Nature nurture

How to keep agrobiodiverse forest and farm systems alive in the modern world

Janine Duffy, Isabela Núñez del Prado Nieto and Duncan Macqueen

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Abbreviations

AGCOT	Agricultural Growth Corridors of Tanzania
CADC	Certificate of Ancestral Domain Claim
CMG	Community microfinance group
FMSS	Farmer-managed seed systems
GAPOKTAN	Gabungan Kelompok Tani (Farmer Group Association)
GIAHS	Globally Important Agricultural Heritage System
IIED	International Institute for Environment and Development
IPBSAP	Indigenous Peoples' Biodiversity Strategy and Action Plan
IPRA	Indigenous Peoples' Rights Act
KEF	Kalahan Educational Foundation
MOA	Memorandum of agreement
MVIWAARUSHA	Mtandao wa Vikundi vya Wakulima na Wafugaji Mkoa wa Arusha (Network of Groups of Farmers and Breeders of Arusha)
NGO	Nongovernmental organisation
NTFP	Non-timber forest product
NTFP-EP	The Non-Timber Forest Products – Exchange Programme
RUPP	Resource utilisation and protection policy
SACCO	Savings and credit cooperative organisation

Summary

Agrobiodiversity (or agricultural biodiversity) underpins food security, nutritional health, livelihood resilience, ecosystem functioning and the capacity of food systems to respond to environmental change. Yet globally, agrobiodiversity is declining at an alarming rate as increasingly simplified and industrialised agricultural systems replace more diverse farming and agroforestry landscapes. Historically, around 7,000 plant species were cultivated for food; today, approximately half of all plant-based calories come from just three crops: rice, wheat and maize. This narrowing of the global food base increases vulnerability to climate change, pests, diseases and market shocks while reducing dietary diversity and nutritional health. These trends reflect wider global patterns in which agricultural expansion and intensification are among the leading drivers of biodiversity loss. Reversing them is an important priority for both biodiversity conservation and food production, highlighting the need for approaches that strengthen, rather than separate, the relationship between conservation and agricultural production.

Many of the world's remaining agrobiodiverse production systems — where biodiversity conservation and food production go hand in hand — are maintained by smallholder farmers and Indigenous Peoples. Through generations of seed selection, knowledge sharing, cultural practice and agroforestry management, these groups have developed highly diverse systems that integrate crops, trees, livestock, wild foods and forest products. These systems provide food, fuel, medicine and other essential resources while maintaining the genetic diversity and ecological functions that underpin resilient landscapes.

But sustaining such systems is rarely straightforward. Producers often face multiple challenges, from insecure land and resource rights to limited access to seed and planting material, knowledge gaps, labour constraints, inadequate finance, market uncertainties and policy environments that frequently favour simplified production systems. And climate change is likely to intensify many of these challenges. For individual producers, addressing such challenges alone can be difficult. This is where collective organisations — groups of individuals or institutions that come together to jointly identify and work towards a shared goal or interest — can play an important role. By working together, collective organisations help members share knowledge, coordinate action, pool resources, improve access to markets and finance, and strengthen collective bargaining power, allowing producers to navigate or overcome these barriers.

As such, understanding how collective organisations help sustain agrobiodiverse production systems under pressure, and the challenges that they face, is central to efforts to nurture nature while supporting viable rural livelihoods. The purpose of this report is to strengthen evidence and understanding of this role by identifying the practices and principles that collective organisations use to maintain and adapt agrobiodiverse production systems. Our primary audience includes leaders of collective organisations of smallholder producers and Indigenous Peoples, and their technical support partners. A secondary audience includes government decision makers in the agriculture, forestry and other land-use sectors and international resource partners in climate, nature or development finance.

The report draws on three case studies from Indonesia, the Philippines and Tanzania that examine how collective organisations support smallholder farmers and Indigenous Peoples to sustain agrobiodiversity in different social, ecological and political contexts. In Indonesia, Dayak producer groups in West Kalimantan, supported by the Riak Bumi Foundation (Riak Bumi), help maintain diverse agroforestry and swidden farming systems (also known as shifting agriculture or slash-and-burn farming) that combine rice, fruits, vegetables, medicinal plants, timber species and non-timber forest products. In the Philippines, the Kalahan Educational Foundation (KEF) supports Ikalahan (also known as Kalanguya) communities to maintain Indigenous agroforestry systems comprising diverse crops, fruit trees, forest resources and locally adapted varieties across their ancestral domain. And in Tanzania, Mtandao wa Vikundi vya Wakulima na Wafugaji Mkoa wa Arusha (MVIWAARUSHA)[1] works with networks of smallholder farmers and pastoralists to sustain diversified agroecological farming systems that integrate crops, livestock, trees and local seed varieties.

1 Translated from Swahili to English, the organisation's full name, Mtandao wa Vikundi vya Wakulima na Wafugaji Mkoa wa Arusha, means 'Network of Groups of Farmers and Breeders of Arusha'.

A review of the historical and institutional contexts that have shaped agrobiodiversity in each country shows that agrobiodiverse production systems have been impacted by a long history of changing land and resource use. In Indonesia, commercial agricultural expansion, particularly oil palm, alongside logging, mining and infrastructure development, have reduced and fragmented areas managed under diverse agroforestry systems. In the Philippines and Tanzania, pressures are more closely associated with the expansion and intensification of smallholder agriculture, although infrastructure development, logging, fuelwood extraction and emerging commercial agriculture in Tanzania also play important roles. While the immediate drivers differ between contexts, they are rooted in common structural drivers, including colonial legacies, investment-led and export-oriented development policies, and extractive political economies that have historically favoured agricultural expansion, resource extraction and commercialisation over more diverse and locally adapted production systems.

In response to these pressures, smallholder farmers and Indigenous Peoples have a long history of defending control over land, seed systems and ecological knowledge, both through organised political action and by maintaining their diverse production systems. In Indonesia, this has involved longstanding efforts to defend customary land rights. In the Philippines, resistance has centred on a decades-long struggle for recognition of Ikalahan ancestral lands, helping secure some of the earliest formal recognition of Indigenous land rights in the country. In Tanzania, farmers' organisations have mobilised to defend farmer-managed seed systems (FMSS) against regulatory frameworks that increasingly favour commercial seed markets. These struggles form an important part of the historical context within which contemporary efforts to sustain agrobiodiversity have emerged.

Alongside these longer-standing struggles, broader processes of economic and social change are increasingly reshaping agrobiodiverse production systems. Growing market integration, changing consumption patterns, new livelihood aspirations, migration, technological change and the increasing need for cash income are influencing how people manage land, crops and natural resources. Rather than remaining static, communities are continually adapting their production systems to these changing realities, whether by incorporating new crops, responding to market opportunities, engaging with modern agricultural technologies or diversifying livelihood strategies. While such adaptations can help sustain livelihoods, they can also create pressures towards simplification, commercialisation and the loss of locally adapted species and varieties, requiring communities to continually negotiate the balance between economic opportunity and maintaining agrobiodiversity.

Against this backdrop, we analyse the empirical evidence from the three case studies, revealing the strategies and tactics that collective organisations are using to help smallholder farmers and Indigenous Peoples sustain agrobiodiverse production systems in each context, and reflect on the trade-offs and challenges these organisations are navigating in relation to these approaches. The common strategies are: maintaining diverse production systems by sharing seed and knowledge; promoting nutritional, health and other benefits of agrobiodiversity; aggregating baskets of products for businesses built on diversity; mobilising access to finance that supports diversity; and bolstering political will behind traditional agrobiodiverse production systems.

Maintaining diverse production systems through seed and knowledge sharing

Traditional seed and knowledge systems emerged as a foundation upon which agrobiodiverse production systems depend. Across all three case study contexts, farmers save, exchange and adapt seed through informal community networks and pass on knowledge through intergenerational transmission, peer-to-peer learning and everyday farming practice. Collective organisations strengthen these systems through complementary approaches, including community seed banks, tree nurseries, demonstration farms, farmer training, educational initiatives and partnerships with research organisations. While approaches differ in their degree of formalisation, ranging from largely community-rooted systems in Indonesia and the Philippines to more structured seed banks and farmer training networks in Tanzania, they all seek to strengthen, rather than replace, the socially embedded systems through which communities have traditionally maintained the knowledge, skills and genetic resources that agrobiodiversity depends on.

Communities in all three case study areas face common challenges associated with weakening intergenerational knowledge transmission, youth migration and changing livelihood aspirations. In response, collective organisations are developing new ways of engaging younger generations through schools, cultural programmes and other learning platforms. This has typically involved building long-term relationships with schools, universities and education authorities to create practical entry points for engaging young people with agrobiodiversity, rather than seeking formal curriculum

reform. The Philippines differs in that KEF operates the Kalahan Academy, allowing it to integrate agrobiodiversity learning directly into its own educational curriculum.

Together, the case studies demonstrate that sustaining agrobiodiversity requires maintaining not only genetic resources, but also the social, cultural and institutional conditions needed to continually share, adapt and renew knowledge and planting materials. They also show that these approaches can be most effective when they function as bridging mechanisms that reinforce and extend existing community-based knowledge networks. But as changing aspirations, migration and wider rural transformation reshape young people's engagement with traditional agriculture, collective organisations must continue developing new ways of engaging youth to develop the new generations of farmers, knowledge holders and community leaders that will safeguard the social and cultural systems that agrobiodiversity depends on.

Promoting nutritional, health and other benefits of agrobiodiversity

A second common strategy involves actively promoting the multiple benefits of agrobiodiversity as a way of encouraging its continued management and use. While communities have long recognised the nutritional, health, cultural and ecological values of diverse production systems, collective organisations across the three case studies are working to reinforce these benefits within communities in response to growing pressure towards agricultural simplification.

They do this through cultural practices and community events, customary knowledge exchange, formal education, farmer training and other awareness-raising activities, demonstrating to communities, youth and external stakeholders that the value of agrobiodiversity lies not only in its contribution to agricultural production and smallholder livelihoods, but also in the wider social, cultural and ecological benefits it provides. By encouraging communities to recognise the multiple and interconnected benefits provided by diverse production systems, they do not present nutrition, health, cultural identity and ecological sustainability as separate outcomes, but rather, as mutually reinforcing reasons for maintaining agrobiodiversity, creating stronger incentives for its long-term conservation and use.

Aggregating baskets of products for businesses built on diversity

Commercialisation is often associated with agricultural simplification, encouraging producers to specialise in a narrow range of commodities. Yet across the three case studies, collective organisations pursue a different approach, developing businesses around baskets of products derived from the diversity that is already present within local farming and agroforestry systems. Through aggregation, value addition, enterprise development, collective branding and market linkages, these organisations seek to make diversity economically viable while allowing farmers to maintain diverse production systems.

However, the case studies also demonstrate that commercialisation is not a straightforward pathway for supporting agrobiodiversity. Maintaining diversity often sits uneasily alongside market demands for consistency, standardisation and scale, while certification and regulatory requirements, changing market conditions and limited business capacity of smallholders and the organisations that support them can constrain enterprise development. Building viable enterprises around diverse products requires considerable organisational capabilities, including business planning, quality control, processing, marketing, financial management, relationship-building and the ability to coordinate production across multiple producers and products.

Organisations also need to balance market opportunities with community priorities, cultural values and biological diversity, while continually adapting to changing commercial conditions. The associated challenges and skills needed should not be underestimated. The case studies demonstrate that commercialisation can support agrobiodiversity when it is grounded in collective organisation, aligned with ecological realities and local values, enabled by appropriate financial and regulatory systems, and supported by market actors who are willing to work with diversity rather than uniformity. Where these conditions are absent, commercialisation may remain limited or favour a narrower range of species and products.

Mobilising access to finance that supports diversity

Access to appropriate finance is a critical enabling factor for sustaining and expanding agrobiodiverse production systems, as developing diversified systems often requires farmers to experiment with new crops, tree species, locally adapted seed or processing technologies. Conventional finance tends to favour larger-scale, standardised forms of production and requires collateral that many smallholders cannot provide, and the three case studies illustrate differing capacities to leverage finance that addresses this challenge. In Indonesia, producer groups have established small-scale savings mechanisms that complement financial support from credit unions, village government programmes and external partners, providing useful but relatively limited support. In Tanzania, MVIWAARUSHA has established a much more extensive member-owned financial architecture combining savings and credit cooperative organisations (SACCOs), community microfinance groups (CMGs) and specialised agroecological loans that channel affordable finance towards diversified production and biodiversity-friendly enterprises. By contrast, experiences in the Philippines illustrate both the challenges of sustaining internally managed finance and the importance of external project funding where such mechanisms are not established.

Together, the case studies show both the potential of finance to support agrobiodiversity and the challenges involved in developing financial mechanisms that are appropriate for diversified production systems. While the Tanzania case study illustrates what becomes possible when producer organisations develop dedicated financial institutions, the Indonesia and Philippines case studies show that it is not always feasible to establish or sustain such mechanisms. The varying degrees of success in leveraging appropriate finance reflects differences in organisational capacity, governance, institutional context and member trust, and suggest that financing agrobiodiversity depends on much more than access to capital. Rather than point to a single model, the three examples highlight that, while well-governed internally managed finance can become a powerful asset for agrobiodiversity, external finance continues to play an important role in supporting collective organisations in some contexts.

Bolstering political will behind traditional agrobiodiverse production systems

Creating enabling policy and institutional environments is another area where collective organisations play an important role. Across the three case studies, organisations have sought to create more enabling environments for agrobiodiversity through rights-based advocacy, policy engagement and efforts to secure formal recognition of community-based approaches to biodiversity management. This has included securing Indigenous and customary rights over land and natural resources, promoting and securing recognition for FMSS and strengthening local governance arrangements. To advance these goals, organisations have employed strategies such as participatory mapping, community mobilisation, alliance building, policy dialogue and engaging with decision makers at multiple levels.

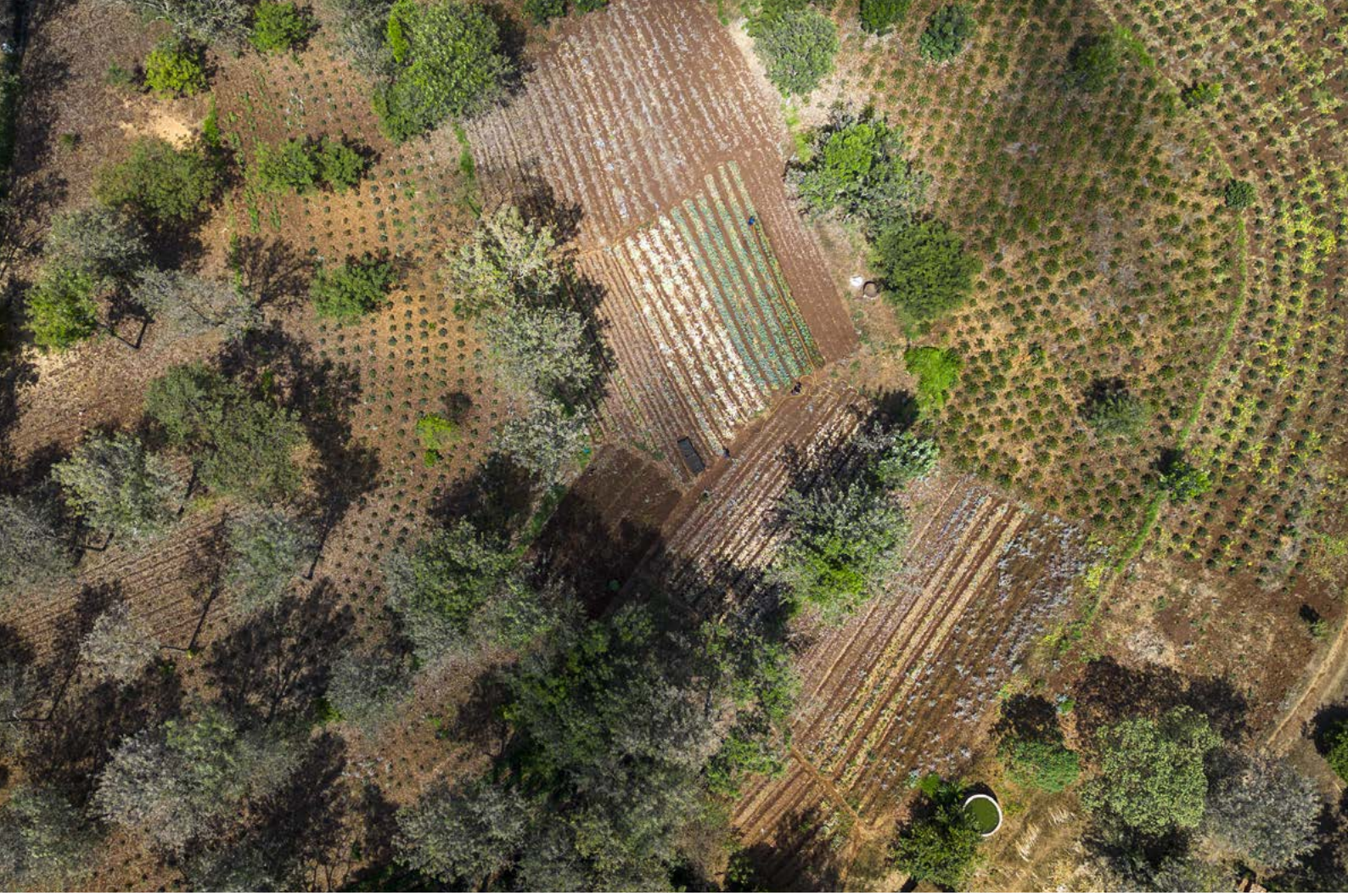
The case studies demonstrate that policy influence is a slow, highly relational and resource-intensive process that depends on trust, long-term relationships, coalition building and the ability to align agrobiodiversity with wider political priorities to gain wider buy-in. They also show that collective organisations and smallholders have to make sustained efforts, often in the face of challenges or setbacks, to secure legal or policy recognition, and that this is a milestone rather than an endpoint, often requiring ongoing engagement to ensure governments implement their policy commitments. These experiences highlight that strengthening the policy environment for agrobiodiversity requires long-term organisational commitment and sustained resources, which can be difficult to maintain, particularly for local organisations. Progress also depends on the ability to build and sustain consensus across multiple actors and scales. Across all contexts, relationship building has emerged as a central component of political engagement, with organisations investing in long-term connections that help navigate institutional change and identify opportunities for advancing agrobiodiversity.

The three case studies demonstrate that creating enabling environments for agrobiodiversity is not a one-off advocacy exercise but an ongoing organisational function. Even after important policy gains are achieved, continued engagement is required to translate legal recognition into implementation, maintain political support and respond to changing institutional and policy environments to foster the enabling conditions through which agrobiodiversity can be maintained and supported over time.

Conclusions

The ongoing efforts of smallholder farmers, Indigenous Peoples and their collective organisations to continually adapt, innovate and respond to changing ecological, social and economic conditions sustain agrobiodiversity. Collective organisations are not passive custodians of traditional farming systems; rather, they are active agents that strengthen the knowledge, institutions, enterprises, financial systems and policy environments needed for agrobiodiversity to continue evolving while supporting resilient rural livelihoods. Drawing together evidence from the three case studies, this report identifies six key conclusions regarding the enabling conditions needed to strengthen agrobiodiversity and support the continued nurturing of nature. Rather than prescribe specific recommendations, the following conclusions provide a foundation for the next phase of the Nature Nurture project, which will develop practical guidance and recommendations for collective organisations and their supporting partners.

- Collective organisations play a central role in sustaining diverse production systems, providing the social and institutional infrastructure needed to maintain agrobiodiversity while supporting resilient and inclusive rural livelihoods. Yet they cannot be expected to shoulder this responsibility alone. Additional support and sustained investment in their organisational capacity, technical capabilities, financial sustainability and ability to engage effectively with markets and policy processes is therefore essential.
- Building businesses around diversity requires investment in local food systems, short supply chains and market arrangements that recognise and reward the nutritional, cultural, ecological and economic value of diverse crops, trees and livestock. For collective organisations, this means building enterprises around the diversity that already exists within local production systems. For supporting partners, it means investing in the capacities needed to make these enterprises viable.
- Sustaining agrobiodiversity depends on recognising, legitimising and strengthening FMSS and traditional ecological knowledge as living, adaptive systems that enable genetic diversity, cultural knowledge and local adaptation to continue evolving over time. The ongoing vitality of these systems depends on collective organisations finding creative and locally appropriate ways to engage younger generations, because without sustained intergenerational transfer, the knowledge, skills and genetic resources agrobiodiversity depends on risk being progressively eroded.
- Building businesses around diversity requires significant organisational capacity and long-term investment. While collective organisations play a crucial role in making diversity economically viable, success depends on far more than producing high-quality products. Collective organisations should not underestimate the organisational, logistical and commercial challenges involved in transforming diverse products into viable enterprises.
- Mobilising appropriate finance for agrobiodiversity depends on organisational capacity, governance and local institutional context. Where collective organisations have the necessary governance, organisational capacity and member trust, internally managed finance can provide patient, flexible and locally controlled investment that is better aligned with the realities of agrobiodiverse production systems. Where these conditions are not in place, complementary public, private and donor finance is vital to support agrobiodiversity and strengthen organisational capacity over time.
- Sustaining agrobiodiversity requires long-term political engagement by collective organisations to secure land and resource rights, strengthen recognition of FMSS and traditional ecological knowledge, and create enabling policy environments for diverse production systems. Building political support depends on sustained engagement from grassroots action through to policy advocacy, requiring organisations to build coalitions, cultivate long-term relationships and strategically align agrobiodiversity with broader political and development priorities.



