Promoting nature-based solutions for climate resilience and low carbon economy among ethnic minorities: A case study of Son La province, Vietnam

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Abstract

This paper describes the initial results of a project focusing on the nature-based solutions (NbS) to climate change and food security among ethnic minority people in Son La province. The project results showed that nature-based solution practices such as organic agriculture, circular agriculture, vermicomposting, agroforestry using indigenous species and local crops have improved food security and climate change adaption among local communities. There is a positive acceptance among local people, especially young people to pilot NbS practices. Local people see the benefits of transitioning to rice organic agriculture where they can sell their products to tourists at higher prices and it attracts more tourists to visit their village and experience the beauty of nature. The success of promoting nature-based solutions in agriculture in Son La comes from many reasons. The main reason is the application of market system development approach where climate friendly enterprises involve in planning agriculture production, co-investing in production and consumption. In addition, climate change interventions should aim at reducing local vulnerability and increasing their resilience.

Key words: Circular agriculture, nature-based solution, climate change, ethnic minorities, Northern Mountainous Region

1. Introduction

Climate change and food security are major societal challenges. Food production depends on the sustainable management of healthy ecosystems. However, 50% of the world's agricultural ecosystems have been degraded (Iseman and Miralles, 2021). For example, Vietnam has approximately 21 million hectares of agricultural and forest land, of which 7.55 million hectares are affected by degradation (Gobin et al., 2020). Current agricultural and food systems need to become more resilient. Nature-based solutions (NbS) offer the potential to achieve this goal. The Food and Land Use Coalition's Report (2019) presented the scientific evidence and argument case for 10 critical transformations of the food system and three of which are NbSs arguing that by 2030, could help mitigate climate change, protect biodiversity, ensure healthier food, significantly improve food security, and create more inclusive local economies. In the UN decade of Ecosystem Restoration (2021-2030), approaches that rehabilitate natural ecosystems, integrate them into systems that sustain livelihoods and food production, and improve natural processes in modified ecosystems are given

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priority. The need for a transformation of agricultural systems is very clear, and NbS could play an important role in a sustainable future of food production (IPCC, 2019).

The International Union for Conservation of Nature defines NbS as any action to protect, sustainably manage, and restore ecosystems, that address societal challenges effectively and simultaneously providing human well-being and biodiversity benefits (IUCN, 2016). NbS were endorsed in the IPBES Report, the Climate Change and Land Report of the IPCC, and the Global Adaptation Commission Report, and were highlighted as one of key actions at the 2019 UN Climate Action Summit (Seddon et al., 2020). However, NbS faces many challenges including a lack of awareness; knowledge gaps about applications and effectiveness; insufficient understanding of costs and benefits; diverse stakeholder values and perceptions; and limited policy and economic instruments (Nelson et al., 2020). In addition, improving the adoption of NbS requires learning from the past experience. Knowledge derived from previous cases would support the identification of the drivers and barriers of NbS implementation, generate lessons learned, and support upscaling (Schröter et al., 2021). Despite this, Simelton et al. (2021) found limited evidence of NbS in agricultural systems in developing countries. Thus, research is needed to build a suite of empirical evidence and move from information gathering to knowledge building.

Vietnam is one of the world most vulnerable countries to climate change (Dasgupta et al., 2007). Climatic stresses most impact vulnerable communities, such as those in the upland areas of the Northern Mountainous Region (NMR) (Son et al., 2019). It is also within NMR where many of the ethnic minorities of the country reside (Vien, 2003). Ethnic minority residents of the Northern Mountainous Region are among the poorest living in poverty in this region (Rambo and Jamieson, 2003). They often live in the more remote areas, and their limited access to markets, services, and reliable transportation networks adds to their vulnerability (Son, 2013). Climate change impacts have already affected the efforts to improve their living standards.

The Government of Vietnam has recently enacted National Climate Change Strategy in 2022. In addition, Vietnam committed to reaching net zero by 2050 at COP26. Ministry of Agriculture and Rural Development also promotes the development of ecological agriculture to strengthen the Vietnam export of agricultural products. However, mountainous region lacks of funding for climate change actions as the government and donnors often see sea level rise as the main threat of climate change. Thus, funding is tailored to mainly the coastal areas. In addition, the awareness and knowledge of climate change among ethnic minority people is limited which will cost time and resource to build capacity for local people.

