtaining their food, including (1) cultivated systems, (2) collection from natural systems and (3) food from external systems (Table 14). In the Yucatec Maya food system, the milpa is the most conspicuous subsystem, supported by home gardens. The following section elaborates on food sub-systems within the four communities examined in this study, including their seasonal importance. Information comes from the communities and the research partner. Secondary literature, where used, is referenced.

Subsystem	Seasonal calendar
Milpa	April-June: Slash and Burn June-September: Milpa, maize is the most important crop in terms of volume. October-December: Milpa, beans, the most important crop in terms of volume.
Home garden	All year. Includes planting, harvesting, pruning, and weeding.
Bee keeping	All year. Includes feeding, multiplying the hives, harvesting honey and other products, weeding and maintenance. This activity is important for monetary income to the family.
Ka'an che'	All year.
Animal husbandry	All year.
Forest products	Only seasonally.
Parcela (parcel)	All year
Sembrando vida (Sowing life)	All year.

Table 14 : Seasonal use of systems within the Yucatec Maya food system.

(1) CULTIVATED SYSTEMS.

- **Milpa**. The Maya milpa is a traditional component of the Yucatec Maya food system. The milpa is a polyculture characterised by the sowing of a diverse variety of crops in the same hole, of which the triad of maize (Zea mays), beans (Phaseolus sp) and squash (Cucurbita sp) are most notable. This triad complements each other ecologically: beans grow along maize stalks; beans fix nitrogen, and squash (with crawling, low-level vines) provides moisture to the soil, repels insect pests, and helps weed control. Alongside these three crops, many other species and varieties of crops are intercropped. This includes fruit trees, which provide shade and protection. With such diversity, all milpa are said to be unique, each comprising different species and breeds adapted to local climatic and ecological conditions.

  Milpa cultivation is a multi-stage process that spans intra and inter-annual cycles. In brief, the cycle begins with the selection of a plot of forest to be cultivated, followed by the clearing of that plot using manual tools (e.g. bat, machete, axe) and creation of a firebreak. In mid-March

to mid-May, when vegetation is dry and the weather is warm, the plot is burned. After the first 2-3 rains of May/June, the main sowing period begins. The timing of the main corn harvest is influenced by the maize variety, which is selected based on the farmer's expectations of rainfall patterns; this period can range from as short as two months to as long as six months after maize emergence. Other crops (with different maturation cycles) are sown at different times of year, and thus are harvested across the year. Plots are cultivated for 2-3 years, after which the fertility of the soil decreases and yields decline. Plots are then left to fallow for 10-18 years and allowed to recover before restarting the cycle. Sometimes plots may be left for 40 years or more, during which time the plot might reach a climax community of a mature tropical forest. The fallowing of land, followed by burning, enhances the fertility of the region's stony, thin soil. It also helps to eliminate weeds, pests, and diseases. Burning is carefully controlled, with firebreaks strongly maintained. Trunks and branches that are not fully burned are used as firewood by the milperos (the name given to those that practise milpa).

The milpa subsystem not only contributes to the food and nutrition security of local communities but has favoured the conservation of the Maya forest and forest regeneration. At any given time, only around 10% of forested space is under active milpa cultivation, whilst secondary vegetation and medium forest occupy around 65% and 15% of forested space respectively. Surpluses produced from the system are often sold to consumers mainly within the community.

- **Milpa fallows.** The fallow lands of the milpa (in recovery from cultivation) are used extensively and sustainably during the 10-18 years of rest. The land is thus not left 'idle' but under active management and use. The fallow land provides multiple edible resources, for example through hunting and beekeeping – as well as non-edible resources that are essential for the family's self-food sufficiency (e.g. firewood, timber for construction).
- **Home gardens:** In the Yucatan Peninsula, home gardens (called pach pakal in local language) exhibit greater plant diversity compared to the fields, featuring a mix of permanent trees and shrubs alongside annuals. These gardens also include animal husbandry. Although home gardens do not yield as much as milpa fields, their proximity to family homes allows for daily care, primarily by women, enhancing plant and animal productivity. Home gardens are crucial for milpa families, providing supplementary food resources during successful milpa seasons and serving as a critical food and income source during less productive periods. These gardens support various agricultural activities, including tree and shrub care, short-cycle maize cultivation, and vegetable and seedbed production.
- **Ka'an che':** Commonly referred as Canché, this is a type of protected food production area, characterised by a soil bed placed on a rustic wooden or woven platform. This platform is suspended about one metre above the ground to safeguard it from domestic animals and to facilitate working on it. This elevated design helps ensure the protection and viability of the plants cultivated in the Ka'an Che'.
- **Commercial production area:** Locally referred to as "mecanizado" in Spanish, this term indicates the use of tractors for ploughing the land. These areas typically range between 2 to 5 hectares and are primarily focused on market production. They serve as a source of income while also providing food for the family. In some cases, vegetables are the main crops, particularly in areas with deeper soils. Commonly grown species include lemons,

oranges, dragon fruit, and papaya. Most of the produce is sold locally or within the state, particularly in tourist destinations such as Cancun.

- **Animal husbandry**. Many households raise animals in their home gardens, such as chicken, turkeys, ducks. Some gardens also include animals from the forest like deer, tepezcuintle (Cuniculus paca), sereque (Dasyprocta punctata). Some farmers have started raising chicken, turkey or sheep in larger-scale production systems.

(2) NATURAL SYSTEMS

- **Forest**: For the Yucatec Maya, the forest plays a crucial role in their daily lives and sustenance, providing essential resources beyond agricultural production. Harvesting fruits and materials for housing are among the most important activities. Notably, species such as currant (Ribes uva-crispa, fam Grossulariaceae) and sacpá (Sapindus Saponaria, fam Sapindaceae) are commonly harvested, especially during the dry summer months. The forest supplies a diverse array of fruits, medicinal plants, and construction materials, which are integral to the community's food security, health, and housing needs. This dependence underscores the importance of forest conservation and sustainable management practices to ensure the continuous availability of these vital resources for the Yucatec Maya.

(3) EXTERNAL SOURCES

- **Market**: While the Yucatec Maya traditionally rely on family's food self-sufficiency agriculture, there is a growing dependence on food from external markets. This shift is driven by several factors, including variability in agricultural production, economic pressures, and changing consumption patterns. Market-sourced foods supplement the diet, particularly when local production is insufficient due to environmental challenges or unsuccessful harvests. Additionally, the introduction of monoculture practices and cash crops, influenced by government programs, has altered traditional farming systems, further increasing reliance on market foods. This dependency poses risks, as market fluctuations and the availability of affordable, nutritious options directly impact food security and dietary health within Yucatec Maya communities.

5.3 Results

5.3.1 Step 1: Characterisation of the agroecological transition

TAPE Step 1, which involves the Characterisation of the Agroecological Transition (CAET) to assess the levels of "agroecological transition," was used to evaluate the agroecological performance in the four selected Indigenous communities in the Yucatán Peninsula. Step 1 indicates the relative strengths and weaknesses (in agroecological terms) of the food systems of the different communities.

The use of TAPE in this study shows that, overall, the surveyed Yucatec Maya Indigenous Peoples' food systems shows agroecological performance that can be deemed as at moderate levels of

agroecological transition (Figure 100). Combined results show moderate average scores (50-70%) for 9 out of 10 elements of agroecology. One element – Culture and Food Traditions – received an average score of over 70%. This element reflects the continued use of traditional varieties/breeds and practices of food production, preparation, and consumption. No elements received average scores considered "non-agroecological". Besides **Culture and Food Tradition**, moderate scores were seen for **Responsible Governance** (66.7) and **Human and Social Values** (64.0), reflecting producer empowerment and participation in governance of land and natural resources, and empowerment of women and youth. Lowest scores were received for **Recycling** (50.1) and **Circular and Solidarity Economy** (53.9). The varying performance levels across the 36 indicators of CAET are presented in radar plot (Figure 101)

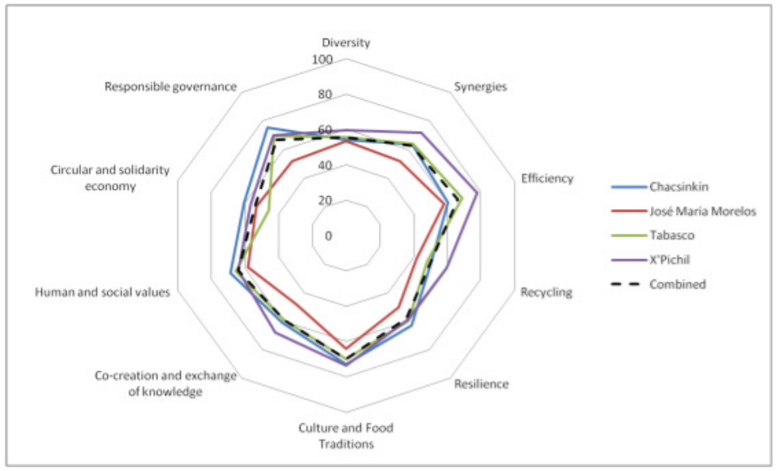

Figure 100: Radar plot showing the results of the CAET score for Chacksinkin , José María Morelos,Tabasco and X,Pichil in Mexico

Communities	Chacsinkín	José María Morelos	Tabasco	X'Pichil	Combined
CAET score	62.9	53	60.6	65.9	60.7
Diversity	54	53.3	55.4	59.5	55.6
Synergies	63.5	51.9	64	72	62.9
Efficiency	60.4	58.1	68.8	77.6	66.3
Recycling	50.4	41.9	48.1	59.7	50.1
Resilience	62.7	50.3	59.9	59	58
Culture and Food Traditions	72.8	63.9	70	73.7	70.1
Co-creation and Sharing of Knowledge	61.1	47.8	59.4	67.7	59.1
Human and Social Values	68.3	58.2	65.5	63.9	64
Circular and Solidarity Economy	60.6	53.1	45.6	56.5	53.9
Responsible Governance	75.6	51.9	69.4	69.9	66.7

Table 15 : Summary table of the CAET results per element and overall for whole sample (N=120) from Chacksinkin, José María Morelos,Tabasco and X'Pichil in Mexico

Disaggregated by community, the highest overall CAET score was received in X'Pichil (65.9) (Table 15). The lowest CAET score was recorded in José María Morelos. In X'Pichil, high/

'advanced' scores were received for **synergies, efficiency and culture and food traditions** (>70). The lowest score was received for **Circular & Solidarity Economy** (56.5), although no elements scored below 50. In Chacsinkín, advanced scores were recorded for **Culture and Food Traditions and Responsible Governance**. The lowest score was received for **Recycling** (50.4), and no elements scored below 50. In Tabasco, **Culture and Food Traditions** received an advanced score (70.0). Recycling and **Circular and Solidarity Economy** received scores below 50. In José María Morelos, no advanced scores were seen. Particularly low scores were given on **recycling** and **co-creation of knowledge**.

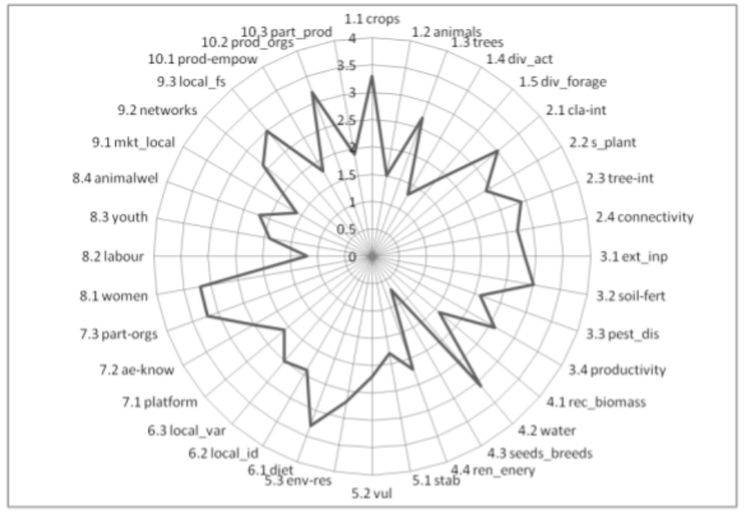

Figure 101: Radar plot of the 36 CAET indicators 4 sites in Mexico

Advanced >70%

The element of Culture and Food Traditions achieved an advanced score of 70.1, highlighting a significant strength in the agroecological practices of the Yucatec Maya Indigenous Peoples' communities. This high score reflects the communities' strong adherence to traditional food production, preparation, and consumption practices, underscored by sub-indicators such as appropriate diet and nutrition awareness (2.7), local/traditional identity (3.3), and the use of local varieties and breeds (2.4). Community-specific performance shows consistent high scores, particularly in Chacsinkín (72.8), Tabasco (70.0), and X'Pichil (73.7). The milpa fosters both food production and cultural identity, deeply rooted in Maya traditions, cosmovision, and rituals. The Maya's respect for nature, seen as having spiritual guardians, is maintained through community rules and ceremonies that honour natural resources. However, even Jose Maria Morelos, despite its lower overall CAET score demonstrates a profound connection to cultural traditions with a slightly lower score at 63.9%. These results underscore the importance of Traditional Knowledge and cultural practices in maintaining biodiversity and resilience within these communities.

Moderate-High Scores (60-70%)

The element of **Responsible Governance** with an overall moderate - high score of 66.7, reflects the communities' empowerment of producers, participation in governance and management of land and natural resources. Traditional governance systems of ejido that are characterised by

communal land ownership and collective decision making, plays a pivotal role in governing the Maya food systems. Chacsinkin has the highest governance score at 75.6 indicating effective community leadership and resource stewardship. Additionally, communities participate in training on agroforestry practices initiated by Sembrando Vida. Despite challenges such as market regulation, efforts to organise and export the local products demonstrate adaptability within the Yucatec Maya food system. Conversely, José María Morelos with its weakened traditional food system demonstrates the lowest score of 51.9, suggesting potential challenges in inclusive decision making and resource management.

The element of **Efficiency** (66.3) score reflects communities' optimal use of resources within the food system, encompassing aspects such as input management, soil fertility, and pest control. The moderate-high score reflects the communities' commitment to sustainable farming practices and reduced reliance on external inputs. X'Pichil stands out with the highest efficiency score (77.6), attributed to effective soil management and limited use of synthetic fertilisers. However, challenges persist in José María Morelos, where efficiency scores at 58.1 indicate potential challenges in resource management and productivity.

Overall, the **Human and Social Values** at 64.0 indicates a moderate-high score reflecting the communities' commitment to social inclusion including gender equity, labour conditions, and community cohesion. The Maya's deep rooted respect for nature and communal values underpin the food systems. Chacsinkin demonstrates notable performance in **Human and Social Values**, followed by Tabasco (65.5) and X'Pichil (63.9) indicating a supportive community network and decent labour conditions. Customary norms and practices in these communities govern the use of cultivated spaces and natural resources that ensure gender inclusive decision-making process. Traditional platform, "Iknal" for knowledge exchange and innovation constitute an important space for the transmission of traditional ecological knowledge to the younger generation. José María Morelos scored the lowest in human and social values, suggesting potential gaps in gender equity and social cohesion as they transition away from the traditional food systems.

The element of **Synergies** that evaluates the integration of diverse agricultural practices within the Maya food system, shows a functional score (62.9) indicating a considerable level of integration with practices such as intercropping and soil management contributing to the ecosystem resilience. Among the communities, X'Pichil (72) indicate strong synergies and effective resource use. The continued adherence to the milpa system in X'Pichil ensured a considerable level of integration with practices such as intercropping, crop rotation and soil management complemented by fallow management. On the other hand Jose' Maria Morelos (51.9) has the lowest score with more adoption of conventional farming and decline in Milpa, leading to less effective resource use and a lower level of ecosystem integration.

Moderate-low scores (50-60%)

The element of Diversity (55.6) scores evaluate the diversity of crops, animals, trees and economic activities within the system. Although this score may appear low, it reflects disparities in the sub-indicators. Notably, crop diversity is high across all sites, with maize, beans, and squash being

the primary crops. There is also rich intraspecific diversity within the milpa system, where some communities grow over 10 different crop varieties. However, the diversity of animals is relatively low, with few livestock integrated into the system, particularly in the home gardens. The integration of trees occurs in the home gardens, while the milpa is complemented with strong fallow management and regeneration practices. It is important to note that the indicator of diversity might seem low because it does not account for the fact that the subsystem Milpa is not designed to include domestic animals. Instead, these systems focus on both intra- and interspecific crop diversity, along with wild plants that grow naturally.

X'Pichil shows the highest diversity score at 59.5, largely due to its rich crop and tree diversity, supported by the milpa system and agroforestry practices like tree integration in home gardens. In comparison, the diversity scores in Jose María Morelos (53.3), Tabasco (55.4), and Chacsinkin (54) show only small differences, suggesting similar crop diversity but fewer agroecological practices. **Recycling** (50.1) scores indicate varying levels of biomass and nutrient recycling and waste management practices. Among the areas evaluated, X'Pichil stands out with a relatively high score of 59.7. This is largely attributed to its well established practices of incorporating crop residues from various subsystems back into the soil, contributing significantly to both biomass recycling and nutrient retention. These practices are crucial for enhancing soil fertility and reducing the dependency on external inputs. However, despite X'Pichil's strong performance in recycling biomass, its overall score is limited by other factors. Its agricultural system relies on rainfed farming, meaning there is minimal need for water-saving strategies. Additionally, the use of renewable energy sources is minimal across all sites studied.

In contrast, José María Morelos exhibits the lowest recycling score at 41.9, which highlights a different set of challenges. This lower score reflects a heavier reliance on external inputs such as synthetic fertilisers and chemical pesticides, rather than the internal recycling of organic matter within the system.

Resilience scores (57.97) reflect the stability of income and production, social mechanisms to reduce vulnerability, and environmental resilience within communities. Among the four communities, Chacsinkin scores the highest (62.7), largely due to its strong social mechanisms that provide effective social safety nets. On the other hand, José María Morelos scores the lowest (50.3), mainly because of its weakening social safety systems. However, these scores must be contextualised within the framework of Indigenous Peoples' food systems and social practices. The indicators used in TAPE, which emphasise economic and environmental stability, may not fully capture the intrinsic resilience embedded in these systems, which prioritise community-based values over purely economic factors.

Circular & Solidarity Economy (53.95) scores reflect varying levels of local product marketing, consumer relationships, and solidarity within the local food system. The results showed that Chacsinkin (60.6) had stronger engagement in local markets and community support. In contrast Tabasco (45.6) had the lowest score. These communities prioritise self sufficiency with effort being made also to diversify livelihood opportunities through beekeeping, agrotourism and gastronomy.

Correlations Among the 10 Elements of Agroecology

The matrix of correlations between the ten elements of agroecology and the overall agroecological performance of the food systems studied in Mexico is presented in Table 16. The analysis shows that Resilience has a strong correlation with Responsible Governance (0.68), emphasising that effective governance is crucial for building and sustaining resilience. Additionally, Resilience demonstrates significant correlations with Diversity (0.58) and Recycling (0.58), indicating that resilient systems benefit from a diverse array of components and efficient recycling processes. This underscores the importance of integrating traditional practices and effective resource management to bolster resilience.Culture & Food Traditions show notable correlations to Resilience (0.59) and Recycling (0.47), reflecting its role in supporting both resilient systems and effective recycling practices.

Synergies show moderate correlations with Co-creation and Sharing of Knowledge (0.52) and Recycling (0.46), suggesting that effective synergies facilitate collaboration and integration across various elements.