Aerial view of a farm in Ayalabe village in Karatu district, Tanzania. © Roshni Lodhia/Panos/IIED

1 Introduction

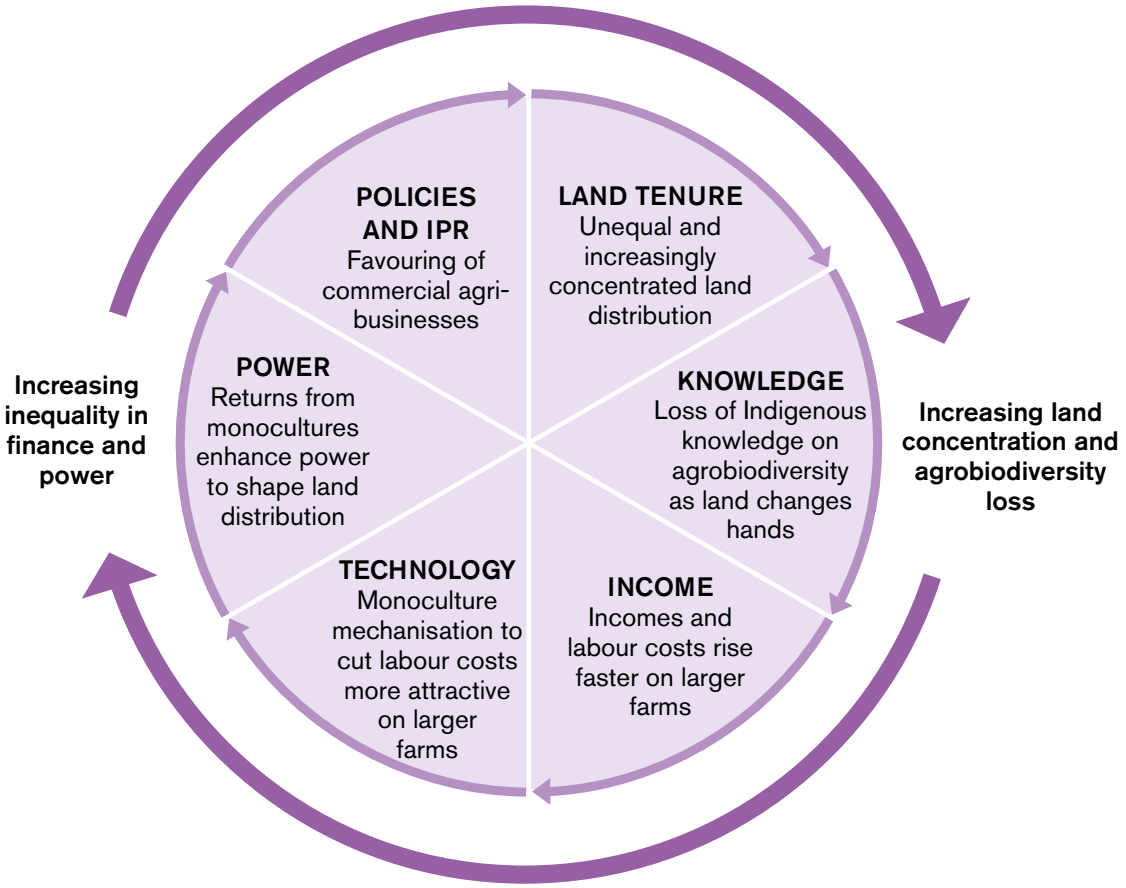
1.1 The importance of agrobiodiversity and the need to nurture nature

1.1.1 The big issue: degradation of nature and loss of agrobiodiversity

Humanity's central sustainable development challenge is how to pursue people's desire for wealth and health (economic aspiration) without exceeding the Earth's natural limits (ecological ceiling) or leaving people behind (social foundation). This tension between economic ambition, ecological boundaries and social equity has been clearly articulated (Rockström et al., 2009; Raworth, 2017). But although this framing is useful, to understand why progress has been so limited, we need to look more closely at the value systems and political-economic structures that shape how these goals are pursued.

The persistence of environmental degradation alongside deep social inequality reflects dominant political-economic models that prioritise material wealth accumulation, often for a relatively small proportion of the global population. These models have driven the expansion of industrial-scale agricultural plantation systems, many of which involve monocultures, although some practice crop rotation and can offer a level of diversification, particularly relating to shade-grown crops. Industrial-scale monoculture and plantation agriculture has been replacing smallholder farming systems that are typically more diverse, contributing to both biodiversity loss and social inequity (Weis, 2007; IPES-Food, 2016). The benefits of this system are frequently concentrated among actors that are geographically and economically distant from the landscapes where ecological degradation occurs, a dynamic described as "ecologically unequal exchange" (Hornborg, 1998) and a form of global environmental injustice (Givens et al., 2019). The implication is that such political-economic dynamics generate profound environmental and social inequalities across regions.

Figure 1. The cycle of growing inequality underlying agrobiodiversity loss (Source: Macqueen, 2024)



*IPR = intellectual property rights

One of the clearest manifestations of this process is the erosion of agrobiodiversity (or agricultural biodiversity), driven by a self-reinforcing cycle of inequality in which industrial-scale agricultural plantation systems, often monocultures, displace diverse smallholder systems (Macqueen, 2024; Figure 1). Although humans have historically cultivated around 7,000 plant species for food, today, just 80 make a major contribution to food supply and around half of all plant-based calories come from just three crops: rice, wheat and maize (IPES-Food, 2016). Structural, spatial and temporal heterogeneity of pre-industrial agricultural land use underpinned its agrobiodiversity (Fuller et al., 2016), whereas the post-industrial narrowing of the global food base increases vulnerability to climate change, pests and market shocks while reducing dietary diversity and nutritional health (Remans et al., 2014; Jones, 2017). These trends reflect wider global patterns, where agricultural expansion and intensification are among the most significant drivers of biodiversity loss (Díaz et al., 2019). And while the poorest and most marginalised are often the first to feel the consequences of such inequality, most of society loses through inequality across a wide range of indicators, including the potential collapse of food systems (Wilkinson and Pickett, 2009). This shift towards industrial monoculture agriculture is not simply a technical development; it is part of a broader restructuring of global food systems. Food regime analysis

shows how successive configurations of agriculture, trade and state policy have organised food production in ways that serve particular political-economic interests (Friedmann and McMichael, 1989; McMichael, 2009). The contemporary "corporate food regime" is characterised by globalised commodity chains, concentration of power among transnational agribusiness firms and the expansion of input-intensive monocultures supported by neoliberal policy frameworks (McMichael, 2005). These dynamics have often come at the expense of smallholder and Indigenous production systems and the agrobiodiversity they sustain.

At the same time, many of the most enduring alternatives to industrial monocultures are not new innovations. Rather, they are long-standing smallholder and Indigenous systems that sustain diverse agroecological landscapes through locally embedded knowledge, social organisation and collective stewardship. And despite often existing outside of the dominant market systems, they offer important insights into how production systems can balance livelihoods with ecological sustainability.

Although few nation states have successfully aligned economic development with ecological sustainability and social equity, there are important examples at local and subnational levels. This report focuses on three such 'nature nurture' landscapes, where local groups are attempting to pursue a reasonable quality of life while also nurturing the nature that sustains them.

1.1.2 The value of nature and agrobiodiversity

Why do people value nature — and more specifically, the agrobiodiversity that we use for food, fuel and to furnish our homes? What benefits might local people get from expanding agrobiodiversity on their farms and indeed, protecting the natural biodiversity of any forests they might protect? Given the complexity and labour of managing nature and multiple crops, trees and livestock together on productive land, what might motivate these groups?

For smallholder farmers and Indigenous Peoples, these values are rarely abstract. Rather, they are rooted in everyday practices of production, consumption and cultural life. Various studies have documented a wide range of benefits associated with agrobiodiversity, including:

- **Food security and livelihood resilience:** cultivating natural forests and multiple species on productive land reduces the risk of failure when encountering climate change, political-economic or even pandemic shocks (Zimmerer and de Haan, 2020; Kerr et al., 2021)
- **Nutritional and health benefits:** cultivating and consuming a wide range of plants and animals (especially fruit and vegetables) can greatly enhance nutritional health while also making use of traditional medicines (Harris et al., 2022; Zaccari et al., 2023)
- **Provision of other useful products:** nature forests and agrobiodiverse farms can also provide household products — such as construction materials, fuelwood or organic manure — as byproducts in ways that enhance self-sufficiency (Immerzeel et al., 2013; Subedi et al., 2020)
- **Preservation of beauty in natural and biocultural heritage:** many groups have long histories of in-situ conservation and using locally adapted crops, trees and livestock breeds; and maintaining these uses is often an integral part of their cultural tradition and identity (Agnoletti and Santoro, 2022; Swiderska et al., 2022), and
- **Provision of other ecosystem services:** when managed well, nature and more agrobiodiverse farming can provide a wide range of ecosystem services, such as carbon sequestration, soil erosion control and fertility enhancement, water cycle management, pollinator and seed dispersal agent preservation, and pest and disease control (Gerits et al., 2021; Drucker et al., 2022).

These benefits often emerge over long biocultural histories within agroforestry systems (agriculture that incorporates the cultivation of woody perennials — trees, shrubs, palms, bamboo and so on — alongside crops and/or livestock). Such systems require sustained investment in knowledge generation and transmission, often across generations. So, it is not surprising that traditional landscapes managed by family farmers and Indigenous Peoples retain much of the world's remaining agrobiodiversity (Maxted et al., 2020: Rist et al., 2020) and that efforts to maintain and expand this diversity depend heavily on learning from and working with these groups (Labeyrie et al., 2021).

1.1.3 System thinking: how values in nature and agrobiodiversity fit alongside other values

If it is so beneficial, why does humanity more generally not conserve nature and agrobiodiversity? As noted above, the answer lies in the fact that nature is not the only thing people value. And if the clear benefits of nature and agrobiodiversity do not trump these other things, people may discard them in favour of what they value more and what drives their pursuit of those other values. So, nature and agrobiodiversity are only likely to flourish when pursuit of those values aligns with the pursuit of other compatible values.

To achieve prosperity ("that which people value and have reason to value in line with the common good", Alkire, 2010), it is necessary to broaden thinking beyond the threefold economic–environmental–social framing and investigate what people value and what drives their pursuit of those values within a systems approach. What humans value is inevitably person-specific and therefore difficult to summarise. We follow the argument of Sen (2004), expanded in Alkire (2010), that it is necessary to select key categories of value, or dimensions of development, but also important to resist specifying a canonical list to be applied at all times and in all places.

Common categories of values people pursue include: beauty in nature and culture; material health and wellbeing; affirmative social relationships; present and future security; creative fulfilment of potential; and sense of identity/purpose (see Appendix 1).

Reasons for conserving agrobiodiversity may include its contribution to a number of different value categories, including simply beauty in nature and culture, its material contribution to health and wellbeing or the creative fulfilment of potential from its cultural use. Yet at the same time, the pursuit of those same values can threaten agrobiodiversity, as seen in the pursuit of material wealth and health through income generated by industrial-scale agriculture. So, conserving agrobiodiversity requires a balance in the values pursued, to avoid focusing on just one type of value. This is most easily assured through shared decisions made by those living in a particular territory within collective organisations — groups of individuals or institutions that come together to jointly identify and work towards a shared goal or interest — rather than through the predilections of individuals, especially those external to the territory concerned.

Indeed, the possible pursuit of value for the common good or for self-interest by people with different powers introduces the possibility of a distinct polarity in development outcomes (Schwartz, 1992; Bardi and Schwartz, 2003; Crompton, 2010). This is also true for agrobiodiversity conservation. What motivates the pursuit of value matters, as do the institutional structures that are set up for that value pursuit. In the case studies contained in this report, the collective organisations set up to pursue value on behalf of local people have played a crucial role in elevating the importance of agrobiodiversity for its contribution to several value categories. We cannot understate the importance of these collective structures for balanced decision making and ensuring collective good triumphs over self-interest. The conservation of agrobiodiversity depends on what values people pursue, who pursues them and why.

1.1.4 Why nature nurture requires support

Nurturing nature is not a neutral process. It involves navigating trade-offs between different drivers of value and associated development pathways. It also means fighting alongside family farmers and Indigenous People to advance food sovereignty, which emphasises peoples' rights to govern their own food systems, including land, seed and biodiversity, rather than reducing food and nature to commodities within market-based systems (Patel, 2009). It means fighting against the creeping industrialisation that treats nature as a factory to enrich the few. Nurturing nature will not just drift back in; it is something people need to fight for.

The challenges of maintaining nature and agrobiodiversity in a wide variety of agroforestry systems are considerable and well documented (van Noordwijk et al., 2016; Bettles et al., 2021; Hastings Silao et al., 2023; Tranchina et al., 2024). They include issues such as:

- **Tenure:** a lack of tenure security that disincentivises nature management or the introduction of long-term and space-demanding trees in production landscapes
- **Use rights:** policies that allow crop management but discriminate against tree ownership (the trees may belong to the state even if the land does not)

- **Market information gaps:** uncertainties about value chains and markets for, and marketing of, highly varied agroforestry products or nature services
- **Finance:** a lack of finance to pay the upfront costs necessary for agroforestry establishment and ongoing maintenance
- **Labour and collective action challenges:** shortages of labour or time to implement or maintain agroforestry systems, especially during start-up and to aggregate, process and sell products from multiple smallholdings
- **System complexity:** knowledge deficits on technical and agronomic matters to do with managing context-specific nature, agroforestry systems and tree cultivation
- **Access to seed:** a lack of seeds or seedlings of unfamiliar agroforestry (especially tree) species or local land races and policy barriers to local seed management and sale, and
- **Prevalent knowledge biases:** the promotion of 'modern' monoculture farming approaches and chemical inputs.

Climate change may also exacerbate these challenges — for example by reducing tree growth, intensifying tree-crop resource competition and reducing crop yields (Watts et al., 2022).

For many smallholders, addressing these constraints individually is difficult. However, collective organisations can play an important role in navigating and overcoming these barriers. By supporting their members to work together, these organisations can help facilitate knowledge exchange, pool costs and investment needs, strengthen producers' negotiating power with markets, government and potential land-use competitors, and create trusted spaces for collective learning, decision making and action (Covey et al., 2021; Macqueen et al., 2020; 2026; Pasiecznik et al., 2015). Rooted within the communities they serve, these organisations are often well placed to pursue longer-term social, ecological and economic goals that extend beyond the interests of individual producers alone. This can help sustain important public goods, including agrobiodiversity, ecosystem health, food security and resilient rural livelihoods (Macqueen et al., 2026). Understanding how collective organisations help sustain agrobiodiverse production systems under pressure and the challenges they face is therefore central to efforts to nurture nature while supporting viable rural livelihoods, and the focus on this report.

1.2 The Nature Nurture project and research approach

1.2.1 The Nature Nurture project

The Nature Nurture project is a collaborative initiative led by the International Institute for Environment and Development (IIED) that aims to improve evidence and knowledge on how to upscale inclusive, resilient, agrobiodiverse production systems used by smallholder producers.[2] Key questions revolve around understanding and spreading the practices and principles that maintain these systems. Under the project, IIED established a consortium with organisations that work closely with smallholder producers and Indigenous Peoples, operating in similar but distinct contexts in Tanzania, the Philippines and Indonesia. The similarities of these contexts lie in their relatively remote locations, the mixture of subsistence and commercial farming, and the pressures on land and resources from external economic and policy forces.

In Tanzania, we partnered with Mtandao wa Vikundi vya Wakulima na Wafugaji Mkoa wa Arusha (MVIWAARUSHA)[3] a member-based organisation representing more than 12,000 smallholder farmers and pastoralists across northern Tanzania. In Indonesia and the Philippines, we partnered with the Non-Timber Forest Products – Exchange Programme (NTFP-EP), an association of 25 members with over 100 partner nongovernmental organisations (NGOs) and community-based organisations working with forest-based farming communities across Asia.[4] As part of the wider Nature Nurture consortium, NTFP-EP collaborated with the Riak Bumi Foundation (Riak Bumi),[5] a community-based organisation based in West Kalimantan that works with rural communities in and around Indonesia's Danau Sentarum

2 See www.iied.org/nature-nurture-upscaling-smallholder-resilience-for-agrobiodiverse-supply-chains
3 Translated from Swahili to English, the organisation's full name Mtandao wa Vikundi vya Wakulima na Wafugaji Mkoa wa Arusha means 'Network of Groups of Farmers and Breeders of Arusha'. For more information, see www.mviwaarusha.or.tz
4 Outside of the Nature Nurture project, NTFP-EP also works in Cambodia, India, Malaysia and Viet Nam. For more information, see www.ntfp.org
5 For more information, see www.riakbumi.or.id

National Park, and the Kalahan Educational Foundation (KEF), an Indigenous-led organisation established by the Ikalahan People in Northern Luzon, the Philippines, to support sustainable development within their ancestral domain.

1.2.2 Case studies

Under the Nature Nurture project, the consortium produced three partner-led case studies, one for each project country (Kayombo et al., 2025; Adhiguna et al., 2025; Gerdan et al., 2025). These studies document local knowledge, agrobiodiversity and production practices, while examining how collective organisations support smallholder farmers and Indigenous Peoples to sustain diverse production systems alongside the pursuit of sustainable livelihoods. MVIWAARUSHA led the research in Tanzania, while NTFP-EP worked with Riak Bumi in Indonesia and KEF in the Philippines to lead the research in those countries.

The case studies followed a common research framework developed through the Nature Nurture project. Each study drew primarily on interviews with smallholder farmers and Indigenous Peoples in each case study site, complemented by the knowledge and experience of participating producer organisations. The Indonesia study involved 20 Dayak farmers (10 women and 10 men); the Philippines study, 40 Ikalahan farmers (20 women and 20 men), equally representing households practising traditional and more commercially oriented farming; and the Tanzania study, 20 smallholder producers (10 women and 10 men).

Each smallholder production system in the three studies is embedded within a distinct socioecological landscape. In Indonesia's West Kalimantan, Dayak producer groups live in forest-agriculture mosaics far from major market centres, adapting traditional agroforestry systems to shifting land use and market demands. In the high-altitude terrain of the Philippines' Northern Luzon, KEF represents an Indigenous community stewarding its ancestral domain amid growing pressures from road development, trade and tourism. And in northern Tanzania, MVIWAARUSHA organises smallholder and pastoralist farmers across the farmland and open woodlands of the Monduli–Karatu area, adjacent to protected areas, where commercialisation and conservation are reshaping land use and livelihoods. Together, these case studies provide a basis for synthesising experiences from different social, ecological and market contexts, enabling the report to distil broader insights into how collective organisations support the maintenance of agrobiodiversity and the challenges they might face.

1.2.3 Supplementary literature review

To situate the case study experiences within their wider socioeconomic and political contexts, IIED undertook a supplementary literature review to inform the synthesis. This review examined the historical drivers of degradation and agrobiodiversity loss in each case study country, the ways in which smallholder farmers and Indigenous Peoples have resisted and responded to these pressures over time, and the contemporary changes that are reshaping agrobiodiverse production systems in each country.

1.2.4 Case study synthesis and supplementary data gathering

Building from the individual case studies, this report presents a synthesis of their findings. To structure the analysis and distil wider insights, the synthesis draws on Macqueen's (2024) identification of five strategies through which smallholder and Indigenous Peoples' organisations advance agrobiodiversity management (see Box 1).

The five strategies are:

- Sharing knowledge and seed to cultivate diversity
- Promoting the multiple benefits of agrobiodiversity
- Organising collective enterprises that aggregate and add value to diverse products
- Reshaping finance and investment to support diversified production and fund complexity, and
- Bolstering political will and shaping enabling policies.

Box 1. Macqueen's five strategies for advancing agrobiodiversity

An analysis of six forest and farm producer organisations involved with the Forest and Farm Facility,* which were considered to be managing agrobiodiversity well and using at least some deliberate proactive management strategies, identified the following broad, interconnected strategies through which smallholder and Indigenous Peoples' organisations help sustain agrobiodiversity (Macqueen, 2024). Together, these strategies illustrate how producer organisations help create the social, economic, financial and political conditions needed to maintain diverse production systems over time.

Sharing knowledge and seed to cultivate diversity to maintain the knowledge, skills and genetic resources on which agrobiodiversity depends: organisations support farmer-to-farmer learning, strengthen local seed systems and create opportunities for knowledge exchange, experimentation and adaptation.

Promoting the multiple benefits of agrobiodiversity to increase recognition of the nutritional, health, cultural, ecological and livelihood benefits that diverse production systems provide: by making these values more visible, organisations strengthen incentives to maintain diversity.

Organising collective enterprises that aggregate and add value to diverse products to make agrobiodiversity economically viable: organisations aggregate products from multiple producers, support processing and value addition, develop collective brands and connect producers with markets that reward diversity rather than uniformity.

Reshaping finance and investment to support diversified production and fund complexity, recognising that agrobiodiverse systems often require different forms of finance from conventional agriculture: organisations mobilise savings, credit and investment that enable members to invest in diverse production systems and associated enterprises.

Bolstering political will and shaping enabling policies to secure the wider institutional conditions needed for agrobiodiversity to thrive: organisations advocate for secure land and resource rights, recognition of farmer-managed seed systems (FMSS), supportive governance arrangements and policies that value agrobiodiversity.

* www.iied.org/forest-farm-facility-phase-ii

In this report, we use the five strategies as a lens rather than a rigid template. They provide a structured way to organise and explore evidence on sustaining agrobiodiversity, illustrating how different tactics are enacted within different contexts and how organisations seek to balance biodiversity stewardship with sustainable livelihoods. The synthesis builds on Macqueen's framework by exploring how these strategies play out in practice, while also highlighting some of the challenges faced by each group.

Although this synthesis draws primarily on the empirical research from partner-led case studies, it is also informed by IIED field visits to each case study site between May 2023 and May 2026, which enabled deeper engagement with community stakeholders and allowed us to explore emerging findings. The five Nature Nurture project consortium and research partners also critically reviewed the draft synthesis and refined the insights at two in-person learning exchanges in November 2025 and May 2026.

The rest of the report is set out as follows. Section 2 introduces the organisations featured in the three case studies and the agrobiodiverse systems they support. Section 3 examines the historical and contemporary pressures facing these systems, alongside the forms of resistance and adaptation that have emerged in response. Building on this context, Section 4 then explores the common strategies and tactics through which collective organisations help sustain agrobiodiversity and reflects on the challenges and trade-offs associated with these approaches. Section 5 concludes the report by identifying six priorities for nurturing nature, informed by the experiences and lessons emerging from the three case studies. These will provide a foundation for the next phase of the Nature Nurture project, which will develop practical guidance for collective organisations and their supporting partners seeking to nurture nature.