Mountainous regions are important given their high biodiversity and supply of nature's contributions to people to both upland and lowland human communities (Kohler et al., 2010). Mountain areas are typically exposed to multiple hazards such as floods and landslides. Hazards cannot be prevented, but mountain regions can be supported in managing the risks associated with these hazards. The support can begin with the promotion of NbS practices such as agroforestry and reforestation. NbS is not a new set of practices because learning from the nature in food production is still common in many local and traditional agricultural production systems (Albrecht & Wiek, 2021a).

Son La is a mountainous province in the Central Northwest of Vietnam. Son La province is also a relatively poor and underdeveloped mountainous area. Son La province is located in the tropical monsoon climate, bearing the common characteristics of the Northwest mountains: cold and dry winters and hot, humid summers with lots of rain. In the past years, Son La is regularly affected by floods, flash floods and landslides and drought. Assessment of climate change in Son La in recent years (DONRE, 2019) shows that the average annual temperature in areas in the province fluctuates in the range of 21-23°C, the average temperature between years tends to increase. Rainfall in Son La is unusual and heavy rains have occurred and become difficult to predict. Extreme weather events occur with increasing frequency and impact. Van Ho is one of 4 poor and mountainous districts of Son La with an area of 97,984.00 ha consisting of 14 communes at the elevation of 800-1000m asl. Due to inappropriate land-use practices, land has been degraded leading to high agriculture production costs and decreased productivity. In the project areas, agricultural land has been allocated to households and individuals for long-term use. The main climate risks in the region are drought in the dry months (9-12), flood in rainy season (6-8), changing weather pattern causing difficulties in crop production planning. Changing weather patterns and increasing frequency of natural hazards such as droughts and storms are affecting local agricultural productivity. They are causing severe impacts on crops, livestock and fish and farm infrastructure and this significantly affects local livelihoods, food production and food security. However, adaptive capacity of local communities is limited due to many reasons. One of the reasons is that the funding for climate change projects in the mountainous region is limited because donors tend to prioritize the coastal areas given the risk from sea level rise. The most vulnerable people in project area are the poor and ethnic minority people who expose to increasing climate risks and have limited adaptive capacity. In addition to climate stresses, the vulnerability of local communities is also determined by other social processes such as the poverty, inequality, unsustainable use of natural resources, poor infrastructure and pandemic such as Covid 19.

However, local communities are also recognized as active actors of many ecosystems and contribute to enhancing the resiliency of those ecosystems. They draw on indigenous knowledge as well as new technologies to find solutions which could help them to cope with the changing climate. They are often the pioneers in devising and innovating adaptation solutions out of the situational needs as well as through the use of in-built indigenous and local knowledge systems (Son and Kingsbury, 2020). Capacity gaps exist at the local level that prevent fully capitalizing on the potential to innovate and lead appropriate adaptation actions in a sustainable manner. Thus, further work is needed to build local capacity and empirical evidence to move from information gathering to knowledge building.

2. Nature-based solution principles and standards

The design and assessment of NbS practices in the project area follow the NbS principles and standards developed by the IUCN (Figure 1). IUCN has developed a Global Standard for NbS that support both the public and private sectors to reliably scale-up NbS to accelerate its transition to a low carbon future and to assist in the design, implementation, and verification of NbS actions (IUCN, 2020). The IUCN Global Standard for NbS is an assessment tool that consists of eight criteria and 28 indicators, which address the pillars of sustainable development and project management. The document instructs users on how to conduct a selfassessment to (1) Design new NbS; (2) Upscale pilots by identifying gaps and; (3) Verify past projects and future proposals. The output is a percentage match compared against good practices, with suggestions to identify areas for further work and adherence to the IUCN Standard for NbS (IUCN, 2020).