Circular and Solidarity Economy and Responsible Governance have moderate CAET scores of 0.56 and 0.66, respectively. In contrast, Human and Social Values has the lowest CAET score of 0.37, showing weak correlations with most other elements, particularly Synergies (0.32) and Recycling (0.16). This suggests that better integration of human and social values could enhance their impact and improve their alignment with other key elements in the agroecological system.

	div	Syn	eff	rec	res	cultf	cocr	human	circ	respg
div	1	0.55	0.3	0.48	0.58	0.43	0.38	0.26	0.37	0.28
Syn	0.55	1	0.44	0.46	0.47	0.32	0.52	0.32	0.28	0.42
eff	0.3	0.44	1	0.38	0.4	0.28	0.4	0.16	0.2	0.2
rec	0.48	0.46	0.38	1	0.58	0.47	0.47	0.16	0.36	0.45
res	0.58	0.47	0.4	0.58	1	0.59	0.48	0.34	0.46	0.68
cultf	0.43	0.32	0.28	0.47	0.59	1	0.34	0.32	0.21	0.35
cocr	0.38	0.52	0.4	0.47	0.48	0.34	1	0.17	0.32	0.45
human	0.26	0.32	0.16	0.16	0.34	0.32	0.17	1	0.06	0.27
circ	0.37	0.28	0.2	0.36	0.46	0.21	0.32	0.06	1	0.44
respg	0.28	0.42	0.2	0.45	0.68	0.35	0.45	0.27	0.44	1

Table 16: Matrix of correlation between the 10 elements of agroecology in Mexico, across 120 household food systems.

5.3.2 Step 2: Core Criteria of Performance: Multidimensional Performance of Agroecology

The following section presents the average results of indicators of performance for the four communities. These indicators span five dimensions of sustainability and are aligned with the indicators and targets of the Sustainable Development Goals (see Chapter2: Methodology).

Economic Dimension

Analysis of the economic variables highlights notable differences in agricultural productivity and revenue among communities (Figure 102).Chacsinkín has the lowest productivity per capita and total farm revenue, relying primarily on crop and forest resources, with no income from animals or animal products. José María Morelos features higher productivity and diverse income sources, including crops, animals, animal products, and forest resources, indicating a more resilient and varied agricultural economy. Tabasco and X'Pichil show varying degrees of economic performance, with X'Pichil achieving the highest productivity and revenue through significant earnings from crops and animal products. Overall, the data reveals that communities with diversified agricultural activities, such as José María Morelos and X'Pichil, generally exhibit higher productivity and more stable economic outcomes compared to those with less varied income sources.

X'Pichil appears to outperform the communities in terms of net and gross revenue, deriving most of its farm revenue from animal/livestock production and no revenue from forest products. Chacsinkin recorded the highest annual productivity, however its net revenues and gross revenues were much lower than the other communities. Tabasco was the only community to record sizable revenues from forest products.

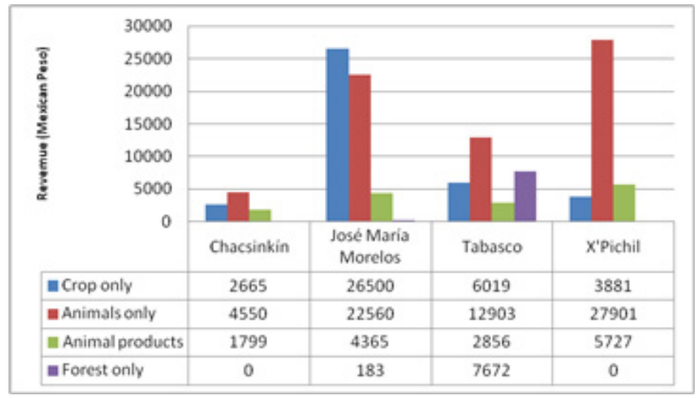

Figure 102: Summary of key economic variables, disaggregated by community, Mexico

There is a positive relationship between agroecological performance and total added value (Figure 103), where households with more advanced agroecological practices tend to generate higher value added. However, this relationship is not very strong overall. In X'Pichil, there is no significant variation in value added across different CAET levels, suggesting that advancing in agroecology does not necessarily lead to a significant increase in value added. The trend for value added per capita mirrors that of total value added, reflecting the distribution of added value among household members (Figure 104). Although this correlation is positive, it is weak.

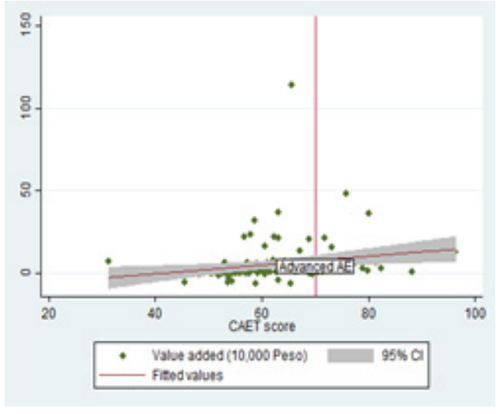

Figure 103: Relationship between the level of agroecology performance and added value across 4 communities in Mexico.

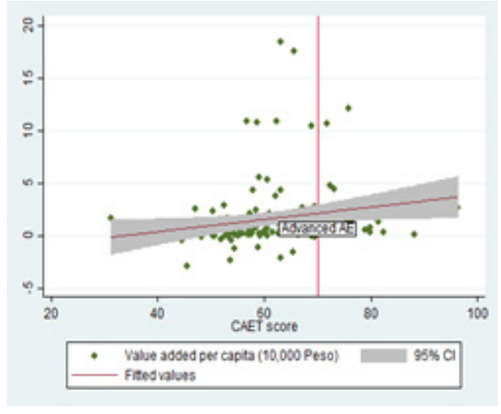

Figure 104: Relationship between the level of agroecology performance and added value per capita across 4 communities in Mexico.

There is a positive relationship between CAET and total value of production (Figure 105), which combines the value of both crop and animal production. Agroecologically advanced households tend to generate more total value of production. This trend is consistent across communities, reflecting the combined impact of improved practices on both crop and animal outputs. The relationship between CAET and total value of production per capita follows the same positive trend, where households that are more agroecologically advanced show higher value of production per capita (Figure 106).

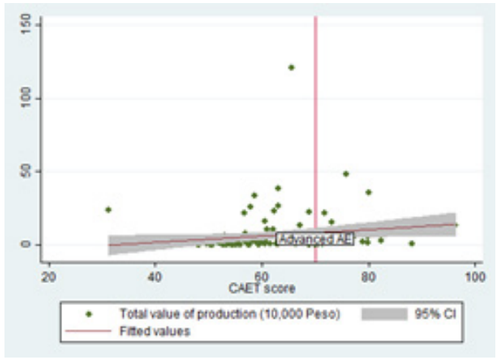

Figure 105: .Relationship between the level of agroecology performance and total value of production in across 4 communities Mexico.

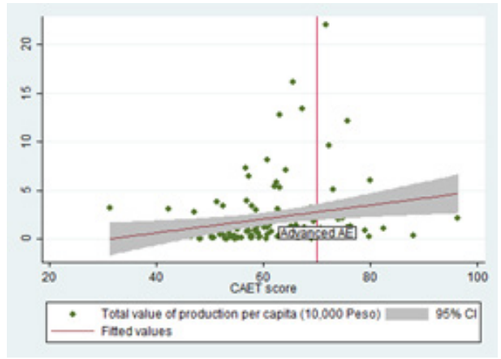

Figure 106: .Relationship between the level of agroecology performance and total value of production per capita in across 4 communities Mexico.

Chacsinkín shows a strong positive relationship between advanced agroecological practices and higher crop production value per hectare. In Chaksinkin, the medium sized farms enable practices that support higher yields per hectare. In contrast, communities such as José María Morelos, X'Pichil, and Tabasco show a weaker relationship, with crop production values not differing

significantly between households at various CAET levels. In X'Pichil and Tabasco, larger farms often demand more labour and inputs, which can reduce per-hectare productivity. Additionally, households in these areas tend to focus on increasing crop diversity, both within and between species. In José María Morelos, the less intact traditional systems and smaller farm sizes further limit overall productivity. The aggregated results show a generally weak overall relationship between CAET and crop production value per hectare (Figure 107).

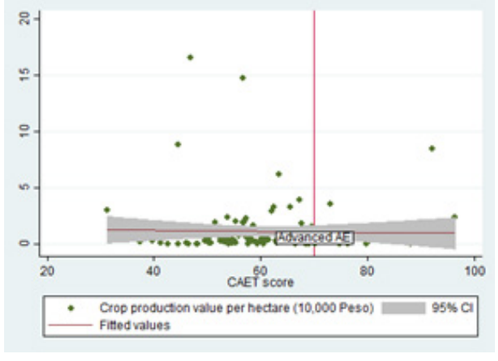

Figure 107:. Relationship between the level of agroecology performance and crop production value per hectare in across 4 communities Mexico.

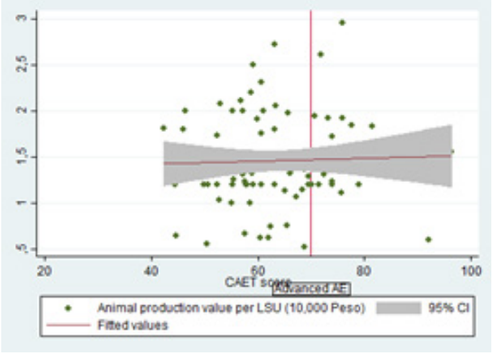

Figure 108. Relationship between the level of agroecology performance and animal production value per LSU across 4 communities Mexico.

The relationship of CAET with animal production value per LSU is stronger than that seen with crop production value per hectare, but it is nonetheless not very strong. Among the communities, Chaksinkin, Xpichil and Tabasco have a positive relationship with Tobasco having the strongest. José María Morelos shows a negative trend, with animal production value per LSU declining in households with higher CAET. This variation can be attributed to the fact that while animal integration is practised in home gardens, systems like the milpa, which are more prevalent in some communities, are not designed for animal domestication. The relationship between CAET and animal production value per LSU, though positive, remains relatively weak overall (Figure 108).

The relationship between CAET and net revenue is positive, suggesting that more advanced agroecological practices lead to higher net revenue (Figure 109). This aligns with the trends observed for value added and total production. However, the increase in net revenue is not very substantial, possibly due to a significant portion of produce being used for self-consumption rather than sale. This indicates that while agroecological practices improve financial outcomes, the impact on net revenue may be limited, reflecting reduced market dependence and increased self-sufficiency.

The relationship between CAET and net revenue per capita follows the same positive trend as total net revenue (Figure110). The pattern observed is consistent across communities, indicating financial benefits associated with agroecological advancement, although the absolute increase remains modest.

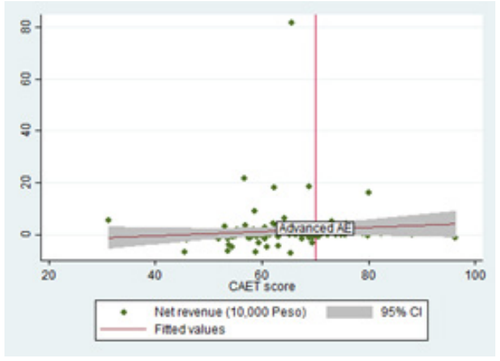

Figure 109: Relationship between the level of agroecology performance and Net revenue across 4 communities Mexico.

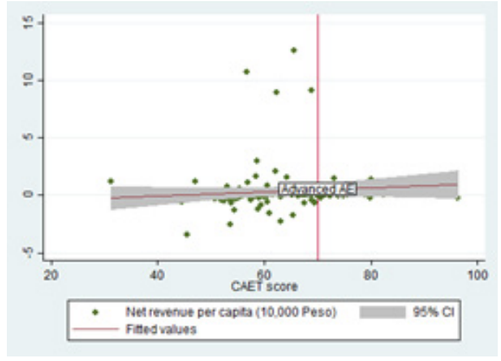

Figure 110: .Relationship between the level of agroecology performance and Net revenue per capita across 4 communities Mexico.

The economic advantages of agroecological practices are evident though factors such as land size, existing practices, and self-consumption play significant roles in shaping these outcomes. The findings indicate that households with greater implementation of agroecological practices demonstrate improved economic performance, though the improvements are gradual and shaped by various contextual factors.

Food Security, Human Health and Nutrition dimension

Food security scores across the communities are high, indicating that food insecurity is virtually non-existent within the studied food systems (Figure 111). X'Pichil has the highest food security score, with traditional farming practices still prevalent. Even in Chacsinkín and José María Morelos, where agroecology performance scores are lower, food security remains high. In terms of dietary diversity, José María Morelos stands out with the highest score, reflecting a more varied diet that aligns with its higher food expenditure per capita. Conversely, Chacsinkín has the lowest dietary diversity and food expenditure, indicating limited access to diverse foods and lower spending. Tabasco and X'Pichil display moderate scores for both dietary diversity and food expenditure.

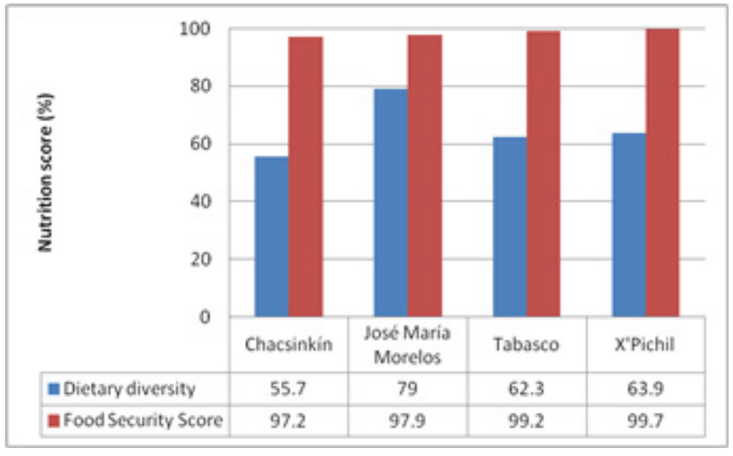

Fig 111: Summary of key nutrition variables, disaggregated by community in Mexico

FIES show positive correlation with higher agroecological, but the benefit is marginal with FIES values already high across all communities (Figure 112). The trend indicates that as households progress in agroecology, food insecurity decreases. The milpa system, focusing on self-consumption, helps maintain food security, keeping households highly food secure. The milpa system, which focuses on self-consumption of crops, helps maintain food security, and households are generally highly food secure. Adoption of these practices decreases the likelihood of moderate food insecurity (Figure 113).All the communities also have the same pattern, i.e., moderate food insecurity declines as households become more agroecologically advanced. Only Xpichil show a slight positive trend, i.e., moderate food insecurity rises with an increase in CAET score. But the increase is very minor and not of much concern. Temporary food shortages during certain periods must be the reason for it.

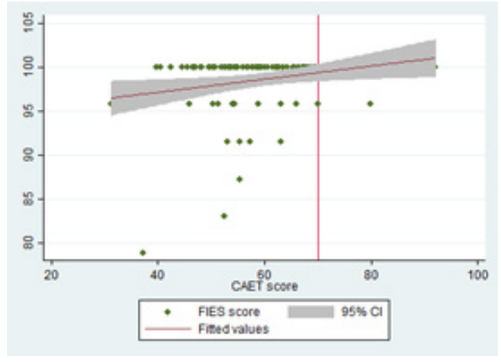

Figure 112: Relationship between the level of agroecology performance and FIES across 4 communities Mexico.

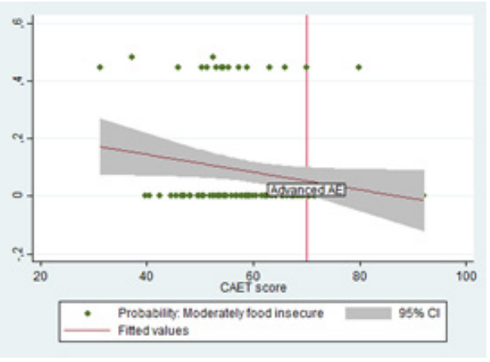

Figure 113: Relationship between the level of agroecology performance and probability of moderately food insecurity across 4 communities Mexico.

All four communities show a positive relationship between CAET and dietary diversity. José María Morelos and X'Pichil show higher dietary diversity with agroecological advancement. In the case of José María Morelos the proximity with the market allows for greater access to diverse food options. The relationship between CAET and dietary diversity show an overall positive but weak

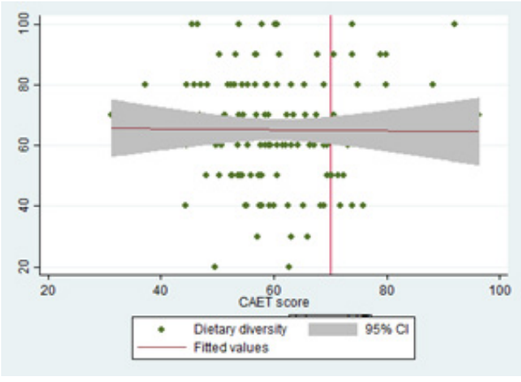

Figure 114: Relationship between the level of agroecology performance and Dietary Diversity across 4 communities Mexico.

trend (Figure 114). Dietary diversity scores are relatively high across all households, with only minor variations between agroecologically advanced and less advanced households.

The relationship between CAET and the percentage of food expenditure is strong, with agroecologically advanced households spending a smaller share of their income on food (Figure 115). This is likely due to increased self-sufficiency, as additional production replaces market purchases in all the four communities. This relationship is strong and all the communities.

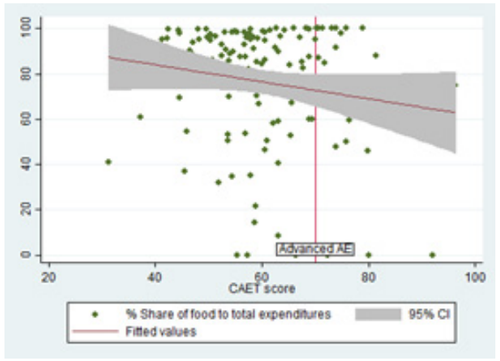

Figure 115: . Relationship between the level of agroecology performance and % share of food to total expenditures across 4 communities Mexico.

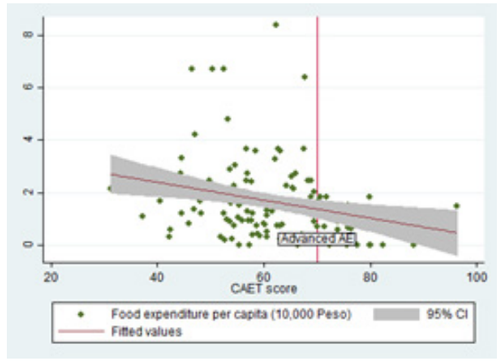

Figure 116: Relationship between the level of agroecology performance and food expenditure per capita across 4 communities Mexico.

Advanced agroecological practices also contribute to lower food expenditure per capita, as increased crop and animal production reduces reliance on market purchases (Figure 116). This trend is consistent across all communities except José María Morelos, where food expenditure increased slightly. Overall, agroecological practices lead to significant savings on food, which can be redirected toward other needs, improving household well-being.

Environment Dimension

The results of the indicators in the environmental dimension of sustainability reveals significant differences in farming practices and ecosystem health across the four communities (Figure 117). The Gini-Simpson Index scored high in Chacsinkina and X'Pichil and lowest in José María Morelos. X'Pichil with the most intact traditional food systems exemplified a more environmentally friendly approach with its minimal chemical use, higher organic pesticide use, and high biodiversity. José María Morelos, has the highest fertiliser use, shows lower biodiversity and a more intensive, conventional farming approach. X'Pichil saw the highest overall pesticide score, and Chacsinkin the lowest. Highest crop diversity scores were reported in Chacsinkin and X'Pichil; all communities also reported high abundance of natural vegetation and pollinators.