The 51st anniversary celebrations of KEF, Philippines. © Duncan Macqueen/IIED

2

Organisations that nurture nature and the agrobiodiverse systems they maintain

Table 1. Summary of the case study organisations

Name	Country	Location	Description	Reference
Dayak producer groups	Indonesia	The seven community-based producer organisations operate across Labian and Labian Ira'ang villages in West Kalimantan.	Representing around 330 members, these groups focus on supporting diverse livelihoods, production and forest conservation. Through collective production, knowledge sharing and emerging value chains, they help maintain agrobiodiverse forest–farm systems combining swidden agriculture, agroforestry and forest products.	Adhiguna et al. (2025)
KEF	Philippines	KEF is located in Barangay Imugan in Santa Fe municipality, Cagayan Valley Region, but also works across six additional *barangays*: Unib, Baracbac, Bacneng, Santa Rosa, Malico (Santa Fe) and Malico (Pangasinan)	Indigenous-led organisation supporting just over 4,700 Kalanguya–Ikalahan people, focused on protecting ancestral land, livelihoods, culture and Indigenous knowledge. KEF helps maintain diverse forest–farm systems combining Indigenous agroforestry and swidden farming with diverse crops, fruit trees and forest resources.	Gerdan et al. (2025)
MVIWAARUSHA	Tanzania	MVIWAARUSHA is located in Njiro, Arusha town, and operates across 6 districts in the Arusha region: Meru, Arusha, Karatu, Longido, Ngorongoro and Monduli	Member-based organisation representing more than 12,000 smallholder farmers and pastoralists, focused on strengthening livelihoods, access to markets and finance, and collective advocacy. MVIWAARUSHA supports diverse agroecological production systems combining crops, livestock, trees, beekeeping and locally adapted seed varieties.	Kayombo et al. (2025)

2.1 Dayak producer groups (Indonesia)

The Dayak people are made up of diverse Indigenous ethnic groups who traditionally inhabit the interior regions of West Kalimantan. The people of Labian and Labian Ira'ang villages, where the case study is focused, are predominantly from the Embaloh Dayak and Iban Dayak tribes. Labian, with its three sub-villages — Ngaung Keruh, Ukit-Ukit and Tumbali — has a population of 645 (317 men and 328 women). Labian Ira'ang also has three sub-villages — Bakul, Kereng Lunsa and Sembawang — and a population of 462 (247 men and 215 women). Livelihoods in both villages are based on a combination of swidden agriculture (also known as shifting agriculture or slash-and-burn farming), small-scale fruit and vegetable cultivation and harvesting non-timber forest products (NTFPs) from surrounding forests and waterways.

Across both villages, farmers are organised into seven self-organised producer groups (see Appendix 2) that play a central role in coordinating livelihoods, sharing knowledge and managing natural resources. These groups form the primary organisational structure through which the communities maintain and develop agrobiodiversity, supporting activities that range from rice cultivation and rubber production to forest conservation and managing tree-based products such as the illipe nut from the *tengkawang* tree. These producer groups are also supported by Riak Bumi, a community-based organisation based in West Kalimantan.

Although they vary in size, focus and level of formalisation, together the producer groups reflect a system that combines household-based production with collective organisation. Some groups focus on conservation and forest management, including activities such as patrolling forest areas and maintaining water systems. Others are oriented towards agricultural production and income generation, supporting the cultivation of rice, rubber, *purik* leaves (*kratom*[6]), roots and other crops. More recently, groups have also emerged around specific value chains, particularly tengkawang, where activities include tree planting and illipe nut harvesting, processing and quality control. Group membership ranges from around 25 to over 90 members,[7] and the areas managed vary from approximately 50 to over 250 hectares, reflecting differences in function, tenure arrangements and levels of collective organisation.

In Labian, four main producer groups operate across the three sub-villages, including groups focused on forest restoration, illipe nut production, rubber farming and rice cultivation. In Labian Ira'ang, three groups operate with similar objectives, combining conservation, intercropping and agroforestry production with efforts to improve livelihoods.

Together, these producer groups manage a mosaic of land under different tenure arrangements, including communal and privately held areas, and support a wide range of activities across forest and farm landscapes.

2.2 Kalahan Educational Foundation (KEF) (the Philippines)

The Ikalahan People, also known as the Kalanguya, are one of the Indigenous cultural communities of Northern Luzon's Cordillera and Caraballo mountain ranges. Known for their deep spiritual and ecological connection to the land, these traditionally forest-dependent swidden farmers govern themselves through customary laws and practices, including a traditional justice system and community-based rituals that guide relationships with both people and the environment. Following actual and planned incursions, the Ikalahan asserted their ancestral rights, winning legal recognition in 1972 and forming KEF in 1973.

Established as an Indigenous People's organisation to serve both as a legal representative and steward of the Ikalahan's cultural, environmental and socioeconomic aspirations, KEF aims to:

- Promote the development of livelihoods for the community
- Help communities promote, protect and improve sustainable development
- Promote good traditions and cultural integrity
- Encourage youth to finish basic education, and
- Strengthen Christian values and relationships among the community.

To ensure the continuity of land security, improve livelihoods and protect and conserve natural resources, KEF established three institutions — the Kalahan Academy, health services and the Agroforestry Office — which represent its core programmes and service arms. Each serves a distinct yet interconnected function to help KEF fulfil its mission of holistic Indigenous community development:

- The **Kalahan Academy** provides primary and secondary education while embedding Indigenous knowledge, cultural values and ecological understanding within the curriculum, including subjects such as basic ecology and cultural studies. This approach supports both environmental awareness and the preservation of Ikalahan identity.
- The **health services** arm was particularly active during KEF's early years, extending basic medical care and outreach to remote communities, alongside preventive health and nutrition programmes, especially for mothers and children. These services were sometimes linked to environmental initiatives, including water, sanitation and the use of herbal medicine.
- The **Agroforestry Office** serves as KEF's environmental and land-use arm, implementing KEF's resource utilisation and protection policy (RUPP). Its work includes reforestation, land-use planning and watershed protection, alongside support for sustainable farming practices, soil conservation and promoting agrobiodiversity.

6 A leaf that can be brewed or steeped to make tea, kratom has long been used as a traditional medicine, especially by communities in Indonesia (Budiarti et al., 2025).
7 Demographic information for members is not available.

KEF is located in Barangay[8] Imugan in Santa Fe municipality, Nueva Vizcaya province, Cagayan Valley Region (Region II). The Kalanguya–Ikalahan ancestral domain encompasses a landscape of primary tropical rainforest, which serves as a wildlife sanctuary and watershed area, alongside secondary forests interspersed with agroforestry farms, where households cultivate a mix of subsistence and commercial crops.

The Memorandum of Agreement (MOA) No 1, a historic 1974 contract between the Philippine government and the Ikalahan people that established the Kalahan Forest Reserve, formally recognised KEF's right to manage a 14,730-hectare area. Over time, this recognition has expanded into a broader role, with KEF now coordinating activities across the wider Kalanguya–Ikalahan ancestral domain. Spanning approximately 58,118 hectares, this landscape includes elevations from around 900 metres in Imugan to over 1,300 metres in Malico, shaping diverse agroecological conditions.

KEF works across seven *barangays* — Imugan, Unib, Baracbac, Bacneng, Santa Rosa, Malico (Santa Fe) and Malico (Pangasinan) — serving a population of just over 4,700 people. Within this context, KEF functions as the central coordinating institution linking land management, livelihoods and community governance across the ancestral domain.

2.3 Mtandao wa Vikundi vya Wakulima na Wafugaji Mkoa wa Arusha (MVIWAARUSHA) (Tanzania)

MVIWAARUSHA is a member-based organisation of more than 12,000 smallholder farmers and pastoralist groups in northern Tanzania's Arusha region. Headquartered in Njiro, Arusha town, its members operate across a range of ecological zones, from the highland areas of Karatu to the lowlands of Monduli and the upper slopes bordering the Ngorongoro Conservation Area. These diverse landscapes support a mix of crop farming, livestock keeping, beekeeping and small-scale fisheries.

Established in 2011 as a network of farmers in Monduli district known as MVIWAMO, over time the network expanded to include members from Karatu and the former Arumeru East and West districts, and it was re-registered in 2013 as MVIWAARUSHA. It has since evolved into a regional network linking farmer and pastoralist organisations across village, ward and district levels.

Today, it operates across six district councils — Meru, Arusha, Karatu, Longido, Ngorongoro and Monduli — through six district networks, 42 ward networks and 446 village-level groups. As of 2023, it represented 12,498 individual members, including 7,996 women and 4,502 men, of whom 3,749 are youth.

MVIWAARUSHA aims to strengthen the collective voice and capacity of smallholder farmers and pastoralists, supporting them to improve livelihoods while promoting sustainable land management. Its work centres on building agroecological and agrobiodiversity practices, strengthening farmer organisations, improving access to markets and finance, and enhancing advocacy capacity at multiple levels. Agrobiodiversity is central to these efforts, underpinning food security, livelihood resilience and environmental sustainability.

Through its network model, MVIWAARUSHA mobilises farmers and livestock keepers within their local areas while connecting them to wider systems of support. Functioning as both a coordinating and representative body, it links village-level producer groups to district and regional decision-making platforms, while embedding inclusive governance practices that enable members to participate in decision making, leadership and resource management. This approach strengthens its members' capacity to manage diverse production systems within Tanzania's changing ecological and economic conditions.

8 A *barangay* is the smallest local government unit in the Philippines.

2.4 Agrobiodiversity and agroforestry system management

2.4.1 The Dayak People's agrobiodiverse productive systems

The Dayak groups in Labian and Labian Ira'ang maintain a rich and diverse agroecological system that integrates more than 60 varieties of cash crops, subsistence crops and wild forest products (see Appendix 3). Men predominantly cultivate commercial cash crops such as *kratom,*[9] rubber, rice, cacao and *tengkawang/*illipe nuts, while women play a vital role in producing diverse food crops and tending household gardens with vegetables and fruits such as cucumbers, chillies, bananas and pineapples. Both men and women harvest a wide range of NTFPs, such as illipe nuts, rattan, bamboo, wild fruits and medicinal plants, as well as fish, sago worms and other animals to supplement their incomes and food security.

The Dayak People's farming practices are holistic and regenerative, and their productive systems emphasise harmony with nature and preserving biodiversity. These practices provide a buffer against crop failures caused by environmental challenges while fostering economic resilience. The agricultural system includes rotational farming with long fallow periods of up to 20–25 years, allowing forest regeneration and maintaining a mosaic landscape that is rich in species diversity. They use controlled burning to restore soil nutrients naturally and traditional agroforestry systems, such as *tembawang* and *lembo* in West and East Kalimantan, respectively, and integrate rubber, fruit trees, rattan and medicinal plants, reflecting the Dayak People's deep ecological knowledge and spiritual respect for the forest as their ancestral home.

2.4.2 The Ikalahan traditional agroforestry system

The Ikalahan People practice a traditional agroforestry and swidden farming system, cultivating land primarily in the lower to mid-mountain areas with less than 50% slope and along ridge tops where farming is still viable. Each household typically cultivates around 1 hectare of land. Previous studies have documented the following seven practices through which the Ikalahan People maintain the fertility of their farming system (Camacho and Del Rosario, 2013):

1. *Iinum-an* (the *kaingin* swidden agricultural system), which involves sequential clearing of forest and fallow regrowth
2. *Kinebbah* (fallow period), which allows soil to recover under natural regeneration, sometimes by planting leguminous alnus trees for 10–15 years to restore the soil
3. *Gen-gen*, which combines soil terracing and composting by burying unused sweet potato materials to enrich the soil in mini-terraces
4. *Day-og*, a process of digging holes along water canals and scooping out soil as planting mounds for crops that need good irrigation and burying weeds such as *panawel* (*Ageratina adenophora*) and other plants as a green fertiliser
5. *Balkah* (vegetative terracing planted with tiger grass), to prevent soil erosion
6. *Tuping* (a terracing system for rice) in high areas, which involves mosaic-like piling of rocks
7. *Pamettey* (a homemade pesticide system for controlling plant pests and diseases), which uses ash, red chilli and certain local plants with bitter and unpleasant taste as ingredients.

Ikalahan farming practices continue to evolve. Traditional *kaingin* farming — which used to be sustainable due to small populations and a deep understanding of forest regeneration cycles — is giving rise to more established and sedentary agroforestry systems and commercial farms, encouraged by securing land tenure in 1972. But the Ikalahan People have maintained diversity in their farming systems, integrating fruit tree farming, organic farming methods and sustainable forest management to enhance both food security and environmental preservation.

9 Scientific names for crops are listed in Appendix 3.

The traditional farming system has an extremely rich species diversity. As well as conventional crops, the Ikalahan People cultivate 88 main useful species of fruit trees, palms, vines and shrubs (see Appendix 3). They also use forest areas to harvest a wide range of plant and animal products, and to grow commercial and subsistence crops. The former include *ube* (purple yam), *calamansi*, pineapple and mango, while the latter include wild mushrooms, guava and indigenous plants such as *pikaw*, *samplora* and *luban*, which are important for daily sustenance and contribute to preserving traditional knowledge and the Ikalahan People's connection with the environment.

2.4.3 MVIWWARUSHA members' agrobiodiverse production systems

The smallholder farmers and pastoralists within the MVIWAARUSHA network maintain highly diverse farming systems that integrate crop cultivation, livestock keeping, tree planting and natural vegetation management. These systems reflect the range of ecological zones where members live, from the lower zone of Monduli district (1,000 metres or less) to the central zone around Karatu (around 1,700 metres) and the higher zone near the Ngorongoro Conservation Area (over 2,000 metres). The region's tropical savanna and humid subtropical climate supports a mosaic of farms, grazing lands and settlements interspersed with forest and woodland patches. Farmers here collectively cultivate, consume and sell more than 20 crops varieties, harvest wild or semi-wild foods and materials from nearby forests and communal lands, including fruits, vegetables and medicinal plants (see Appendix 3) and rear ten types of livestock, including bees.

Commonly cultivated crops include maize, beans, pigeon peas, sunflower and vegetables, which are used for both household consumption and sale. Most smallholders sell roughly half of their harvest and retain the rest for household consumption, positioning them as key contributors to both local food security and market supply in northern Tanzania. Crop residues feed livestock after harvest, while manure is returned to fields to enhance soil fertility. Livestock, especially cattle, goats and sheep, are grazed freely on non-cultivated areas and harvested fields, while a smaller number of higher-value animals are managed under zero-grazing systems. Members use wild-harvested species such as baobab, *mushubiri* and *mkarisa* for nutrition and traditional medicine, illustrating the close connection between people, biodiversity and local ecosystems.

Tree planting and protection form an integral part of everyday farm management. Members establish and maintain trees on farms and along field boundaries to provide shade, fodder, firewood and fruit, and to help stabilise soils and conserve moisture. The integration of trees, crops and livestock underpins both production and ecological resilience. Beekeeping is also an important activity, with hives placed near natural vegetation and water sources to provide income through honey and wax sales, enhance pollination and motivate the protection of tree cover.

Knowledge of farming, seed management and environmental stewardship is shared across generations and strengthened through MVIWAARUSHA's training and exchange activities. Members participate in awareness campaigns and community tree-planting activities that promote the protection of natural vegetation soil and water resources, strengthening both the ecological and social foundations of agrobiodiversity.

The three case studies described here illustrate how smallholder farmers and Indigenous Peoples continue to maintain agrobiodiversity-rich landscapes in diverse contexts. But these systems operate within wider political-economic dynamics that often undermine biodiversity and local control. Section 3 examines the threats these systems face and how communities have responded to them.

Landscape of the Kalanguya–Ikalahan ancestral domain, Philippines. © Duncan Macqueen/IIED

3

Agrobiodiversity under pressure: historical drivers, resistance and emerging change

3.1 A brief history of deforestation and agrobiodiversity loss in our case study countries

Traditional swidden and agroforestry systems that sustain high levels of agrobiodiversity have come under increasing pressure from political-economic dynamics that prioritise short-term profit over ecological stewardship. In this cycle, control over land and productive resources — including forests, minerals and seeds — becomes increasingly concentrated among politically and commercially powerful actors, often driving the expansion of large-scale logging, plantation agriculture and extractive industries and leading to the displacement of local communities. The resulting deforestation, fragmentation and conversion of traditional agroforestry landscapes reduce the ecological space within which agrobiodiversity has historically been maintained.

As simplified monocultures and standardised production practices progressively replace diverse, locally adapted farming systems, they also erode the ecological knowledge, seed systems and cultural practices people use to maintain and adapt diversity over time. Rising labour costs, mechanisation and chemical inputs reinforce these simplified production models, while the concentration of profits and decision-making power within industrial production systems further perpetuates inequalities and reinforces patterns of ecological degradation and social exclusion.

Although they have unfolded through different historical and institutional pathways, these dynamics are evident across all three case studies. Drawing on a review of the literature, we examine the historical drivers of agrobiodiversity loss in each context, the ways in which smallholder farmers and Indigenous Peoples have resisted and responded to these pressures over time and the contemporary social, economic and environmental changes that continue to reshape agrobiodiverse production systems. Together, these provide important context for understanding the strategies and challenges explored in Section 4.

3.1.1 West Kalimantan, Indonesia

Deforestation in West Kalimantan increased from the 1970s, primarily driven by large-scale logging and agricultural expansion. Timber extraction, fuelled by both legal and illegal logging operations, catalysed much of the initial forest loss, particularly impacting the lowland rainforests (Tsujino et al., 2016). At the same time, government policies promoting transmigration and agricultural development led to extensive clearing of forested areas for settlements and cropland. From the 1980s to the early 2000s, the establishment and rapid expansion of oil palm plantations became a dominant factor in deforestation, often replacing secondary forests or previously logged land (Myers et al., 2016). Despite some reduction in deforestation rates during the 2010s, commercial pressures and agricultural land conversion have remained persistent challenges in the region's landscape management.

The erosion of swidden agriculture and Dayak land rights is a critical dimension of West Kalimantan's deforestation history, highlighting tensions between Indigenous land use and commercial development imperatives, particularly palm oil plantations (de Jong, 1997). Swidden agriculture, traditionally practiced by Dayak communities in West Kalimantan, has historically played an integral role in the region's socioecological landscape. This form of shifting cultivation involves rotational clearing and fallowing of forest plots, enabling sustainable subsistence farming while maintaining forest biodiversity and ecological functions. The Dayak Peoples use of swidden systems embedded within forest landscapes preserves both agrobiodiversity and forest cover over long periods (Joshi et al., 2004).

But the expansion of commercial agriculture, especially oil palm plantations, alongside government policies favouring fixed land use and large-scale land conversion marginalised traditional swidden practices. The transition from swidden to other land uses contributed to deforestation, biodiversity loss and reduced soil fertility; it also accelerated soil erosion (van Vliet et al., 2012). As forests were cleared for plantations and settlements, the Dayak Peoples lost access to customary lands, disrupting their livelihoods and accelerating the loss of forest ecosystems.

3.1.2 The Philippines

The Philippines has experienced a long history of deforestation, shaped by successive phases of colonial and post-colonial resource extraction. Before colonisation, forest cover exceeded 90% (Suarez and Sajise, 2010) and Indigenous communities such as the Ikalahan practised small-scale, regenerative systems including *kaingin* farming, allowing

forests to recover through fallow cycles under customary governance. These systems supported both livelihoods and the maintenance of diverse forest and agricultural landscapes.

Colonial rule introduced a shift towards externally driven resource use. Under Spanish rule, forests were increasingly appropriated for shipbuilding, construction and fuel, reducing forest cover to around 70% by the end of the colonial period (Suarez and Sajise, 2010). Later, the US administration intensified large-scale commercial logging, supported by institutions such as the Bureau of Forestry and Roadbuilding, which opened remote forest areas. By the mid-20th century, forest cover had declined to roughly 50%. After independence, timber licence agreements (TLAs), agricultural expansion and resettlement programmes further accelerated forest loss, particularly during the Marcos era when logging expanded under politically connected companies (Maohong, 2012). By the 2020s, forest cover had declined to approximately 24%.

Attempts to reverse this trend — including logging bans and reforestation initiatives such as the National Greening Program — have had mixed success, constrained by fragmented planning, weak community involvement, poor ecological matching and continued pressures from illegal logging, mining and land conversion (GIZ, 2013; Lozano et al., 2025).

The main proximate drivers of deforestation have been smallholder agricultural expansion, wood extraction and infrastructure development, with underlying causes including expanding populations, poverty, commodity demand, economic development and poor governance at both policy and institutional levels (Kummer and Sham, 2023).

The Ikalahan People have directly experienced these pressures. In 1970, the Philippine government earmarked around 6,300 hectares of their ancestral lands for a holiday resort, while lowlanders linked to powerful interests used fake titles to try to appropriate community land. A successful legal defence in 1972 marked a crucial moment in resisting these pressures and securing the basis for maintaining their agroforestry systems. Following formal government recognition, some of the lowlanders' titles were revoked, eventually leading them to abandon plans to develop the area (Gerdan et al., 2025).

3.1.3 Tanzania

In Tanzania, patterns of forest loss and agrobiodiversity decline reflect a layered history of shifting land governance and economic priorities. Before colonial intervention, its people maintained diverse agroecological systems through customary tenure arrangements that balanced cultivation, grazing and forest use. Agroforestry systems in the northern highlands and rotational grazing by Maasai pastoralists sustained soil fertility, biodiversity and ecological resilience over time (Soini, 2005; Homewood et al., 2009).

Colonial rule fundamentally restructured these systems by reclassifying land as state property, undermining customary rights and local management systems, and prioritising commercial production and resource extraction. Policies restricted shifting cultivation and pastoral mobility in many areas, while promoting timber extraction, plantation forestry and cash crops. These changes contributed to the simplification of diverse production systems and the erosion of locally adapted ecological practices (Sunseri, 2005).

Post-independence policies further reshaped land use. The Arusha Declaration and subsequent Ujamaa socialist development path (late 1960s to mid-1980s) extended state control through villagisation and collective agriculture. Although intended to promote self-reliance and rural development, these policies often intensified deforestation for settlement and fuel, contributing to soil degradation and habitat loss (Fiechter et al., 2024; Sunseri, 2005). From the mid-1980s onwards, structural adjustment and market liberalisation reduced state oversight and encouraged private investment, increasing logging, charcoal production and agricultural land conversion, particularly around urban centres (Benjaminsen et al., 2013; Mwampamba, 2007).

Today, deforestation is driven primarily by smallholder agricultural expansion, alongside charcoal production, timber extraction and infrastructure development (Doggart et al., 2020; Nzunda and Yusuph, 2022). These proximate drivers are rooted in deeper structural dynamics, including population growth, market integration and policy frameworks that prioritise commercialisation over locally embedded, diverse farming systems. Over time, these dynamics have contributed to the gradual erosion of agrobiodiversity and the knowledge systems that sustain it.