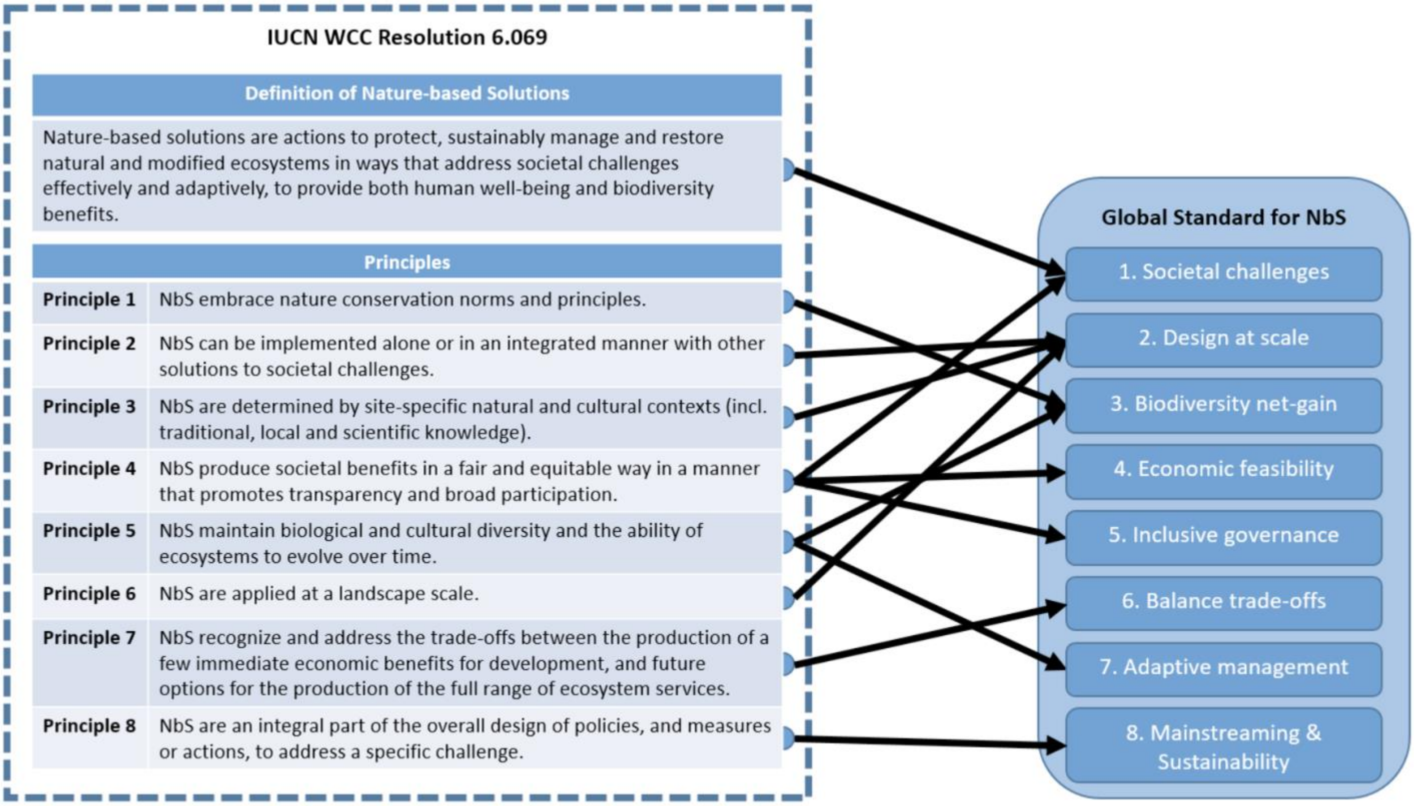

Figure 1. Link between the NbS principles and the NbS Standard Criteria

(Source: IUCN, 2020)

The piloting and testing NbS initiatives in different communities are used to prove the effectiveness and usefulness of ecosystem-based climate change resilient livelihoods. The piloting of NbS interventions follow five guiding principles that could enhance the possibility of successful implementation which are place-specificity, evidence base, integration, equity, and transdisciplinarity (Albert et al., 2021) (Figure 2). In this project, NbS principles and practices follow IUCN global standard for NbS (IUCN, 2020). Under this standard, agroecological farming practices including permanent agriculture, organic farming practices, climate-smart agriculture practices such as mulching or using organic soil amendments, agroforestry, conservation agriculture, or syntropic food forest are considered NbS practices.