The Gini--Simpson index shows a strong positive relation with CAET scores suggesting that systems that are more agroecologically advanced show higher biodiversity (Figure 118). This trend is consistent across all the communities emphasising that food systems with intact milpa support biodiversity.

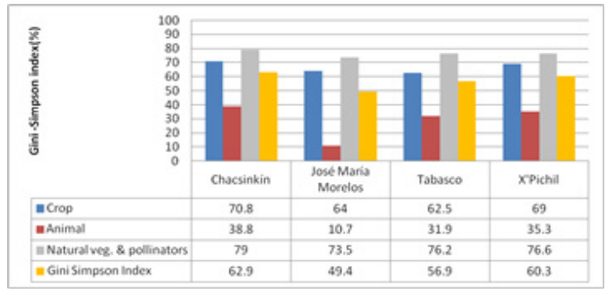

Figure 117: Summary of key environmental variables, disaggregated by community in Mexico

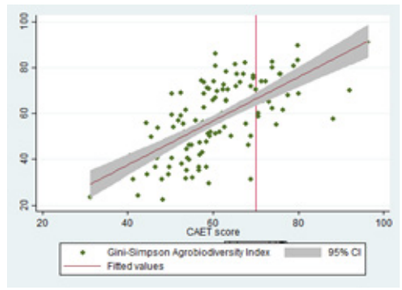

Figure 118: Relationship between the level of agroecology performance and Gini-Simpson agrobiodiversity index across 4 communities Mexico.

There is also a positive correlation between overall agroecology performance and crop diversity (Figure 119). However, X'Pichil shows a weaker correlation between agroecological advancement and crop diversity, likely because the system already maintains high crop diversity. Crop agrobiodiversity is generally higher than animal agrobiodiversity in the communities studied, with the predominant milpa system focused on crops rather than animal.

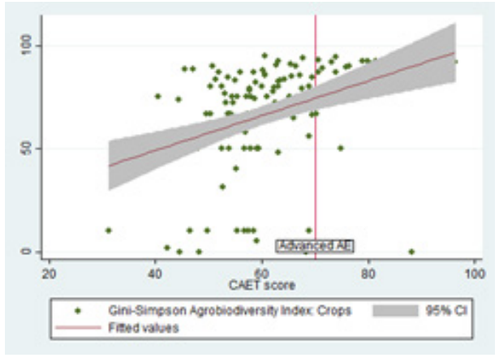

Figure 119: Relationship between the level of agroecology performance and crop agrobiodiversity index across 4 communities Mexico.

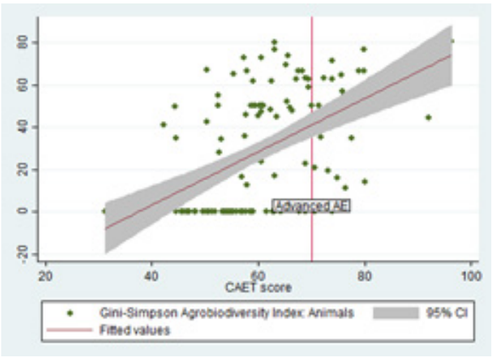

Figure 120: . Relationship between the level of agroecology performance and animal agrobiodiversity index across 4 communities Mexico.

Animal agrobiodiversity shows a much stronger and consistently positive relationship with CAET across all communities, indicating that more advanced systems have greater animal diversity (Figure 120). However, animals are not domesticated into the milpa, though the system interacts with many wild animals. Additionally, beekeeping is adopted to support financial gain besides providing ecosystem services.

Concerning soil health, all communities recorded soil health values considered healthy (>3.5). There is a strong positive relationship between CAET and soil health across all communities, indicating that agroecological advancement significantly enhances soil quality (Figure 121). The milpa system

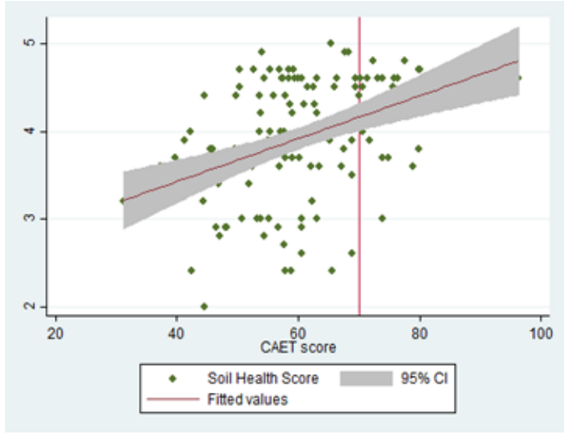

Figure 121: Relationship between the level of agroecology performance and soil health across 4 communities Mexico.

focuses predominantly on crops like squash, maize, and beans, with ash used for soil fertilisation rather than manure. Given the challenging stony, limestone-based soil of the Yucatan Peninsula, soil health is critical, and practices such as ash fertilisation, mulching, cover cropping with legumes, and allowing land to lie fallow help maintain soil fertility.

Social Dimension

The social sustainability indicators showed that high women empowerment and youth employment are supported by systems where the milpa system is more intact. The abbreviated version of the Women's Empowerment in Agriculture Index (A-WEAI) showed high scores in all communities, and particularly strong scores (>80%) in Tabasco and X'Pichil (Figure 122). Gender parity scores were universally high.

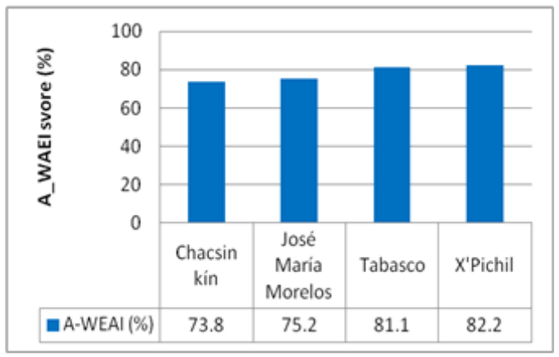

Figure 122: Summary of A-WAEI (%) disaggregated by communities in Mexico.

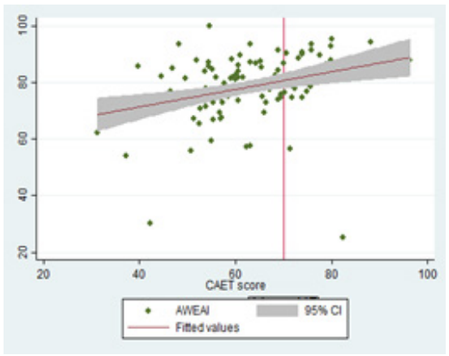

Figure 123: Relationship between the level of agroecology performance and A-WEAI across 4 communities Mexico.

There is a strong positive correlation between CAET and AWEAI, showing systems with high agroecology performance improve women's empowerment across areas like land tenure, decision-making, and access to resources (Figure 123). This is consistent across all communities.

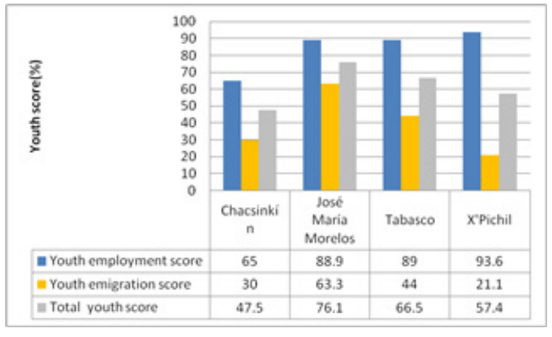

Figure 124: Summary of key social variables, disaggregated by community in Mexico

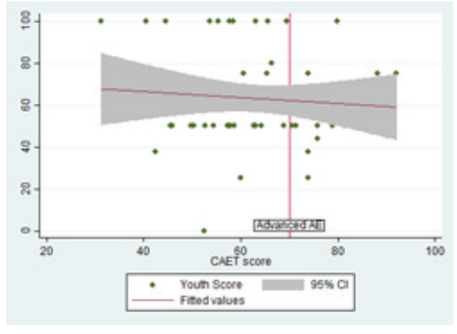

Figure 125: Relationship between the level of agroecology performance and Youth score across 4 communities Mexico.

Youth employment and emigration scores (0-100) reflect the proportion of youths engaged in agricultural work or education and their desire to remain in the community and continue in agriculture, respectively across the four sites (Figure 124). José María Morelos exhibits the highest overall youth score, indicating a significant proportion of youths are employed or in education, with fewer wishing to emigrate. In contrast, X'Pichil has the highest youth employment score but also shows a high rate of youth emigration, suggesting that while the system supports employment of youth, they are more likely to emigrate to seek new opportunities.

The CAET and youth score exhibit an overall negative relationship (Figure 125), indicating that greater agroecological advancement does not always correspond to increased youth involvement and retention. In José María Morelos, the shift away from traditional milpa practices has led to decreased youth engagement. Meanwhile, in X'Pichil, limited support for agroecological improvements may contribute to higher youth migration.

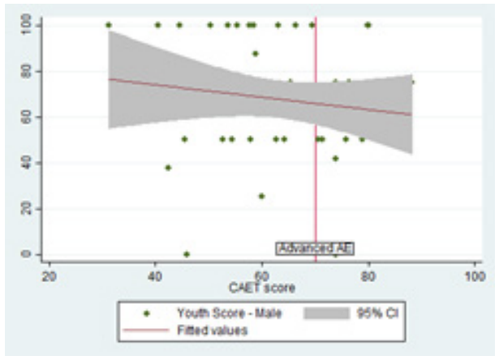

Figure 126: Relationship between the level of agroecology performance and Youth score-male across 4 communities Mexico.

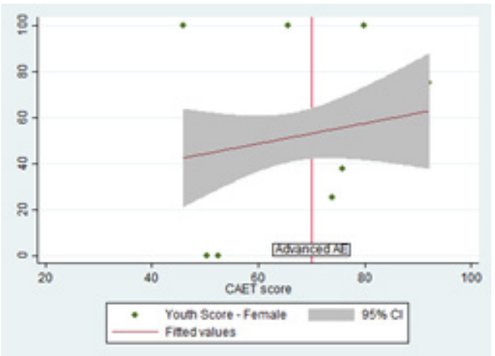

Figure 127: Relationship between the level of agroecology performance and Youth score-female across 4 communities Mexico.

Youth involvement in agroecology varies by gender due to different priorities and opportunities. The overall negative relationship between CAET and male youth scores (Figure 126) indicates that as agroecological advancement increases, male participation and commitment tend to decrease, with Tabasco being the exception where male youth are more supportive. In contrast, female youth are generally more motivated to stay and support agroecological practices, reflecting a positive relationship with CAET (Figure 127) . However, X'Pichil shows a negative trend for female participation as well, likely due to high migration pressures affecting both genders.

Governance Dimension

Tenure score considers (with equal weight) the existence of legal recognition of access to land, the perception of security of access to land, the existence of the right to sell, bequeath or inherit land. The tenure scores across communities reveal significant gender disparities in land rights and security (Figure 128). In Chacsinkín , both male and female scores are relatively high. José María Morelos exhibits the largest gender gap highlighting weak governance issues. Tabasco and X'Pichil show moderate scores with notable gender gaps. These variations suggest that while land tenure governance generally favours men, there is considerable need to ensure more equitable land rights for women.

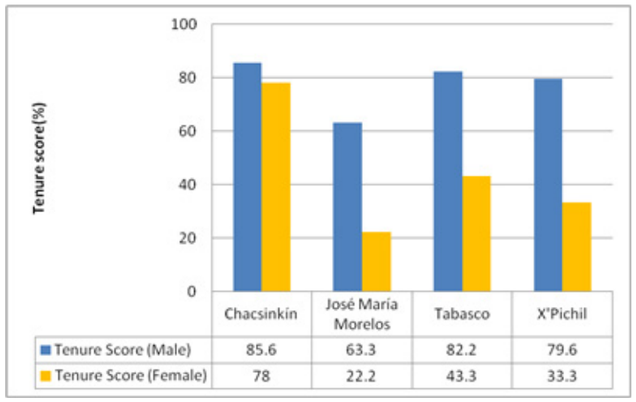

Figure128: Summary of key governance variables, disaggregated by community across four communities in Mexico

5.3.3 Step 3: Joint Interpretation and Reflection on Results

TAPE Step 3 enabled the confirmation of analysis with the study communities, and the verification of the adequacy of the TAPE framework. The protocol for Step 3 was co-designed with the research team in Mexico and is summarised in Box .

Box 7: Protocol for Step 3 in Mexico.

Identify Stakeholders: Community members and farmers who participated in the study from the studied area actively

Communication Channel: Two approaches are adopted: Group meetings were held in two study sites (X-Pichil and Chacsinkin) and discussion with individual families who were part of the study in the other two sites(JMM and Tabasco). Furthermore, the process also included engaging discussions with knowledge holders,

Box 7: Protocol for Step 3 in Mexico.

Objective and discussion framework: The team has designated Step 3 for collaborative interpretation of the obtained results, and not for data validation, as the variability from enumerators has been minimised through rigorous training.

Review of overall Results and Interpretation: The overall results from the data gathered are presented to community members through group meetings or during discussion with individual farmers and their families. Discussion on the results are facilitated, revealing factors contributing to the findings. . This process also highlighted indices that did not fully represent the Maya Peoples food systems. Reflecting on the elements of agroecology sparked conversations on education and value systems, also revealing factors that pose threats to the sustainability to local food systems.

Adequacy of the framework: To better capture the aspects of the Yucatec Maya Peoples food systems, using TAPE, two additional processes were undertaken. Firstly, adjustments to the wordings in description of the indices (eg in diversity of crops) is proposed. Secondly, the ten elements are structured according to the Yucatec Maya thinking.

Identify Strategies for Improvement: Community awareness of a fractured food system exists, and the Step 3 process reveals the most vulnerable elements. These are identified as focal points for intervention to transform the Yucatec Maya Peoples food systems. It also identify with communities with best practices that could serve as templates for solutions.

Confirming the TAPE results and analysis –

The application of TAPE (Tool for Agroecology Performance Evaluation) in four Yucatec Maya communities yielded varying scores, reflecting the different stages of their agroecological performance. To interpret the results meaningfully, group meetings and individual discussions were held with families and knowledge holders. This approach ensured the community's perspectives on the data were understood, while also being mindful of the region's political sensitivities. These insights gathered from the community discussion included:

Recognition of Broken Food Systems: The communities acknowledged that their food systems have deteriorated, with significant losses in Traditional Knowledge and practices. They emphasised the need to transform these systems by reducing or eliminating agrochemical use and advocating for substantial changes in public policies. A major concern for this loss of traditional knowledge is because of the younger generation's disengagement from food production.

Diversity and Methodological Gaps: The communities were surprised by the low scores in the element of Diversity. Discussions suggested that TAPE might not effectively capture intraspecific diversity. In agricultural terms, even monocropped plots often consist of multiple varieties, which also represents diversity.

Challenges and Vulnerabilities: Regarding the elements of Recycling, Resilience, and Circular and Solidarity Economy, the discussions highlighted the intrinsic presence of these concepts in Maya thinking. The discussion reveals that the Yucatec Maya Peoples food systems inherently align with the elements of Agroecology. The values such as **Human and Social Values** are foundational to the Yucatec Mayans approach, emphasising community well-being and respect for nature. Co-creation

and Sharing of Knowledge involves learning through communal and intergenerational exchange. Circular and Solidarity Economy focuses on local resources and mutual aid, avoiding dependency on external inputs. Responsible Governance ensures harmony and coordination within the community. Diversity is maintained through cultivating multiple species and varieties, enhancing Resilience which is fostered by adapting practices to withstand environmental challenges. Efficiency is achieved by maximising natural resources and minimising labour. Recycling involves reusing organic materials to enrich the soil. Synergies are created by integrating different systems, enhancing overall productivity. Culture and Food Traditions are preserved through the continued use of traditional farming methods and local crops. This Indigenous perspective highlights a dynamic equilibrium in their food system, underscoring the importance of integrating traditional knowledge with agroecological principles for sustainable food production.

However, it was noted that external factors such as education, media, public policies, corruption, and social fabric deterioration negatively impact the food system and associated values. These factors appear to be the most vulnerable, explaining the loss of sustainability and serving as potential entry points for strategies aimed at transforming and regenerating the Yucatec Maya Peoples food system.

5.4 Discussion

5.4.1 Summary of results

The use of TAPE across the four Yucatec Maya communities in the Yucatan Peninsula has provided invaluable insights into the agroecological landscape of these regions. This assessment, conducted in alignment with the TAPE methodology, has shed light on various facets of agroecology.
The key results from the TAPE of Chacsinkin, Tabasco, X'Pichil and José María Morelos are summarised below:

- The Yucatec Maya Peoples' food system is composed of several subsystems, with the most prominent being the milpa, followed by the home garden. Other components include food sources from the forest (through hunting and wild food harvesting), beekeeping, livestock, mechanised plots, and Ka'anche' (similar to raised beds). Most of the food produced or gathered supports the family's self-sufficiency and sharing.
- The Yucatec Maya food system in the four communities demonstrates moderate to high agroecological performance. X'Pichil, where traditional food practices are well preserved, received the highest score, while José María Morelos, most influenced by the Green Revolution, scored the lowest.
- The TAPE report recognizes the complex interaction between traditional agroecological practices and external pressures, such as market dynamics and government policies. Despite these challenges, the Yucatec Maya people have shown resilience, retaining vital aspects of their traditional food systems.Culture and food traditions consistently achieved the highest scores across all communities, highlighting a deep sense of local identity and respect for customs and rituals even in those where traditional farming practices have been less intact.
- Resilience is a key factor in agroecological performance, strongly linked to cultural practices

and food traditions. Integrating traditional knowledge and food practices enhances communities' ability to adapt to challenges, making cultural heritage vital for sustainable food systems.

- In terms of nutritional dimension, food insecurity was virtually nonexistent, and dietary diversity was sufficient in all communities.
- With respect to the economic dimension, communities in which traditional practices remained most intact generally saw higher farm revenues.Traditional agricultural practices, rooted in resource efficiency and low input cost offer long-term economic benefit.
- In nutritional dimension, food insecurity was virtually non-existent and, in all communities, adequate dietary diversity was maintained through traditional systems that emphasised self-sufficiency and fostered a strong culture of sharing within the community.
- In terms of the environmental dimension, these systems exhibit high crop diversity, which contributes to a strong soil-plant integration and enhancing soil fertility. High biodiversity and natural vegetation are maintained in areas where traditional systems remain intact. Communities where traditional practices have been least intact tend to spend the most on chemical inputs.
- In the social dimension, more advanced agroecological systems showed higher empowerment for women and employment rates for youth. However, despite traditional farming's ability to provide significant youth employment, many young people have emigrated or expressed a desire to emigrate.
- Formal land tenure recognition was consistently higher for men than women, but perceived tenure security, with land communally owned, was higher than formal recognition.
- The findings highlight a notable contrast in performance between X'Pichil and José María Morelos, with X'Pichil showcasing the highest overall performance and Jose Maria Morelos exhibiting the lowest. This disparity is crucial for informing the design and management of traditional food systems. X'Pichil emerges as a model of success, showcasing effective and sustainable practices worthy of replication. Conversely, insights from José María Morelos illuminate the challenges and factors contributing to the decline of local knowledge in traditional food systems. Given its size and role as a distribution centre for green-revolution inputs, including government initiatives, José María Morelos offers critical insights into the complexities of modernization's impact on traditional agricultural practices.

