



**Food and Agriculture
Organization of the
United Nations**

National Agricultural Innovation System Assessment in Lao PDR

Consolidated report

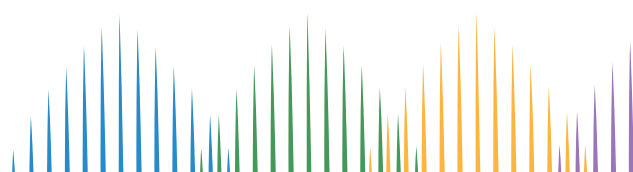
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The TAP-AIS project

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Abbreviations and Acronyms

AI	Agricultural Innovation
AIS	Agricultural Innovation Systems
CD	Capacity Development
CDAIS	Capacity Development for Agricultural Innovation Systems Project
CNA	Capacity Needs Assessment
CSO	Civil Society Organisation
DAFO	District Agriculture and Forestry Office
DALaM	Department of Agricultural Land Management
DeSIRA	Developing capacities in agricultural innovation systems: Scaling up the Tropical Agriculture Platform (TAP) Framework)
DOPF	Department of Planning and Financial
DoPLA	Department of Policy and Legal Affairs
DPs	Development Partners
DRDC	Department of Rural Development and Cooperative
DTEAP	Department of Technical Extension and Agro-Processing
EU	European Union
FA	Faculty of Agriculture
FAO	Food and Agriculture Organization of the United Nations
FEBA	Faculty of Economic and Business Administration
GSAF	Green and Sustainable Agriculture Framework in Lao PDR
LFN	Lao Farmer Network
LNCCI	Lao National Chamber of Commerce and Industry
MAF	Ministry of Agriculture and forestry
MOF	Ministry of Finance
MOIC	Ministry of Industry and Commerce
MOST	Ministry of Science and Technology
MPI	Ministry of Planning and Investment
NAFRI	National Agriculture and Forestry Research Institute
NGGS	National Green Growth Strategy
NGO	Non-Government Organization
NUoL	National University of Laos
OA	Organic Agriculture
PAFO	Provincial Agriculture and Forestry Office
TAP	Tropical Agriculture Platform
TMAC	ThongMang Agricultural Cooperative

Key Definitions

Agriculture Innovation (AI): The process whereby individuals or organizations bring existing or new products, processes and forms of organization into social and economic use to increase effectiveness, competitiveness, resilience to shocks or environmental sustainability, thereby contributing to food and nutritional security, economic development and sustainable natural resource management (TAP, 2016).

Agriculture Innovation System (AIS): A network of actors or organizations, and individuals, together with supporting institutions and policies in the agricultural and related sectors, that brings existing or new products, processes, and forms of organization into social and economic use. Policies and institutions (formal and informal) shape the way that these actors interact, generate, share and use knowledge, as well as jointly learn (TAP, 2016).

Capacity Development (CD): The process whereby people, organizations and society as a whole unleash, strengthen, create, adapt and maintain capacity over time (TAP, 2016).

Functional Capacities (FC): Functional capacity is largely defined in the context of a sector or in a thematic context. Functional capacities include capacities relevant to individual and organizational effectiveness, such as management, leadership, budgeting, marketing, information and communication technology and strategic planning, in addition to soft skills such as communication and advocacy (FAO, 2012)

Organizational Capacity (OC): The organization's potential to perform –its ability to successfully apply its skills and resources toward the accomplishments of its goals and the satisfaction of its stakeholders' expectations (ECDPM, 2003).

Enabling Environment: The context in which individuals and organizations put their competencies and capabilities into actions (TAP, 2016).

Executive Summary

The government of Lao PDR has been promoting green and sustainable agriculture which should continue to evolve, refocusing on strengthening climate science and innovation to provide the population with nutritious and safe food more sustainably. However, in the absence of a common research agenda, decisions on which agriculture innovations are realized and through which methods are made with insufficient information and understanding on how agriculture innovation affects social relations, the enabling environment, and food production. Mostly, agriculture innovations are considered from the standpoint of economic efficiency, particularly related to the creation of incomes and jobs for the country. However, the wider impact of agricultural innovation and the complex process of realizing innovation has yet to be comprehensively explored.