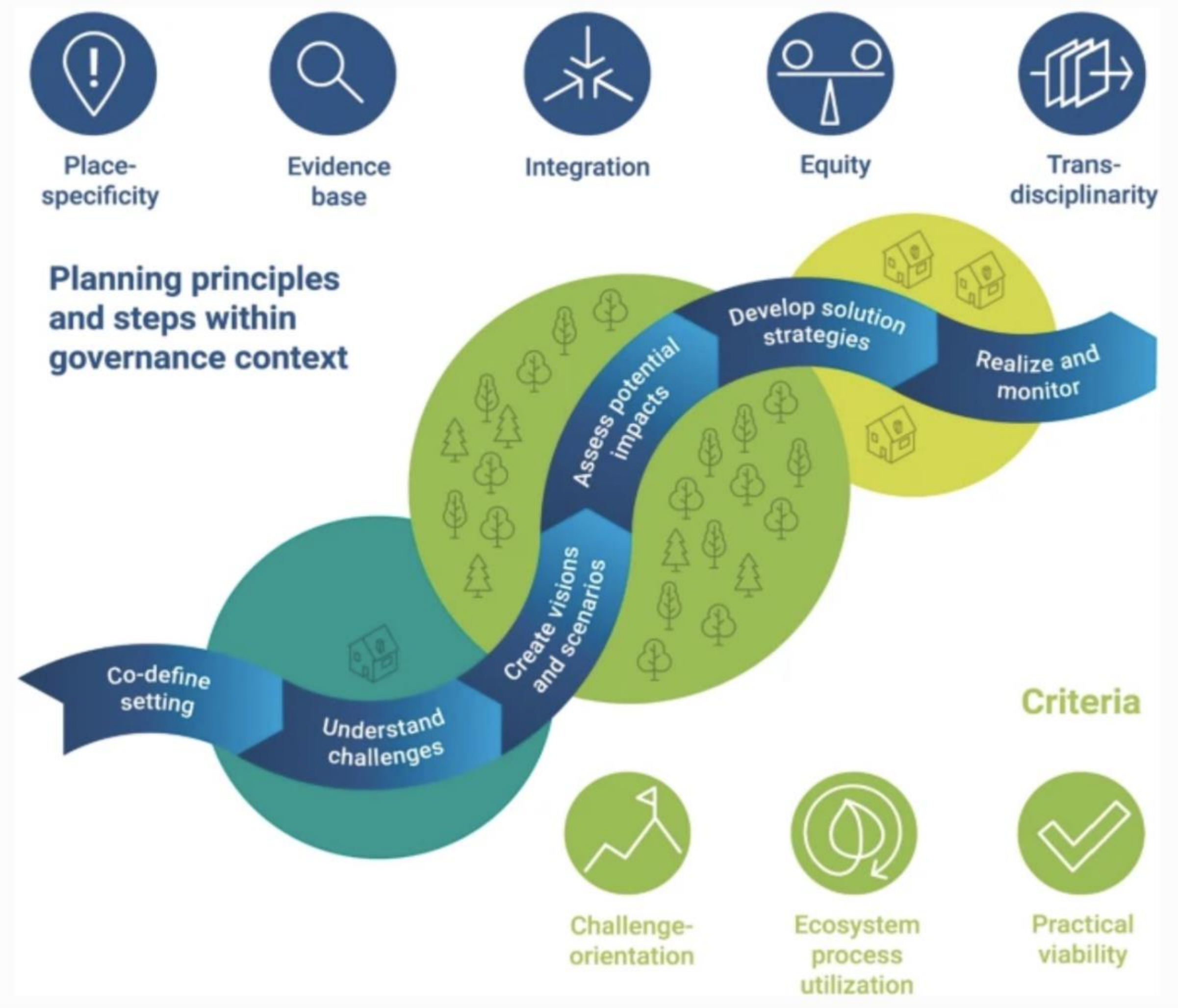

Figure 2. Conceptual framework of principles and steps for planning NbS
(Source: Albert et al., 2021)