5.4.1 Models for agroecological best practice

The TAPE report highlights X'Pichil as a model for best agroecological practices, showcasing how community-led initiatives can effectively prioritise self-sufficiency and minimise external input reliance. The successful integration of Traditional Knowledge, seed conservation, cooperative governance, and diverse planting practices underpins X'Pichil's exemplary agroecological performance. Key practices identified in X'Pichil's approach include:

1. **Retention of Traditional Knowledge:** The community maintains strong traditional practices, particularly in soil and fire management within milpas. This ancient wisdom continues to guide sustainable agricultural techniques and supports soil health.
2. **Seed Conservation and Knowledge Sharing:** X'Pichil emphasises the conservation and

exchange of both seeds and vegetative plant forms among community members. This practice not only preserves genetic diversity but also helps mitigate environmental risks and enhances food security.

3. **Governance and *Ejido* System:** Effective decision-making is facilitated through the ejido system, with notable participation from women, though youth involvement is less prominent. This governance structure supports cooperative frameworks and community engagement.
4. **Diverse Planting Practices:** The design and management of X'Pichil's food system incorporate both intra- and interspecific diversity. This diversity is crucial for resilience and productivity, ensuring a robust and adaptable agricultural system.
5. **Integration of Subsystems:** The agroecological model integrates various subsystems, including milpas, home gardens, K'aan che' (traditional agricultural plots), beekeeping, forest conservation, and other community activities. This holistic approach ensures that all components of the food system are interconnected and mutually supportive.

5.4.2 Recommendations and Policy Consideration

The use of TAPE can provide entry points to inform evidence-based policy change to support communities in the region and empower communities to accelerate their process of transition to agroecology. Using the framework of the ten elements of agroecology, the following recommended activities may help to support communities to build and maintain their agroecological status:

1. ***Diversity and Circular and Solidarity Economy:*** TAPE confirms that the primary focus of production is family's self-sufficiency, yet surplus yields from maintaining diverse crops, animals, and trees in traditional systems yield significant economic benefits. Promoting such diversity is crucial for building community resilience. While beekeeping integration has been noteworthy, the absence of market regulations has diminished benefits for farmers. Diverse market linkage strategies can enhance support and bolster economic advantages for farmers.

2. ***Efficiency and Recycling:*** There is an increased dependency on chemical inputs in production, often propelled by government programmes such as promotion of non-native species, free provision of chemical fertilisers. This has led to adverse effects on diversity, particularly affecting beekeepers. To address this, farmers can be supported to prioritise sustainable farming methods, supported by extension that have strong agroecological training.
3. ***Resilience and Co-Creation and Sharing of Knowledge:*** TAPE highlights the challenge of variability in income and production, environmental susceptibility and weakened social safety nets. The study points out a low overall youth score with increased migration from communities and decline in the use of traditional platforms for transferring knowledge on Indigenous values and practices. To address this challenge, intercultural co-creation and co-learning through an intercultural lens can facilitate the sharing of traditional knowledge and encourage collaborative learning opportunities.
4. ***Responsible Governance:*** The Yucatec Maya food system is influenced by public policies that have both positive and negative impacts. Despite the milpa being recognised as a

Globally Important Agricultural Heritage System, there is no structured discussion on its potential contributions to food production, biodiversity, carbon sequestration, and sustainable livelihoods. Government programs often fail due to a lack of planning and consultation with Indigenous farmers. To prevent erosion of the Yucatec Maya food system, it is critical to integrate local and scientific knowledge into public policies, incorporate local governance, revise norms regarding shifting cultivation, and develop academic and research programs to support sustainable food systems, with civil societies and farmer networks playing a crucial role.

Public policy recommendations:

1. **Integrate Indigenous Knowledge:** Acknowledge the wisdom in Indigenous knowledge, in this case Yucatec Maya, encourage its use and promote training of new generations using that knowledge behind their food systems, especially regarding fire management, a critical component of the milpa. There are different types of fires, under different names, based on soil conditions, debris left after the cutting of trees, and weather conditions that must be considered.
2. **Enhance Communication Through Local Language:** Promote efficient communication by encouraging the use of local language to discuss simple and complex concepts behind the design of programs aiming at conserving and increasing the productivity of Indigenous food systems.
3. **Strengthen Governance and Inclusion:** Promote and encourage proper governance processes where the voices and wisdom from Indigenous Peoples, Yucatec Maya, participate in the process of decision making, both in designing and implementing programs aiming at conserving and increasing the productivity of their food systems.
4. **Support Intergenerational and Intercultural Co-creation of knowledge Training and Collaboration:** Promote and encourage the training of new generations, allowing and providing conditions for local knowledge to partake along with science. The training must be designed based on local needs and a shared vision, local and governmental.

CHAPTER
6

Summary of TAPE Results and Reflections on the TAPE Methodology for Indigenous Peoples' food systems

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Background and Rationale to Project

The UN Food Systems Summit (UNFSS) has underscored the urgent need to transform global food systems in response to critical challenges such as biodiversity loss, climate change, and malnutrition. Despite their pivotal role in conserving biodiversity and developing sustainable food systems, Indigenous Peoples have often been marginalised in food systems policy. Recognising this gap, The Indigenous Partnership for Agrobiodiversity and Food Sovereignty (TIP), with support from The Rockefeller Foundation, initiated the project, Demonstrating that People and Landscapes Thrive under Indigenous Peoples' food systems, aimed to gather evidence on the agroecological outcomes of Indigenous Peoples' food systems.

This comprehensive multi-site study, conducted across Northern Thailand, Northeast India. Kenya and Mexico utilised an adapted version of the FAO's Tool for Agroecology Performance Evaluation (TAPE) to assess nearly 500 households across sixteen diverse landscapes. The

survey documented the qualitative and quantitative outcome of these systems to characterise these systems based on the 10 elements of agroecology. TAPE was conducted through four steps. Step 0 involved a context-setting exercise, providing an overview of target territory and identifying key drivers that can foster a favourable environment for sustainable food systems. Step 1 food systems according to the multiple dimensions of agroecology to the multiple indicators of the 10 elements of agroecology. Step 2 assessed food system performance based on a list of core performance criteria, spanning economic, environmental, health, social and governance dimensions, and aligning with the Sustainable Development Goals to help local actors prioritise key areas for targeted improvement. Step3 engaged stakeholders in interpreting the gathered data results to ensure that the interpretation accurately represented the food systems under study. This participatory approach reflected the specific priorities and nuances of the Indigenous Peoples' food systems. Additionally, stakeholders collaborated to identify strategies for improving performance and advancing agroecological transition.

The project complemented TAPE with the storytelling approach, creating a rich dialogue between Indigenous and Western knowledge systems. The project collected 30 stories from Northern Thailand, North East India and Kenya. The process and outputs of storytelling supplement and complement data collected via TAPE. Although TAPE is a comprehensive instrument of assessment, it is focused on outcomes for people and individual farms. The collection of stories enables the project to think about benefits more widely, as they are articulated and defined by different Indigenous Peoples communities. It also facilitates consideration of the worldviews, values, interrelationships, community dynamics that explain the contribution of Indigenous Peoples' food systems to people and landscapes, catalysing learning about what to protect and promote in the context of a rapidly changing climate.

A significant focus of the project was on empowering Indigenous Peoples youth to participate in research and policy advocacy. By involving them in the research process, the project aimed to build their capacity and ensure the continuity of traditional knowledge and practices. The involvement of Indigenous Peoples communities in the research process empowered them to advocate for their food systems and their role in addressing global challenges. This empowerment is crucial for ensuring that Indigenous Peoples voices are heard in policy discussions. The project highlighted the critical role that women and knowledge holders play in preserving and transmitting traditional practices. Their involvement is essential for the sustainability and resilience of Indigenous Peoples food systems. By highlighting the deep connection Indigenous Peoples communities have with their land and their sustainable practices, the project provided valuable insights into how these systems can contribute to more sustainable and equitable global food transitions.

About this report

This report, prepared by the TIP research team and its partners, provides a comprehensive summary of results across various country contexts. It highlights how Indigenous Peoples' food systems align with multiple dimensions of agroecology and support socio-ecological outcomes beneficial to both people and the planet. The report then examines the strengths of the study and assesses the adequacy and performance of the TAPE framework within Indigenous Peoples' food systems. It offers suggestions for practitioners using TAPE in these contexts, as well as

considerations for the future evolution of the standard (non-IP) TAPE instrument. Additionally, the report discusses the utility and value of a storytelling approach in complementing the TAPE method, conveying rich meanings about the ontological and social foundations of food systems and practices. It concludes with key policy recommendations to support Indigenous Peoples' food systems and their contributions to nature, people, and the planet.

6.1 Overview of the Indigenous Peoples' Food Systems studied

The study encompassed 16 landscapes across Northern Thailand, Northeast India, Kenya, and Mexico, with each country contributing four sites. These locations were selected to offer a broad representation of diverse food systems within the communities and to reflect the evolving transitions within these systems. The participating communities were predominantly agrarian, focused mainly on farming for self sufficiency while also exploring opportunities for income diversification. Prior to the study, Free, Prior, and Informed Consent (FPIC) was obtained from all participating communities and households.

In Northern Thailand, the Karen Peoples' food systems in Mae Paw Khee, Hin Lad Nai, Khun Mae Yod, and Huay E Kha are characterised. Rotational farming, with a fallow cycle of 7-10 years, is the predominant practice in three of these communities. In both Hin Lad Nai and Mae Paw Khee, forest gardens are also maintained, incorporating tea cultivation, agroforestry, vegetable farming, and beekeeping. Unlike some other regions, Mae Paw Khee and Hin Lad Nai have not adopted cash cropping. Huay E Kha relies primarily on food production from paddy fields. Additionally, home gardens, livestock raising, and foraging from forests and aquatic systems form an integral part of the agricultural landscape. These communities also engage in handicraft production during off-farm periods.

In Northeast India, the study focused on the villages of Darechikgre (Garo Peoples), Dewlieh (Khasi Peoples), Plasha (Karbi Peoples), and Umsawwar (Khasi Peoples), all of which practise shifting cultivation, though the extent varies between villages. Dewlieh and Darechikgre rely heavily on shifting cultivation, maintaining a fallow cycle of 7-15 years. Plasha combines shifting cultivation with paddy farming, while in Umsawwar, only a few households engage in shifting cultivation. Bun cultivation, a rotational cropping system on grasslands with a 3-5 year fallow cycle, is the predominant farming method in Umsawwar. In Darechikgre and Plasha, upland rice is the main staple cultivated in the shifting fields, alongside other crops, while in Dewlieh, millet and maize are the primary cereals. In the bun system, millet, maize, tubers like potatoes, and other food plants are grown together. Kitchen gardens are common across all villages, with a few fruit trees integrated into these spaces. Foraging and the collection of resources from forests, grasslands, and aquatic bodies are an integral part of the food systems. Resource management is overseen by the Dorbar Shnong village council in Dewlieh, Plasha, and Nongtraw, and by the Nokma in Darechikgre.

In Kenya's Mau Forest, the Ogiek Peoples from the villages of Nessuit, Mariashoni, Nkareta, and Keneti have traditionally relied on hunting and gathering. However, there has been a societal shift towards more sedentary farming, with only Keneti continuing to practise a mix of pastoralism and farming. Home gardens and commercial crop plantations, primarily growing potatoes,

maize, peas, and leafy greens, are now common in these communities. Livestock rearing is also prevalent within home gardens. Due to restricted forest access, the Ogiek now depend on the seasonal collection of wild honey, herbal plants, and wild berries. Of the four villages, Nessuit, Mariashoni, and Nkareta face frequent threats of eviction and forest access restrictions, which have significantly impacted the continuation of their traditional practices.

In Mexico, the study sites focused on the Yucatec Maya communities of José Maria Morelos, X'Pichil, Tabasco, and Chacsinkin. The Milpa system is the predominant food system in these communities, involving the intercropping of maize, beans, and squash. Fields are cultivated for 2-3 years and then left fallow for 16-18 years. Many households rear animals in their home gardens, and some allocate 1-5 hectares of land for the commercial cultivation of fruit trees. Beekeeping is common in José Maria Morelos and X'Pichil. Among the four villages, X'Pichil and Chacsinkin have maintained their traditional food systems, while those in José Maria Morelos and Tabasco are less intact. Forest resources are still utilised for harvesting wild fruits and materials for housing.
The food systems studied across these regions highlight the strong connection between Indigenous Peoples and their landscapes. These systems merge traditional knowledge with adaptive strategies to manage resources sustainably. They not only ensure food security but also reinforce cultural traditions, ecological stewardship, and community resilience. Each community's food system reflects unique traditional practices that are shaped by the diverse cultural and environmental contexts in which they exist. The key attributes of these systems include:

- Diverse Systems: Communities across all study areas employ diverse farming systems that are adapted to their local environments. While rotational farming in Northern Thailand, shifting cultivation in India, the milpa system in Mexico, paddy cultivation, and home gardens share some similarities, each has evolved uniquely in terms of land management and crop selection. These variations reflect the adaptability of Indigenous Peoples to their specific surroundings.
- Integration with Natural Ecosystems: Forests, grasslands, and aquatic resources are essential components of these food systems, providing supplementary food, medicinal plants, and materials for housing. This integration strengthens the communities' resilience. The Ogiek Peoples' connection to their ecosystems, particularly through forest resources, exemplifies this deep ecological relationship.
- Sustainability and Biodiversity: Fallow management practices in shifting cultivation, rotational farming, and the milpa system are centred on ecological balance and sustainability. These practices allow for soil regeneration and biodiversity conservation, ensuring the long-term health of the land and the food systems it supports.
- Livestock Rearing: While livestock is not a primary focus in the food systems of Northern Thailand, Northeast India, and Mexico, small-scale livestock rearing has been incorporated into home gardens. In contrast, the Ogiek Peoples, who traditionally relied on livestock, have seen their practices affected by restricted forest access and land loss. With the shift to sedentary farming, they have begun integrating animals into their home gardens as a new way to sustain livestock management.
- Beekeeping: Beekeeping is a key element of the food systems across the studied communities, supplementing wild honey collection. The Ogiek Peoples practise beekeeping in forest

areas, while in Mexico and Thailand, it is integrated into fallow lands, and home gardens, demonstrating the versatility and importance of beekeeping across different environments.

6.2 Summary of TAPE results

The use of TAPE in this study provides important data and insights into the overall sustainability of diverse Indigenous Peoples' food systems, assessed through different indicators of agroecological performance. Overall, the Indigenous Peoples' food systems examined have moderate-to-high scores on the ten elements of agroecology (Figure 129), indicating high implementation of agroecological practices and principles of food systems studied. The Karen Peoples' food systems of Northern Thailand demonstrated the highest agroecological performance. The Garo, Karbi, and Khasi Peoples' food systems in Northeast India, along with the Yucatec Maya Peoples of Mexico, displayed moderate agroecological performance. In contrast, the Ogiek Peoples of Kenya had the lowest agroecological performance, facing significant challenges due to their transition away from traditional food systems. While direct comparisons between results should be made with caution, given the varied systems and contexts, the findings highlight common strengths within Indigenous Peoples' food systems, as well as some of the challenges faced, and attributes of food systems that the TAPE instrument was unable to fully capture.

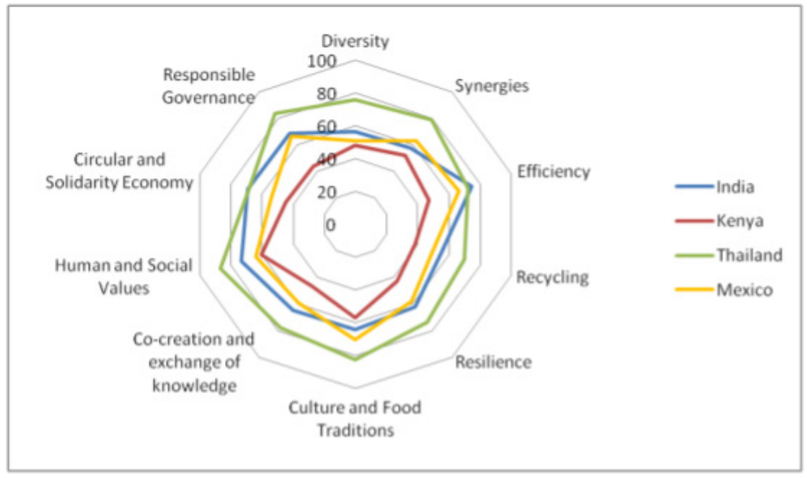

Figure 129: Radar plot presenting the average scores for each of the ten elements of agroecology, as assessed during TAPE Step 1.

Agroecology Elements	India	Kenya	Thailand	Mexico	Mean
Diversity	56.5	48	76	51	57.9
Synergies	57.6	51.7	79	62.9	62.8
Efficiency	74.9	47.1	72.1	66.3	65.1
Recycling	55.4	38.6	69.9	50.1	53.5
Resilience	62.3	42.8	74.1	58	59.3
Culture and Food Traditions	64	56.7	82.3	70.1	68.3
Co-creation and exchange of knowledge	65.1	46.1	77.6	59.1	62.0
Human and Social Values	73.2	60.2	86.7	64	71.0
Circular and Solidarity Economy	69.2	44.8	68.5	53.9	59.1
Responsible Governance	68.3	43.6	83.6	66.7	65.6
Overall	64.65	47.96	76.98	60.21	62.5

Table 17: Average scores for each of the ten elements of agroecology across country contexts.

Amongst the most consistently high-scoring TAPE elements was that of Human and Social Values and indicating that the food system supports (and conversely, is supported by) high levels of female empowerment, quality labour conditions and youth empowerment within agriculture. During TAPE Step 3, communities consistently ranked human and social values as amongst the most important constituents of a thriving food system. These values are reflected in both agricultural practice as well as community stories and local folklore. Practices of labour exchange, for example, which are common to all of the study contexts, support the timely completion of agricultural tasks under respectful conditions, and help to actively maintain community relations, cooperation, and systems of reciprocity. Such practices also tend to bring youth and Elders together, thus supporting ongoing knowledge transmission and youth empowerment. The stories captured through the project in India, Thailand and Kenya helped to highlight human and social values on a deeper level, illuminating how respectful relationships with each other, with animals and the natural world can result in community wellbeing and food sufficiency. Such values are not captured (and may be challenging to quantify) in the current indices of TAPE.

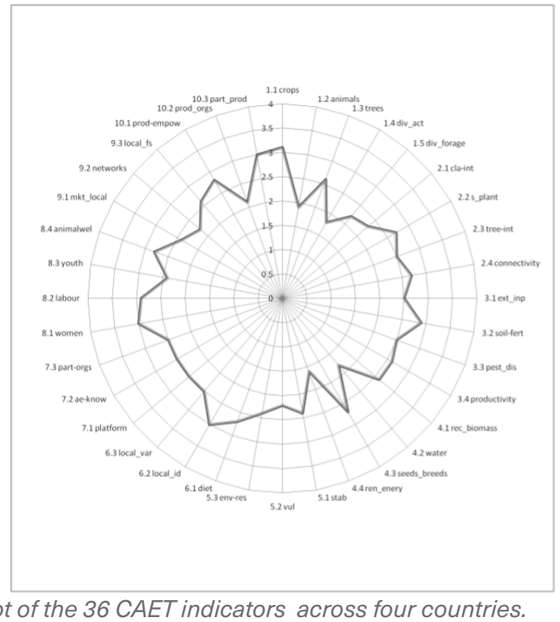

Figure 130: Radar plot of the 36 CAET indicators across four countries.