Therefore, the TAP-AIS project (GCP/GLO/017/EC) on strengthening the agricultural innovation system in Lao PDR, implemented by National Agriculture and Forestry Research Institute (NAFRI) and the Food and Agriculture Organization of the United Nations (FAO) and funded by European Union, carried out a broad assessment of the national Agriculture Innovation System (AIS) to develop a comprehensive understanding of the current status of the national AIS in Lao PDR and identify the main entry points for strengthening capacity of key organizations and stakeholders of the national AIS. The AIS assessment was carried out in close partnership with the Ministry of Agriculture and Forestry (MAF)'s key departments: the National Agriculture and Forestry Research Institute (NAFRI), the Department of Policy and Legal Affairs (DOPLA), the Department of Technical Extension and Agro-Processing (DTEAP) and the Department of Agricultural Land Management (DALaM) as well as the Ministry of Industry and Commerce (MOIC), the Ministry of Science and Technology (MOST), the National University of Laos (NUoL), Lao Farmer Network (LFN) and CLICK (a CSO which serves as a secretariat for LFN) and close consultation with others key national stakeholders.

In the Lao context, agricultural innovation has the potential to improve livelihoods of farmers and rural people, improve food and nutrition security, and allow for sustainable management of natural resources. An *agricultural innovation system* is described as a network of individuals, organizations and enterprises, with supporting institutions and policies in agricultural and related sectors that brings together existing or new products, processes and forms of organization to create additional socio-economic value. While farmers are the ultimate innovators and many innovations start locally, they require conducive policy, institutional support and facilitated partnership with different actors in order to scaled up and out sustainably. Farmers are willing and able to innovate through adoption of improved practices, building facilities and adapting technologies such as crops production, livestock breeding, seed varieties, and water management for crops and aquatic production if they are supported by the government and development partners.

The AIS Assessment uses a systems approach to look at the AIS with its multi-

stakeholder, multifaceted and multi-purpose interactions, interlinked partnerships, institutions, and functions. A comprehensive methodology was used to analyze the AIS functions, structures, enabling environment, and system capacities. In addition, two case studies - Thong Mang Agricultural Cooperative (TMAC) and the Lao Farmer Network (LFN) were used to understand innovation processes in the Lao agriculture sector and provided a framework to explore partnerships and processes among the government, development partners, private sector actors, farmers and other operators in the agricultural sector. For example, how actors involved in review, analysis, formulation and implementation of policies, strategies, programmes, business plans, and projects relate to the development of commodities and value-added agri-business ventures. Through the case studies on TMAC and LFN, the importance of support from both government and development partners, participation of stakeholders in agriculture development process, and strengthening capacities to innovate were highlighted as critical for their achievement. This AIS Assessment may also be useful in illuminating capacity gaps, the role of innovative value-addition initiatives, and activities in the overall development of the agricultural sector and the national economy in Lao PDR.

The main results and key messages of the assessment acknowledge the following.

- Lao agriculture innovation partnerships have been established in different forms but need more support from development projects and local authorities for better coordination and strengthening capacity to develop new services and products. Overall, there is a need to encourage, incentivize, and support innovation processes.
- There are different understandings and definitions of “innovation” and innovation systems. The topic of innovation should be addressed at all levels. Innovations are happening across the country but have not yet been documented for scaling out. The development of a database for innovations in Lao PDR is important for government agencies, farmers, the private sector and development partners in order to make evidence-based policy decisions to encourage and support agriculture innovation.
- The sector has limited functional capacity to facilitate innovation processes effectively based on proper information and analysis especially with regard to the economic and market situation of the agriculture, forestry and rural sector.
- The sector faces difficulties in developing and adopting policies and enacting laws and regulations to address some of the fundamental constraints in the sector. In addition, the sector is facing serious constraints in the development of a consolidated and cohesive long-term vision and strategy for the different subsectors.
- There are seven key functions (information exchange, advisory services, demand articulation, networking, capacity development, resource mobilization, and policy), which have been identified as important in supporting innovation processes and enabling innovation. These functions are performed by different actors involved in the public and private sectors, CSOs, NGOs, academia and research.