The research will be performed in the field to explore the change in ecosystem services and the trade-offs associated with nature-based solutions. The application of modeling software InVEST is used to quantify associated trade-offs and explore how changes in ecosystems may alter other benefits to stakeholders. InVEST (i.e., Integrated Valuation of Ecosystem Services and Tradeoffs) is a suite of free, open-source, software models used to cartographically depict (e.g., through visualization) and value the goods and services from nature that sustain and fulfill human life. This modeling suite is used for mapping and valuing ecosystem services, in effect supporting the quantification of tradeoffs associated with alternative management choices and exploring how changes in ecosystems could lead to other benefits.

3. **Designing and piloting NbS practices**

Agri-food systems depend on well-functioning ecosystems and the services they provide, such as the provision of healthy and fertile soils, water, pollination, climate regulation and natural pest management, as well as buffering of extreme events. Therefore, it is important to increase the ability of farmers and resource managers to identify and apply NbS approaches and practices, especially in agriculture. The objective is to increase the capacity of farmers, government officials on understanding and applying NbS to develop and implement more sustainable approaches that contribute directly to the maintenance of ecosystems, improvement of food security, and the betterment of livelihoods for climate resilience. In this project, agroecological practices (FAO, 2018) have been applied to rebuild soil organic matter, improves soil fertility and increases the soil biodiversity for environmental and economic benefits. In addition, mainstreaming agroecological practices on arable land could help soil carbon sequestration. This requires fundamental change from the current farming practices which rely heavily on high inputs and damages soil biology, towards agroecological farming practices which restore natural nutrient cycling such as constant soil cover, intercropping and cover cropping; long and diverse crop rotations; organic amendments (von Braun, 2018; FAO, 2021). Key activities focused on nature-based and climate-resilient farming techniques for smallholders within the crop-livestock systems to build climate change resilience (FAO, 2018).

Syntropic food forest

Unsustainable practices of industrialized food systems contribute to climate change, natural resource depletion and negative impacts on health. By contrast, syntropic food forests have the potential to provide healthy food, sustainable livelihoods, quality environmental services, and spaces for education purposes, recreation and community activities (Albrecht & Wiek, 2021a). Food forests are multifunctional agroforestry systems made of several plant layers of varying heights, including trees, shrubs, and groundcover plants (Albrecht & Wiek, 2021b). In project area, two food forest models have been developed for research, piloting and demonstration purposes.

Syntropic food forest is a nature based solution to food security and climate change resilience. In the late 20th century, alternative agriculture known as syntropic agriculture or food forest or successional agroforestry which mimics nature in food production was developed by Ernst Götsch. Syntropic farming adopts basic principles of carbon storage, microclimate regulation, biodiversity improvement, and creates livelihood opportunities (Albrecht & Wiek, 2021). In Brazil, syntropic farming systems developed as a biodiverse multistrata design and management approach (Götsch, 1992) with ecological restoration potential and high yield (Young, 2017). Unlike most modern agricultural systems that rely heavily on fossil fuels, herbicides, pesticides and fertilizers, the syntropic forest is a nature-based solution which is low-maintenance, helps to regenerate a natural ecosystem through combining forest trees with fruit, nut trees, shrubs, herbs and perennials in different layers. This combination creates a closed circulatory system, which does not need to add nutrients from the outside. Syntropic food forests could significantly address these challenges in various local contexts. The majority of food forests perform well on social-cultural and environmental criteria by building capacity, providing quality food, enhancing biodiversity, and regenerating soil fertility. However, the practice and application of food forests are still very limited. Therefore, it is essential to implement measures to promote the development of syntropic food forest, especially in the Mountainous Region of Vietnam where majority of population are ethnic minority people. Andrade et al. (2020) argued that syntropic agriculture is scalable. It could achieve productivity targets, while promoting succession and regeneration of native ecosystems.