Within the element of **Human and Social values**, the sub-indicator on women's empowerment was amongst the most highly scoring of all indicators assessed in TAPE (Figure 130). Nearly half of the communities studied, such as the Karen Peoples and Khasi Peoples, follow matrilineal systems, where women play a central role in decision-making, inheritance, and the management of land and natural resources. Even in communities that are not strictly matrilineal, women are frequently active participants in land management and agricultural decision-making. They are

highly respected as custodians of agrobiodiversity, with in-depth knowledge of traditional seed varieties, seed-saving practices, and overall ecosystem management.

Kenya was the only country context in which women were perhaps less empowered in their ability to access (material and financial) resources: whilst women-centred co-operatives aimed at supporting agricultural and productive activities exist, women often struggle to access financial resources to support such work. Traditional land tenure systems, coupled with ongoing issues related to land rights, including forced evictions and marginalisation, have disproportionately impacted Ogiek women, limiting their access to land ownership and, consequently, to credit and investment opportunities.

Culture and food traditions also scored consistently highly, with the sub-indicator on traditional identity amongst the highest performing sub-indicators. Whilst in all communities included in the study, the Indigenous Peoples are threatened by a combination of policy pressures, market pressures and environmental/climate change, these high scores suggest a remarkable resilience and commitment to traditional practice. Overall, traditional practices and rituals that promote Indigenous identity were maintained, even in communities (such as the Ogiek) that have transitioned furthest away from traditional food practices, and there remains a strong sense of traditional identity.

The element of **Efficiency**, which captures the use of external inputs and management of soil fertility, pests, and diseases, also scored consistently highly in the systems examined. Whilst some communities have moved towards increasing use of external inputs on commercial crops, overall, traditional farming techniques and systems were still retained in many communities, which rely on organic practices/biological prevention methods – such as mulching, planting of nitrogen-fixing legumes, crop rotation - to manage soil fertility, pests, and diseases. Communities reflected on the in-built efficiencies within traditional systems: for example, in Karen rotational farming systems, periodic and controlled burning helps eliminate disease and decreases the number of insect pests. Burning also breaks down biomass for plant uptake, so there is no need for synthetic fertilisers and herbicides. The **management of soil fertility was amongst the highest-scoring sub-indicators**. Whilst often vilified, the use of fire to promote soil fertility was a key feature of the food systems examined in at least three of the countries - in the Karen rotational farming system, in the Yucatec Maya milpa, and in Northeast India, in jhum cultivation and bun cultivation.

The element of **Responsible Governance**, which encompasses inclusive decision making and equitable access to resources, shows a moderate score. This underscores the crucial role of effective governance in achieving positive agroecological outcomes. In agroecologically advanced systems, traditional governance structures are strongly upheld and deeply embedded in local cultures. These systems promote values such as solidarity, mutual responsibility, and fair resource management. Practices such as communal land ownership and collective decision-making are shown to enhance both resilience and responsible governance. However, the erosion of these traditional governance mechanisms, exacerbated by policy and market pressures, has led to lower scores in responsible governance, particularly in Kenya. The disruption of customary systems and external influences have compromised inclusive decision-making and equitable resource access, highlighting the need to support and preserve traditional governance structures to maintain and improve agroecological outcomes.

Synergistic relations constitute an essential component of the Indigenous Peoples' food system assessed. Through the seasonal dependency matrices and qualitative interactions with communities at step 0 and step 3, our study offered insight into Synergies that are actively maintained in Indigenous Peoples' food systems at multiple scales. At the species-level, the simultaneous sowing of maize, beans, and squash in the Yucatec Maya milpa system, for example, enhances ecological synergies within challenging soil conditions. At plot-level, intercropping, cover cropping and the integration of fruit trees within agricultural plots was noted as a common practice in all food systems examined, particularly in households' home gardens. Finally, at landscape-level, the Indigenous agroecosystems were diversified, comprising multiple, interconnected systems, and zones of ecological compensation (e.g. fallows, protected/sacred spaces, community forests) in all country contexts examined. The maintenance of multiple systems not only supports ecosystem health and regeneration but can also contribute to the dietary diversity of communities across the year and provide resilience against food crises.

The element of **Diversity** scored lower than expected across the systems studied, primarily due to the limited integration of livestock, as many of these food systems are not designed for animal rearing. In addition, three of the four Ogiek communities have transitioned away from pastoralism, which also contributed to the reduced diversity score. Despite this, the sub-indicator for **crop diversity remained consistently high** across all communities. The research, particularly through seasonal dependency matrices, showcased the wide range of crop species and varieties cultivated, with some communities growing over one hundred different species throughout the year. This rich crop diversity serves multiple essential functions, including promoting agrobiodiversity, enhancing ecological synergies, supporting dietary diversity and food security, and bolstering the resilience of the entire system.

The food systems assessed demonstrate strong practices of reuse of biomass and nutrients and depend heavily on self produced seeds and breeds. However, the element of **Recycling** scored lower in the studied sites. This lower rating is largely due to the rainfed nature of these systems, which limits the need for deliberate water-saving measures such as irrigation. Furthermore, these agricultural systems are characterised by their limited use of machinery and external fuel sources. While a few households have adopted renewable energy, such as using solar power for home lighting, the overall use of renewables in the farming process remains minimal

Multidimensional performance of agroecology

The assessment of the multidimensional performance of Indigenous Peoples' food systems and the role of agroecology has demonstrated their contribution to achieving various dimensions of sustainability. These practices align with the core criteria for sustainable agricultural practices essential for meeting the SDGs (FAO, 2019)

Economic Dimension: Indigenous Peoples' food systems that exhibit higher levels of agroecological performance are positively associated with improved economic outcomes, underscoring their economic viability. Farms that implement advanced agroecological practices generally achieve higher productivity, generate greater value from their agricultural activities, and

incur lower expenditures on inputs such as chemical fertilisers and pesticides. However, when analysing the value derived from crop production per hectare, the data reveals a weak to negative relationship. This trend is primarily attributed to the focus on self-sufficiency in these systems. Farms that emphasise self-sufficiency often prioritise internal consumption and resilience over maximising crop yields of few species for external markets.

Nutritional Dimension: The Food Insecurity Experience Scale (FIES) results reveal that food insecurity is nearly non-existent within the food systems analysed, highlighting the effectiveness of these systems in ensuring stable food access. This strong food security is largely attributed to the diverse systems within these communities. Agroecologically advanced systems are associated with lower food expenditure, reflecting greater efficiency and sustainability in food production. Furthermore, these systems offer enhanced dietary support, providing a wider range of nutritious foods and contributing to improved overall dietary quality.

Environment Dimension: The agroecologically advanced systems studied demonstrated significantly lower use of chemical pesticides and fertilisers per hectare, while farms where traditional farming practices are less prevalent showed a higher reliance on chemical inputs. Soil health remained consistently high across all study sites. In the most advanced agroecological systems, there is widespread adoption of soil management practices such as biomass recycling, intercropping, and crop rotation. Additionally, households with more advanced agroecological practices tend to have higher levels of agrobiodiversity. This includes a diverse array of crops, animals, natural vegetation, trees, and pollinators, contributing to a more resilient and balanced ecosystem. The presence of such diversity supports ecological stability and sustainability, as it enhances the ability of the system to withstand and recover from environmental stresses.

Social Dimension: Gender parity is consistently high across all the sites studied, reflecting an equitable distribution of roles and opportunities between men and women. Indicators of youth empowerment reveal that more advanced agroecological systems offer greater employment opportunities for young people, supported by diversified livelihood options. The findings also suggest that women in more advanced agroecological systems are slightly more empowered, as they have a more significant role in decision-making processes concerning crop and animal production, as well as in decisions on the use of income generated from agricultural activities.

Regional variations in agroecological performance across four countries

Advanced agroecological performance (>70%)

In Northern Thailand, the communities of Mae Paw Khee and Hin Lad Nai, where traditional farming practices are most intact, demonstrated high agroecological performance. These communities rely on rotational farming systems alongside home gardens and livestock rearing. An important characteristic of these communities is their sustainable fallow management and the use of forest gardens. These practices enable the communities to sustain their livelihoods without adopting cash cropping. Despite facing restrictive policies that pose challenges to the continuation of traditional farming practices, the communities of Mae Paw Khee and Hin Lad Nai

have demonstrated remarkable resilience and innovation. They have adopted creative strategies to raise awareness about the benefits and strengths of their agroecological systems.

In Northeast India, the food system of the Karbi People in Plasha showcases strong agroecological performance. The community sustains a diverse range of farming practices, including shifting cultivation, wet paddy farming, home gardens, and reliance on forest resources. Households have also integrated beekeeping into their homegardens. Although cash crops such as pineapple and arecanut are gradually expanding, the use of chemical inputs is deliberately avoided. The food system in Plasha actively preserves its cultural and food traditions, which are deeply intertwined with human and social values. Governance is adaptive, ensuring effective resource management and equitable decision-making. The village also fosters a high level of knowledge exchange, integrating traditional wisdom with modern agricultural practices.

Moderate- high agroecological performance (60-70%)

In Northern Thailand, Huay E Kha (65.4) and Khun Mae Yod (62.3) exhibit overall moderate-to-high agroecological performance. The practice of rotational farming has diminished in these communities, with a notable shift towards wet paddy cultivation driven primarily by commercial interests. While strong cultural and food traditions, as well as human and social values, are maintained, they face significant challenges in terms of efficiency. This is largely due to their reliance on chemical inputs, which undermines the sustainability of their agricultural practices.

Darechikgre (68.8) and Umsawwar (67.4) in Northeast India demonstrate moderate-high agroecological performance, with notable strengths in efficiency and strong human and social values. These values are evident in the way communities cooperate and manage shared resources. The governance structures in both villages support responsible and inclusive decision-making, fostering strong knowledge exchange. However, market dynamics have influenced a shift towards cash cropping, with Darechikgre increasingly focusing on areca nut cultivation and Umsawwar turning to broom grass production, which may affect the balance of their agroecological systems.

In the Mau Forests of Kenya, the food system of the Ogiek Peoples of Keneti (67.8) reflects a moderately high level of agroecological performance. This relatively strong score is attributed to the community's ability to integrate traditional pastoralism, honey production with sedentary farming practices. By maintaining these diverse practices, the Ogiek have been able to preserve ecological balance while meeting their nutritional and economic needs. Adherence to traditional governance structures foster a strong sense of responsibility for natural resource management and ensure that cultural values are maintained. The community has established guidelines to limit the use of chemical inputs prioritising resource efficiency.

In Mexico, the food systems of the Yucatec Maya communities of X'Pichil (65.7), Chacsinkín (62.9), and Tabasco (60.6) reflect moderately high levels of agroecological performance, each maintaining varying degrees of connection to traditional practices. Among these, X'Pichil stands out with the most intact traditional food systems. The community relies on a diverse system that includes the milpa, home gardens, beekeeping, and wild food harvesting. These practices not

only provide food security but also preserve biodiversity and sustain the local ecosystem. The use of cultivated land and natural resources in X'Pichil is governed by customary norms, cultural values, and long-established practices, ensuring sustainable management of resources passed down through generations.

Moderate- low agroecological performance (50-60 %)

Dewlieh (51.9) demonstrates lower overall agroecological performance compared to the other villages in Northeast India. While the community manages its resources efficiently, several challenges limit its full potential. A key issue is limited tenure security, which impacts the governance of land and resource management. Additionally, the community is undergoing a generational shift, with a growing younger population. Although this shift brings opportunities for innovation and modernisation, it also complicates the transmission of traditional food system knowledge. It is important to recognise that Dewlieh's relatively lower score may not fully capture the potential of their practices, as factors like socio-economic conditions and external pressures have contributed to the lower rating.

In Mexico, José María Morelos (53) demonstrates a moderately low agroecological performance, reflecting the erosion of its traditional food systems. The community faces significant challenges in maintaining its agroecological practices, as local knowledge continues to decline. As a key distribution hub for Green Revolution inputs, including chemical fertilisers and high-yield crop varieties promoted by government programs, the town has seen a rapid shift toward industrial agriculture. This transition has come at the cost of traditional farming methods, resulting in biodiversity loss, soil degradation, and a weakening of cultural practices closely linked to the land.

Low agroecological performance (<50 %)

The communities of Nessuit (42), Mariashoni (41.7) and Nkareta (39.4) from the Mau Forest of Kenya show low performance indicating significant challenges in their agroecological systems. These communities are undergoing a profound societal transition from traditional hunting and gathering lifestyles to more sedentary agricultural practices. This shift has increased their dependence on cash cropping, which in turn relies heavily on external inputs such as chemical fertilisers and pesticides. Limited access to the forest has restricted their ability to gather resources and maintain traditional practices that were integral to their subsistence. The erosion of land rights and forced evictions have further undermined the stability of their food systems. This dependency, coupled with the ongoing socio-environmental pressures, has made it increasingly difficult for these communities to maintain sustainable and resilient food systems.

6.3 Learning on the Indigenous Peoples' Food Systems from Storytelling

A synthesis of thirty stories from the Karen Peoples of Northern Thailand, the Garo Peoples, Karbi Peoples, and Khasi Peoples of North East India, and the Ogiek Peoples of Kenya reveals

valuable lessons for developing resilient and equitable food systems. These narratives provide seven essential insights into Indigenous Peoples' food systems. (TIP, 2024).

1. Food systems are rooted in the locality and the peoples

Central to the Indigenous Peoples' Food systems is a profound **connection to local** environments, highlighting the significance of local knowledge and accountability. Indigenous Peoples' food systems are intimately linked to specific ecological contexts, reflecting a deep understanding of local landscapes, species, and ecological dynamics. They are tailored to the unique characteristics of their ecosystems, which contrasts sharply with global policies that often apply a one-size-fits-all approach, leading to ineffective outcomes due to the disregard for diverse local contexts.

2. Food systems are biocentric, designed for all life

These stories also emphasise a **biocentric perspective** in Indigenous Peoples' food systems, where the health of various life forms and ecosystems is prioritised. This approach differs significantly from anthropocentric models that focus primarily on human needs and desires.

3. Food systems are inter-species collectives

Indigenous practices highlight the importance of **inter-species collaboration,** where humans are seen as integral participants rather than dominators of nature. The emphasis is on nurturing and respecting all living entities, which supports overall ecosystem health and resilience.

4. Food systems are co-evolved slowly, blending traditional and new

A notable aspect of Indigenous food systems is the **blending of traditional wisdom with modern knowledge.** These systems are dynamic and evolve through experiential learning and adaptation to changing climatic and environmental conditions. By integrating proven traditional practices with contemporary innovations, they address specific challenges effectively while preserving the wisdom of past generations.

5. Food systems value sufficiency, sharing and self-reliance

Additionally, Indigenous food systems are marked by **a sufficiency mindset,** where values of sharing and mutual support are prioritised over commodification and individual gain. Food is often shared within the community, fostering social cohesion and ensuring sustainable resource use. This approach contrasts with Western market-driven food systems, which can lead to overexploitation and inequality. By focusing on sufficiency, these food systems support diverse ecosystems and promote community self-reliance.

6. Food systems are supported by reciprocal governance and knowledge management practices

Governance in Indigenous food systems is characterised by **reciprocity and care,** replacing competitive and exploitative practices. These structures are built on principles of mutual aid, equitable resource distribution, and respect for ecological balance. They foster a sense of collective responsibility and ethical stewardship, ensuring that all community members contribute to and benefit from balanced resource management.

7. Resilience grows from respecting and nurturing nature, not saving it

These stories also convey that **resilience is rooted in a respectful and nurturing** relationship between humans and nature. Humans are seen as active participants in ecosystem health, guided by principles of respect and humility. Recognising that removing humans from ecosystems can have unintended negative consequences underscores the importance of maintaining this connection for biodiversity and ecological stewardship.

Lessons from these stories advocate for integrating local, biocentric, and reciprocal principles into modern food system policies to create systems that are both resilient and just.

Challenges to the Indigenous Peoples' food systems

Beyond the expression and scoring of agroecological principles, the application of TAPE in each four different countries shone light on the ways that Indigenous Peoples' food systems are being increasingly marginalised and undermined by policy and market dynamics. In Thailand, the lack of tenure recognition for traditional rotational farming lands, strict regulation on the use of burning, establishment of protected areas has pushed many communities into commercial monocropping. This shift undermines traditional agroecological practices that are crucial for maintaining biodiversity and sustainability.

In India and Mexico, the condemnation of fire usage along with government subsidisation of chemical inputs, introduction of high yielding varieties and market incentives has similarly led some households to move away from traditional organic/biological methods of farming. Additionally, extension support is lacking for those households wanting to retain these methods, or transition back to these. In India, the declining number of elderly farmers further threatens the preservation of traditional farming knowledge and wisdom.

Amongst all country contexts examined in this study, the strife of the Ogiek Peoples' food systems was particularly apparent. The Ogiek sites in Kenya were unique within this project for several reasons: Ogiek Peoples were traditionally hunter-gatherer communities, with a predominance of (wild) animal and plant sourcing from the forest. But these communities – including those in the study – are undergoing rapid societal shift due to loss of rights to land and forest in the name of conservation[2], and the promotion of a new cash-crop based livelihood that is alien to them. The poorer scores received by the Ogiek communities in this study must be interpreted in the context of these constraining conditions and add important impetus to calls for policy change in favour of traditional food systems.

Identifying best practices and templates for solutions

Despite the hardships faced by the communities in this study, overall, the results are encouraging, and a few communities in particular show remarkable ability to withstand external pressures and navigate them on their own terms. Such communities can be considered best practice models

[2] At the time of writing, many Ogiek communities are facing eviction: https://www.theguardian.com/global-development/2023/nov/08/we-are-living-in-absolute-fear-call-to-stop-indigenous-evictions-in-rift-valley

for agroecology (also referred to as "agroecological lighthouses" by Nicholls and Altieri, 2018), which offer templates of solutions that can be scaled and/or learnings applied elsewhere. In Thailand, Hin Lad Nai village is renowned as a "model" village, showing how traditional practices and the active conservation of biodiversity can be successfully maintained alongside adaptation to monetary economy. Hin Lad Nai has consciously avoided the ingression of cash crops (unlike other neighbouring villages) and thus, avoided the challenge of increasing land-use pressure and resultant degradation witnessed by surrounding villages in the region. The forest-based rural development model that Hin Lad Nai has pursued ensures the sustainable management of natural resources and provides nutrition security, whilst being economically viable.

In India, the results of TAPE indicated Plasha village as a notable example of successfully integrating traditional values and food system practices with adoption of cash cropping, particularly pineapple cultivation. With strong community leadership, the Plasha community maintains a deep sense of cultural identity, practising many rituals related to agriculture and use of traditional breeds and varieties. Customary laws continue to hold significant influence over food production, supporting sustainable management of resources as well as community cohesion. Additionally, the communities in Darechikgre and Umsawwar offer valuable models for facilitating the intergenerational transmission of knowledge within their respective communities. These include the creation of community-led initiatives like the Children's Dorbar in Umsawwar, showcasing effective approaches to preserve traditional wisdom and retention of the food systems.