The recommendations based on the assessment results include: (1) making more effort

to encourage and support agriculture innovation to make progress in a competitive environment; (2) increasing investment or funding in research and extension to underpin agricultural innovation; (3) enhancing effective management and use of water as well as helping farmers access water for production, particularly for organic vegetables; (4) developing necessary and related capacity with a focus on soft skills to unleash innovations. It is important to develop a plan to implement the recommendations as well as mechanisms to follow up and monitor how these recommendations are considered and addressed by policy makers.

Innovation is the central driving force to achieving food security and sustainable agricultural development, transforming food systems and creating jobs and incomes to lift family farmers out of poverty. There are opportunities to enhance farmers' capacity to innovate by providing them with information and guidance on climate-smart and sustainable practices to increase productivity in an environmentally and socially sustainable manner. These efforts should include strengthening farmers' resilience to climate change, and reducing agriculture's contribution to climate change by cutting greenhouse gas emissions and increasing carbon storage on farmland. Farmers need innovative practices, innovative ways of working and getting organized, and getting information such as better weather forecasting, early warning systems and agriculture risk insurance. The critical issue is to strengthen and empower producers to take charge of their farming to become more profitable, sustainable and resilient agribusinesses that contribute to the rural economy and the sustainable development goals.

1. Introduction

This document presents findings and results from agricultural innovation system (AIS) assessment in Lao PDR. It was prepared while implementing the Developing Capacities in Agricultural Innovation Systems: Scaling up Tropical Agriculture Platform Framework (TAP-AIS). The assessment comprised desk reviews and interviews with key stakeholders to provide an opportunity to reflect on their organization's strengths, identify gaps, and propose capacity building needs for ongoing improvement efforts.

Innovation is the key driving force which will transform food systems, help family farmers get out of poverty, and help the world achieve food security, sustainable agriculture, and the Sustainable Development Goals (SDGs). Innovation is more than technology with a clear understanding that innovations cannot simply be transferred from one place to another. Innovation processes need to be locally owned and respond to the needs and conditions of local stakeholders and to agro-ecosystems. Therefore, innovation processes need to be supported through development and implementation of enabling policies and mechanism that allow intra-sectoral and inter-sectoral coordination and create a favorable environment to unlock innovation potential.

In Lao PDR, a well-functioning country AIS would above all encourage better coordination between national organizations and the private sector that can help local value chain stakeholders develop agricultural innovations.

The objective of a national agricultural innovation supporting platform is to help national organizations work together to make the AIS more efficient and sustainable by better meeting the demands of farmers, agri-business and consumers. Its first challenge is to consider the functional and technical dimensions of capacity development for individuals and organizations to create an enabling environment.

The AIS assessment was designed to support and inform decision-makers on investments and strategizing on AIS to develop innovation capacities and trigger innovation processes. It will contribute to promoting climate-relevant, productive and sustainable transformation of agriculture and food systems through developing capacities to innovate at the national level. Through participatory methods, the assessment results give decision-makers an understanding of the strengths and weaknesses and the entry points to improve the AIS, to design innovation capacity and development strategies, and to plan investments.

2. Background

From 2015-2019, the National Agriculture and Forestry Research Institute (NAFRI), the Food and Agriculture Organization of the United Nations (FAO) and Agrinatura implemented the European Union (EU)-funded Capacity Development for Agricultural

Innovation Systems (CDAIS) project. Building on the successful implementation of the CDAIS project, and to continue strengthening national AIS, Lao PDR was selected as one of the nine countries included in the new “Developing Capacity in Agriculture Innovation Systems: Scaling up the Tropical Agriculture Platform Framework” (TAP-AIS) project. TAP-AIS project is not the phase 2 of ex-CDAIS. Even though, both projects (current TAP-AIS and CDAIS) are funded by the EU to support the Tropical Agriculture Platform (TAP), a G20 initiative.