3.2 Community resistance and defence of agrobiodiversity

Across the three contexts, the pressures described above have not gone uncontested. Indigenous Peoples and smallholder farmers have developed a range of strategies to defend control over land, seed and ecological knowledge. These forms of resistance extend beyond visible political action or legal mobilisation to include everyday practices through which communities sustain their production systems, cultural identities and relationships with the natural environment.

Resistance in this sense operates across multiple dimensions. On one level, there are efforts to secure formal recognition of land and resource rights, challenge regulatory frameworks that marginalise local systems and influence policy. On another, there are practical actions such as using and transmitting traditional ecological knowledge, maintaining diverse farming and forest management systems and reproducing locally embedded institutions that govern land and resources. These practices are not passive remnants of the past, but active processes through which communities sustain alternative ways of organising production and managing biodiversity.

3.2.1 Indonesia

The Dayak communities of West Kalimantan have long engaged in diverse strategies to resist the encroachment of industrial logging, plantation agriculture and state control over forest land, all of which have threatened their traditional swidden-based landscapes. Central to their resistance has been the assertion of *adat* (customary land) rights, which function as a legal and cultural foundation for defending ancestral territories from external claims. Unlike formal state land titles, which require bureaucratic registration and often exclude rural populations, *adat* systems are rooted in communal knowledge, cultural practices and long-standing stewardship of ancestral territories (Szczepanski, 2002). They encompass both communally owned lands, often protected for shared use, such as sacred forests and agroforestry plots, and individually managed swidden agricultural plots maintained according to customary law.

But *adat* rights recognition and enforcement have historically been tenuous within Indonesian legal frameworks, which tend to prioritise state forest ownership and formal land registration. While there have been notable cases of recognition — such as customary forests granted to the Dayak Iban of Sungai Utik — these remain limited and uneven in their application (Zein and Daubach, 2019). This has led to ongoing debates about the extent to which formal *adat* recognition can effectively secure Indigenous land rights, with some scholars arguing that it must be complemented by broader institutional and political strategies (Bedner and Arizona, 2019).

In this context, resistance takes both formal and everyday forms. Participatory mapping and community-based forest monitoring have emerged as key tools for documenting customary territories and land-use systems, providing evidence to support legal claims and advocacy (Kroese, 2025). At the same time, the continuation of swidden agriculture and agroforestry systems — practices that embody sustainable resource management and sustain biodiversity within mosaic landscapes — is itself a form of resistance, maintaining alternative relationships with land in the face of pressures towards monoculture production (van Vliet et al., 2012). Through these practices, communities not only defend their territories but also actively reproduce the ecological knowledge and institutions that underpin agrobiodiversity.

3.2.2 The Philippines

In the Philippines, resistance to the loss of Indigenous land has often taken the form of sustained legal and institutional struggles to secure recognition of ancestral domains. Indigenous communities have faced long-standing pressures from state-led development, commercial land interests and competing claims over forest land. In response, they have mobilised to defend their territories through legal action, advocacy and by strengthening the customary governance system.

The experience of the Ikalahan People and the establishment of KEF is a defining example of this resistance. In the early 1970s, the Ikalahan People faced significant threats to their ancestral lands, including government plans to convert approximately 6,300 hectares into a commercial development. Ikalahan elders, Reverend Delbert Rice and attorney Julian de Vera worked together to fight this, winning legal recognition of their ancestral land claims in 1972. They went on to establish KEF Inc, which has become the legal personality of the Ikalahan people in these areas.

This victory paved the way for the establishment of the 14,730 hectare Kalahan Forest Reserve in 1974 and the issuance of MOA No 1 between the government and KEF, which legitimised the Ikalahan's prior and vested rights over their ancestral lands (Rice, 2001). Recognising their claim, it assured that the Ikalahan People would not be driven away from their ancestral lands and gave them complete control and authority to manage and use the land and its resources. As the Philippine government's first official recognition of Indigenous ancestral land tenure in the post-colonial period (Barrientos, 2020), MOA No 1 was a foundational step that helped pave way for more comprehensive recognition under the Indigenous Peoples' Rights Act (IPRA) – Republic Act 8371 of 1997.

In 1989, the Philippine government conceptualised a community-based forest-management programme. Based on the success of KEF's implementation of MOA No 1, the Community-Based Forest Stewardship Agreement became the basis for delineating ancestral lands and domain claims in 1993 through Administrative Order No 2 Series of 1993 and the IPRA in 1997.

On 4 June, 1999, KEF became the first organisation to avail a Certificate of Ancestral Domain Claim (CADC) community-based forest management agreement with the Philippine government. The total extent of the Kalanguya–Ikalahan ancestral domain is almost 58,118 hectares, as delineated under the IPRA framework. Following the issuance of the CADC in the 1990s, the government went on to recognise the full area through a Certificate of Ancestral Domain Title (CADT).

Resistance in this context has not been limited to legal recognition. The Ikalahan have developed and maintained systems of governance that regulate land use and resource management according to both customary principles and formal rules. As part of its commitment to protect both forest and traditional agricultural practices, KEF has put in place a RUPP to manage both the 14,730-hectare Kalahan Forest Reserve and land uses such as swidden farming, forest-product harvesting, tree cutting (including chainsaw registration and use), hunting, fishing, quarrying, fire prevention and land encroachment. KEF's delineation of at least 10 hectares of watershed sanctuary per *barangay* significantly influenced local government policy. Violations of the RUPP carry specific penalties, reflecting the community's commitment to the long-term sustainability of their ancestral domain.

3.2.3 Tanzania

In northern Tanzania, smallholder and pastoralist resistance has centred on contesting seed governance and defending FMSS as a foundation of agrobiodiversity and local resilience. For most smallholders, saving, exchanging and adapting seed remains the primary source of planting material and plays a central role in maintaining agrobiodiversity. Such FMSS are embedded within local knowledge, social networks and ecological adaptation processes, enabling farmers to sustain diverse crop varieties suited to specific environments.

However, national seed legislation has increasingly favoured formal seed systems based on certified varieties, standardisation and commercial distribution. These frameworks typically require laboratory testing, registration fees and varietal uniformity criteria that are difficult for smallholders to meet; they also often exclude traditional and locally adapted crops (Haug et al., 2023). Reforms linked to agreements such as the International Union for the Protection of New Varieties of Plants 1991 Convention have further strengthened intellectual property protections for commercial breeders while restricting the circulation of uncertified seed. In some cases, such regulations impose significant penalties for the sale or exchange of farmer-managed seed, effectively criminalising long-standing practices. The result is a dual system in which formal markets privilege commercial breeders and urban-based seed companies, while smallholders, who produce an estimated 95% of Tanzania's seed (ASARECA and KIT, 2014), operate in a legal grey zone. As such, these laws entrench a commercial model of seed governance built around private breeders and export crops, while undermining the everyday seed exchange practices that sustain biodiversity and local adaptation. These dynamics reflect broader patterns in global agricultural development, where seed systems have become sites of contestation over knowledge, control and value.

Within this context, organisations such as MVIWAARUSHA have emerged as part of wider networks of farmer-led resistance, working to defend and reassert the legitimacy of FMSS. Their work reflects a broader pattern of mobilisation in which farmers seek to challenge restrictive regulatory environments while strengthening the social and ecological foundations of local seed systems. This includes both collective efforts to influence policy and the reinforcement of local practices that sustain seed diversity.

Resistance therefore operates at multiple, interconnected levels. At the most immediate level, farmers continue to save, exchange and adapt seed through local networks, sustaining crop diversity and ecological resilience despite regulatory constraints. These everyday practices form a critical foundation of agrobiodiversity and represent an ongoing, embedded form of resistance. At a broader level, farmer organisations and civil society actors are working to reframe FMSS as a legitimate and valuable component of national agricultural systems, highlighting their contribution to climate resilience, food security and cultural identity.

These struggles over seed governance reflect deeper historical continuities in agriculture governance, where external control over seed, land and knowledge has long constrained local autonomy. Contemporary commercial seed regimes reproduce relations of dependency that limit farmers' capacity to innovate and sustain crop diversity. Representing more than a technical or economic response, the defence of FMSS in Tanzania forms part of a broader effort to strengthen farmer control over seed, agricultural knowledge and production systems while maintaining agrobiodiversity (Haug et al., 2023; TOAM, 2015).

3.3 Changing contexts and emerging pressures within agrobiodiverse landscapes

It is not just external pressures that have brought about incursions of commercial monoculture land use into the traditional territorial domains of local groups. There have also been fast-changing social dynamics associated with globalisation. Indigenous People are often marked out not by their desire to reform the system, but by their desire for autonomy and political-cultural space to remain different (Hall and Fenelon, 2008). But despite such resistance and revitalisation, the rapid evolution of geopolitics and governance, markets and consumption, technology and capabilities, mobility and migration, social media and popular culture introduce new pressures, many of which drive the pursuit of value towards self-enhancement rather than public goods provision. Contrary to many perceptions, traditional systems are not static; instead, they have to resist in new ways, accommodating new needs — for example, for cash income to engage in the global economy in however restricted a way — or more radical departures, such as migration in the event of rapidly accelerating climate extremes (Xu et al., 2020).

3.3.1 Indonesia

The Dayak People have adapted their cultivation practices and cultural expressions in response to pervasive economic and political pressures stemming from industrial land conversion and state policies. Traditionally reliant on swidden agriculture, many Dayak communities have transitioned to more sedentary, market-oriented farming systems involving perennial cash crops such as rubber and fruit trees (de Jong, 1997). This shift reflects both the need to generate income in a rapidly changing economy and constraints on land availability due to plantation expansion.

Culturally, the Dayak have negotiated a balance between maintaining traditional knowledge systems and incorporating modern livelihood strategies, such as participating in wage labour and engaging with broader market economies. They have reshaped some customary rituals and social institutions linked to forest stewardship to accommodate new socioeconomic realities and revitalised others as symbols of identity and resistance against cultural erosion (Joshi et al., 2004).

In Labian and Labian Ira'ang villages, Dayak producer groups have shifted to different crops depending on market prices, moving, for example, from peppers to rubber plantations and now to *kratom*, which is in high demand. They maintain their traditional agroforestry and forest garden systems — *tembawang* and *lembo* in West and East Kalimantan, respectively — developed over generations as sustainable methods of cultivation and resource management within the tropical forest landscape, adapting them to new economic realities by incorporating cash crops and emphasising products with market value, blending tradition with livelihoods that can withstand broader economic pressures (Bamba and Munandar, 2023).

3.3.2 The Philippines

The government's 1972 recognition of the Kalanguya–Ikalahan ancestral domain did not remove all pressures on the traditional agricultural management system, which has increasingly had to accommodate the need for cash income (to cover bills, school fees, medicals costs and so on) and pressure to both expand areas of commercial monocropping and use chemical fertilisers and pesticides to increase profits. As a result, there is ongoing tension between more integrated traditional subsistence farming patterns and more commercial practices (Gerdan et al., 2025).

For example, local farmers have traditionally cultivated as many as 20 different varieties of *camote* (sweet potato), one of the Ikalahan People's most important crops. The pressure to move towards more commercial farming practices has not altered the species (in this case, *camote*) that farmers grow; and comparisons of the most frequently planted crops in both commercial and traditional systems reveal that farmers still produce many of the same crops. In some ways, that is to be expected, as in the remote region of Imugan, the main market for agricultural produce remains the community retail stores at Nueva Vizcaya Agricultural Terminal in Bambang, which is the provincial collection centre of all agricultural products some 40+ kilometres from the farmers' production sites. So, demand for *camote* is the same, whether from it comes from traditional or more commercial farms. What has changed is that farmers are favouring more productive, but potentially less nutritious varieties over less productive, more unusual and potentially more nutritious varieties. As a wholesale commodity market, the Nueva Vizcaya Agricultural Terminal offers little product differentiation, in terms of production processes such as organic farming, geographical origin or fair trade. About five main commercial varieties of *camote*, covering the main colours, are widely traded, and competition is based primarily on price, so there is little incentive to maintain traditional varieties, even if they have higher nutritional value. As a result, there is a strong market pressure to move away from traditional *camote* varieties and narrow the production base towards more profitable commercial varieties.

This pressure is also felt to some degree at species level. For example, commercial farmers favour commercial crops that are widely eaten in international menus — such as tomatoes and cucumbers —over more traditional crops with more restricted local familiarity such as *sayote* and *pihing* or taro. Commercial farming strategies also tend to use larger field sizes to allow mechanisation alongside chemical fertilisers and pesticides to augment profits. The more labour-intensive methods of smaller more integrated plot maintenance, local composting, crop rotation and contour planting to maintain soil fertility and reduce pests can lose out in commercial decision making.

3.3.3 Tanzania

The farming and pastoral landscapes of Monduli, Karatu, Arusha, Meru, Longido and Ngorongoro, where MVIWAARUSHA works, are being reshaped by rapid social and economic change. These areas have long supported mixed farming and livestock systems that sustain agrobiodiversity through the integration of crops, trees and rangelands, but that balance is being tested by growing market engagement, infrastructure expansion and the spread of agricultural modernisation policies. Large-scale investment programmes, such as the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) and the newer Agricultural Growth Corridors of Tanzania (AGCOT), have presented a powerful vision of transformation, promising jobs, improved infrastructure, access to credit and integration into lucrative value chains. AGCOT extends the corridor approach to four agricultural growth zones across the country, including a northern corridor, which overlaps with the wider region where MVIWAARUSHA operates (AGCOT Centre, 2025). Although direct implementation has been limited to date, AGCOT reflects a broader state-led push for agricultural modernisation, positioning commercial, large-scale and investment-led farming as the central pathway for national development. Modern farming — associated with hybrid seeds, fertilisers and chemical inputs — is increasingly viewed as a marker of success (Snyder et al., 2020). For many rural households, these programmes appear to offer a pathway out of poverty and into prosperity; yet they have largely favoured capital-intensive production, concentrating access to land and water while narrowing the ecological base of smallholder systems (Sulle, 2020).

Among MVIWAARUSHA's members, livelihood patterns reflect the growing need for cash income within mixed farming systems. While traditional crop diversity remains important for household food security, there has been a gradual reorientation towards market sales, with many farmers selling part of their harvests to cover school fees, healthcare, housing and farm inputs. The most marketable and higher-priced crops — such as maize, sunflower, beans and vegetables — are particularly valued for this purpose (Kayombo et al., 2025). These changes point less to a wholesale

shift towards commercial agriculture and more to incremental adaptations to the monetisation of daily life, where cash income has become central to sustaining family wellbeing.

For pastoral and agropastoral communities, including many Maasai communities within MVIWAARUSHA's network, land pressures have become increasingly acute. Cultivation has expanded not as a rejection of pastoralism but as an adaptive response to shrinking communal grazing lands caused by population growth, conservation initiatives and private enclosures (McCabe et al., 2010; Benjaminsen et al., 2013). In areas bordering the Ngorongoro Conservation Area and the highlands of Monduli and Karatu, restricted access to rangelands and water has pushed many households to combine livestock keeping with crop cultivation and small-scale trade. These mixed systems now underpin livelihood security but also bring new challenges, including increasing land fragmentation and reduced livestock mobility (Homewood et al., 2009). Recent research shows that many Maasai communities are engaging with modernity in pragmatic and creative ways, embracing education, wage work and new forms of enterprise while retaining cultural values tied to livestock and land (Wijngaarden, 2021). This selective incorporation of change underscores that adaptation does not equate to cultural loss; but rather, to a reworking of identity within changing political and economic realities.

A KEF demonstration farm of varieties of camote (sweet potato), Philippines. © Duncan Macqueen/IIED

4

Strategies and tactics for maintaining agrobiodiversity in different contexts

This section synthesises evidence from the Tanzania, Indonesia and Philippines case studies to examine the strategies and tactics through which local organisations maintain agrobiodiverse production systems while sustaining viable livelihoods.[10] To structure the analysis, we draw on Macqueen's synthesis of five strategies (see Box 1), through which

10 For more detailed information on each case study, refer to the individual case study publications (Kayombo et al., 2025; Adhiguna et al., 2025; Gerdan et al., 2025).

smallholder and Indigenous Peoples' organisations enhance agrobiodiversity management. Emerging from analysis of six forest and farm producer organisations involved with the Forest and Farm Facility, chosen because they were seen to be managing agrobiodiversity well and using at least some deliberate proactive management strategies, the five strategies are: sharing knowledge and seed to cultivate diversity; promoting the multiple benefits of agrobiodiversity; organising collective enterprises that aggregate and add value to diverse products; reshaping finance and investment to support diversified production and fund complexity; and bolstering political will and shaping enabling policies.

We use the five strategies as a lens rather than a rigid template. They provide a structured way for organising and exploring evidence on sustaining agrobiodiversity, illustrating how different tactics are enacted within distinct socioecological landscapes and how organisations seek to balance biodiversity stewardship with sustainable livelihoods. Following a foundations-to-enablers logic that emerges from the case studies, this section explores: the everyday systems (seed and knowledge sharing) that keep diversity in circulation; how multiple benefits are made visible and valued; enterprises built on diversity; inclusive finance as mechanisms for livelihood viability; and how to influence policy and political conditions that can enable or constrain these strategies over time.

4.1 Maintaining diverse production systems through seed and knowledge sharing

Agrobiodiverse production systems depend on the continual maintenance and transmission of local ecological knowledge and diverse seed systems. Smallholders can only cultivate diverse production systems if they have the knowledge, seed and other productive inputs they need. In the Majority World, 75–90% of farmers get seed primarily from informal local seed systems (Heindorf et al., 2021). This figure varies across regions, and is slightly higher in Africa than Asia and Latin America, at 80–90% and 70–80%, respectively (La Via Campesina, 2015). So, decisions about what to plant and how and where to obtain seed are primarily local issues. But collective organisations play an important role in supporting and strengthening these community-based systems, helping to sustain and extend the spread of knowledge while improving access to diverse crop and tree varieties.

The three case studies illustrate that local ecological knowledge and informal seed systems form the foundation upon which agrobiodiversity depends. Across all three contexts, farmers learn what to grow, how to manage diverse crops, trees and landscapes, and how to adapt to changing conditions through intergenerational learning within households, peer-to-peer exchange between neighbours and community networks, and learning by doing. Seeds and other planting materials also circulate largely through informal saving, sharing and exchange systems.

In all three case studies, collective organisations play an important role in strengthening and extending these systems through a range of complementary approaches, including farmer training, tree nurseries, community seed banks, demonstration farms and educational initiatives (see Table 1). While these approaches differ in their degree of formalisation and institutional support, they share a common objective: sustaining the knowledge, skills and genetic resources upon which agrobiodiversity depends. The case studies also illustrate that traditional systems are place-based and embedded into social relationships and practices, leaving them vulnerable to broader demographic, economic and institutional changes that extend beyond the immediate control of local organisations.

Local ecological knowledge remains central to agrobiodiversity management across all three case study contexts, but it is sustained through different cultural and institutional arrangements. Knowledge is primarily transmitted through intergenerational learning within households, observation, experimentation and practical experience, rather than formal instruction in all three contexts, while cultural traditions shape both what knowledge is maintained and how it is shared.

4.1.1 Knowledge exchange

Among Dayak communities in Indonesia, knowledge systems are closely intertwined with cultural identity, household practice and peer-to-peer exchange. Storytelling, poems and traditional recipes play an important role in keeping knowledge alive and reinforcing relationships between biodiversity, farming and Dayak identity, while cultural rituals such as *gawai* (harvest parties) embed knowledge within community life. Women play a key role in knowledge transmission because they often have more specialised knowledge of local plants and forest resources than men, as

Dayak custom passes knowledge of subsistence and medicinal crops from mothers to daughters. Men, by contrast, tend to hold more knowledge on commercial crops.

In the Philippines, Ikalahan knowledge is similarly grounded in lived experience and passed between generations through demonstration, observation, application and experience. The use of traditional recipes encourages the continued cultivation and consumption of Indigenous crops, while farmers regularly exchange knowledge with neighbours and adapt successful practices observed in other households. Individual success stories shared within the community help increase education on the best farming strategies and practices.

In Tanzania, local ecological knowledge is also transferred primarily within households and farming communities, where parents, grandparents and neighbours teach younger generations through learning-by-doing and informal teachings. Farmers also learn by observing and adopting the practices of their successful neighbours.

Although expressed through different (although inherently similar) cultural traditions, all three case studies demonstrate that local ecological knowledge forms part of broader culture, identity and everyday practice.

4.1.2 Seed exchange

The circulation of seed and other planting material is similarly rooted in community-based systems. In all three countries, households remain key custodians of locally adapted seed, while community networks enable varieties to circulate beyond individual farms.

A farmer sorts his pigeon peas in Dofa village in Karatu district, Tanzania. © Roshni Lodhia/Panos/IIED

In Indonesia, self-provisioned seed plays a central role in sustaining diversity and farmers place strong emphasis on local seed, because they have adapted them over generations to better cope with local pests, diseases and environmental conditions. Households carefully select and save seed, particularly rice, with individual households maintaining two to six rice varieties and communities typically cultivating more than ten varieties. Farmers continually rejuvenate their rice and other seeds through annual planting cycles and exchange with neighbours to match different soils and growing conditions, while informal barter helps maintain both genetic diversity and reciprocal social relationships. Farmers who cannot cultivate in a particular season often provide seed to others and receive replacement seed after harvest. Traditional wisdom emphasises sharing part of the harvest with wild animals and cultivating diverse crops to support pest control, ecosystem stability and forest conservation. Together, these practices reflect

a holistic understanding of production that integrates multiple species into ecologically balanced farming systems, while simultaneously respecting other creatures that depend on produce from the fields. Although most households manage and store seeds individually, some producer groups have begun establishing nurseries for rubber, *kratom* and vegetables, alongside propagating cuttings of culturally important *tengkawang* trees.

Farmers in the Philippines also largely manage their own seed stocks, relying heavily on seed saving from previous harvests, intergenerational knowledge and exchange with neighbouring farmers, particularly for traditional crops such as maize, ginger, *sayote*, *galyang* and *camote*. Women play the primary role in selecting seed and cultivating subsistence crops that support family nutrition. Seed is traditionally stored in household kitchens, where cooking smoke is believed to prolong its viability. Unlike their Dayak counterparts, Ikalahan farmers rarely barter for seed and crops. Instead, they give away surplus planting material to other community members, ensuring local varieties continue to be maintained and multiplied, especially crops that have decreased in market price. For commercial crops, they increasingly rely on purchased seed, illustrating how market integration is reshaping parts of the local seed system.