In Mexico, the TAPE results highlight the capacity of X'Pichil village in maintaining its traditional farming system, despite the absence of policy support and stringent regulations on fire usage. While self-sufficiency and sharing come first, farmers have a network of direct contacts for sale of surplus produce, avoiding the potential exploitation associated with intermediaries. In implementation of Mexico's Sembrando Vida, the community has also chosen to set up nurseries of tree species that are locally adapted and economically viable to support agroforestry systems. Guided by customary norms, values, and practices, the community displays adept management of cultivated areas and natural resources.

Even in Kenya, TAPE highlights how the community of Keneti has been more able than the other communities to avoid some of the adverse consequences associated with the uptake of cash cropping. The local community has imposed regulation to limit the excessive use of fertilisers, even on cash crops; and most households use minimal fertilisers on agricultural products and have adopted crop rotation to support soil fertility. To avoid exploitative relationships with intermediaries, livestock producers are increasingly banding together in informal groups to bring livestock to a common place, where consumers will come to purchase animals and animal products directly. With this being the first generation of Ogiek Peoples to be dependent on sedentary, often commercial agriculture, communities are precariously learning how to navigate these new challenges. With Keneti seemingly navigating these new challenges more successfully, the community may offer lessons to others in the region. Taken together, these examples show the utility of TAPE in helping to pinpoint systems or attributes that are functioning well, and thus offers evidence to develop interventions to scale up agro ecological benefits .

6.4. Study Strengths and Opportunities for Advancement

Study Strengths

The value of TAPE implementation for Indigenous Peoples Food Systems

The results from this study demonstrate how TAPE can be a useful and important tool in establishing a baseline assessment of the agroecological status and performance of the Indigenous Peoples' food systems. The multidimensional approach of TAPE not only identifies well-performing systems but also reveals the practices, structures, and enabling factors that support them. Equally, the instrument elucidates systems that are perhaps agroecologically under-performing, and offers hypotheses as to why this may be the case (e.g. due to particular practices or aspects of the constraining environment). In doing so, TAPE thus offers a way to develop well-informed interventions to support agroecological practice.

The information gleaned can be a useful tool for engagement and negotiation towards regional, national, and global policy-level change to support the sustainability of Indigenous Peoples' food systems. However, it can also be used as a tool by producers and communities themselves. During TAPE Step 3, when results were shared with the communities, producers found that the information provided valuable insights into their food systems and empowered them to make practical changes to improve their food systems and livelihoods. In Dewlieh, Northeast India, producers have already begun diversifying crop production in their home gardens. They realised through TAPE that their reliance on markets and food expenditures was particularly high during the winter months. The survey also highlighted their lack of documentation regarding expenses and productivity, prompting them to focus on better record-keeping to enhance their food and livelihood planning. Similarly, in Khun Mae Yod, Northern Thailand, the community became motivated to seek alternatives to chemical inputs and enhance their rotational farming practices. In this sense, the use of TAPE within Indigenous Peoples' food systems is further encouraged to generate data and evidence that supports both structural policy changes and local community needs. Additionally, practitioners are also encouraged to produce community-friendly outputs of results that can be shared with the community and usefully applied as resources.

Further strengths of the study process can be identified. The process of completing the TAPE exercise required the thorough training of local youth enumerators on agroecology and research practice. Thirty one Indigenous Peoples including 22 local youths participated as enumerators and were trained as part of this process. Not only has this built the knowledge and research capacity of local youth, but it also encouraged important self-reflection on their food system and evoked a sense of pride. During internal reflection sessions following data collection, one enumerator commented that undertaking the survey had offered her a better understanding of her own food system and the practices they entail, as well as a broader understanding of Indigenous Maya language. Exercises such as TAPE thus may offer a way to empower local youth to participate in the promotion and retention of their food system more actively. At the organisational-level, research teams similarly reflected that the exercise had helped them to better understand the food systems that they were working with. The research team from India commented that

through the seasonal dependency matrix, they had gained new knowledge on the true diversity of food systems utilised, and the crops and animal diversity that they support. Typically, previous interactions with the community had centred on predominant food systems only (e.g. shifting cultivation fields or home gardens), or only on dominant crop types. The team remarked that these new insights were helpful in making them reflect on the intervention design within their partner communities.

This study introduced key modifications to the TAPE instrument and process to more effectively capture the unique characteristics and strengths of Indigenous Peoples' food systems. Recognising that these systems are pluralistic and consist of multiple interconnected components, the addition of the seasonal dependency matrix was particularly significant. This enhancement allowed for a more comprehensive understanding of the diversity within food systems and the range of foods produced or gathered. In its original form, crop diversity is confined to expressions such as "More than 3 crops of different varieties [are grown]" in Step 1, or abundance counts in agrobiodiversity indicators of Step 2. The addition of the matrix also offered richer insight into seasonal undulations in food provision and food source use. For example, it allowed the identification of any "lean" periods - when access to market-sourced alternatives becomes more critical. Understandings of seasonal diversity are not enabled by the original instrument but are an important prerequisite to food system intervention.

The value of combining TAPE and participatory storytelling

A separate report (TIP, 2024) details how participatory storytelling added value to the TAPE instrument in building an evidence base about how, when, why and in what ways Indigenous Peoples' food systems support people and landscapes to thrive. Participatory storytelling has the following features that complement the methodology of TAPE:

- **Deepening the inquiry space:** Participatory story collection is an open-ended invitation, which deepens the evidence-generation space beyond a predetermined framework or category of elements / elements.
- **Privileging lived experience:** People tell stories about what is most important to them, eliciting new knowledge derived from lived experience.
- **Uncovering causal dynamics:** Storytellers, people in their community, field partners and international research teams collectively analyse the stories for causal patterns and directions of causality between outcomes, practices and worldviews.

For Indigenous Peoples, stories were a way of reconnecting to their cultural identity and integrity, creating new opportunities to reproduce cultural knowledge, especially intergenerationally between elders and young people. As our field partner, NESFAS, reflected about their work with Khasi, Karbi and Garo peoples:

> *"There was an overwhelming positive response from the community. It was like a community bonding finding commonalities in the stories. The analysis of the stories provided a platform for discussing collective identity. Reflecting on the value, it was evident the story analysis*

session was an important community empowerment exercise especially because the stories are not commonplace among young people. So marginalised voices came out and helped cultural preservation".

For actors working with FAO, and other related agencies and NGOs, the collection of Indigenous Peoples' stories generated another layer of evidence that Indigenous Peoples' food systems incorporate elements of agroecology. To see examples of recycling, synergies and resilience embedded in folk tales, descriptive accounts of hunting, planting and water management practices underlined the embeddedness of agroecology elements in the ways Indigenous Peoples approach the design of their food systems.

The stories also revealed different ways of being, seeing and doing common to the diverse Indigenous Peoples' food systems, but distinct from worldviews underpinning FAO's elements of agroecology. Some of these ways of being, seeing and doing influenced how Indigenous Peoples' related to FAO's elements of agroecology, which have implications for how food systems are designed and evaluated for success (see Table 18).

Worldviews underpinning FAO elements of agroecology	**Worldviews and values underpinning Indigenous Peoples' food systems**	**Implications for how Indigenous Peoples relate to FAO elements of agroecological food systems**
Anthropocentric	Bio-centric Eco-centric Pluricentric Cosmocentric	Humans cannot be centred in assessments of whether a food system is working. The health of all beings need to be considered because biodiversity and harmonious interrelationships underpin security and resilience.
Instrumental	Sacred Spiritual Relational	Food is an expression of love and inter-being, integral rather than incidental to culture, identity and spiritual connection. Scared connections structure the design of food systems, which is a different departure point from western economics.
Scarcity	Sufficiency	When no person or being takes more than they need, space is created for nature to regenerate itself, meaning that less is more when measuring agroecological inputs. Smaller, more diverse yields are valued over larger, less diverse yields. Social components of resilience are more highly valued than economic components of resilience.

Table 18: Articulating the worldviews underpinning FAO elements of agroecology in comparison with worldviews and values underpinning indigenous food systems, and the implications of these differing worldviews for how indigenous peoples relate to FAO elements of agroecological food systems (TIP, 2024, forthcoming).

A separate report (TIP, 2024, forthcoming) that synthesises the findings from all 30 stories shows how participatory storytelling showed linkages between food systems practices and outcomes and a different set of elements and worldviews to those in the TAPE instrument. The stories suggest measuring success of Indigenous Peoples' food systems against a different set of qualities and criteria, including:

- rootedness in the locality and people
- biocentricity
- collectivity with species and living entities
- co-evolution of traditional and new
- sufficiency, caring and self-reliance
- reciprocal governance systems
- respect for the wisdom of nature and natural processes

Importantly, indigenous qualities appear conducive and complementary to common elements of agroecology. They are perhaps pointing more towards cultural transformations than technical ones, but overall they present as helpful in on-going learning and guidance about agroecological transitions, particularly in non-indigenous systems.

The stories also suggest some important bidirectionality and causality in the relationships between elements of agroecology that influence overall performance. For example, the stories showed diversity to be an outcome of agroecological performance but the maintenance of diversity was also depicted as an input of food systems that are resilient This understanding of biodiversity - as a foundational element as well as a desirable outcome - may go some way to explain why the 20-25% of Earth's land surface managed by Indigenous Peoples' coincides with areas that hold 80% of the planet's biodiversity (UN/DESA, 2021). It also suggests that a low TAPE score on resilience may be best improved by looking at enhancing diversity, including seasonal and inter-annual diversity. This is a different starting place from interventions (e.g., economic) seeking to directly improve scores on resilience.

In summary participatory storytelling permitted the project to travel freely, unencumbered, into the knowledge systems of highly diverse biocultural regions, with connections to ancestral wisdom stretching back beyond western modernity's years. It took participants on a more self-reflexive journey, which added a deeper layer of learning about why food systems have been designed as they have. In facilitating a more explicit interplay between Indigenous Knowledge and Western Science new questions emerged about how western modernity relates to food cultivation and production. In so doing, the project gestured towards futures where different methodologies and ways of knowing are purposefully brought into conversation with one another to respond to the challenges of our times.

Enhancing TAPE Study for Indigenous Peoples' Food Systems

The use of TAPE in Indigenous Peoples' food systems highlighted opportunities for further enhancement of the instrument and the study process. While initial modifications were made to better align with unique attributes of these systems, there remains potential to enhance its ability to capture additional dimensions of the food systems and their socio-cultural contexts. Future iterations of TAPE could consider further adaptations or the integration of complementary methods to better capture the relative complexity of Indigenous Peoples' food systems compared to conventional agricultural systems.

Indigenous Peoples' food systems adopt a landscape approach creating a mosaic of systems that not only supports a diverse array of food sources but also enhances ecological functions. TAPE could benefit from further adaptation to territories that encompass multiple systems to include both cultivated and natural environments. Although the inclusion of the seasonal dependency matrix helped illuminate the diversity of systems within communities, subsequent steps of the questionnaire could further enhance the capture of landscape-level diversity. For instance, in Steps 1 and 2, participants often needed to provide responses that either aggregated information across their entire food system (such as total crops or trees) or represented average characteristics (like the average percentage of soil covered by cover crops). This approach necessitated careful oversight from enumerators to avoid favouring any single system in the responses. Moreover, there were cases where neither amalgamation nor averaging was applicable. A relevant example is found among many Karen farmers who practise both paddy cultivation and rotational farming; while the ownership of paddy fields is legally recognised, rotational farmland lacks similar recognition.

Communal land is a vital component of Indigenous Peoples' food systems (IPFS) across all communities. These communal spaces are managed and governed according to customary norms, facilitating their use for agriculture, foraging, grazing, and the collection of non-edible subsistence resources. While TAPE has been designed to be adaptable to various contexts and incorporates diverse perspectives, it notably emphasises on agricultural systems that operate within private property regimes. Although some communities shows an increasing trend towards land use regimes models akin to private ownership, communal lands are still maintained in all. While such regimes may be noted during Step 0, the subsequent steps of TAPE could be improved to better capture the agroecological significance of these communal lands.

Certain attributes of the Indigenous Peoples' food systems may be misinterpreted within the scoring system of TAPE. While discussions in steps 0 and 3 acknowledge these nuances, future iterations of TAPE can enhance the scoring strategy in Step 1 to better recognise these aspects of Indigenous Peoples' food systems. For instance, the existing scoring framework may not be able to fully reflect the full scope of crop diversity. Farms that cultivate multiple varieties of a single species (such as different maize varieties cultivated in milpa) may be undervalued in the scoring system, even though they exhibit significant horizontal resistance. Similarly, in many of the communities studied, livestock raising is not an integral constituent of the system leading to lower scores in animal diversity. Many of the Indigenous Peoples communities prioritise self-sufficiency over market sales, dedicating a significant portion of the year to farming activities, with only a limited engagement in off-farm economic activities. Additionally, agroecosystem-related services, such as processing and transportation of goods, are often undertaken by a small number of community members. However, these efforts provide essential support to the entire community. This emphasis may diminish the perceived diversity of economic activities in the scoring system, even though the communities meet their nutritional and social needs. Indigenous

[3] We say "akin to" since formal land titles are still often lacking.

Peoples' food systems are predominantly rain-fed, with species selected for their adaptability to local climatic conditions and grown in alignment with seasonal rains. Practices such as mulching and intercropping are adopted to conserve water. However, these systems do not always involve direct water harvesting or saving techniques. The scoring system for this indicator is structured to give higher scores based on the use of both equipment for water harvesting and conservation practices. As a result, Indigenous Peoples' food systems receive lower scores due to the absence of equipment-based water saving practices, despite their effective water conservation strategies. Future study could consider expanding criteria to include a broader range of water saving practices beyond equipment use. Indigenous Peoples' food systems embody resilience through communal, ecological, and non-monetary mechanisms, often relying on community knowledge, resource-sharing practices, and diverse crops and land-use strategies. The current emphasis on economic and environmental stability may overlook the self-sufficiency and natural productivity variations inherent in these systems, which are driven by ecological factors rather than inefficiencies. Future adaptations could broaden the indicators to better capture these unique forms of resilience.

Indigenous Peoples' food systems often involve complex intercropping and agroforestry systems, making it challenging and time-consuming to assess the productivity and revenue of individual crops. Many of these crops are grown for subsistence, and their value is not always reflected in monetary terms. Additionally, with labour and inputs shared communally, calculating true economic costs or returns can be difficult, potentially leading to underreporting. While this study has made efforts to standardise local metrics, future research could greatly benefit from additional time and investment to develop a broader set of metrics. This would enable a more comprehensive understanding of the productivity and revenue of Indigenous Peoples' food systems.

The soil health indicators used in this study, such as physical measurements and microbial testing, though valuable, were beyond the scope of this research, especially, given the complexity of assessing multisystems with varying soil types. These methods can also be costly and time-intensive. There is significant potential to align soil health assessments more closely with Indigenous approaches, which emphasise long-term, location-based observations. Indigenous knowledge systems often assess soil health through indicators such as crop performance, the presence of specific plants, insect behaviour, the plot's orientation relative to environmental factors like sunlight etc. Future study designs could benefit from integrating these qualitative, culturally-informed methods with conventional scientific approaches, creating a more holistic and inclusive framework for assessing soil health across different ecological and cultural contexts.

6.5 Policy Recommendation

The TAPE study reveals that Indigenous Peoples' food systems have tenets that can contribute to sustainable food system transformation. However, it is crucial to recognise that, despite their historical resilience, Indigenous Peoples' food systems are increasingly threatened by external pressures such as land encroachment, deforestation, climate change, and global economic forces. These factors can undermine the foundational elements of these systems compromising their ability to function resiliently. To effectively support Indigenous Peoples' food systems in the sites studied, six core areas for inclusion into policy framework have been recommended:

1. **Legal Recognition of Land and Resource Rights:** Recognising the intrinsic value of Indigenous Peoples' food systems is crucial to securing land and resource rights and fostering their long-term resilience and sustainability. For example, the eviction of the Ogiek Peoples from their ancestral lands in Kenya highlights the need for legal frameworks that protect land tenure and customary rights while preventing land grabbing and resolving disputes. Similarly, negative perceptions of traditional practices such as rotational farming, shifting cultivation, and milpa undermine their importance to Indigenous Peoples. These practices are often wrongly viewed as primitive or environmentally harmful, despite their proven benefits for biodiversity, soil health, and sustainable land use. Legal frameworks consistent with the UN Declaration of the Rights of Indigenous Peoples should be developed to protect these traditional agricultural methods and ensure that Indigenous Peoples have the right to manage and sustain their food systems on their own terms.

2. **Integration of Indigenous Knowledge in Policy Frameworks:** National policies on agriculture, forestry, and environmental management should actively incorporate Indigenous knowledge, practices, and values. For instance, integrating local crop varieties and traditional resource and forest management practices intrinsic to Indigenous Peoples' food systems can support community sustainability and resilience. Efforts should also prioritise, documenting, preserving, and training in Indigenous knowledge systems. Creating platforms for knowledge co-creation, where Indigenous practices are shared and given equal importance as scientific research, can bridge traditional wisdom with modern science. Such collaborations will lead to more effective and culturally relevant policies.
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3. **Support for Sustainable Livelihoods and Economic Inclusion:** Supportive policies to enhance green livelihoods based on Indigenous Peoples' food systems are vital for improving their economic inclusion. This involves offering financial support, training, and technical assistance to bolster these practices, as well as improving market access for Indigenous Peoples products.. It is also essential to align development projects with the specific needs and values of Indigenous Peoples to ensure that these projects are both beneficial and sustainable.

4. **Strengthening Governance and Participation:** Active participation of Indigenous Peoples in governance is essential for equitable policies. Integrating Indigenous values into governance provides unique insights into community management and resource stewardship. Including Indigenous representation and empowering local institutions ensures policies reflect their needs. Creating platforms for dialogue and policy co-creation fosters inclusivity and supports cultural preservation and governance sustainability.

5. **Promoting Environmental and Cultural Sustainability:** Aligning policies with Indigenous Peoples practices that safeguard biodiversity and cultural heritage is essential. Support for community-led conservation, nutrition improvement through the wide div and sustainable resource management is crucial, and regulations should be revised to accommodate traditional practices. Investing in programs that connect Indigenous food systems with climate adaptation and biodiversity goals can protect these systems from external threats.

6. **Improving Access to Services and Infrastructure:** Enhancing access to services and infrastructure is vital for strengthening Indigenous Peoples and their food systems. This involves expanding healthcare, education, and financial services while integrating Indigenous Knowledge. Investing in infrastructure and supporting community-led initiatives will help sustain and improve Indigenous Peoples' food systems and livelihoods.

CHAPTER
7

Brief report on Food Insecurity Experience Scale results from Indigenous Peoples' communities in Northeast India

Background

- The Sustainable Development Goals challenge the world to end hunger and ensure access for all people to safe, nutritious, and sufficient food all year round. Most recent estimates (from 2021) indicate that approximately 29.6 percent of the global population (2.4 billion people) are moderately or severely food insecure, an increase of almost 400 million since 2019 (FAO, 2023). In Southeast Asia, little progress has been made in reducing the prevalence of food insecurity. As in many regions, the COVID-19 pandemic saw a further setback in progress towards reducing food insecurity.
- The Food Insecurity Access Scale (FIES) is one of two indicators selected to assess progress towards the ambitious goal of ending global hunger. The scale assesses the severity of food insecurity at the household or individual level, based on a brief eight-item survey to which respondents provide yes/no to questions regarding their access to adequate food (FAO, 2017). FIES is a statistical measurement scale similar to other widely-accepted scales designed to measure unobservable traits (latent variables), and since its inception, has been widely applied as a reliable and valuable tool for global food security monitoring (Ballard, Kepple and Cafiero, 2013).
- In two separate studies, the Northeast Society for Agroecology Support (NESFAS) used the FIES to measure the prevalence of food insecurity in almost 700 households in 21 Indigenous Peoples' communities in two states in northeast India (Meghalaya and Nagaland). All communities are predominantly reliant on shifting cultivation (or a variant of). This brief report summarises the outcomes of these studies. Sampling strategy and data collection processes can be found at the base of this brief.