Circular agriculture

Circular agriculture is an agricultural management concept that promotes the reuse of all resources that can be used by the production system itself **(**Velasco-Munoz et al. 2021). In circular agriculture, all steps of the food production from growing, harvesting, processing, transporting, marketing, consuming and disposing food are designed to promote sustainable development. Circular agriculture is not a new concept and was widely practiced by local and indigenous communities around the world. However, it has been pushed aside by modern farming technologies which base on monoculture and intensive farming practices. Circular agriculture with more diverse production systems is associated with healthy ecosystems. The integration of mixed crop-livestock and organic farming and agroforestry, is a key element of a circular agriculture model that aims to use natural resources more efficiently (ElJanati et al., 2021 Bianchi et al., 2020). Circular agriculture is also more labour intensive compared to modern farming, which offers a solution to stimulate local economy (Velenturf and Purnell, 2021). Thus, the adoption of circular agriculture can make an important contribution to poverty reduction and food security and create employment opportunities for local communities (Velasco-Munoz et al., 2021). The transition to circular agriculture requires more emphasis on the promotion of smallholder farming, centred in organic, mixed-farming and agroforestry practices. In the case study area, the project has supported communities to design and innovative practices which combine their local knowledge and scientific knowledge.

Mixed farming

NbS practices are closely connected with the concept of mixed farming. Mixed farming implies a switch away from mono-crop agriculture to growing a set of interdependent crops where the cultivation of one creates favourable conditions for others. Crop diversity is seen as an effective strategy to improve soil fertility, enhance resilience of the production systems. Mixed farming that combines crop cultivation with animal husbandry offers additional opportunities to strengthen circular agriculture development. Use of local feed and manure instead of imports and chemical fertilizers can also contribute to the reduction of CO_2 emissions in agriculture (Ryschawy et al., 2012). In the project area, in 2022 the project supports 20 households to adopt mixed farming practices under food forest and agroforestry models. Particularly, farmers have been learned to intercrop maize and bean, growing red pea nuts in the one-crop rice land to adapt to drought and lack of water in the dry season. They also practice rice and duck farming systems. Experts from the Thai Nguyen University of Agriculture and Forestry guided farmers to mix different crops such as shade tolerant plants growing in the home gardens.

Organic agriculture

Organic agriculture is another approach of NbS to climate change resilience which aims to eliminate the dependence on chemical fertilizers and pesticides. Agricultural production has major impacts on the environment, as a leading contributor to greenhouse gas emissions. Climate change is also expected to have significant adverse effects on agriculture (FAO, 2017). Because agriculture and food systems contribute to climate change, biodiversity loss and land degradation at the same time as being affected by them, it is imperative to transform food systems so that they become less damaging to the environment and more resilient to climate change. Organic agriculture reduces the impacts of the industry and continue to feed the growing global population. Organic farming could provide more rural employment and development opportunities because it typically more labour intensive. It has been argued that pesticide-free organic farming can promote the participation of women in agriculture production (Meemken and Qaim, 2018; Reganold et al., 2016). In the project area, more than 10 hectares of rice is organically cultivated under the Participatory Guarantee System of IFOAM. All households practice organic farming to support nature-based tourism which in turn provide them with livelihood opportunities. Local communities support the rice organic production as it restores the soil and water resources. They realise the significant improvement in the local environment where locusts come back in the rice field; shrimps come back in the streams. They can see many tadpoles in the rice field which does not exist before when farmers use pesticide. Organic rice production is planned in partnership with businesses which play very important role in facilitating transforming agricultural production.

Agroforestry

Agroforestry, which is tree planting in combination with crops or pastures, is an integral part of NbS approach. It is well known that tree planting can help restore biodiversity in agricultural landscapes, while increasing soil fertility by enhancing the accumulation of organic matter from decaying nature (Toensmeier, 2017). Agroforestry can also make agriculture more circular by reducing the dependency on chemical fertilizers and pesticides. As agroforestry reduces the need for inputs, it is more accessible for female farmers who often have less financial resources and limited access to credit, which can provide new opportunities for women's empowerment in the rural economy. In addition, the collection of firewood and fodder is primarily the task of women in rural areas around the world. Agroforestry makes these products available on the farm and thus reduces the time spent by women on such activities, which can contribute to their empowerment (FAO, 2019; Nyberg et al., 2020). 59 households in Buot village of Chieng Yen commune are supported to practice agroforestry prioritizing local varieties and animal breeds for market preferences and biodiversity conservation purposes. All farmers in the project area are practicing agroforestry in different forms. The project only provides training for local people to make use of local resources and improve the resource use. For example, farmers are trained to intercrop right species (tolerant crops, nitrogen fixing crops, medicinal plants) in the home gardens. For forest tree planting, project supports farmers to grow local species, multi-purpose trees such as Canarium, Cinamomum to maximize the benefits of the agro-forestry systems.