The TAP-AIS project is implemented in nine countries with aims to strengthen capacities to innovate for climate resilient agriculture and food systems. The project is part of a larger EU Initiative “Development Smart Innovation through Research in Agriculture (DeSIRA): Towards climate-relevant Agricultural and Knowledge Innovation Systems”. The project supports the implementation of the Tropical Agriculture Platform (TAP) Action Plan 2018-2021, and will deliver four outputs:

- a. TAP governance strengthened and TAP Secretariat operational;
- b. Countries’ AIS are assessed, capacity development needs are identified and AIS strengthened;
- c. TAP tools and approaches are integrated into African Comprehensive Africa Agriculture Development Programme ex-Pillar IV organizations, and in regional research and extension organizations in Asia-Pacific, and Latin America and the Caribbean; and
- d. Increased awareness and knowledge on using the TAP Common Framework on capacity development for agricultural innovation systems through information and communication platforms.

3. Objectives and priorities

The overall objectives of the assessment were to develop an understanding of AIS and how it functions and supports climate-relevant transformation of agriculture and food systems, identify major bottlenecks and identify entry points for strengthening AIS in Lao PDR, to inform policy and decision makers on AIS’s performance, and make recommendations for its improvement.

There were five specific objectives:

1. Identify functions and support necessary for AIS
2. Develop an understanding of AIS and how identified functions and support are connected
3. Identify major constraints and entry points for strengthening AIS
4. Inform policy and decision makers on performance of AIS and make recommendations for improvement
5. Strengthen capacity of stakeholders (government staff, NGOs, academia) through a learning-by-doing approach along the AIS assessment process

The assessment was expected to provide contextualized information and evidence on the supportive functions of the AIS, on available resources and infrastructure, and on the capacity of actors to innovate which, in turn, provides entry points for strengthening the overall agri-food system. By communicating an AIS perspective, the action-oriented assessment process itself is a capacity development opportunity for a range of stakeholders, policy makers included.

4. Agricultural innovation in the national context

4.1 National development context

Due to rapid regional economic growth and accelerated urbanization in Laos and neighboring countries, the demand from high income consumers has increased for traditional and commercial agriculture products. This has made agricultural investment strategically important and this investment is rapidly expanding. Investors are mostly regional multinational agribusiness companies with both agricultural and non-agricultural investments throughout the country. Investors include smaller companies and private investors promoting cash crops through contract farming arrangements or through renting agricultural land from farmers on short-term leases or long-term land concessions. The rising incomes of the growing middle classes in the region and within the country is also creating increased demand for clean and safe food products. Regional and national markets for high quality and safe tropical vegetables and herbs offer good commercial prospects for farmers with better livelihoods. The country is less densely populated than most of its neighbors and enjoys a relatively large area for cultivation. By some measures, agro-ecological conditions in Lao PDR are among the most favorable in Asia. But the agriculture sector is constrained by limited investment, both public and private. Input and output markets remain fragmented and underdeveloped with limited access to credit.

The 9th National Social and Economic Development Plan (NSED) 2021-2025 focuses on socio-economic development based on the existing potentials in order to help the country effectively outgrow the Least Developing Country (LDC)'s criteria through quality, inclusive and green growth and achieve the Sustainable development Goals (SDGs) by 2030. The 9th NSED realizes the importance of ensuring a more inclusive and sustainable growth for the future and helping the country to achieve the targets set under this plan. The key drivers are, i) the young population, ii) rich natural resources and iii) strategic location of Lao PDR and (iv) the booming Asian economies, in particular, China, and the Association of Southeast Asian Nations (ASEAN) countries. Lao PDR has a geographical advantage with a well performing economy that the government can leverage to enjoy robust development. The under aged 25 population accounts for 60 percent of the total population and can contribute significantly to the country's development. In addition, Lao PDR has enjoyed stable economic growth over the past

years and the country is blessed with tremendous potential for clean energy, fertile soil for agriculture, and rich natural resources offering a foundation for growth and employment.