Key findings

- The results of the two surveys consistently show that severe food insecurity is virtually non-existent in the communities studied. Moderate food insecurity is experienced at rates that are typical of high-income countries in Europe, North America, and East Asia.

Prevalence of moderate-severe food insecurity (%)	
Survey 1 (2021, N=576)	Survey 2 (2023, N=120)
11.3%	10%

- The results suggest that communities were able to withstand pressures of COVID-19 pandemic (and associated restrictions) and might indicate bounce back/recovery from the pandemic, with further reductions in food insecurity seen post-pandemic.
- The food systems within the communities are predominantly based upon traditional practices of shifting cultivation, alongside the use of other cultivated systems, natural systems, and use of external sources (e.g. market, Public Distribution System). These findings support that these traditional food systems can ensure access to safe, nutritious, and sufficient food.

Limitations & Caveats

- Due to the different sampling approaches adopted, the surveys cannot be taken as directly comparable - rather they should be taken as surveys from which findings are supportive of one another.
- Similarly, only hypotheses of temporal change can be made based on this data, since this was not a longitudinal survey, and thus was not completed on the same households nor using the same sampling approach.
- In both cases, the FIES was applied in one season only (both during wet season, thus cannot capture seasonal variation.
- 2021 Data Collection: The 2021 round of FIES data collection included 576 Indigenous households from 18 communities in Meghalaya and Nagaland. Based on information gathered from a previous 2018 study, communities where shifting cultivation was found to be practised by more than half of the households were selected for inclusion. From each community, 32 households were randomly selected from each village. Where villages were smaller than this, all households were invited to participate in the study. Data collection took place during the months of June 2021, which represents the wet/monsoon period in northeast India.
- 2023 Data Collection: The 2023 round of FIES data collection included 120 Indigenous households in four communities of Meghalaya. The data were collected as part of a larger

study using the Tool for Agroecology Evaluation (TAPE), within which there is a module on food insecurity. The four communities were selected for the study to represent the traditional food systems of the three dominant tribes within Meghalaya. All communities rely heavily upon shifting cultivation (or a variant of). From each community, 30 households were selected for participation at random. The data collection took place between May and September 2023.

This report was prepared in January 2024, by Dr Charlotte Milbank, The Indigenous Partnership for Agrobiodiversity and Food Sovereignty (TIP), based on 2021 survey data provided by FAO and NESFAS, and 2023 data collected by NESFAS as part of a survey using the FAO TAPE tool.

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ANNEX

ANNEX 1 : Example of Seasonal Dependency Matrix (based on Dewlieh, Meghalaya)

Food Sub-Systems	Foods available from each source, in each month											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Shifting Cultivation [field]				*Tit dympuin (mushroom variety)*	Black mustard, Mustard, Buckwheat, Jakhria, Jalyniar	Black mustard, Mustard, Buckwheat, Jakhria, Jalyniar, Sweet potato leaves, Tangduma, Hookers chives, Cucumber	Black mustard, Mustard, Buckwheat, Jakhria, Jalyniar, Sweet potato leaves, Tangduma, Hookers chives, Cucumber, Potato, Taro Stem, Ginger.	Black mustard, Mustard, Buckwheat, Jakhria, Jalyniar, Sweet potato leaves, Tangduma, Hookers chives, Cucumber, Potato, Taro Stem, Ginger, Bitter tomato, Garlic chives, Chilli, Maize	Black mustard, Mustard, Buckwheat, Jakhria Jalynia, Sweet potato leaves, Tangduma, Cucumber, Potato, Taro Stem, Bitter tomato, Garlic chives, Hookers chives, Chilli, Maize	Black mustard, Mustard, Buckwheat, Jakhria Jalyniar,, Sweet potato leaves, Tangduma, Cucumber, Potato, Taro Stem, Bitter tomat, Garlic chives, Hookers chives, Chilli	Rice bean, Perilla seeds, Buckwheat, Jakhria, Jalyniar, Sweet potato leaves, Tangduma, Cucumber, Potato, Phan jata, Phan shriew, Phan sawhoin, Taro Stem, Bitter tomato, Garlic chives, Hookers chives, Chilli Ginger	Rice bean, Perilla seeds, Buckwheat,, Jakhria, Jalyniar, Sweet potato leaves, Tangduma, Cucumber, Potato, Phan jata, Phan shriew, Phan sawhoin, Taro, Bitter tomato, Garlic chives,, Hookers chives, Chilli, Ginger, Turmeric, Finger millet, Adlay millet
Shifting Cultivation [fallow]						Sweet potato, Cassava, Jakhria, Gynura sp., Taro, Jalyniar, Phan	Sweet potato, Cassava, Jakhria, Gynura sp., Taro, Jalyniar, Phan	Sweet potato, Cassava, Jakhria, Gynura sp., Taro, Jalyniar,	Sweet potato, Cassava, Jakhria, Gynura sp, Taro,	Sweet potato, Cassava, Jakhria, Gynura sp, Taro, Jalyniar, Ginger.	Black mustard, Jakhria, (Jalyniar, Sweet potato, Cassava., Ginger	Sweet potato leaves, Black mustard, Jakhria, (Jalyniar,, Ginger	Sweet potato, Cassava, Jakhria, Gynura sp, Taro, Jalyniar, Tit	Sweet potato, Cassava, Jakhria, Gynura sp, Taro, Jalyniar, Tit	Sweet potato, Cassava, Jakhria, Gynura sp, Taro, Jalyniar	Sweet potato, Cassava, Jakhria, Gynura sp, Taro, Jalyniar,	Sweet potato, Cassava, Jakhria, Gynura sp, Taro, Jalyniar,
						jata, Phan shriew, Phan sawhoin, Ginger.	jata, Phan shriew, Phan sawhoin, Ginger.	Phan jata, Phan shriew, Phan sawhoin, Ginger.	Jalyniar, Ginger.				thlong,, Tit tynrai.	thlong, Tit tynrai			
Kitchen Garden						Banana, Chilli, Bitter tomato, Lemon, Banana stem, Leech gourd, Hooker's chives, Mint, Mustard, Culantro, Gynura sp, Eggs	Banana, Chilli, Bitter tomato, Lemon, Banana stem, Hooker's chives, Mint, Mustard, Culantro, Gynura sp, Eggs	Banana, Chilli, Bitter tomato, Lemon, Banana stem, Hooker's chives, Mint, Gynura sp, Eggs	Banana, Gynura sp, Chilli, Bitter tomato, Hooker's chives, Fish mint, Buckwheat, Jakhria, Mint, Jabuit, Eggs	Buckwheat, Bayberry, Tree tomato, Gynura sp, Fish mint, Hooker's chives, Lemon, Mulberry, Plum, Banana stem, Banana, Peach, Passion fruit, Jakhria, Bitter tomato, Mint, Eggs	Buckwheat, Bayberry, Tree tomato, Gynura sp, Fish mint, Hooker's chives, Lemon, Plum, Banana stem ,Banana, Peach, Passion fruit, Jakhria, Taro stem, Eggs	Buckwheat, Tree tomato, Gynura sp, Fish mint, Hooker's chives, Lemon, Plum, Banana stem, Banana, Peach, Passion fruit, Jakhria, Taro stem, Chow chow, Pear, Eggs	Buckwheat, Tree tomato, Gynura sp, Fish mint, Hooker's chives, Lemon, Plum, Banana stem, Banana, Peach, Passion fruit, Jakhria, Taro stem, Chow chow, Pear, Jackfruit, Khasi Cherry, Mint, Bitter tomato, Eggs	Buckwheat, Tree tomato, Gynura sp, Fish mint, Hooker's chives, Lemon, Plum, Banana stem,Banana, Passion fruit, Jakhria, Chow chow, Pear, Jackfruit, Khasi Cherry, Mint. Bitter tomato, Eggs	Buckwheat, Tree tomato, Gynura sp, Fish mint, Hooker's chives, Lemon, Plum, Banana stem, Banana, Passion fruit, Jakhria, Chow chow, Khasi Cherry, Mint, Bitter tomato,, Eggs	*Gynura sp, Hooker's chives, Chilli, Tree tomato, Bitter tomato, Guava, Lemon, Mint, Mustard, Lettuce, , Sohlah, Taro, Turmeric, Arrowroot, Eggs*	*Gynura sp, Hooker's chives, Chilli, Tree tomato, Bitter tomato, Guava, Lemon, Mint. Mustard, Lettuce, Sohlah, Taro, Turmeric, Arrowroot, Eggs*

Forest	Gynura sp, Jakhrih, Banana stem, Pashor kait lieh, Pashor kait iong, Lapong dieng, Jasim,	Gynura sp, Jakhrih, Banana stem, Pashor kait lieh, Pashor kait iong, Lapong dieng, Jasim,	Gynura sp, Jakhrih, Banana stem, Pashor kait lieh, Pashor kait iong, Lapong dieng, Jasim,	Gynura sp, Jakhria, Banana stem, Lapong dieng, Jasim, Jawieh, Jajew myrkhan,, Rodent,	Gynura sp, Jakhria, Banana stem, Lapong dieng, Jasim, Jawieh, Jajew myrkhan,, Rodent,	Gynura sp, Jakhria, Banana stem, Lapongdieng, Jasim, Jawieh, Jajew myrkhan,, Rodent, Squirrel,	Gynura sp, Jakhria, Banana stem, Lapong dieng, Jasim, Jawieh, Jajew myrkhan,, Rodent,	Gynura sp, Jakhria, Banana stem, Lapong dieng, Jasim, Jawieh, Jajew myrkhan, Rodent,	Gynura sp , Jakhria, Banana stem, Lapongdieng, Jasim, Jawieh, Jajew myrkhan , Rodent, Squirrel,	Gynura sp, Jakhria, Banana stem, Lapongdieng, Jasim, Jawieh, Jajew myrkhan , Rodent, Squirrel,	Gynura sp , Jakhria, Banana stem, Lapong dieng, Jasim, Jawieh, Jajew myrkhan, Rodent,	Gynura sp , Jakhria, Banana stem, Lapong dieng, Jasim, Jawieh, Jajew myrkhan, Rodent,
	Jawieh, Jajew myrkhan, Rodent, Bamboo rat, Squirrel	Jawieh, Jajew myrkhan, Rodent, Bamboo rat, Squirrel	Jawieh, Jajew myrkhan, Rodent, Bamboo rat, Squirrel	Squirrel , Kait lieh, Kait-iong.	Squirrel , Kait lieh, Kait-iong.	Kait lieh, Kait-iong.	Squirrel , Kait lieh, Kait-iong.	Squirrel , Kait lieh, Kait-iong, Tit thlong, Tit Tynrai	Kait lieh, Kait-iong, Tit thlong, Tit Tynrai, Sohjrum haiah, Sohben, Sohkha wiang, Sohlapong	Kait lieh, Kait-iong, Tit thlong, Tit Tynrai Sohjrum haiah, Sohben Sohkha wiang, Sohlapong, Niangkrai, Niangsohriew (insect)	Squirrel , Kait lieh, Kait-iong.	Squirrel , Kait lieh, Kait-iong.
River	Gaongta loach, Channa sp, Crab, Dohpieh	Gaongta loach, Channa sp, Crab, Dohpieh	Gaongta loach, Channa sp, Crab, Dohpieh,	Gaongta loach, Channa sp, Crab, Dohpieh	Gaongta loach, Channa sp, Crab, Dohpieh, tadpole	Gaongta loach, Channa sp, Crab, Dohpieh, tadpole	Gaongta loach, Channa sp, Crab, Dohpieh, tadpole	Gaongta loach, Channa sp, Crab, Dohpieh, tadpole	Gaongta loach, Channa sp, Crab, Dohpieh , tadpole, dohjier	Gaongta loach, Channa sp, Crab, Dohpieh , tadpole, dohjier	Gaongta loach, Channa sp, Crab, Dohpieh, tadpole,	Gaongta loach, Channa sp, Crab, Dohpieh, tadpole, dohjier
Food welfare	Rice	Rice	Rice	Rice	Rice	Rice	Rice	Rice	Rice	Rice	Rice	Rice

Market	Rice, Pork, Chicken , Eggs, Onion, Turmeric, Salt, Tea leaves, Sugar, Potato, Tomato, Cabbage, Cauliflower, Carrot, Beans, Lentil,	Rice, Pork, Chicken , Eggs, Onion, Turmeric, Salt, Tea leaves, Sugar, Potato, Tomato, Cabbage, Cauliflower, Carrot, Beans, Lentil,	Rice, Pork, Chicken , Eggs, Onion, Turmeric, Salt, Tea leaves, Sugar, Potato, Tomato, Cabbage, Cauliflower, Carrot, Beans, Lentil,	Rice, Pork, Chicken , Eggs, Onion, Turmeric, Salt, Tea leaves, Sugar, Potato, Tomato, Cabbage, Cauliflower, Carrot, Beans, Lentil	Rice, Pork, Chicken , Eggs, Onion, Turmeric, Salt, Tea leaves, Sugar, Potato, Tomato, Cabbage, Cauliflower, Carrot, Beans, Lentil	Rice, Pork, Chicken, Eggs, Onion, Turmeric, Salt, Tea leaves, Sugar, Potato, Tomato, Cabbage, Cauliflower, Carrot, Beans, Lentil	Rice, Pork, Chicken , Eggs, Onion, Turmeric, Salt, Tea leaves, Sugar, Potato, Tomato, Cabbage, Cauliflower, Carrot, Beans, Lentil	Rice, Pork, Chicken , Eggs, Onion, Turmeric, Salt, Tea leaves, Sugar, Potato, Tomato, Cabbage, Cauliflower, Carrot, Beans, Lentil	Rice, Pork, Chicken, Eggs, Onion, Turmeric, Salt, Tea leaves, Sugar, Potato, Tomato, Cabbage, Cauliflower, Carrot, Beans, Lentil	Rice, Pork, Chicken, Eggs, Onion, Turmeric, Salt, Tea leaves, Sugar, Potato, Tomato, Cabbage, Cauliflower, Carrot, Beans, Lentil	Rice, Pork, Chicken , Eggs, Onion, Turmeric, Salt, Tea leaves, Sugar, Potato, Tomato, Cabbage, Cauliflower, Carrot, Beans, Lentil Mustar	Rice, Pork, Chicken , Eggs, Onion, Turmeric, Salt, Tea leaves, Sugar, Potato, Tomato, Cabbage, Cauliflower, Carrot, Beans, Lentil Mustar
	Mustard leaves	Mustard leaves	Mustard leaves								d leaves.	d leaves.

ANNEX 2 : Template for Story Collection Work Plan

Activity	Questions to consider	Notes
Preparing for story collection		
Selection criteria for stories and storytellers	• What is our selection criteria for story topics? • What is our selection criteria for storytellers? • How will we connect to people who can share stories?	
Free, prior, informed consent	• What consent processes do we need in place at every stage of the storytelling process? • Do we have a consent form? • Have we submitted our consent process and forms to the project team?	
Collecting & recording stories		
Invitation	• What do we need to say to introduce ourselves, the project? • How will we explain why we are asking for a story? • How will we build trust and confidence?	
Follow-up questions	What questions will we use to: • Encourage • Clarify • Deepen	
Recording	• What documentation techniques will we use? • Who will be responsible for documenting? • Have we got a personal information sheet? • Where are the safest places to store the personal information and the stories (so they are not together)?	
After story collection		
Translation	• How will we translate the stories? • How will we check our translations with the storytellers?	
Quality checking	• Have we sent two stories to the project team for quality review? • Have we incorporated any feedback into our story collection plans?	
Logistics		
Making it happen!	• Who will be in our story collection teams? • How long will it take to collect a single story (including travel time)? • When will we collect stories? • How does the story collection fit into the timeline for the TAPE survey? • How will we continue to communicate with the storyteller? Who will be responsible for this? • Who will translate the stories? How will we check our translations with the storyteller?	

ANNEX 3 A two-way consent form

Consent form for storytellers

Summary of project

We are from [insert name of partner organisation]. We are working with The Indigenous Partnership (TIP), which is a global organisation that seeks to protect, promote, and champion Indigenous Peoples Food Systems. Together with TIP, we are trying to understand the ways that Indigenous Peoples' food systems support agroecological outcomes and work in harmony with nature for the benefit of people and the environment. The objective of this project is to generate global policy support for Indigenous Peoples and their food systems.

As part of this project, we would like to invite members of your community to share stories/folktales on aspects of your food system and food practices that you feel are important to convey to wider audiences. Your story will be collected in your language and be used to write a summary report for TIP.

In future, it may also be used to share with global audiences to change narratives around Indigenous Peoples' food systems and advocate for positive policy change. However, if we choose to share it more widely, we will return to the community to ask for your consent again.

You can choose to withdraw participation of this project at any time and we will get rid of any information you have given to us. Do you have any questions for us?

Seeking Consent:

1. Do you consent to take part in this project as a storyteller? YES / NO
2. Do you consent to having your voice recorded as you tell your story? YES / NO
4. Do you consent to having photos or videos taken of you as you tell your story? (Note: this will not affect your ability to participate in the project)? YES/NO

Thank you so much for your time.

About the project you've contributed to:

We are from [insert name of partner organisation]. We are working with The Indigenous Partnership (TIP), which is a global organisation that seeks to protect, promote, and champion Indigenous Peoples Food Systems. Together with TIP, we are trying to understand the ways that Indigenous Peoples' food systems support agroecological outcomes and work in harmony with nature for the benefit of people and the environment. The objective of this project is to generate global policy support for Indigenous Peoples and their food systems.

As part of this project, we would like to invite members of your community to share stories/folktales on aspects of your food system and food practices that you feel are important to convey to wider audiences. Your story will be collected in your language and be used to write a summary report for TIP.

The project's commitment to you:

Thank you for taking part in our project to protect, promote, and champion Indigenous Peoples Food Systems.

In return for your participation, the project's commitment to you is to:

1. Keep any information you give us safe.
2. Come back to the community to ask your permission about how we use your story.
3. Respect your wishes to withdraw your contribution at any time.