In Tanzania, household seed saving also remains fundamental, with more than 60% of all seed and animal offspring sourced from informal neighbouring farmer networks. As in the Philippines, they store seed in their kitchens to improve longevity. MVIWAARUSHA members regularly share information among themselves on seed, crop and livestock availability, although bartering and exchanging seeds and livestock is less common than in Indonesia and transactions increasingly involve direct sales between farmers.

4.1.3 The role of collective organisations

While these community-based knowledge and seed systems continue to provide the foundation for agrobiodiversity, collective organisations strengthen and compliment them in different ways and with different degrees of institutionalisation.

A seed bank that stores farm-managed Indigenous seeds in Karatu district, Tanzania. © Roshni Lodhia/Panos/IIED

In Indonesia, seed and knowledge systems continue to remain largely decentralised and embedded within households. And while producer groups in the two case study villages serve as important knowledge hubs to strengthen collective learning on seed saving, pest management, biocultural heritage and ecosystem-friendly farming, there are not many more formal mechanisms — such as community-wide seed banks — to systematically conserve and distribute planting material. Some producer groups have established small-scale nurseries for rubber, *kratom*, vegetables and other crops

and encourage the propagation of culturally and economically important species such as *tengkawang*. But these practices are not yet widespread and the absence of a community-wide seed bank highlights a gap in formalised seed management. To provide additional support to smallholders and producer groups, Riak Bumi has facilitated external partnerships with universities and networks such as the Kalimantan Tengkawang Network to enrich local knowledge with scientific insights, to aid both production and market outcomes.

A farmer from Dofa village watering his tree nursery in Karatu district, Tanzania. © Roshni Lodhia/Panos/IIED

KEF's approach in the Philippines combines customary governance with a growing number of organisational initiatives that strengthen both knowledge and seed systems. Its RUPP provides a framework of customary and adaptive rules that guide swidden cultivation, forest management and sustainable natural resource use across the ancestral domain with clearly defined violation penalties that reinforce long-term stewardship. Alongside this, KEF has expanded seedling production, planting and maintenance through its partnership with the Community Environment and Natural Resources Office (CENRO) of the Department of Environment and Natural Resources (DENR), contributing to forest restoration and the propagation of native and agroforestry species. It has also established a demonstration farm to show how diverse combinations of traditional crops can provide greater resilience than monocultures, while also conserving and distributing traditional *camote* varieties free of charge to farmers. The longer-term ambition is that the demonstration farm will develop into a community seed bank. KEF further reinforces knowledge transmission through the Kalahan Academy and 'school of living traditions', where formal schooling is temporarily suspended to encourage youth participation in rituals and cultural practices, creating opportunities for younger generations to engage with Indigenous ecological knowledge, cultural practices and farming traditions.

Of the three collective organisations, MVIWAARUSHA has developed the most formalised institutional support for knowledge and seed systems. Five community seed banks serve as living repositories for farmer-managed seed and indigenous varieties, containing small demonstration samples and larger stocks for purchase by members and external buyers. Farmers may borrow seed and return an equivalent amount after harvest. If a variety is unavailable, seed bank leaders connect buyers with other members who hold them, ensuring seeds continue to circulate in the community, providing access during shortages and enabling the reintroduction of neglected crops into active cultivation.

The seed banks are replenished through collective seed multiplication, where groups bulk-produce key local crops such as maize, beans and pulses. Loans from savings and credit cooperative organisations (SACCOs) and community

microfinance groups (CMGs) provide capital for these activities, lowering individual risk while maintaining strong and diverse stocks for both the seed banks and local markets. Seed exchange events play an important role in this process. By bringing farmers together from different areas, MVIWAARUSHA has been able to identify new or previously unknown local varieties, obtaining samples for inclusion in community seed banks to expand the diversity of available planting material. Established in 2022, MVIWAARUSHA's tree nurseries further expand the availability of diverse food and farm trees. Members receive nursery bags and training in grafting and seedling propagation, enabling them to raise food and farm trees such as avocado, guava and papaya. These nurseries expand the range of species available to smallholders and contribute to broader restoration programmes coordinated by MVIWAARUSHA. Knowledge sharing is similarly institutionalised through farmer field days, demonstration plots, seed fairs, training linked to CMGs and SACCOs, school environmental clubs, teacher training, links to government agroecological training centres and even Farm Radio broadcasts that extend practical agroecological knowledge to wider farming communities.

These contrasting approaches illustrate that there is no single model for sustaining local ecological knowledge and seed systems. Organisations adapt their support to existing community institutions, governance arrangements and organisational capacities. In all three case studies, collective organisations build on, rather than replace, community-based knowledge and seed systems, recognising that agrobiodiversity depends on maintaining the social relationships through which knowledge and planting material circulate.

4.1.4 Challenges faced

The case studies demonstrate that these systems are increasingly vulnerable to broader demographic, economic and social change. All three countries face a common challenge: weakening intergenerational knowledge transmission, particularly in response to changing livelihood aspirations, increasing mobility and broader rural transformation among the younger generations. This finding reflects wider trends of local ecological knowledge loss documented globally (Aswani et al., 2018). More specifically, outmigration and rural transformation are reducing youth engagement with traditional farming systems and weakening oral and experiential pathways of intergenerational knowledge transmission.

A Dayak weaver producing handwoven *ikat* textiles using traditional techniques passed down through generations, Indonesia. © Duncan Macqueen/IIED

In Indonesia, knowledge transmission has traditionally depended on collective farming activities and the shared social spaces provided by longhouses, which commonly housed 20–30 families. The transition towards individual housing, together with changing lifestyles and greater use of digital technologies and social media, has shifted social interactions, particularly in the evenings, reducing opportunities for informal knowledge exchange. And as younger generations increasingly pursue education and employment beyond agriculture, their participation in traditional farming practices has declined, alongside opportunities for experiential learning.

Beyond farming, these shifts also extend to traditional crafts linked to agrobiodiversity and forest-based livelihoods. Practices such as *ikat* weaving and basket making, which depend on sustainably harvested NTFPs

including rattan, bamboo and natural dyes, have traditionally been learnt through participation within households and communities. However, younger generations show less interest in time-intensive craft production and are increasingly drawn towards formal education and alternative livelihood opportunities. This has implications for both cultural continuity and agrobiodiversity, as many of these crafts are closely connected to sustainable forest species management, and as engagement declines, the associated ecological knowledge risks being weakened or lost.

Similar dynamics are evident in the Philippines and Tanzania. While KEF's educational programmes and cultural initiatives continue to support Indigenous knowledge transmission, broader social dynamics, including migration and changing livelihood aspirations, increasingly influence young people's participation in traditional farming and cultural practices. In Tanzania, household knowledge transfer remains strong, yet changing livelihood aspirations, economic pressures and improved access to formal education mean that children spend less time learning alongside their parents and grandparents, reducing opportunities for everyday knowledge exchange. Across all three contexts, the challenge extends beyond preserving knowledge itself to maintaining the social conditions through which it is continually practised, adapted and renewed.

Collective organisations have responded to this challenge by creating new opportunities for intergenerational learning by engaging with formal education systems and other structured learning platforms, echoing wider evidence that educational institutions can play an important role in sustaining local ecological knowledge (Aswani et al., 2018).

In Indonesia, this is mediated through partner organisations such as Riak Bumi (rather than the producer groups themselves), which link with schools and youth groups to reconnect younger generations with agroforestry practices and traditional crops. In Tanzania, MVIWAARUSHA works more directly with schools, combining environmental clubs, teacher training and practical activities such as tree nurseries to link learning with everyday practice, yielding positive results among young people. In both the Indonesian and Tanzanian case studies, engagement has relied on identifying creative entry points into the formal education system via relationship building. For example, MVIWAARUSHA focused on tapping into existing agroecological networks with connections to local schools, rather than attempting to influence or revise the official school curriculum, which would likely have required a longer timeframe and more complex institutional processes.

By contrast, in the Philippines, KEF has greater scope to embed Indigenous knowledge directly within formal education through the Kalahan Academy and its school of living traditions. Even so, KEF's initiatives are not immune to wider social change, as many young people are increasingly drawn to mainstream schooling pathways and livelihoods beyond traditional production systems.

As well as demonstrating efforts to proactively sustain knowledge transmission despite challenges, these examples highlight the need for interventions to operate within broader social changes that cannot be fully controlled at local level. The case studies illustrate that supporting agrobiodiversity requires attention not only to technical conservation measures, but also to the social, cultural and institutional conditions that enable knowledge and seed systems to persist and adapt over time. While informal, community-based processes remain fundamental to maintaining local ecological knowledge, the experiences of Tanzania, Indonesia and the Philippines demonstrate that they can be strengthened through complementary support. Community seed banks, farmer field schools, educational initiatives and other knowledge-sharing platforms can help create additional opportunities for knowledge exchange, intergenerational learning and access to genetic resources, while complementing and strengthening the socially embedded and experiential processes through which knowledge is traditionally transmitted (Nesterova, 2020; Vernooy et al., 2015). Rather than replacing informal systems, these initiatives function as bridging mechanisms that reinforce and extend existing community-based knowledge networks. But as changing aspirations, migration and wider rural transformation reshape young people's engagement with agriculture, collective organisations must continue developing new ways of engaging younger generations in the knowledge, practices and stewardship that sustain agrobiodiversity. Without new generations of farmers, knowledge holders and community leaders, the social and cultural systems upon which agrobiodiversity depends risk being progressively weakened.

4.2 Promoting nutritional, health and other benefits of agrobiodiversity

Across the three case studies, communities have long recognised the multiple and interconnected values of agrobiodiversity. Diverse crops, trees, livestock and wild species simultaneously contribute to nutrition, health, cultural identity, ecological sustainability and resilient livelihoods, and these multiple values have traditionally underpinned decisions to maintain diverse production systems. However, as commercialisation, changing livelihood aspirations and wider social and economic pressures (see Section 3) increasingly encourage smallholders to simplify production systems and replace diverse farming systems with monocultures designed to maximise yields and short-term economic returns, collective organisations have assumed a growing role in reaffirming and communicating these multiple benefits. Through education, community events, farmer training, demonstration activities and cultural initiatives, they help ensure the wider values of agrobiodiversity remain visible to communities, younger generations and external stakeholders alike.

The case studies suggest that reinforcing these multiple values strengthens the incentives for communities to continue managing agrobiodiversity. When diverse production systems are valued for their nutritional, cultural, ecological and health benefits — as they have been for generations — there are stronger motivations to conserve local crop varieties, maintain traditional management practices and transmit knowledge to future generations. So, rather than create new values around agrobiodiversity, collective organisations are reinforcing and adapting long-held understandings to contemporary social, economic and environmental contexts.

4.2.1 Nutrition diversity and natural medicines

Nutrition and health are common entry points across all three contexts, reinforcing the well-established links between agrobiodiversity, dietary diversity and health outcomes (Remans et al., 2014; Jones, 2017). In Tanzania, MVIWAARUSHA explicitly links agrobiodiversity to household nutrition, food security and resilience, encouraging members to cultivate and consume a wide range of crops, including maize, beans, bananas, vegetables, pulses, tubers and fruits, alongside traditional livestock systems and wild food plants.

Races at the Ikalahan Camote Awareness Day as part of the 51st anniversary celebrations of KEF, Philippines. © Duncan Macqueen/IIED

Vegetables such as *sunga*, *mchicha* and *mnafu,* together with fruits including papaya and guava, feature prominently in household diets, while livestock provide milk, meat, eggs and manure that supports soil fertility and sustained production. MVIWAARUSHA also promotes the cultivation of forgotten grains and other nutrient-rich local crops among its members, including traditional maize varieties known for their superior nutritional value. Communities maintain extensive knowledge of medicinal plants, often preferring traditional remedies to modern medicines and valuing species such as baobab, *mushubiri* and *mkarisa*, known for their nutritional and healing properties. They also highly value honey from stingless bees for its antibacterial, anti-inflammatory and antioxidant properties, and smallholders have long processed, packaged and sold natural products such as medicinal honey. MVIWAARUSHA has built on these traditions by improving processing, packaging and marketing, helping to promote the health benefits of these products.

In the Philippines, KEF promotes the nutritional value of indigenous crops through formal education, community health services and awareness-raising activities. Although now much reduced, its health programmes historically combined nutrition education with the promotion of traditional herbal medicine, particularly for mothers and children, while the 2024 Camote Awareness Day celebrated the nutritional qualities of traditional *camote* varieties and encouraged their continued cultivation and consumption. Communities in Indonesia similarly associate agrobiodiversity with diverse diets and traditional foods and demonstrate extensive knowledge of medicinal plants. Traditional recipes and food preparation practices help maintain the cultivation and use of a wide range of crops, supporting year-round access to diverse foods. External parties have further promoted the nutritional value of traditional foods, strengthening community knowledge, while partnerships between Riak Bumi, producer groups and universities have explored the medicinal properties of species such as *tengkawang*, reinforcing the health benefits of maintaining diverse production systems.

4.2.2 Biocultural heritage

Although particularly prominent in Indonesia and the Philippines, the cultural dimensions of agrobiodiversity remain important in all three case studies. In the Dayak communities, agrobiodiversity is inseparable from cultural identity and spiritual life. Crops, livestock and forest products are embedded within ceremonies, rituals and customary practices as food, offerings and ceremonial materials. They process glutinous rice into palm wine for rituals and cooked in bamboo during communal celebrations, while using rattan, banana leaves, betel leaves, areca nuts, *gambir* and bamboo in spiritual rites. Pigs, chickens, freshwater fish and other livestock also play vital roles in different ceremonies, while *temulawak*, sugarcane, certain foliage and root crops are used in death rituals. Producer groups play an important role in sustaining this biocultural heritage by bringing communities together around the management of traditional crops and forest products, creating spaces for the continued exchange of customary knowledge, intergenerational learning and collective practices associated with diverse farming systems. In doing so, they help ensure cultural traditions evolve with, and do not become disconnected from, changing livelihood opportunities. The *tengkawang* tree illustrates how cultural, ecological and economic values reinforce one another: its nuts are used in traditional foods, crafts, dyes and rituals, creating strong incentives for communities to conserve both the species and the surrounding forest. Community practices, such as protecting naturally germinating nuts, further strengthen forest regeneration.

Tenkawang trees in Labian village, West Kalimantan, Indonesia. © Isabela Núñez del Prado Nieto/IIED

Among the Ikalahan, cultural values are similarly embedded within farming systems and reinforced through customary governance, education and the celebration of indigenous foods. Traditional recipes encourage the continued cultivation of indigenous crops, while the Kalahan Academy and its school of living traditions connect younger generations with Indigenous ecological knowledge, farming practices and cultural identity. KEF further promotes biocultural value through community events such as Camote Awareness Day, which celebrates the nutritional, culinary and cultural importance of diverse local varieties. Alongside the development and marketing of products derived from indigenous fruits and crops, these activities reinforce agrobiodiversity as a living expression of Ikalahan heritage.

Ritual and ceremonial practices are less visible in the Tanzania case study than in the Indigenous Dayak and Ikalahan examples. Here, communities express the cultural value of agrobiodiversity through everyday farming practices, traditional foods, medicinal plants and farmer-to-farmer knowledge exchange. MVIWAARUSHA reinforces these connections through seed fairs, community seed banks, local food enterprises and by promoting traditional ecological knowledge. Across all three case studies, collective organisations recognise that the cultural meanings attached to agrobiodiversity are as important as its productive benefits in motivating communities to conserve diverse farming systems.

4.2.3 Ecological benefits

Collective organisations promote the ecological benefits of agrobiodiversity in all three contexts, although they emphasise different aspects, depending on local priorities. In Indonesia, Dayak agroforestry systems intentionally mimic the structure and diversity of natural forests, combining rice, vegetables, medicinal plants, fruit trees and timber species beneath native forest canopies. Farmers and producer groups recognise that these diverse systems improve nutrient cycling, natural pest regulation, wildlife habitat and ecological resilience while supporting commercial production. In the Philippines, KEF promotes similar principles through sustainable farming, soil conservation and agroforestry, while its demonstration farm illustrates to community members and external stakeholders how diversified cropping systems can provide greater resilience than monocultures under changing climatic conditions. In Tanzania, MVIWAAURHSA demonstrates ecological benefits to smallholders through training in integrated farming practices that connect crops, livestock and trees. A small number of household biogas systems, supported by MVIWAARUSHA training and loans, act as demonstration sites and illustrate how livestock can simultaneously contribute to clean energy production, reduced dependence on firewood and improved soil fertility by using slurry as organic fertiliser. Together with tree nurseries and pollinator-friendly beekeeping, these activities demonstrate to members how agrobiodiversity contributes to broader ecosystem functioning as well as agricultural production.

A KEF demonstration farm of varieties of camote (sweet potato), Philippines. © Duncan Macqueen/IIED

4.2.4 Mechanisms used to promote values

The three case studies illustrate how communities and collective organisations use different mechanisms to promote the benefits and values described here. The Dayak communities rely heavily on cultural practice, customary knowledge and everyday farming to reinforce the benefits of agrobiodiversity, supported by producer groups that strengthen collective learning and the cultural value of traditional crops and forest products; KEF combines formal education, health services, community events and demonstration activities; and MVIWAARUSHA primarily uses farmer training, practical demonstration and community learning. By encouraging communities to recognise the multiple and interconnected benefits provided by diverse production systems, they do not present nutrition, health, cultural identity and ecological sustainability as separate outcomes, but rather, as mutually reinforcing reasons for maintaining agrobiodiversity.

Recognising and communicating these multiple benefits can also create opportunities that extend beyond conservation alone. As discussed in Section 4.3, the nutritional qualities, cultural heritage and ecological characteristics associated with agrobiodiverse products can provide important foundations for value addition, product differentiation and market development. However, these economic opportunities are not the primary reason communities maintain or value agrobiodiversity. Rather, collective organisations can build them into the social, cultural, nutritional and ecological values that already motivate continued stewardship, reaffirming and creating new opportunities for strengthening rural livelihoods linked to the multiple values of agrobiodiversity under changing social and economic conditions.

4.3 Aggregating baskets of products for businesses built on diversity

Commercialisation is often associated with simplifying farming systems, encouraging producers to specialise in a narrow range of high-value commodities. But across all three case studies, collective organisations pursue a different approach. Rather than encourage farmers to replace diverse production systems with monocultures, they seek to develop businesses around baskets of products derived from the diversity that already exists within local systems. Achieving this requires producer organisations to perform functions that individual farmers would struggle to undertake alone. By aggregating small quantities of multiple crops, trees, livestock products and forest resources across many producers, they create marketable volumes while maintaining diversity at farm level. Across the case studies, these organisations support market research, enterprise development, aggregation, product processing, branding, quality control and market linkages. In doing so, they seek to align commercial activity with the continued management, rather than simplification, of agrobiodiversity.

4.3.1 Building collective businesses around baskets of products

The baskets of products emerging from the three case studies reflect the diversity of local landscapes and production systems.

In Indonesia, Dayak producer groups, supported by Riak Bumi, aggregate products from forest and agroforestry systems including *tengkawang*, rubber, *kratom*, peppers and local fruits. Farmers have adapted their production over time in response to changing market opportunities, shifting between pepper, rubber and more recently, *kratom* and illipe nuts, as prices have fluctuated, while continuing to manage diverse agroforestry landscapes and customary *tembawang* systems. For example, Dayak communities collect illipe nuts only once every three-to-five years during mast seasons (when the trees produce a large quantity of nuts), gathering the nuts that have fallen to the forest floor and leaving others on the trees to ensure regeneration. Such non-destructive harvesting avoids deforestation and chemical use, and preserves forest biodiversity. Individuals also cultivate *twengkawang* trees within the traditional *tembawang* land-management system, which combines conserving biodiversity with maintaining livelihoods through an individually or collectively managed customary forest-garden system. Income from illipe nuts provides farmers with an important safety net during years when returns from rubber, vegetables or other crops are low, reducing pressure to convert forests or simplify production. Dayak producer groups also foster cooperation between farmers to manage shifting cultivation and permanent crops such as rice, rubber and durian and facilitate the sharing of traditional knowledge, labour and resources, enabling more efficient and sustainable crop production adapted to local land and water conditions.

Kratom leaves harvested by local smallholders drying prior to processing and sale in Labian Ira'ang village, West Kalimantan, Philippines. © Riak Bumi

Diverse varieties of camote (sweet potato) cultivated by Ikalahan smallholders, Philippines. © Duncan Macqueen/IIED

Beekeepers in Esilalei in Monduli district, Tanzania. © Roshni Lodhia/Panos/IIED

Riak Bumi has also supported produced groups to sustainably harvest forest honey from the national park, training them to leave at least 20% of the honey product in the hive to ensure sufficient food reserves for the bees and the long-term sustainability of the colonies.

In the Philippines, KEF has similarly developed enterprises around a basket of indigenous crops and forest products to incentivise the continued cultivation and protection of diverse fruit species. These fruits are harvested from the communal forest, which community members can access free of charge. KEF has also developed commercial activities around Arabica coffee. Grown under agroforestry systems, the coffee is carefully handpicked, processed and roasted in small batches, allowing the farmers to produce high-quality roasted ground coffee and green beans that cater to local speciality markets. Collecting wild forest honey is another important enterprise, with sustainable harvesting to protect the bees. Current efforts focus on expanding opportunities around the Ikalahan's diverse *camote* varieties. Ikalahan farmers have historically cultivated around 172 *camote* varieties within the ancestral domain, of which around 21 remain today. KEF is working to recultivate these and locate rare varieties, including a sought-after purple one. Looking further ahead, KEF also sees opportunities to explore the expansion of its basket of products through additional crops such as *chayote*, ginger and taro, which are all thriving in these communities.

MVIWAARUSHA has adopted a similar approach in Tanzania, developing enterprises that originate from members' mixed farming systems and agroforestry systems where farmers cultivate multiple crops and natural products in modest quantities. Honey, sunflower oil and tree seedlings currently form the core of this basket. Aggregating production across many smallholder farms, MVIWAARUSHA enables farmers to maintain diverse cropping systems while collectively supplying marketable volumes that individual producers could not achieve alone. One of the most established examples is honey production. Beekeeping has deep roots across the Arusha region, with many smallholders managing hives alongside crops and livestock. Although Tanzania's beekeeping sector generates an estimated US$5.2 million annually (ARCAN, 2024), most smallholder producers lack the scale and coordination to access formal markets. MVIWAARUSHA has helped organise local beekeepers into associations that collectively aggregate, process and market honey. Aggregation has enabled smallholders to sell to buyers in Arusha town and other regional markets, and there is interest in expanding to national and export markets. A similar approach has been applied to sunflower oil, which is widely grown within mixed cropping systems that include maize, beans, pigeon peas and vegetables.