The importance of good nutrition raises the demand for nutritious food options, which in turn is essential for driving the development of a strong, coherent and diverse food production system providing improved food security, nutrition and livelihoods. The goals set by the government were targeted at maximization of production and food security, the situation has drastically changed with a focus on moving towards nutritional security rather than sufficient food production (largely accomplished), and the focus on the total amount of calories has taken a lesser role to concerns over food safety, health, and child development. This is reflected in the 'commercialization' and progressive move to modernize the agricultural sector through focusing on key commodities and livestock and developing associated value chains. This has been the foundation of the agricultural sector and there has been a realization that Lao agriculture is restricted in its ability to compete in the market segment of bulk products against larger neighbors (e.g. China, Viet Nam, and Thailand).

The country still faces challenges in the agricultural sector, including problems related to climate change, sustainable management of natural resources, the spread of plant pests and animal diseases, concerns about food safety, and inadequate food marketing systems. The agricultural sector will remain critical for meeting the country's aspirations related to poverty reduction and inclusive growth. The growth of the agricultural sector during 2016-2020 was 2.1 percent, contributing about 16.6 percent of the national Gross Domestic Product (GDP). It is also the major employment hub of the country, accounting for about 70 percent of the labour force of the country (MAF, 2015). For the near future, agriculture will remain the primary source of income and livelihoods for most people many of whom remain at a subsistence level. Reducing poverty and more widely sharing the gains of development requires measures to help farmers and producers increase productivity, become more commercially oriented, and better connected to markets. The 9th NSEDP 2020–2025 defines overall objectives, outcomes, targets, and outputs to be realized at the end of the 9th NSEDP implementation. For the agriculture and rural development sector, the directions for the sector are: i) quality, green growth, ii) sustainability; and iv) economic growth.

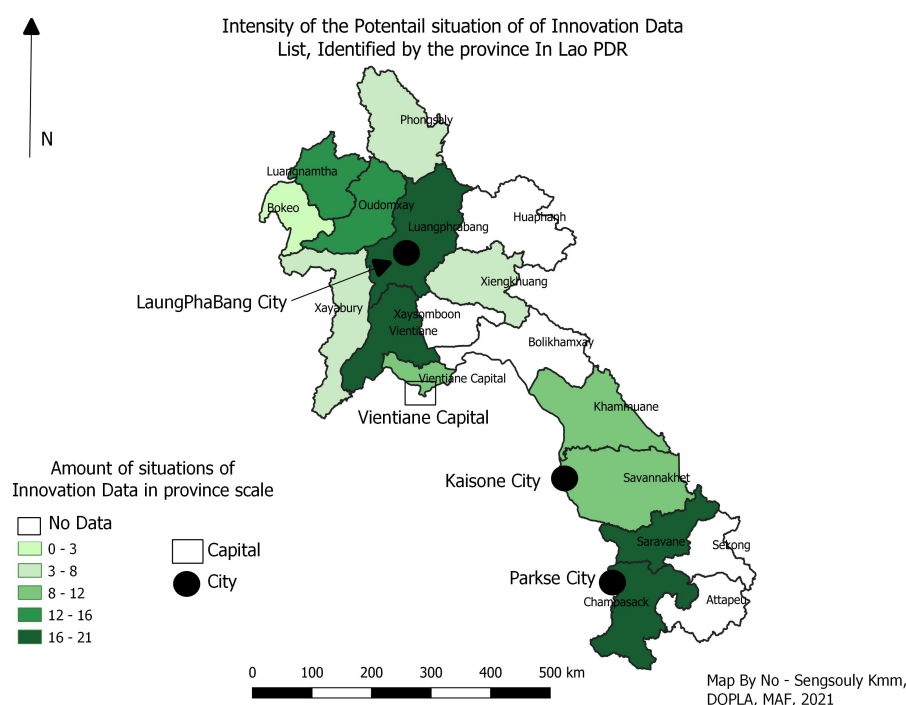
Besides fiscal constraints, climate change, and natural disasters causing damage and losses to people's lives and assets in the past two to three years, the COVID-19 pandemic has had adverse impacts on the country's socio-economic development. While COVID-19 has had a direct or indirect impact on the entire nation (primarily through secondary effects), certain districts and provinces, and certain population groups face disproportionate challenges. Vulnerable population groups may include those engaged in daily labour, workers in the informal economy, migrant workers, the elderly, those with pre-existing conditions, and the poor. Lao PDR is experiencing high numbers of returning migrants from Thailand due to the pandemic. The border checkpoints have been closed, especially the border with Thailand, accelerating the rate of nationals returning home before the closures. From 11 March to 15 April 2020,

approximately 78,322 migrants (23,405 women) returned and more are expected to return once the borders with neighboring countries re-open.