Vermicomposting

Vermicomposting is the process of turning organic matters into worm castings. The worm castings are very important to the fertility of the soil. The castings contain high amounts of nitrogen, potassium, phosphorus, calcium, and magnesium. The content of the earthworm castings, along with the natural tillage by the worms burrowing action, enhances the permeability of water in the soil. Worm castings can hold close to nine times their weight in water (Munroe, 2023; Sharma, K. and Garg, V.K., 2019). In the project area, vermicomposting is practiced to support organic agriculture, pig raising, and fish raising. At the start of project, 10 households participated in vermicomposting training and piloting. Today, more than 20 households practiced it in different scales, some households raised worm in 4-5 square meters to feed the chickens while some practiced in bigger area of more than 10 square meters. Businesses also co-invested in this farming practice. They expect to get products for use in their farms as well as selling to other pig farms nearby. Farmers reported that by applying circular agriculture model (vermicomposting, animal raising, growing crops) reduced at least 35% cost of animal raising while increase at least 15% revenue from selling products thanks to higher quality as a result of using vermicomposting for animal raising.

4. Lessons learned for scaling up NbS practices

The scale-up of NbS practices benefits from the appreciation of local and indigenous knowledge. NbS practices promoted in this project are not new to local communities. Local communities in the mountainous region of Vietnam in general have adopted many NbS practices to adapt to local environment. For example, local communities in project area have practiced agroforestry for years. Therefore, their knowledge and experience about practicing NbS are very relevant and important to be included in the scale-up plan. In this project, we value the local knowledge through their voices and ideas and this gains acceptance from the communities.

This project empowers of farmers, officials and policymakers through capacity building and up-scale. The promotion and scale up of NbS practices are often hindered by the lack of both technical knowledge and market access for produce. As discussed by (Nelson et al., 2020), NbS confront diverse challenges which include the lack of awareness; knowledge gaps of applications and effectiveness; limited understanding of costs and benefits; diverse stakeholder values and perspectives; and limited policy and economic instruments. Therefore, capacity building for relevant stakeholders, especially local communities is essential. Farmers need to be given the opportunity to experiment with the new practices with technical support. Model farmers have played an important role in encouraging and convincing their fellow farmers to apply and scale-up.

The Market Systems Development approach is very important for the sustainability and scale up of NbS practices. Cooperating with businesses to develop markets for nature-based products to sustain the NbS to agricultural production is essential to sustaining the nature-based solutions proposed in this project. Private sector participation incentivizes farmers and local authorities to pilot and up-scale NbS practices for sale at higher prices. This is to ensure the sustainability of nature-based production with the participation of the private sector. The project works with authorities and farmers to promote nature-based solutions, products, and other ecosystem services. Social enterprises working to support the empowerment of women, livelihood improvement, and agricultural businesses, has collaborated to pilot the selling of given products and services to sustain the nature-based solutions proposed in this project.

5. Conclusions

Agriculture and food systems contribute to climate change, biodiversity loss and land degradation at the same time as being affected by them. Therefore, it is important to transform food systems so that they become less damaging to the environment and more resilient to global shocks. NbS approach offers the potential to achieve this. NbS practices such as food forest, organic agriculture, circular agriculture (vermicomposting, agroforestry, mixed farming) has been applied in the project area to rebuild soil organic matter, improves soil fertility and increases soil organism biodiversity, creating many environmental and economic benefits to farmers. The promotion of NbS principles and practices could transform agricultural production in the way that can unlock local indigenous resources to develop local economy where local people can earn livelihoods from their land sustainably.

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