4.3.2 Investing in value addition and shared enterprise infrastructure

Value addition plays an important role across all three studies in increasing returns from these baskets of products while reducing dependence on lower-value raw commodity sales. Collective organisations also invest in shared processing facilities, equipment and technical partnerships that enable producers to undertake activities that would be difficult for individual farmers alone.

In Indonesia, producer groups provide training on how to process local fruits into jams and dried products, while Riak Bumi supports the groups to process illipe nuts into illipe nut butter. Some groups — such as Gabungan Kelompok Tani (GAPOKTAN — Farmer Group Association) in Labian Ira'ang and the Tengkawang Labian Farmers Group — are also exploring new applications for illipe nuts through partnerships with Tanjungpura University and other organisations. Proposed developments include food products, chocolate, cosmetics, candles, lubricants and medicinal products, with the university indicating plans to provide oil-pressing equipment to support production. Such partnerships illustrate how scientific collaboration can expand commercial opportunities for culturally important species. But these activities remain at the proposal stage.

In the Philippines, KEF has invested in shared enterprise infrastructure through the Kalahan Food Processing Center, which has supported the development of value-added products since the 1970s. Through the centre, KEF has progressively developed jams and jellies from various fruit species including *dagwey*, *dikai*, passion fruit, ginger and *santol*. Importantly, KEF did not initially conceive the development of jams and jellies as a commercial enterprise, but as a strategy to protect the forest and preserve traditional livelihoods. KEF is also exploring the development of new value-added products from diverse *camote* varieties that are superior in taste and believed to be rich in nutrition, including flour, chips, cookies, jams, vinegar, wine and sugar. If successful, these initiatives would not only diversify income opportunities but also strengthen incentives for maintaining a wider range of traditional crop varieties. However, these activities also remain at a developmental stage and are subject to uncertainties related to product viability, market demand and processing requirements.

In Tanzania, MVIWAARUSHA provides its members with access to shared enterprise infrastructure that supports the processing, storage, packaging and labelling of honey and sunflower oil. These shared facilities enable producers to improve product quality, apply consistent standards and market higher-value products that would be difficult for individual farmers to produce independently. MVIWAARUSHA has also supported the development of value-added products from beeswax — a byproduct that was previously discarded — by processing it into soaps, lip balms, creams and candles. Together, these initiatives enable producers to capture greater value from biodiversity-based enterprises while making fuller use of resources generated through diverse farming systems.

4.3.3 Supporting enterprise development and market engagement

Collective organisations play a central role in building the organisational capacity needed to sustain enterprises built around diversity. Beyond aggregation and value addition, they undertake functions including market research, business planning, producer training, branding and market development, creating the organisational infrastructure needed to connect diverse baskets of products to commercial markets.

Among the three organisations, MVIWAARUSHA has adopted the most structured approach. Undertaking market research with its member groups has enabled the organisation to assess consumer preferences, price trends and opportunities for scaling local agroecological products. This research identified honey, sunflower oil and tree seedlings as high-potential enterprises, alongside emerging opportunities in pigeon peas and coffee. As well as informing training programmes and investments in product processing, value addition, packaging and uniform branding, these findings are shaping ongoing business-planning support for smallholder groups and cooperatives.

Dagwey jam produced and marketed under KEF's Mountain Fresh brand, Philippines. © Duncan Macqueen/IIED

Entrepreneurial and business training has been a major pillar of MVIWAARUSHA's approach, with members receiving coaching on enterprise management, recordkeeping, marketing and cooperative governance, ensuring that smallholder-led enterprises operate efficiently and reinvest in their businesses. This reflects a more structured approach to developing agrobiodiversity-based enterprises, which includes strengthening farmer groups and exploring more formalised business arrangements. To increase market exposure and learning opportunities, MVIWAARUSHA also facilitates participation in agricultural exhibitions and trade fairs such as the Nane Nane National Agricultural Show and

the Kilimo Endelevu (Sustainable Agriculture) Local Seed and Food Fair in Karatu district, which provide platforms for farmers to showcase their products, make direct sales and learn about buyer preferences. Feedback from these events supports ongoing enterprise training and business planning, ensuring production remains competitive, adaptive and market responsive.

In the Philippines, KEF has developed a shared market identity through the Mountain Fresh brand, which markets products as Indigenous, organic and forest-friendly goods to environmentally and socially conscious consumers. In the past, KEF has also established supplier agreements with local high-end supermarkets and marketed products at small trade fairs. However, it has become increasingly difficult to compete on price in supermarkets, largely due to costs associated with contemporary processing, packaging and labelling requirements, which have affected the financial viability of some products and limited access to previously accessible higher-value markets.

In Indonesia, Riak Bumi works alongside producer groups to strengthen product development and market linkages while facilitating partnerships with universities and networks such as the Kalimantan Tengkawang Network. These collaborations enable communities to explore new processing technologies, commercial applications and market opportunities for locally important species while strengthening the organisational capacity needed to develop businesses built around agrobiodiversity.

4.3.4 Challenges faced

While developing businesses around baskets of products for commercial sale can provide incentives for maintaining agrobiodiversity and essential livelihood opportunities within market-based economies, it is not a straightforward pathway for supporting diversity. Agrobiodiversity depends on maintaining diverse species, varieties and production practices, whereas commercial markets often favour consistency, standardisation and concentration around a smaller number of products. So, while commercialisation can create incentives for conservation, if not carefully managed, it can generate pressures that narrow diversity. The extent to which commercialisation supports agrobiodiversity therefore depends on whether markets, value chains and supporting institutions can accommodate diversity, ecological variability and smaller-scale forms of production.

Products produced by local smallholders on sale at the MVIWAARUSHA farmers' centre in Karatu district, Tanzania. © MVIWAARUSHA

One challenge identified across the case studies relates to the scale, uniformity and consistency of supply that commercial buyers can expect. The aggregation models used aim to pool production from multiple smallholders but many commercial buyers require larger and more consistent volumes than those that producer groups can reliably provide. This is further complicated by the nature of many agrobiodiverse products, which can be seasonal, irregular or harvested according to ecological practices. For example, forest-based products such as illipe nuts in Indonesia are harvested according to fruiting cycles that occur only every three to five years, creating long intervals between production periods; they are also highly sensitive to environmental conditions, affecting yields from one cycle to the next. A recent failed harvest, attributed to changing environmental conditions, meant that Dayak producer groups could not fulfil their memorandum of understanding with private social enterprise Forestwise, highlighting how variability can limit the ability of producer groups to consistently supply markets.

In some cases, the ability to meet the demands of commercial supply reflects not only ecological constraints but also culturally embedded relationships with land and resources. For example, Ikalahan communities in the Philippines have a custom of harvesting only what is needed. This is rooted in values of stewardship and sufficiency, which have long underpinned the sustainable management of forest resources. It can be difficult to reconcile these values with market expectations for increased production and consistent supply, highlighting a potential misalignment between traditional management approaches and commercial production models.

Related to this is the challenge of product diversification and community participation. While diversified product portfolios help spread risk and support agrobiodiversity, developing multiple products requires sustained community engagement and organisational capacity. More fundamentally, the case studies reveal the inherent tension between the objectives of agrobiodiversity conservation and the dynamics of commercial markets. Agrobiodiversity depends on maintaining a diversity of species, varieties and production practices, whereas commercial markets often favour a narrower range of products that can be supplied consistently, efficiently and at scale.

KEF has explored a range of products derived from traditional crops and forest species, often shaped by market demand. But not all initiatives have generated enough community participation to become viable enterprises, with some products identified as having market potential not garnering local buy-in, limiting their uptake and preventing the business ventures from becoming established. This experience also highlights a potential trade-off between market demand and community priorities. Products identified as having strong commercial potential do not always align with the crops or resources that communities are most interested in cultivating, particularly if production requires extra labour, new processing skills or shifts away from existing farming systems. Conversely, species that hold cultural, ecological or subsistence value do not always attract enough market demand to support viable enterprises. This creates a balancing act for organisations seeking to support agrobiodiversity through commercialisation, as efforts to respond to market opportunities must remain grounded in community preferences, traditional production systems and the maintenance of diversity itself. Similar dynamics are evident in Indonesia and Tanzania, where organisations continue to explore opportunities to expand and strengthen their baskets of products while ensuring commercial development remains compatible with local production systems' ecological and cultural foundations.

Policy environments can also shape the commercial viability of agrobiodiversity-based enterprises through broader trade and export regulations. In Indonesia, policy changes restricting the export of unprocessed illipe nuts significantly disrupted existing value chains. Communities had been selling raw illipe nuts to international markets, providing an important economic incentive to maintain *tengkawang* trees within agroforestry systems. But following the introduction of export restrictions, demand for raw nuts declined and prices fell in many areas. Because many communities lacked the technical knowledge, processing equipment and capital required to produce exportable processed products, they were unable to adapt quickly to the policy shift. In some cases, the reduced economic value contributed to declining interest in maintaining *tengkawang* trees and shifts towards alternative crops with more stable returns, including land conversion to other agricultural uses. This illustrates how agrobiodiversity-based enterprises linked to global markets can be vulnerable to policy changes or price fluctuations, especially where communities lack the capacity to move up value chains or diversify market options.

Certification and regulatory requirements create a related set of challenges. While often necessary to access commercial markets, they can be costly and complex for small-scale producers. In Indonesia, for example, requirements such as halal certification, Food and Drug Authority approval and household distribution licences create administrative and financial barriers for producer groups seeking to market value-added products. Such requirements can limit

communities' ability to scale production, even where diverse forest-based products and agroforestry systems exist. Similarly, KEF's food-processing facility no longer meets updated Food and Drug Administration requirements and the organisation lacks the financial resources needed to upgrade it. As a result, products are limited to local and informal markets despite the existence of established products and demand. Additional requirements, such as nutritional analysis and labelling standards for wider distribution, increase costs, constraining the number of products KEF can develop and market. Such regulatory constraints illustrate how agrobiodiversity-based enterprises, which often rely on smaller volumes and diverse product lines, can face disproportionate challenges compared to more standardised commercial production.

Market development and business capacity poses another challenge, particularly the skills and structures needed to move from cultivating to successfully commercialising agricultural products. Even where high-quality products exist, success depends on effective marketing, branding and the ability to identify and access appropriate market segments — all specialist skills. In both Indonesia and the Philippines, challenges around labelling, certification, product positioning and competition with other products affect commercial viability. These challenges are compounded by limited access to market information and distribution networks. In response, organisations have sometimes focused on a smaller number of products with clearer demand, which may support income generation but can also risk narrowing the diversity of commercially supported species, reinforcing the broader tension identified throughout this section between maintaining agrobiodiversity and responding to market incentives that favour concentration around a smaller number of commercially viable products.

To successfully commercialise products, collective organisations must develop dedicated business functions to increase their capacities, including in market analysis, negotiation and long-term planning. MVIWAARUSHA has advanced in this direction by integrating commercial activities into its organisational strategy. In 2024, it launched a new farmers' centre, largely co-funded by its members. The centre provides a focal point for enterprise development, offering training in business management, marketing and product development, alongside a marketplace where producer groups and small enterprises can showcase and sell their products directly to consumers. By bringing together enterprise support, training and market access in a single location, the centre has strengthened farmer participation and investment while creating a more structured platform for developing agrobiodiversity-based enterprises, including exploring the establishment and registration of formal business entities. However, developing such a facility required significant financial and organisational investment, which was only possible due to the scale of the MVWIAARUSHA member network (over 12,000 smallholders) and may not be feasible for many smaller producer groups.

Taken together, the case studies suggest that commercialisation can support agrobiodiversity where it is aligned with ecological cycles, supported by organisational capacity and enabled by appropriate financial and regulatory systems. Where these conditions are absent, commercialisation may remain limited or favour a narrower range of species and products. These dynamics also suggest that supporting agrobiodiversity-based enterprises requires more flexible market actors and alternative business models that can accommodate ecological variability, smaller volumes and diversified production. Recent literature on business-unusual approaches highlights the importance of buyers and investors being willing to work with complexity, longer time horizons and multiple social and ecological outcomes, rather than prioritising standardisation and scale alone (Hou Jones et al., 2024). There may also be opportunities for producer organisations to adopt shared labels and participatory guarantee systems as a more accessible alternative to conventional third-party certification. By enabling groups of producers to collectively communicate the distinctive environmental, cultural and place-based qualities of diverse baskets of products, these approaches can reduce certification costs, strengthen collective marketing and support diversification without requiring separate certification for individual products (Wagner, 2022).

4.4 Mobilising access to finance that supports diversity

Financial mechanisms play an important role in enabling farmers and organisations to sustain and expand agrobiodiverse production systems, supporting investment in diverse crops, seed systems, value addition and market participation. Developing diversified production systems often requires farmers to experiment — for example, with new crops, locally adapted seed, tree species or processing technologies. Doing so frequently requires finance to purchase seedlings, establish nurseries, invest in processing equipment or test new enterprises. However, in remote rural areas, smallholders managing diverse production systems often struggle to access conventional finance from banks, which

typically favour larger-scale, more standardised forms of production perceived as lower-risk investments and frequently requires borrowers to provide collateral. As a result, many producer organisations have increasingly sought to develop their own alternative financial mechanisms that better reflect the realities of diversified farming and the circumstances of smallholders. These often begin as revolving savings and loan funds managed by producer groups before, in some cases, evolving into larger savings and credit cooperatives or credit unions capable of providing more substantial finance to their members (Núñez del Prado Nieto, 2024a). Developing and evolving these internal financial mechanisms offer a pathway for financing agrobiodiversity that is often unavailable through conventional financial systems (Núñez del Prado Nieto, 2024b).

The three case studies illustrate differing capacities for mobilising finance that supports agrobiodiversity. In Indonesia, producer groups have established small-scale savings and loan mechanisms, but these remain relatively limited and are supplemented by support from credit unions, village government programmes and external partners. Similarly, the limited development of internally managed finance in the Philippines highlights some of the challenges associated with establishing and sustaining these mechanisms, with KEF instead relying largely on timebound external project finance and existing community finance institutions. By contrast, MVIWAARUSHA has developed a more extensive member-owned, multi-tier financial system that channels savings and affordable credit towards agroecological production and enterprise development at a much larger scale. Together, the case studies demonstrate that collective organisations can mobilise appropriate finance to varying degrees of success, reflecting differences in organisational capacity, governance, institutional context and member trust. While well-governed internally managed finance can become a powerful asset for sustaining agrobiodiversity, external finance continues to play an important role in supporting collective organisations in contexts where such mechanisms remain limited or have not become established.

4.4.1 Indonesia

In Indonesia, Dayak producer groups mobilise relatively modest financial resources through internally managed savings and loan arrangements while also facilitating access to external finance. Several producer groups have established informal social loan systems that pool members' savings and provide small loans to support household needs and group activities. For example, the Restorasi Ngaung Keruh Lestari (Sustainable Restoration of Ngaung Keruh) group operates a revolving social loan system through which members can borrow funds using agreed forms of collateral, while surplus group income is added to collective savings following agreement among members. Members can also withdraw some of these funds to respond to urgent social needs within the village. Such group-based systems provide flexible and locally managed access to finance, although their scale and reach remain relatively limited.

Producer groups can also connect with wider financial institutions. The Keling Kumang Credit Union provides savings facilities and loans to groups, including collateral-free loans below 5 million rupiah and interest-free loans for some collective enterprises, such as tourism. It also links financial services with broader social and environmental programmes through partnerships such as those with Lingkar Temu Kabupaten Lestari, a district government association that promotes sustainable agriculture and forest conservation with organisations promoting sustainable agriculture and forest conservation. Village government-funded initiatives such as *badan usaha milik desas*[11] provide additional financial assistance to farmer groups, while NGOs, including Riak Bumi, support specific activities such as planting, nursery development and producer group strengthening. Together, these arrangements provide important bridges between community initiatives and more formal financial systems, although financing remains relatively fragmented and dispersed across multiple institutions.

4.4.2 The Philippines

KEF does not operate a dedicated internal savings and credit mechanism to support agrobiodiversity-based enterprises, although it previously established a revolving fund through its organic farming project. Today, most investments in production, reforestation and conservation depend on externally funded projects, many of which conclude once project funding ceases. This reliance on project finance partly reflects earlier challenges in establishing a sustainable internal financing mechanism. Although the organic farming project ended in the early 1990s, the revolving fund it created continued to operate for several years afterwards. However, some beneficiaries perceived the loans as grant-based

11 Known as *BUMDes*, *badan usaha milik desas* (translated into English as village-owned enterprises) are a type of community-based business entity in Indonesia that is established, owned and managed by a village government alongside its local community.

funds rather than repayable finance and were therefore unwilling to repay them, ultimately leading to the closure of the fund. This experience highlights the challenges of sustaining internally managed financial mechanisms, particularly where expectations around repayment, governance and collective fund ownership are not clearly aligned. Despite the absence of a dedicated internal finance mechanism managed by KEF, households can access finance through other community cooperatives and government-supported financial institutions operating across Santa Fe municipality (each *barangay* has one, if not more, financial institution supporting productive activities). While these institutions provide important financial services for local livelihoods, they are not specifically designed to support agrobiodiversity or diversified production systems.

4.4.3 Tanzania

MVIWAARUSHA has developed an extensive member-owned financial architecture that channels affordable finance towards agroecological production and enterprise development. Recognising members' difficulties in accessing conventional credit, it established eight SACCOs — member-run institutions that are legally registered and regulated under Tanzania's Microfinance Act No 10 of 2018 that mobilise member savings, sell shares and provide affordable loans. Collectively managing around 357.57 million Tanzanian shillings in assets (US$135,550)[12] the SACCOs serve 646 individual members (47% women) and 162 groups representing a further 4,051 people. Because they are organised under MVIWAARUSHA's local networks, MVIWAARUSHA members are also members of these SACCOs, ensuring a strong and direct link between farmer organisations and financial cooperatives.

Lending is designed to support diversified production, with specialised agroecological loans offering low fees (typically 0.5%), low interest rates (around 6% per annum, which is far lower than typical commercial rates of around 22% at the Cooperative and Rural Development Bank and over 12% from microfinance lenders), flexible repayment periods and grace periods that better reflect the realities of ecological farming. By 2024, more than one-third of loans issued through MVIWAARUSHA's largest SACCO were specialised agroecological loans, enabling farmers to reintroduce forgotten or neglected crops (such as traditional maize varieties that hold cultural, nutritional and ecological value), test locally adapted seed and adopt agroecological practices such as intercropping, organic fertilisation and water harvesting. There are also dedicated loans to empower women and youth and group loans channelled to CMGs.

A community microfinance group meeting in Karatu district, Tanzania, supported by MVIWAARUSHA. © Roshni Lodhia/Panos/IIED

Beyond individual lending, MVIWAARUSHA has linked its financial services to wider enterprise development. SACCO finance supports agroecological small and medium-sized enterprises investing in processing biodiversity-based products, which can access SACCO loans

12 All US$ figures are estimates based on the average exchange rate between 2024 and 2025.

and showcase and sell their value-added traditional and agroecological products in local farmer markets at the Karatu farmers' centre facilitated by MVIWAARUSHA. This combination of financial support and market access has enhanced their business viability, created new economic opportunities and helped strengthen agroecological value chains.

To complement the SACCO network, MVIWAARUSHA has also supported the establishment of 213 CMGs, small (25–30 members) trust-based savings and loans groups that provide accessible finance for people living further from SACCO offices. CMG members can borrow up to three times their savings, with profits shared at the end of each cycle. Group savings have enabled members to invest in organic farming, intercropping, local seed use and other agroecological activities. In 2024, the CMGs had around 4,200 members, held combined savings of 506 million Tanzanian shillings (US$191,920) and disbursed 598 million Tanzanian shillings (US$226,810) in loans. Women make up the majority of CMG group members, accounting for around 80% of total membership. This strong participation underscores the pivotal role women play in driving ecological farming initiatives and managing group savings and loans systems. Women and youth, who are often marginalised in conventional credit schemes, have gained access to resources that enable their active participation in experimental and ecological farming ventures. This has directly helped improve household food security, income diversification and community-led conservation of indigenous plant genetic resources.

Importantly, the CMGs are directly linked to the SACCOs, enabling groups (as opposed to just individual members) to deposit savings and access substantially larger loans as a collective than they would be able to as individuals. As well as broadening SACCO membership, this linkage strengthens loan portfolios and gives CMGs access to capital they could not mobilise from member savings alone. To further expand lending capacity, MVIWAARUSHA has also established a donor-supported revolving fund of 72.15 million Tanzanian shillings (US$27,335) that channels additional capital to participating SACCOs. The Tanzanian case demonstrates how internally managed financial mechanisms can become a powerful tool for supporting agrobiodiversity where strong governance, member trust and sustained organisational capacity enable them to evolve over time.

4.4.4 Challenges faced

The three case studies demonstrate both the potential of finance to support agrobiodiversity and the challenges involved in developing financial mechanisms that are appropriate for diversified production systems. While the Tanzania case study illustrates what becomes possible when producer organisations develop dedicated financial institutions, the Indonesia and Philippines case studies show that it is not always feasible to establish or sustain such mechanisms. Rather than pointing to a single model for financing agrobiodiversity, the three examples highlight how financial systems evolve in response to organisational capacities, governance arrangements and institutional contexts.

The Tanzania case demonstrates that financial mechanisms specifically designed around the realities of agroecological farming can play an important role in enabling diversified production. Conventional lending often struggles to accommodate farming systems characterised by ecological variability, longer investment horizons and multiple products, making diversified production difficult to finance through standard commercial loans. Trust-based lending through CMGs has proved particularly effective; because they rely on mutual accountability and collective guarantees, repayment performance has exceeded that of individual borrowers, strengthening both the CMGs and the SACCO network. Women and youth have particularly benefited. But the case also demonstrates that establishing and sustaining internally managed finance requires much more than access to capital. MVIWAARUSHA has invested heavily in governance, financial management and organisational development, providing ongoing training in recordkeeping, business planning and cooperative governance, alongside regular audits and performance reviews. Yet the system still faces challenges, including limited financial literacy of members, capital shortages during peak lending periods, weak loan assessments and climate shocks that affect farm incomes and loan repayment, showing that even relatively mature financial systems require continual organisational support to remain effective.