Based on lessons learned from the impacts of COVID-19, Lao PDR should define policy options to mitigate mid-term and long-term impacts focusing on recovery of effected areas and restoring the country's socio-economic development to be stronger and more resilient. Implementing the 9th NSEDP requires the promotion of economic diversification in conjunction with strengthening the competitiveness of the business sector by enhancing connectivity across sectors. At the same time, efforts should also be given to strengthening human resource development and social protection systems to be able to cope with future emergencies.

In Laos, agriculture innovation partnerships have been established in different forms (e.g. farmer-to-farmer, farmer-bank, farmers-government-private sector, but they still need more support from development projects and local authorities for coordination and strengthening capacity to develop new services and products. Innovation data (DOPLA, 2019) shows the type and number of stakeholders involved to encourage and support agriculture innovation. To encourage and support agriculture innovation, there are different understandings about and definitions of 'innovation' that should be addressed at all levels. Innovations happen across the country but have not yet been documented for scaling out. Farmers are key stakeholders in initiating agriculture innovation and counted for 34 percent of the total. Farmers are often unable to develop and improve innovation at scale. Innovation support services are not readily available and accessible in rural areas and producers closer to the larger cities such as Savannakhet, Vientiane and Vientiane Capital, are more enabled to innovate. More effort should be made to identify and collect data on innovation in all areas, including technological, social and institutional innovations.

Figure 1: Intensity of the potential situations of innovation in Lao PDR



4.2. Agriculture sector context

The Lao agriculture sector comprises relatively small and inexperienced agribusiness enterprises, large areas of fallow land, and smallholder producers with low productivity; nevertheless, it is a priority sector to attract agribusiness investors for intensive development. Commercial production of the agriculture sector faces competition from international and regional markets, particularly the People's Republic of China (PRC), Thailand, and Vietnam. Although Lao faces trade barriers and challenges, exports of agriculture products increased from USD 5.5 billion in 2016 to USD 9,4 billion in 2020 (MOIC, 2021). Lao agricultural products and natural resources account for most of the total exports, and main export products include crops such as coffee, cassava, banana, animal products such as cattle and non-timber forest products. At the same time, imports of food products (e.g. drinks, sugar, fruits) increased 79 percent within the last five years from USD 3.9 million in 2016 to USD 5 million in 2020.

The government realizes integration with international markets has opened opportunities for the agricultural sector to access new markets and increase export volumes. However, this will bring new challenges, such as increasing competition both in international and domestic markets. The integration process requires the application of recognized standards in production, which are still unfamiliar to most of Lao producers as most are smallholder farmers with limited experience in commercialization.

Based on the MAF Annual Report 2018, paddy production is expected to increase to 4.2 million tons, coffee 137,500 tons, maize 1.2 million tons, sugarcane 2 million tons, and cassava 2.4 million tons. A major portion of rice production is specialty organic and

regular scented rice. Coffee is the most popular crop and is mainly grown in the southern provinces, tea and other cash crops are grown in the northern provinces. Crop diversification will increase with increased growth of agricultural food products including vegetables, beans, sesame, sweet corn, taro-potatoes, fruits, and other crops. MAF has set 2030 targets for total agriculture land zoning areas of 4.5 million hectares, in which the target for rice paddy is 2.0 million hectares, crop production areas of 1.0 million hectares, and fruit tree areas of 0.8 million hectares are targeted (MAF, 2018).