Signed: [insert signature of person collecting story]
Date: [insert date of project commitment]

If you have any questions or concerns at any time please contact:

Name: [insert name of person storyteller has a relationship with]

Contact details: [insert contact details – mobile phone]

Find [insert name of partner organisation] at:

[insert address and telephone number of organisation]

ANNEX 4: Summary of average scores for Step 1 principles and indicators, disaggregated by community, Northeast India

Principles & sub-indicators	**Darechikgre**	**Dewlieh**	**Plasha**	**Umsawwar**
Overall CAET Score	**68.7**	**51.6**	**71.7**	**67.9**
Diversity (%)	**58.5**	**49.5**	**44.0**	**72.5**
Crops	3.3	3.4	3.1	3.7
Animals	1.7	1.0	0.9	2.3
Trees	2.8	2.4	1.2	3.0
Economic activities	1.8	1.5	1.4	1.8
Natural systems	2.1	1.6	2.2	3.7
Synergies (%)	**58.7**	**40.6**	**58.7**	**70.8**
Crop-livestock-aquaculture	1.8	1.1	2.2	2.1
Soil-plants system	2.8	2.4	3.3	3.6
Integration with trees	2.5	1.4	1.5	2.9
Connectivity between food systems and lands	2.4	1.6	2.4	2.8
Efficiency (%)	**79.2**	**77.9**	**78.6**	**65.6**
Use of external inputs	3.0	3.4	2.5	2.9
Management of soil fertility	3.9	4.0	3.8	2.4
Management of pests/diseases	3.1	3.7	3.4	2.4
Productivity & household needs	2.8	1.4	2.9	2.8
Recycling (%)	**57.1**	**45.0**	**53.8**	**64.5**

Recycling biomass & nutrients	2.3	2.9	3.3	3.3
Water saving	2.1	0.9	1.6	1.5
Management of seeds & breeds	2.8	2.9	2.8	2.6
Renewable energy use	2.0	0.5	1.0	3.0
Resilience (%)	**62.4**	**50.6**	**66.1**	**76.6**
Stability of income & production	2.7	2.3	2.8	2.4
Social mechanisms to reduce vulnerability	3.0	2.2	2.6	3.9
Environmental resilience & capacity to adapt to climate change	1.7	1.2	3.2	2.8
Culture and Food Traditions (%)	**76.2**	**48.9**	**89.0**	**46.8**
Appropriate diet & nutrition awareness	3.0	2.1	3.4	2.4
Local/traditional identity	3.2	1.8	3.8	1.5
Use of local varieties, breeds	2.9	2.0	3.5	1.7
Co-creation of knowledge (%)	**70.5**	**49.2**	**81.8**	**60.8**
Horizontal creation & transfer of knowledge	2.9	1.8	3.1	2.7
Access to agroecological knowledge	2.7	2.3	3.4	2.4
Participation of producers in networks/ associations	2.9	1.8	3.3	2.1
Human and Social Values (%)	**73.6**	**51.3**	**78.1**	**88.1**
Women's empowerment	3.1	2.2	2.2	3.9
Labour (productive conditions, social inequalities)	2.8	2.2	3.5	3.3
Youth empowerment and emigration	3.0	1.3	2.9	2.9
Animal welfare (if applicable)	2.8	2.1	3.9	3.9
Circular & Solidarity Economy (%)	**70.8**	**64.4**	**81.0**	**62.3**
Products and services marketed locally	2.8	2.4	3.0	2.0
Relationships with consumers & intermediaries	2.8	2.6	3.2	2.6
Local food system	3.0	2.7	3.6	2.9
Responsible Governance (%)	**79.8**	**38.9**	**86.0**	**70.8**
Producers' empowerment	2.9	1.7	3.5	3.3
Producers' organisations & associations	2.9	1.3	3.2	1.3
Producer participation in governance of land & natural resources	3.7	1.7	3.6	4.0

ANNEX 5: Summary of average scores for Step 1 principles and indicators, disaggregated by community, Northern Thailand

Principles & sub-indicators	Maepaukee	Hin Lad Nai	Hoi Ae Kang	Khun Mae Yod
Diversity (%)	**86.0**	**83.0**	**68.0**	**64.0**
Crops	3.9	3.8	3.5	3.2
Animals	2.7	2.3	2.3	1.7
Trees	3.8	3.7	2.7	2.4
Collection from natural systems	3.7	3.9	2.8	3.6
Economic activities	3.1	2.9	2.3	1.9
Synergies (%)	**92.5**	**90.5**	**62.3**	**71.9**
Crop-livestock-aquaculture	3.8	3.6	2.5	2.5
Soil-plants system	3.4	3.9	2.2	2.3
Integration with trees	3.9	3.8	2.5	3.7
Connectivity between food systems and lands	3.7	3.2	2.8	2.9
Efficiency (%)	**96.0**	**81.7**	**55.9**	**56.3**
Use of external inputs	3.7	3.2	1.9	1.1
Management of soil fertility	4.0	3.6	2.3	2.9
Management of pests/diseases	3.9	3.2	2.0	2.0
Productivity & household needs	3.8	3.1	2.6	3.0
Recycling (%)	**97.1**	**87.5**	**62.5**	**32.5**
Recycling biomass & nutrients	3.9	3.3	2.6	1.1
Water saving	4.0	4.0	3.0	1.1
Management of seeds & breeds	3.8	3.8	2.7	2.0
Renewable energy use	3.9	3.0	1.7	1.0
Resilience (%)	**90.8**	**81.6**	**63.7**	**61.1**
Stability of income & production	3.0	3.0	2.4	2.8
Social mechanisms to reduce vulnerability	3.8	3.3	2.7	2.0
Environmental resilience & capacity to adapt to climate change	3.7	3.3	2.4	2.0
Culture and Food Traditions (%)	**90.8**	**89.0**	**67.9**	**82.8**
Appropriate diet & nutrition awareness	3.2	3.4	2.7	3.0
Local/traditional identity	3.8	3.8	2.4	4.0
Use of local varieties, breeds	3.9	3.4	3.1	2.9
Co-creation of knowledge (%)	**93.9**	**88.7**	**71.0**	**56.9**
Horizontal creation & transfer of knowledge	3.6	3.7	2.7	1.1
Access to agroecological knowledge	3.7	3.4	3.1	2.9
Participation of producers in networks/ associations	4.0	3.5	2.4	2.8
Human and Social Values (%)	**91.5**	**91.3**	**77.7**	**86.9**
Women's empowerment	3.8	3.8	3.0	3.9
Labour (productive conditions, social inequalities)	3.8	3.1	3.3	3.9
Youth empowerment and emigration	3.1	3.7	2.9	2.0
Animal welfare (if applicable)	4.0	4.0	3.3	4.0
Circular & Solidarity Economy (%)	**92.5**	**84.1**	**56.1**	**42.2**
Products and services marketed locally	3.6	3.0	1.8	1.0
Relationships with consumers & intermediaries	3.8	3.9	2.2	2.9
Local food system	3.7	3.2	2.7	1.1
Responsibe Governance (%)	**91.9**	**93.5**	**68.9**	**81.1**
Producers' empowerment	3.8	3.4	2.7	2.9
Producers' organisations & associations	3.5	3.9	2.7	2.9
Producer participation in governance of land & natural resources	3.7	3.9	2.9	3.9
Overall CAET Score	**92.3**	**87.1**	**65.4**	**63.6**

Agroecology Assessment of Indigenous Peoples' Food Systems Report

ANNEX 6: Summary of average scores for Step 1 principles and indicators, disaggregated by community, Kenya

Principles & sub-indicators	Nessuit	Mariashoni	Nkareta	Keneti
Overall score.	41.6	41.6	39.4	67.5
Diversity (%)	52.0	49.5	37.5	55.5
Crops	2.0	2.0	1.8	2.4
Animals	2.5	2.2	1.7	2.7
Trees	2.3	2.6	1.5	2.2
Economic activities	2.2	1.4	1.1	2.1
Natural systems	1.4	1.7	1.4	1.7
Synergies (%)	51.9	48.4	43.1	62.7
Crop-livestock-aquaculture	2.2	2.3	2.0	2.6
Soil-plants system	1.8	1.6	1.0	2.7
Integration with trees	2.2	2.0	1.7	2.1
Connectivity between food systems and lands	2.1	1.8	2.1	2.8
Efficiency (%)	28.8	34.6	48.5	70.0
Use of external inputs	1.0	1.4	1.9	2.1
Management of soil fertility	0.9	1.0	2.5	3.8
Management of pests/diseases	0.4	0.5	1.1	2.1
Productivity & household needs	2.3	2.6	2.2	3.1
Recycling (%)	29.3	25.1	34.3	63.0
Recycling biomass & nutrients	1.3	1.5	2.0	2.9
Water saving	1.0	0.1	0.4	2.6
Management of seeds & breeds	1.4	1.4	1.6	2.4
Renewable energy use	1.0	1.0	1.5	2.2
Resilience (%)	34.5	41.0	40.8	65.5
Stability of income & production	1.4	2.0	1.6	2.6
Social mechanisms to reduce vulnerability	0.4	0.4	0.5	2.7
Environmental resilience & capacity to adapt to climate change	1.6	2.1	2.1	2.2
Culture and Food Traditions (%)	60.2	53.2	44.8	69.0
Appropriate diet & nutrition awareness	2.8	2.4	1.4	2.9
Local/traditional identity	3.0	2.5	2.0	3.0
Use of local varieties, breeds	1.4	1.4	2.0	2.4
Co-creation of knowledge (%)	46.2	33.0	29.9	76.2
Horizontal creation & transfer of knowledge	2.6	1.5	1.3	3.1
Access to agroecological knowledge	2.2	1.5	1.1	2.9
Participation of producers in networks/ associations	0.7	1.0	1.2	3.1
Human and Social Values (%)	66.8	61.5	47.7	65.9
Women's empowerment	2.0	1.9	1.2	3.2
Labour (productive conditions, social inequalities)	0.8	1.8	1.8	3.3
Youth empowerment and emigration	4	2.7	3.3	2.8
Animal welfare (if applicable)	4.0	3.2	1.3	1.1
Circular & Solidarity Economy (%)	27.6	38.4	33.6	69.4
Products and services marketed locally	2.0	2.3	1.7	2.4
Relationships with consumers & intermediaries	0.0	0.1	1.0	3.0
Local food system	1.3	2.2	1.3	2.9
Responsible Governance (%)	19.2	31.2	33.9	77.5
Producers' empowerment	1.0	1.6	1.7	3.5
Producers' organisations & associations	0.1	0.4	0.7	3.3
Producer participation in governance of land & natural resources	1.2	1.8	1.7	2.5

ANNEX 7: Summary of average scores for Step 1 principles and indicators, disaggregated by community, Northeast India

Principles & sub-indicators	Chacsinkín	José María Morelos	Tabasco	X-Pichil
Diversity (%)	54.0	53.3	55.4	59.5
Crops	2.9	3.2	3.2	3.6
Animals	2.2	0.7	1.7	1.6
Trees	2.1	2.9	2.6	3.3
Economic activities	1.4	1.6	1.4	1.0
Synergies (%)	63.5	51.9	64.0	72.0
Crop-livestock-aquaculture	2.5	0.9	2.3	1.6
Soil-plants system	2.9	2.4	3.2	3.5
Integration with trees	2.1	2.5	2.1	2.8
Connectivity between food systems and lands	2.7	2.5	2.6	3.6
Efficiency (%)	60.4	58.1	68.8	77.6
Use of external inputs	2.9	1.7	3.0	3.2
Management of soil fertility	2.0	2.6	2.7	3.7
Management of pests/diseases	2.3	2.6	3.5	3.7
Productivity & household needs	2.4	2.4	1.7	1.8
Recycling (%)	50.4	41.9	48.1	59.7
Recycling biomass & nutrients	2.5	2.0	2.9	3.0
Water saving	1.2	2.1	1.2	1.9
Management of seeds & breeds	3.6	2.1	3.4	3.3
Renewable energy use	0.8	0.5	0.2	1.4
Resilience (%)	62.7	50.3	59.9	59.0
Stability of income & production	2.4	2.0	2.5	2.0
Social mechanisms to reduce vulnerability	2.3	1.3	1.9	1.7
Environmental resilience & capacity to adapt to climate change	2.2	2.3	2.0	2.2
Culture and Food Traditions (%)	72.8	63.9	70.0	73.7
Appropriate diet & nutrition awareness	2.7	2.6	3.0	2.5
Local/traditional identity	3.4	3.0	2.9	3.7
Use of local varieties, breeds	2.6	2.0	2.5	2.6
Co-creation of knowledge (%)	61.1	47.8	59.4	67.7
Horizontal creation & transfer of knowledge	2.7	1.9	2.4	2.9
Access to agroecological knowledge	2.0	1.8	2.1	2.6
Participation of producers in networks/ associations	2.7	2.0	2.6	2.7
Human and Social Values (%)	68.3	58.2	65.5	63.9
Women's empowerment	3.3	3.2	3.1	3.2
Labour (productive conditions, social inequalities)	3.3	2.9	3.3	3.3
Youth empowerment and emigration	1.4	1.2	1.0	1.1
Animal welfare (if applicable)	1.9	1.0	2.3	
	2.3			
Circular & Solidarity Economy (%)	60.6	53.1	45.6	56.5
Products and services marketed locally	2.4	2.6	1.9	2.2
Relationships with consumers & intermediaries	2.0	1.7	0.9	2.0
Local food system	2.9	2.1	2.7	2.6
Responsible Governance (%)	75.6	51.9	69.4	69.9
Producers' empowerment	3.3	2.4	3.2	3.1
Producers' organisations & associations	2.4	1.4	1.6	1.9
Producer participation in governance of land & natural resources	3.4	2.5	3.6	3.4
Overall CAET Score	62.9	53.0	60.6	65.9

Annex 8: Average scores for each of the sub-indicators of the ten elements of agroecology across country contexts.

Sub-indicators [TAPE Step 1]	India	Kenya	Thailand	Mexico	Mean
Crops	3.4	2	3.6	3.3	**3.1**
Animals	1.5	2.2	2.3	1.5	1.9
Trees	2.4	2.2	3.2	2.7	2.6
Economic activities	1.6	1.6	2.6	1.3	1.8
Collection from natural systems	2.4	1.6	3.5	1.4	2.2
Crop-livestock-aquaculture	1.8	2.3	3.1	1.8	2.3
Soil-plants system	3	1.8	3	3	2.7
Integration with trees	2.1	2	3.5	2.4	2.5
Connectivity between food systems and lands	2.3	2.2	3.2	2.9	2.7
Use of external inputs	2.9	1.7	2.5	2.7	2.5
Management of soil fertility	3.5	2.2	3.2	2.8	**2.9**
Management of pests/diseases	3.1	1.1	2.8	3	2.5
Productivity & household needs	2.4	2.6	3.1	2.1	2.6
Recycling biomass & nutrients	3	2	2.7	2.6	2.6
Water saving	1.5	1	3	1.6	1.8
Management of seeds & breeds	2.8	1.7	3.1	3.1	2.7
Renewable energy use	1.7	1.4	2.4	0.7	1.6
Stability of income & production	2.6	2	2.8	2.2	2.4
Social mechanisms to reduce vulnerability	2.9	1.1	3	1.8	2.2
Environmental resilience & capacity to adapt to climate change	2.2	2.1	2.9	2.2	2.4
Appropriate diet & nutrition awareness	2.7	2.4	3	2.7	2.7
Local/traditional identity	2.5	2.6	3.7	3.3	**3.0**
Use of local varieties, breeds	2.5	1.8	3.2	2.4	2.5
Horizontal creation & transfer of knowledge	2.6	2.1	2.9	2.5	2.5
Access to agroecological knowledge	2.7	1.9	3.1	2.1	2.5
Participation of producers in networks/associations	2.5	1.6	3.3	2.5	2.5
Women's empowerment	2.9	2.2	3.7	3.2	**3.0**
Labour (productive conditions, social inequalities)	3	2.1	3.4	3.2	2.9
Youth empowerment and emigration	2.5	3	2.9	1.2	2.4
Animal welfare (if applicable)	3.2	2.2	3.8	1.9	2.8
Products and services marketed locally	2.5	2.2	2.8	2.2	2.4
Relationships with consumers & intermediaries	2.8	1.1	3.2	1.6	2.2

Local food system	3	2.1	2.7	2.6	2.6
Producers' empowerment	2.8	2.1	3.2	3	2.8
Producers' organisations & associations	2.1	1.2	3.3	1.8	2.1
Producer participation in governance of land & natural resources	3.3	1.9	3.6	3.2	**3.0**

Annex 9: Codes for the 10 elements of Agroecology

Agroecology Elements	Code
Diversity	div
Synergies	syn
Efficiency	eff
Recycling	rec
Resilience	res
Culture and Food Traditions	cultf
Co-Creation and Exchange of Knowledge	cocr
Human and Social values	human
Circular and Solidarity Economy	circ
Responsible Governance	respg

Annex 10 : Codes for the sub-indicators of the 10 elements of Agroecology

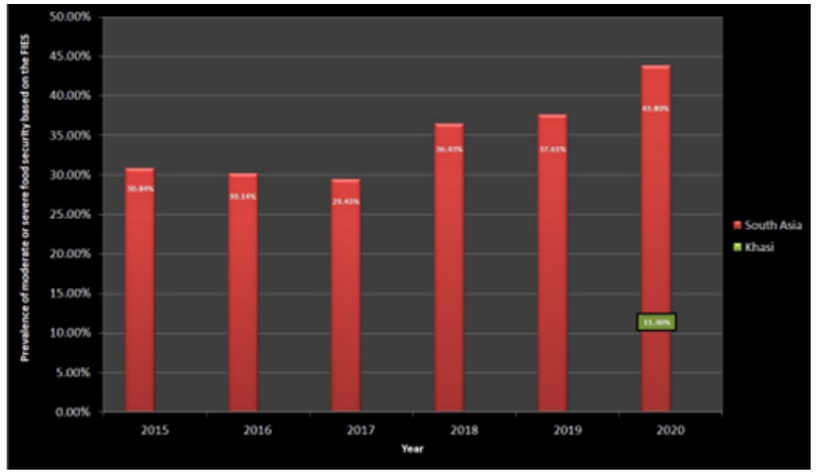
Agroecology Elements and Sub-indicators	Codes
Diversity	
Crops	1.1 crops
Animals	1.2 animals
Trees	1.3 trees
Economic activities	1.4 div_act
Natural systems	1.5 div_forage
Synergies	
Crop-livestock-aquaculture	2.1 cla-int
Soil-plants system	2.2 s_plant
Integration with trees	2.3 tree-int
Connectivity between food systems and lands	2.4 connectivity
Efficiency	
Use of external inputs	3.1 ext_inp
Management of soil fertility	3.2 soil-fert
Management of pests/diseases	3.3 pest_dis
Productivity & household needs	3.4 productivity
Recycling	
Recycling biomass & nutrients	4.1 rec_biomass
Water saving	4.2 water
Management of seeds & breeds	4.3 seeds_breeds
Renewable energy use	4.4 ren_enery
Resilience	
Stability of income & production	5.1 stab
Social mechanisms to reduce vulnerability	5.2 vul
Environmental resilience & capacity to adapt to climate change	5.3 env-res

Appropriate diet & nutrition awareness	6.1 diet
Local/traditional identity	6.2 local_id
Use of local varieties, breeds	6.3 local_var
Co-Creation and Sharing of Knowledge	
Horizontal creation & transfer of knowledge	7.1 platform
Access to agroecological knowledge	7.2 ae-know
Participation of producers in networks/associations	7.3 part-orgs
Human and Social Values	
Women's empowerment	8.1 women
Labour (productive conditions, social inequalities)	8.2 labour
Youth empowerment and emigration	8.3 youth
Animal welfare (if applicable)	8.4 animalwel
Circular and Solidarity Economy	
Products and services marketed locally	9.1 mkt_local
Relationships with consumers & intermediaries	9.2 networks
Local food system	9.3 local_fs
Responsible Governance	
Producers' empowerment	10.1 prod-empow
Producers' organisations & associations	10.2 prod_orgs
Producer participation in governance of land & natural resources	10.3 part_prod

A.1. Results of the 2023 data collection, using FIES within the TAPE instrument.

	Prevalence of moderate-severe food insecurity (%)	
	Moderate Food Insecurity	Severe Food Insecurity
Darechikgre	0%	0%
Dewlieh	0%	0%
Plasha	10%	0%
Umsawwar	10%	0%
Overall	10%	0%
Responsible Governance	respg	

A.2. Results of the 2021 FIES data collection. The figures refer to the prevalence of moderate or severe food insecurity based on the Food Insecurity Experience Scale. Statistics completed by FAO Statistics division.



Agroecology Assessment of Indigenous Peoples' Food Systems Report

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