The experiences of Indonesia and the Philippines highlight a different set of lessons. Both case studies have relied more heavily on combinations of external finance, government programmes, credit unions and project funding than on internally managed financial institutions. And while these arrangements have enabled investment in producer groups, agroforestry, enterprise development and conservation activities, they also illustrate some of the challenges of sustaining long-term finance for agrobiodiversity.

In Indonesia, finance remains fragmented across producer-group savings, credit unions, village government programmes and NGO support. And although these mechanisms provide important assistance, they remain relatively small in scale and are not specifically designed to support experimentation or longer-term investment in diversified production systems. Riak Bumi also observed that many communities place greater trust in established financial institutions such as credit unions and government-backed banks than in newly established community-managed finance, creating additional challenges for expanding locally managed revolving funds.

The Philippines similarly illustrates that sustaining internally managed financial mechanisms depends not only on access to capital but also on governance, trust and shared expectations among members. The closure of KEF's organic farming project fund following difficulties with loan repayments demonstrates how revolving finance can become difficult to sustain when members hold different understandings of repayment obligations and collective fund ownership.

Taken together, the three case studies suggest that financing agrobiodiversity depends as much on institutional capacity and governance as on access to capital itself. Internally managed financial mechanisms can provide powerful tools for supporting diversified production where there is enough organisational capacity, member trust and effective governance, as demonstrated by MVIWAARUSHA. But the Indonesia and Philippines case studies show that such systems are not easily established or sustained in every context. In many settings, support from credit unions, governments, NGOs and development partners is therefore likely to remain an important source of investment for agrobiodiversity. Rather than pointing towards a single financial model, the case studies suggest that combinations of internal and external finance may be required to support diversified production under different social, institutional and economic conditions.

4.5 Bolstering political will behind traditional agrobiodiverse production systems

The long-term maintenance of agrobiodiversity depends not only on the actions of farmers and collective organisations, but also on the wider political and institutional environment in which they operate. Rights over land and natural resources, seed regulations and government recognition of community-based management systems all shape whether agrobiodiversity can be sustained over time. Across the three case studies, collective organisations complement local action with political engagement aimed at building political support for agrobiodiversity and strengthening the policy and institutional conditions that enable it. Their approaches range from securing Indigenous and customary rights to gaining recognition of FMSS, influencing local ordinances and national policy, and participating in wider biodiversity governance processes.

A common feature across all three case studies is that political engagement seeks to strengthen the formal recognition of community-based systems that have long supported agrobiodiversity. But the focus of these efforts differs according to local context. In Indonesia and the Philippines, advocacy has centred primarily on securing recognition of Indigenous and customary rights over land and natural resources as a foundation for sustaining diverse agroforestry and farming systems. In Tanzania, on the other hand, it has focused on gaining legal recognition of FMSS as a legitimate component of the national seed system. Each seeks to strengthen the institutional conditions under which communities can continue to manage agrobiodiversity.

4.5.1 Indonesia

In Indonesia, Riak Bumi has worked alongside Dayak producer organisations and communities in Kapuas Hulu district to secure formal recognition of customary forest rights while strengthening NTFP-related livelihood opportunities. Importantly, this process began not with legal advocacy but with livelihood and conservation activities, including training on illipe nut processing and *tengkawang* tree planting, which helped build trust with communities before more complex discussions around customary tenure and governance began. Riak Bumi then facilitated community discussions on the different social forestry schemes available under Indonesian law — including *hutan adat* (customary forest), *hutan desa* (village forest), *hutan kemasyarakatan* (community forest), *hutan tanaman rakyat* (community plantation forest) and *kemitrann kehutanan* (forestry partnership) — before communities collectively decided that *hutan adat* provided the most appropriate pathway.

Securing recognition required extensive documentation of settlement histories, customary governance systems, traditional land-use zones and *adat* law, followed by participatory mapping of customary territories, validation with neighbouring communities and formal verification by the Ministry of Environment and Forestry. From submission to formal recognition in 2024, the process took approximately four years. Across Kapuas Hulu district, 13 customary rights areas have been recognised to date. The process is supported by national systems such as the Ministry of Environment and Forestry's social forestry platform (goKUPS), which tracks applications and recognised areas.

The NTFP-EP Indonesia team is engaging with provincial and district governments to support the implementation of Governor Regulation No 33 of 2022 on developing NTFPs in West Kalimantan. Strengthening policy support for NTFPs is seen as a complementary pathway to tenure recognition, enabling communities to derive value from forest-based resources while maintaining agrobiodiversity.

4.5.2 The Philippines

The Philippines also illustrates a multi-level approach to creating enabling conditions for agrobiodiversity. Since its establishment, KEF has been closely involved in the broader struggle for recognition of Kalanguya–Ikalahan ancestral domain rights, resulting in the first MOA between the government and an Indigenous Peoples' organisation and helping establish an important precedent that later contributed to the IPRA. Although this struggle extended beyond agrobiodiversity, secure tenure has provided the foundation for long-term investment in agroforestry, forest management and traditional farming systems across the ancestral domain. Building on this foundation, KEF continues to strengthen political support for agrobiodiversity at multiple governance levels.

At local level, it works with *barangay* officials to promote a proposed Barangay Agrobiodiversity Conservation and Sustainable Agriculture Ordinance of 2025, which would require participating *barangays* to establish community germplasm banks for conserving heirloom seed and resilient native plant varieties while providing free planting material to local residents. If successful, this work will hopefully be carried on or adopted as a municipal ordinance.

At national level, KEF has actively contributed to the development of the Indigenous Peoples' Biodiversity Strategy and Action Plan (IPBSAP), coordinated through the Indigenous Peoples and Biodiversity Coalition (IPBC), as the Philippines aligns its national biodiversity strategy with the Kunming-Montreal Global Biodiversity Framework. Through this process, KEF and other Indigenous organisations have sought to ensure that the country's biodiversity policy more fully recognises Indigenous rights, traditional ecological knowledge and community stewardship. The IPBSAP represents a first-of-its-kind document serving as a collective commitment by Indigenous Peoples about their roles and responsibilities, traditional knowledge, values, rights and interrelationships with their territories and biodiversity (IPBC, 2024).

KEF has also pursued less conventional forms of policy influence that build political support through demonstration and exchange. Peer learning visits between Indigenous communities, involving tribal elders, youth, civil society organisations and local government representatives, provide opportunities to share experiences of forest governance, cultural practice and agrobiodiversity management. Following initial scoping visits by United Nations staff, KEF is compiling a formal application to nominate the Ikalahan production system as a Globally Important Agricultural Heritage System (GIAHS),[13] as international recognition could further strengthen national political support for Indigenous agrobiodiversity management.

4.5.3 Tanzania

Tanzania presents a different but equally significant example of policy engagement. Rather than focusing on land rights, MVIWAARUSHA has concentrated on securing political and legal recognition of FMSS as a legitimate component of the national seed system. Working alongside civil society partners for more than a decade, it has argued that FMSS are not only culturally important but also essential for maintaining agricultural biodiversity, climate resilience and food sovereignty. Traditional seed represents generations of farmer selection and adaptation to local conditions. Unlike many commercial hybrids, farmer-managed seed can be saved and replanted, maintaining traits such as drought tolerance, pest and disease resistance, suitability for local soils and qualities tied to taste, nutrition and cultural preference. By sustaining these traits across many varieties, FMSS sustain the genetic diversity in local seed that underpins climate resilience and food sovereignty.

13 A GIAHS is a prestigious designation created by the Food and Agriculture Organization of the United Nations that confers international recognition of sites as unique, living agricultural systems that intricately balance human livelihoods, rich biological diversity and cultural heritage.

At community level, MVIWAARUSHA has mobilised smallholders through seed fairs, food exhibitions, farmer exchanges and community seed banks. These grassroots activities have helped build community awareness and pride, while offering practical spaces for farmers to share knowledge. They have also allowed policymakers and researchers to observe first hand the adaptive value of farmer seed for resilience, nutrition and cultural heritage, laying the foundation for subsequent policy engagement, building visibility, legitimacy and momentum for advocacy efforts.

A seed bank that stores farm-managed Indigenous seeds in Karatu district, Tanzania. © MVIWAARUSHA

At national level, MVIWAARUSHA has pursued sustained engagement with policymakers, parliamentarians and technical institutions to build evidence and dialogue around farmer seed. Collaboration with the National Plant Genetic Resources Centre has enabled the documentation and characterisation of more than 80 farmer varieties, creating the technical evidence needed to support formal recognition. This collaboration also reflects knowledge co-production, combining farmer knowledge and scientific systems to support formal recognition that integrates both experiential and formal expertise. By aligning farmer selection practices with scientific evaluation and documentation, MVIWAARUSHA has helped reframe farmer knowledge as a legitimate source of agricultural innovation rather than informal tradition.

These sustained efforts contributed to a landmark decision in June 2025, when the Tanzania Official Seed Certification Institute approved the registration of 13 Indigenous farmer varieties. As the first formal recognition of farmer-managed seed within Tanzania's national regulatory system, this important milestone is the first step towards farmer varieties being sold and exchanged without criminalisation. The decision signals an important shift in state acknowledgement of smallholders' contributions to conserving genetic diversity and enhancing climate resilience. MVIWAARUSHA continues to advocate for implementing regulations that will enable farmers to register, exchange and market their seed in practice, as legal recognition alone is insufficient unless translated into operational policy.

4.5.4 Challenges faced

Across the three case studies, political engagement plays an important role in creating enabling environments for agrobiodiversity. Securing land rights, influencing seed policy and embedding agrobiodiversity within local governance structures can help create the long-term conditions necessary for sustaining diversified farming systems. But the case studies also illustrate that political engagement is often slow, resource intensive and shaped by complex institutional dynamics. These challenges influence both the pace and sustainability of policy change.

A recurring challenge across the case studies concerns the timeframes required to achieve policy change. Securing legal recognition, influencing policy frameworks or embedding new approaches within institutions often unfolds over long periods, which requires sustained efforts by collective organisations and smallholders, despite challenges or setbacks. In the Philippines, the struggle to secure recognition of Kalanguya–Ikalahan ancestral domain rights began in the early 1970s and evolved over several decades, culminating in formal recognition in 1999 and contributing to broader national legislation, such as the IPRA. Similarly, in Indonesia, securing recognition of customary forests required years of community engagement, and extensive documentation, participatory mapping and verification processes before formal approval. In Tanzania, advocacy for FMSS also required sustained engagement over more than a decade, beginning with grassroots mobilisation before progressing to sustained engagement with policymakers, parliamentarians and technical institutions. These experiences highlight that strengthening the policy environment for agrobiodiversity requires long-term organisational commitment and sustained resources, which can be difficult to maintain, particularly for local organisations.

Progress also depends on the ability to build and sustain consensus across multiple actors and scales. Advocacy requires alignment within communities, across organisations and among external stakeholders. In Indonesia, local-level disagreements over land boundaries led to confusion and in some instances territorial conflict, complicating applications for customary land recognition. More broadly, differing priorities and perspectives can make it difficult to define a shared agenda, which is fundamental for effective advocacy. In the Philippines, efforts to advance *barangay* ordinances and broader policy agendas similarly rely on building coalitions that extend beyond individual communities. To navigate theses dynamics, organisations have invested heavily in facilitation, participatory processes and alliance building, recognising that building a collective position among key stakeholders is a prerequisite for effective political engagement.

Institutional dynamics further shape how organisations can pursue change. In Indonesia, recognition of customary forests often depends on formal approval processes within government systems, requiring engagement with administrative and legal procedures before local practices can be formally recognised. In the Philippines, frequent turnover among policymakers creates challenges for continuity, requiring organisations like KEF to build relationships that extend beyond individual political actors. In Tanzania, advocacy around FMSS has required engagement across multiple levels of government, including policymakers, civil servants and technical institutions. Across all contexts, relationship building has emerged as a central component of political engagement, with organisations investing in long-term connections that help navigate institutional change and identify opportunities for advancing agrobiodiversity. This approach enables organisations to navigate changes in leadership, maintain dialogue over time and identify opportunities to advance their agendas within shifting political environments.

Political engagement is also shaped by broader development priorities and competing land uses. In Indonesia, government allocation of land to private oil palm enterprises and other competing land uses has overlapped with customary territories, highlighting the limits of formal recognition alone. More broadly, advocacy efforts must compete with other policy priorities and economic interests. In response, organisations have sought to identify and engage with existing policy agendas that provide entry points for advancing agrobiodiversity. In Tanzania, for example, growing policy attention around 'safe food' created an opportunity for MVIWAARUSHA and its partners to position FMSS within this agenda, highlighting that these systems do not rely on synthetic pesticides and can therefore be promoted as safer and healthier food systems. This illustrates how policy engagement often involves strategic framing, aligning agrobiodiversity with broader development narratives rather than introducing it as a standalone issue. MVIWAARUSHA's work also highlights the importance of identifying policy windows and actively participating in drafting policies and laws when opportunities emerge. More generally, these examples highlight the importance of not only technical evidence, but also the ability to position agrobiodiversity within wider development narratives that resonate with decision makers.

Taken together, the case studies demonstrate that political engagement is long term and highly relational. Progress depends not only on technical evidence and formal advocacy, but also on the ability to build coalitions, navigate institutional processes and align agrobiodiversity objectives with broader political and development priorities. The three case studies demonstrate that creating enabling environments for agrobiodiversity is not a one-off advocacy exercise but an ongoing organisational function. Even after important policy gains are achieved, continued engagement is required to translate legal recognition into implementation, maintain political support and respond to changing institutional and policy environments to foster the enabling conditions through which agrobiodiversity can be maintained and supported over time.

5 Conclusions

Agrobiodiversity is best understood to involve a dynamic process of adaptation and selection. Across generations, smallholder farmers and Indigenous Peoples have cultivated, exchanged and improved crops, trees and livestock, drawing on locally embedded knowledge to respond to changing environmental conditions and human needs. Through these processes, agricultural landscapes have become living repositories of valuable genetic diversity, shaped by — and adapted to — particular ecological and cultural contexts. This diversity underpins the ecological functions that sustain productive landscapes, supporting processes such as soil formation, nutrient cycling, pollination, pest regulation and wider ecosystem resilience. At the same time, agrobiodiversity is deeply intertwined with cultural identity, traditional ecological knowledge and biocultural heritage, reflecting generations of interaction between people and nature. It has, therefore, served not only as a source of food, fibre, fuel and medicine, but also as a means through which communities maintain cultural continuity, strengthen connections to place and build resilience in the face of environmental uncertainty and change.

The accelerating pace of climate change makes these functions of resilience and cultural continuity increasingly important. Rising temperatures, changing rainfall patterns, more frequent climate extremes and the emergence of new pests and diseases are placing unprecedented pressures on forest and farm production systems. At the same time, societies are seeking pathways that can both adapt to and mitigate these changes. In this context, the active in-situ nurturing of agrobiodiversity offers a critical foundation for resilient systems and landscapes. Yet we must not take these outcomes for granted. Sustaining agrobiodiversity requires deliberate investment in the people, organisations, knowledge systems, markets and institutional arrangements that enable it to sustain and flourish. This section summarises the key findings of the report regarding these enabling conditions. Rather than prescribing specific recommendations, these conclusions provide a foundation for the next phase of the Nature Nurture project, which will develop practical guidance for collective organisations and their supporting partners seeking to nurture nature.

5.1 Supporting collective organisations to sustain agrobiodiverse production systems

Collective organisations play a central role in sustaining agrobiodiverse production systems, but they need additional support. Our report highlights the central role that collective organisations can play in sustaining and scaling agrobiodiverse production systems. Maintaining agrobiodiversity is rarely straightforward. Producers must often navigate a range of interconnected challenges — including insecure tenure and resource rights, access to knowledge, seed and planting material, inadequate finance, market uncertainties, and policy environments that frequently favour simplified production systems — and these challenges can be difficult for individuals to address alone. At the same time, the benefits generated by agrobiodiversity, including food security, livelihood resilience, nutritional diversity, ecosystem services, climate adaptation and mitigation, and the preservation of biocultural heritage, extend far beyond individual farms and are shared across communities, landscapes and generations.

Collective organisations are particularly important because they help bridge the gap between individual action and collective benefit. Rooted within the communities they serve, such organisations are often well placed to pursue longer-term social, ecological and economic goals that extend beyond the interests of individual producers alone. By creating spaces for cooperation, learning, investment and collaboration, they help producers navigate barriers that would otherwise undermine agrobiodiverse systems, while ensuring the wider social, ecological and economic benefits of those systems can be sustained and shared. Supporting and strengthening smallholder farmer and Indigenous Peoples' organisations is therefore a key priority for efforts to nurture nature while supporting resilient and inclusive rural livelihoods.

The three case studies in this report demonstrate that these organisations are not passive custodians of agrobiodiversity, but active agents of continuous adaptation and change. Their significance lies not only in the activities they undertake, but in their ability to persist and respond to challenges over time. The case studies do not present stories of linear success, nor organisations that have always found the right solution at the first attempt. Rather, they demonstrate a remarkable capacity to adapt, experiment and persevere in the face of change. While each has faced resource limitations, market pressures, policy barriers, land-use conflicts and shifting social dynamics, all three have continually adjusted their strategies in response. When particular approaches have become less viable, they have sought new opportunities, developed new partnerships, found creative entry points and strengthened or reconfigured other areas of activity. They have sustained and renewed knowledge and seed systems, built enterprises around diverse products, mobilised finance, defended territorial rights and influenced policy environments, often over decades rather than years.

Working together through collective organisations does not remove the tensions inherent in maintaining agrobiodiverse production systems within a neoliberal socioeconomic system, but it does give communities the collective capacity to negotiate and renegotiate those tensions as circumstances change. The case studies suggest that the long-term viability of agrobiodiverse production systems often depends on the resilience, adaptability and collective agency of the organisations that support the people who manage them. Yet the report also demonstrates that these organisations cannot be expected to shoulder this responsibility alone. Strengthening collective organisations requires sustained investment in their organisational capacity, technical capabilities, financial sustainability and ability to engage with markets and policy processes. Such support represents an investment not only in agrobiodiversity but also in the social infrastructure needed to sustain and renew it over time.

5.2 Investing in local food systems, short supply chains and market arrangements

Building businesses around diversity requires investment in local food systems, short supply chains and market arrangements that recognise and reward the nutritional, cultural, ecological and economic value of diverse crops, trees and livestock. The case studies highlight the importance of not only accessing markets but also of actively shaping them to support agrobiodiversity. Reliance on agrobiodiversity is often greatest in subsistence and semi-subsistence systems where diverse crops, trees and wild resources contribute directly to local food security, nutrition, health and livelihood resilience. Yet none of the case study communities exist outside of wider markets: they must all engage, to varying degrees, with commercial economies to generate income, meet household needs and support organisational activities. This creates an ongoing tension. While market engagement can provide important livelihood opportunities and incentives for investment, integration into national and global commodity markets often increases pressure towards specialisation, standardisation and scale, favouring a narrower range of species, varieties and production practices. The case studies demonstrate that sustaining agrobiodiversity frequently involves navigating and managing, rather than avoiding, this tension. While some commercial value chains — including for coffee, cacao, rattan and other agroforestry commodities — can create opportunities to maintain and enhance agrobiodiversity, many export-oriented production systems have historically been associated with its decline. Maintaining agrobiodiverse smallholdings that can aggregate multiple crops from multiple farms at high and uniform quality standards is a genuine challenge. This does not imply that agrobiodiverse producers should be isolated from wider markets. Rather, it highlights the importance of shaping market arrangements and business partnerships that are compatible with, and supportive of, biological diversity (such as those identified by Hou-Jones et al., 2024).

For collective organisations, this means building enterprises around the diversity that already exists within local production systems rather than encouraging greater specialisation around single commodities. Investments in local food systems, territorial markets and short supply chains can help strengthen connections between producers and consumers, increase the value retained within local economies and create demand for diverse products that might otherwise struggle to compete within commodity-oriented value chains. Market niches and labels can be developed to help reward the multiple functions of agrobiodiverse production systems, including their contributions to food security, nutrition, cultural identity and ecosystem health, rather than valuing production solely in terms of profit potential, volume and uniformity. Supporting partners of collective organisations by investing in the infrastructure, market intelligence, product development, processing capacity and business skills needed to make these enterprises viable is key, as strong producer organisations remain central to coordinating the aggregation, processing, storage and marketing of these baskets of products. Yet market engagement is not an end in itself. Instead, collective organisations need to carefully assess whether particular markets, buyers and commercial partnerships reinforce or undermine agrobiodiversity. Where producers engage with regional, national or international markets, commercialisation strategies should build on existing diversity rather than encourage simplification, ensuring that market opportunities strengthen, rather than erode, the ecological and social foundations on which long-term resilience depends.

5.3 Recognising, legitimising and strengthening traditional seed and ecological knowledge systems

Sustaining agrobiodiversity depends on recognising, legitimising and strengthening traditional seed and ecological knowledge systems as living, adaptive systems that enable genetic diversity, cultural knowledge and local adaptation to continue evolving over time. The report demonstrates how traditional seed and ecological knowledge systems provide the essential foundation for maintaining, exchanging, improving and adapting agrobiodiversity over time. These are the mechanisms through which communities transmit genetic resources, ecological knowledge, cultivation practices and cultural traditions across generations, enabling them to conserve, adapt, shape and renew diversity. Over generations, these systems have played a central role in developing agrobiodiversity, enabling crops, trees and livestock to be adapted to local ecological conditions, cultural preferences and changing human needs. They remain vital in the context of climate change, where producers must respond to evolving patterns of temperature, rainfall, pests and disease.

Unlike ex-situ conservation approaches — such as national and international genebanks, seed vaults and living collections maintained in research stations or botanical gardens — in-situ management allows agrobiodiversity to continue evolving in response to changing environmental conditions and human needs. FMSS enable farming communities to continually select, exchange and adapt crops and planting material, strengthening their resilience in the face of climate change and other environmental pressures. But these systems often receive far less recognition and support than formal seed systems, despite their central role in sustaining both subsistence and commercial farming. There must be greater legal recognition and policy support for FMSS, if they are to continue serving as living foundations for agrobiodiversity.

The three case studies demonstrate the importance of farmer seed banks, seed exchange networks, knowledge sharing and intergenerational learning in sustaining the processes for conserving, renewing and adapting agrobiodiversity over time. While ex-situ conservation remains an important safeguard against genetic erosion, the farmer-led and Indigenous systems that actively sustain agrobiodiversity within living production landscapes must have greater recognition and investment. Supporting, recognising and legalising farmer seed banks and community seed systems, alongside the traditional knowledge systems that maintain them, should therefore remain a key priority for collective organisations and their supporting partners as they work to strengthen the resilience, adaptive capacity and long-term vitality of agrobiodiverse production systems.

The case studies also demonstrate that sustaining these systems requires continued investment in the social processes for transmitting knowledge. As demographic change, migration, formal education and changing livelihood aspirations reshape rural communities, the intergenerational transfer of traditional ecological knowledge cannot be taken for granted. Instead, collective organisations need to continually identify creative and locally appropriate ways of engaging younger generations through schools, demonstration sites, cultural activities, enterprise development, digital media and other forms of community learning. Keeping young people connected to agrobiodiversity is not only about preserving

cultural traditions; it is essential for ensuring that traditional seed and ecological knowledge systems remain living and adaptive, capable of responding to changing environmental, social and economic conditions. Without sustained intergenerational engagement, the knowledge, skills and genetic resources that agrobiodiversity depends on risk being progressively eroded.

5.4 Investing in and building the capacity of local productive enterprises

Building businesses around diversity requires significant organisational capacity and long-term investment. The case studies demonstrate the value of developing enterprises around baskets of products that capture value from the diversity already present within local production systems. While this can strengthen resilience, spread risk and create multiple livelihood opportunities, it also throws up significant organisational, logistical and commercial challenges. Building businesses around diversity means aggregating multiple crops, harvested at different times, in different quantities and across multiple smallholders, for multiple markets. Coordinating production, maintaining quality standards, processing diverse products and meeting the requirements of different markets is complex and costly.

Despite these challenges, the case studies also demonstrate that collective organisations can play a crucial role in making diversity economically viable. By aggregating products across multiple producers, coordinating supply, investing in shared processing and enterprise infrastructure, strengthening product quality, undertaking market research, supporting enterprise development and building market linkages, organisations can create market opportunities that individual producers would struggle to access alone. But as the report highlights, successfully building businesses around diversity requires significant organisational capacity, specialised skills and sustained investment. Producing high-quality products alone is not enough. Collective organisations must not underestimate the organisational capabilities required to transform diverse products into viable enterprises and supporting organisations should prioritise strengthening these capacities through long-term technical, organisational and financial support. Recognising that not every market opportunity will support agrobiodiversity, collective organisations should base their enterprise development decisions not only on commercial potential, but on whether they strengthen the diversity, ecological sustainability and community priorities they depend on.

Developing shared labels, place-based identities, certification systems and other forms of collective branding that help distinguish agrobiodiverse products in the marketplace should also form part of this long-term investment in enterprise development. Such approaches can help to communicate the environmental, cultural and social values embodied within these products, helping organisations compete on the distinctive value of their products, rather than solely on volume or price, while building consumer recognition and trust.

5.5 Mobilising appropriate finance for agrobiodiversity

Mobilising appropriate finance for agrobiodiversity depends on organisational capacity, governance and local institutional context. Conventional finance is often poorly suited to the realities of agrobiodiverse production systems. Mainstream financial institutions that offer loans frequently restrict loan proposals to investments in established crops and well-known business models with predictable returns and low transaction costs. They have a high-risk aversion to less common crops (particularly tree crops with long maturation times), to unusual or diversified business models with less predictable returns, and to the high transaction costs of dealing with multiple smallholdings. High interest rates, collateral requirements and repayment schedules that are poorly aligned with the time horizons and experimental nature of many agroforestry and agrobiodiverse production systems also constrain access to finance. As a result, many of the activities that help nurture nature can struggle to access appropriate forms of finance, despite generating significant social, ecological and economic benefits. The three case studies illustrate both the potential and the challenges of developing financial systems that are better aligned with agrobiodiversity. While access to appropriate finance remained limited in the Indonesia and Philippines case studies, MVIWAARUSHA's experience illustrates what can be achieved when collective organisations have the organisational capacity, governance arrangements and member trust to develop and govern their own financial mechanisms.

The case studies demonstrate that collective organisations should seek to mobilise forms of finance that are appropriate to their organisational capacity and institutional context. One way of achieving this is through internally managed financial mechanisms. Where the necessary governance arrangements, member trust and organisational capacity exist, internally managed financial mechanisms can provide an important source of patient, flexible and locally controlled finance for agrobiodiversity. By pooling membership fees, service charges, margins from collective sales and income generated through internal lending, organisations may be able to build financial systems that are better aligned with member needs and the realities of diversified production systems. Such mechanisms can provide more accessible finance, support experimentation and diversification, spread risk across members and enable investment in activities that conventional lenders may perceive as too risky, too small or too complex. Importantly, they also allow financial returns to be retained and reinvested by the collective, strengthening its long-term capacity to support members and nurture nature. However, developing and sustaining such mechanisms requires long-term investment in governance, financial management and organisational capacity.

Our findings suggest that no single financial model is appropriate across all contexts. While internally managed financial mechanisms can provide important advantages where the necessary organisational capacity, governance arrangements and member trust are in place, they are not necessarily appropriate for all contexts. MVIWAARUSHA's experience illustrates what can be achieved when these conditions exist, whereas the Indonesia and Philippines case studies highlight the challenges organisations face in establishing and sustaining such systems. In these contexts, external finance — including support from credit unions, government programmes and donor-funded initiatives — plays an important role in supporting agrobiodiversity. Collective organisations should therefore avoid viewing internally managed finance as the only pathway for supporting agrobiodiversity. Instead, they should identify and mobilise the mix of financial mechanisms that best reflects their organisational capacities, governance arrangements and local institutional context. Where collective organisations do seek to develop internally managed finance, its effectiveness ultimately depends on the strength, legitimacy and accountability of the organisations that govern it. Building trust through transparent decision making, sound financial management and effective oversight is therefore just as important as mobilising access to capital.

5.6 Fostering long-term political engagement and enabling policies

Sustaining agrobiodiversity requires long-term political engagement by collective organisations to secure land and resource rights, strengthen recognition of FMSS and traditional ecological knowledge, and create enabling policy environments for diverse production systems. Many of the challenges facing agrobiodiverse production systems originate beyond local forest and farm systems and cannot be addressed by producers acting alone. Land tenure insecurity, restrictions on customary resource rights, seed regulations, inappropriate subsidy regimes, limited access to finance, policy biases towards simplified production systems and markets that support largescale agribusiness can all undermine efforts to nurture nature. Sustaining agrobiodiversity therefore requires not only action within production landscapes, but also engagement with the wider policy and institutional environments that shape how producers can access and manage those landscapes.

Our report showcases that collective organisations have played, and continue to play, a crucial role in creating these enabling environments by ensuring the interests, rights and knowledge of smallholder farmers and Indigenous Peoples are represented in wider policy and governance processes. This includes advocating for secure territorial and resource rights, recognition and protection of traditional ecological knowledge, and policy environments that support local control over genetic resources, FMSS and the continued adaptation of locally adapted crops, trees and livestock. Importantly, the case studies demonstrate that building political support for agrobiodiversity requires sustained engagement from grassroots action through to policy advocacy. This depends on the ability to build coalitions, maintain long-term relationships across institutions and multiple levels of governance, navigate complex policy processes and strategically align agrobiodiversity with broader political and development priorities. Collective organisations should therefore continue investing in their advocacy capacity, while supporting partners should recognise policy engagement as a long-term process that requires sustained technical and financial support. Strengthening the voice and influence of local groups in policy processes can help create enabling environments in which agrobiodiversity is not merely conserved, but actively nurtured.

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Appendices

Appendix 1. What humans value

This appendix presents a systems framework describing one possible framing of the six main categories of what humans value. Table A1 is drawn from a theory of human prosperity (Macqueen et al., 2020) in which the categories of value were stated to be non-commensurate. In other words, values in one category cannot easily be measured the same way as values in another category, contesting the idea that everything can be placed on a single economic scale. The table groups what humans value into three broad clusters, based on familiarity, common interest and passions.

Crucially, Table A1 highlights that different motives, involving very different virtues or vices, drive the pursuit of value, delivering potentially diametrically opposed development impacts. It accepts evidence that there is a striking and distinct polarity in what drives the human pursuit of value, on a spectrum spanning from self-enhancement (the pursuit of personal enrichment and power) at one end and self-transcendence (the pursuit of benevolence and the public good) at the other (Schwartz, 1992; Bardi and Schwartz, 2003; Crompton, 2010). What motivates or drives human pursuit of value — and the institutional structures that are set up for that pursuit — all matter.

Table A1. A framework of the outcomes of human pursuit of value for the common good or self-interest

Basis of action	**Familiarity**		**Common interest**		**Passions**	
Driver	The common good/Love/Cooperation					
Impact	SUSTAINABLE DEVELOPMENT					
Development outcomes	Diverse abundance and beauty for all	Health, nutrition and material comfort	Trust and friendship between groups	Law and order for social justice and stability	Decent remunerative work and family time	Hopeful, progressive social change
Institutional constructs	Inclusive, conservation-oriented land-use planning	Cooperative enterprise and health systems	Fair representation in localised democracies	Fair and redistributive justice system	Public education and family support	Gendered service-oriented peer rewards
Virtues	Appreciation/ Temperance	Prudence/ Empathy	Humility/ Respect	Justice/ Charity	Creativity/ Fidelity	Diligence/ Equality
What humans value	Beauty in nature and culture	Material health and wellbeing	Affirmative social relationships	Present and future security	Creative fulfillment of potential	Sense of identity/ purpose
Vices	Possession/ Acquisition	Greed/ Indifference	Pride/ Disrespect	Injustice/ Oppression	Envy/Lust	Hedonism/ Sexism
Institutional constructs	Unplanned competitive land rights and use	Corporate enterprise and health systems	Elite control of centralised decision-making	Corrupted officials, judiciary and armed forces	Privatised education and family–work conflict	Status and rewards for wealthy and powerful
Development outcomes	Monocultures, scarcity, degradation — except for the few	Illness, malnutrition and inequality	Mistrust and ghettoed securitisation of wealth	Corruption, conflict and violence	Drudgery, social unrest and family breakdown	Degeneration into listless, sexist escapism
Driver	Self-interest/Ego/Competition					
Impact	DYSTOPIA					

Appendix 2. Dayak forest and farm producer organisations

Table A2. Forest and farm producer organisations in Labian village

Organisation name	Restorasi Ngaung Keruh Lestari (Sustainable Restoration of Ngaung Keruh)	Tengkawang Labian Farmers Group	Dry Rubber Farmers Group	Sungai Anggali Rice Farmers Group
Established	2013	2021	2021	2006
Main objective	Sustainable forestry and nature conservation	Sustainable forestry and environmental protection	Improving the livelihoods of rubber farmers	Realising an independent farming community that promotes environmental sustainability
Location	Ngaung Keruh sub-village, Labian village	Ukit-Ukit, Tumbali and Ngaung Keruh sub-villages, Labian village	Labian village	Ukit-Ukit sub-village, Labian village
Members	50	30	92	25
Main activities	Cleaning water pipes Patrolling forests and farming	Planting *tengkawang* trees Illipe nut harvesting and processing training Quality control to improve product quality	Improving product quality and sales Managing rubber-tree nurseries Grafting training Establishing coffee nurseries between rubber trees	Planting rice, rubber, *kratom* and potato yams for sale and personal consumption
Land managed	258 hectares	50 hectares	92 hectares	50 hectares
Tenure type	Communal	Private and communal	Private	Private

Table A3. Forest and farm producer organisations in Labian Ira'ang village

Organisation name	Usaha Pelestarian Sumber Daya Alam (UPSA) (Natural Resources Conservation Efforts)	Gabungan Kelompok Tani (GAPOKTAN) (Farmer Group Association)	Rehabilitasi Hutan dan Lahan (RHL) (Forest and Land Rehabilitation)
Established	2023	2008	2023
Main objective	Improving economic welfare while promoting environmental conservation	Advancing farming practices to create prosperous and sustainable farming communities	Creating a positive impact by rehabilitating forests and land to support community preservation efforts
Group type	Cooperative	Farmer association	Cooperative
Members	27	69	38
Main activities	Preserving forest vegetation Continuing intercropping practices (particularly with chives and red ginger) Maintaining intercrops Planting *petai*, *jengkol*, *durian*, *tengkawang*	Agricultural extension Planting Pest control Fertilisation Marketing Sustainable use of *tengkawang* to improve community welfare	Planting Fertilisation Replanting Weeding Managing the production of *jengkol*, *petai* and *durian* for commercial sale and household consumption

Appendix 3. Common crops grown and harvested in case study areas

Table A4. Crops widely planted and harvested by Dayak communities in Indonesia

Local/Common name	Scientific name
Aloe vera	*Aloe vera*
Areca nutes	*Areca catechu*
Bamboo	*Dendrocalamus asper*
Banana	*Musa paradisiaca*
Bebuas	*Premna serratifolia*
Belimbing	*Averrhoa bilimbi*
Beranang	*Alocasia macrorrhiza*
Butterfly pea	*Clitoria ternatea*
Cassava	*Manihot esculenta*
Cempedak	*Artocarpus integer*
Chicken	*Gallus gallus domesticus*
Chilli	*Capsicum pubescens*
Chives	*Allium schoenoprasum*
Cocoa	*Theobroma cacao*
Coconut	*Cocos nucifera*
Cocor bebek	*Kalanchoe pinnata*
Coffee	*Coffea canephora*
Cucumber	*Cucumis sativus*
Dabai	*Canarium odontophyllum*
Dogfruit/jengkol	*Archidendron pauciflorum*
Durian	*Durio zibethinus*
Eggplant	*Solanum melongena*
Empakan	*Durio kutejensis*
Fern	*Stenochlaena palustris*
Gaharu	*Aquilaria malaccensis*
Galangal	*Alpinia galanga*
Gambas	*Luffa acutangula*
Ginger	*Zingiber officinale*
Guava	*Psidium guajava*
Kale	*Brassica oleracea*
Katuk leaves	*Sauropus androgynus*
Keldana	*Dipterocarpus gracilis*
Kratom	*Mitragyna speciosa*

Local/Common name	Scientific name
Kumis kucing	*Orthosiphon aristatus*
Langsat	*Lansium domesticum*
Lemongrass	*Cymbopogon flexuosus*
Long beans	*Vigna unguiculata*
Maize	*Zea mays*
Mango	*Mangifera indica*
Meranti	*Shorea leprosula*
Mustard	*Brassica juncea*
Papaya	*Carica papaya*
Patah rodan	*Euphorbia tirucalli*
Perenggi	*Cucurbita moschata*
Petai	*Parkia speciosa*
Pineapple	*Ananas comosus*
Rambutan	*Nephelium lappaceum*
Rattan	*Calamus trachycoleus*
Red rice	*Oryza rufipogon*
Rengas	*Gluta renghas*
Rengat	*Marsdenia tinctoria*
Resak	*Vatica rassak*
Rice	*Oryza sativa*
Rubber	*Hevea brasiliensis*
Sago	*Metroxylon sagu*
Sago worm	*Rhynchophorus ferrugineus*
Serugan	*Cassia alata*
Spinach	*Amaranthus caudatus*
Sugar cane	*Saccharum officinarum*
Sweet potato	*Solanum tuberosum*
Tekam	*Hopea sangal*
Temulawak	*Curcuma xanthorrhiza*
Tengkawang/illipe nut	*Shorea stenoptera*
Turmeric	*Curcuma longa*
Ulin	*Eusideroxylon zwageri*
Yam	*Ipomoea batatas*

Table A5. Crops widely planted and harvested by Ikalahan men and women in the Philippines

Local/Common name	Scientific name
Agayap/native climbing long beans	*Vigna unguiculata subsp. sesquipedalis*
Alugbati/malabar spinach	*Basella alba*
Basil	*Ocimum basilicum*
Bawang/garlic	*Allium sativum*
Beans	*Phaseolus vulgaris*
Biligan/winged beans	*Psophocarpus tetragonolobus*
Bitter gourd	*Momordica charantia*
Bottle gourd	*Lagenaria siceraria*
Cabbage	*Brassica oleracea var. capitata*
Carrot	*Daucus carota ssp. sativus*
Cassava	*Manihot esculenta*
Cauliflower	*Brassica oleracea var. botrytis*
Chayote	*Sechium edule*
Cherry tomato	*Solanum lycopersicum var. cerasiforme*
Chilli pepper	*Capsicum sp.*
Chinese cabbage	*Brassica rapa subsp. pekinensis*
Cucumber	*Cucumis sativus*
Edible fern/pako	*Diplazium esculentum*
Eggplant	*Solanum melongena*
Galyang/giant swamp taro	*Cyrtosperma merkusii*
Ginger	*Zingiber sp.*
Kalunay/spleen amaranth	*Amaranthus spinosus*
Kapaneh	*Cajanus sp.*
Lampakan	*Colocasia esculenta (L.)*
Lettuce	*Lactuca sativa*
Maize	*Zea mays*
Malunggay	*Moringa oleifera*
Mustasa/mustard greens	*Brassica integrifolia*
Okra/lady's fingers	*Abelmoschus esculentus*
Onions	*Allium cepa*
Peanut	*Arachis sp.*
Pechay	*Brassica rapa subsp. chinensis*
Philippine spinach	*Spinacia sp.*
Pigeon pea	*Cajanus cajan*
Pihing	*Colocasia sp.*
Pineapple	*Ananas comosus*

Local/Common name	Scientific name
Pitik	*Colocasia sp.*
Potato	*Solanum tuberosum*
Saluyot/jute mallow	*Corchorus olitorius*
Sili-amki	*Capsicum chinense*
Sili-labuyo	*Capsicum frutescens*
Sili-sultan	*Capsicum sp.*
Sitting beans	*Phaseolus sp.*
Squash	*Cucurbita maxima/Cucurbita moschata*
Snow pea	*Pisum sativum var. saccharatum*
String beans	*Vigna unguiculata*
Sweet potato/camote	*Ipomoea batatas (L.) Lam.*
Taro	*Cyrtosperma merkusii*
Tomato	*Solanum sp.*
Tugi/lesser yam	*Dioscorea esculenta*
Turmeric	*Curcuma longa*
Ube/purple yam	*Dioscorea alata*
Watercress	*Nasturtium officinale*

Table A6. Fruit trees widely cultivated by Ikalahan men and women in the Philippines

Local/Common name	Scientific name
Batwan	*Garcinia binucao*
Bignay	*Antidesma bunius*
Bilih (cucumber tree)	*Averrhoa sp.*
Caimito/star apple	*Chrysophyllum cainito*
Calamansi	*Citrus x microcarpa*
Cherry	*Flacourtia sp.*
Dagwey	*Saurauia bontocensis*
Guava	*Psidium guajava*
Jackfruit	*Artocarpus heterophyllus*
Katmon	*Dillenia philippinensis*
Lemon	*Citrus x limon*
Mango	*Mangifera spp.*
Pomelo	*Citrus maxima*
Santol/cotton fruit	*Sandoricum koetjape*
Tiesa/canistel/egg fruit	*Pouteria campechiana*
Uyok	*Saurauia elegans*

Table A7. Palms, vines and shrubs widely cultivated by Ikalahan men and women in the Philippines

Local/Common name	Scientific name
Banana	*Musa spp.*
Betel nut	*Areca catechu*
Coconut	*Cocos nucifera*
Coffee	*Coffea Arabica/robusta*
Dikai	*Embelia philippinensis*
Guyabano/soursop	*Annona muricata*
Hibiscus/gumamela	*Hibiscus sp.*
Ikmo/betel	*Piper betle*
Kaong (balagnot)/sugar palm fruit	*Arenga pinnata*
Lemon grass	*Cymbopogon citratus*
Papaya	*Carica papaya*
Passion fruit	*Passiflora edulis*
Rattan	*Calamus rotang*
Sugarcane	*Saccharum officinarum*
Tiger grass	*Thysanolaena latifolia*

Table A8. Crops widely planted and harvested by MVIWAARUSHA members (men and women) in Tanzania

Local/Common name	Scientific name
Armai/lamai	*Ximenia caffra*
Cassava	*Manihot esculenta*
Coffee	*Coffea arabica*
Ergumii/emardanyii	*Vangueria madagascariensis*
Kiazi kitamu pori	*Ipomoea aquatica*
Maize	*Zea mays*
Matogwa	*Thespesia garckeana*
Mbuyu	*Adansonia digitata*
Mchicha	*Amaranthus hybridus*
Mchunga/sunga	*Sonchus schweinfurthii*
Mduguyu	*Balanites aegyptiaca*
Mesquite	*Prosopis juliflora*
Mfurunji	*Albizia gummifera*
Mgagani	*Cleome hirta*
Mgunga	*Acacia seyal*
Mgunga	*Acacia xanthophloea*
Mkarisa	*Carissa edulis*
Mkuyu/oreteti	*Ficus sur*
Mkuyu/oreteti	*Ficus sycomorus*
Mlangali	*Euphorbia nyikae*
Mnafu	*Solanum nigrum*
Mpera	*Psidium guajava*
Mringaringa	*Cordia africana*
Msesewe	*Rauvolfia caffra*
Mshubiri	*Aloe secundiflora*
Olekisiko	*Galinsoga parviflora*
Osojo	*Euclea divinorum*
Pilipili kichaa	*Capsicum frutescens*
Sweet potato	*Ipomoea batatas*
Tamarind/ukwaju	*Tamarindus indica*

Knowledge Products

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Agrobiodiversity (or agricultural biodiversity) underpins food security, nutritional health, livelihood resilience, ecosystem functioning and the capacity of food systems to respond to environmental change. Yet globally, agrobiodiversity is declining at an alarming rate. Understanding how collective organisations help sustain agrobiodiverse production systems under pressure, and the challenges that they face, is central to efforts to nurture nature while supporting viable rural livelihoods. The purpose of this report is to strengthen evidence and understanding of this role by identifying the practices and principles that collective organisations use to maintain and adapt agrobiodiverse production systems. The report draws on three case studies from Indonesia, the Philippines and Tanzania that examine how collective organisations support smallholder farmers and Indigenous Peoples to sustain agrobiodiversity in different social, ecological and political contexts.

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