In Lao PDR, climate change projections indicate an increase in average annual temperatures and a decrease in precipitation. While many simulations indicate a shift in the rainy season, they also indicate more frequent and intense extreme weather events, including floods, storm surges, intense rainfall, extreme temperatures, and drought. Traditional agriculture systems, especially in the northern part of Laos, based on slash-and-burn in a mosaic landscape have given way to excavator clearing for mono cropping without fallow periods in a uniform landscape. Agricultural pioneer fronts are still progressing, and at an increasingly rapid pace, in connection with the development of agro-industries and logging enterprises, on increasingly marginal land at the expense of primary forest cover. While these developments have led to short-term productivity gains, they have profoundly changed community-based natural resource management methods and have also led to significant environmental impacts leading to a levelling off or even a drop in yields and a reduction in farmers' resilience. The decrease in forest cover and the low development of agroforestry and agroecological practices result in increased exposure of soils to rainfall, and a reduction in the ecosystem services rendered by these areas: increased runoff and erosion, more frequent occurrence of flash floods, reduced infiltration into the soil and replenishment of water tables, and consequently a reduction in the amount of water available in rivers during the dry season. Although Lao PDR has the highest level of renewable water resources available per unit of agricultural land in Asia, irrigation coverage in the country is low especially in the upland areas where they face water shortage issues for agriculture production.

The impacts of climate change in Lao PDR are already tangible. Climate change issues and disaster impacts are increasing in frequency and create losses such as the heavy floods in 2018. These were severe events that resulted in huge losses from natural and human actions affecting lives, property and the public at a cost of 3 trillion LAK. This resulted in an unprecedented amount of budgeting for emergency response and post disaster recovery. In 2019, from July to September, another severe disaster occurred as a result of a typhoon which resulted in floods covering large areas in the six central and southern provinces. These floods resulted in more than 10,000 people losing their homes and many more who required evacuation to temporally shelter, as well as damages to agricultural land, infrastructure and the natural environment at a cost of 1,300 billion LAK.

The COVID-19 pandemic made both the government and the population realize the value of farmers producing local and healthy food, and the value of becoming more self-reliant by boosting local agricultural production. According to COVID Impact Assessment, a large percentage of the workforce in Laos is employed in the informal

sector, and many work as day labourers (Oxfam, 2021). Unsurprisingly, the lockdown in response to COVID-19 has led to increased unemployment. Almost half (49 percent) the respondents preferred re-migrating rather than staying in Laos, while only a quarter (24 percent) of the respondents preferred to stay and get a job in Laos. On the other perspective, unemployment or workers who returned home could be a solution to fill the workforce gap in the agriculture sector.

4.3. Vision for development

The agriculture sector is a main contributor to Lao PDR's graduation from Least Developed Country status to Middle Income Country status by 2025. Thus, it is important to identify transitional changes as well as new directions that will take the sector on the desired trajectory during the next ten years in which approaches will include:

- greater emphasis on the role of the organised smallholder farmers and value chain entrepreneurs,
- security over production assets including land,
- green and sustainable agriculture,
- integration into domestic, regional and global niche markets, and
- actualization of the government's role in maintaining enabling environments.

The Agriculture Development Strategy (ADS) 2021–2025 is a long-term framework for the development of the agriculture sector. It serves as a reference for orienting MAF decision-makers and development partners working in agriculture and rural development. ADS provides a platform for systematic planning, programming, operationalisation, budget-allocation, coordination, development partner interaction, and monitoring and evaluation of agricultural sector development. Strategic priority areas or pillars constitute those interrelated, well-defined and easy-to-manage parts of the agricultural sector which ADS needs to focus on to have its intended Impacts, achieve its goals and realize its vision. The selection of the three Strategic Priority Areas or Pillars of ADS 2021–2030 was based on a people-centered theory of change management. According to this theory, achievement of the ADS's impact, goals and vision will be made through an interactive process in which farmers, producers, service providers, workers, users and consumers are engaged in three types of relationships and activities: i) Learning, organizing and networking; ii) Accessing, managing and using resources, producing goods and services, and iii) Engaging in competitive economic activities and accessing markets.

Moving toward more sustainable development will involve sufficient production and consumption of acceptable, safe and healthy agricultural products that result in economic growth, poverty reduction, food security and good nutrition and other impacts, including environmental and natural resources. To respond to the need for more green and sustainable agriculture products, the Ministry of Agriculture and Forestry (MAF) is developing the Green and Sustainable Agriculture Framework in Lao PDR (GSAF) to provide strategic elements for the adoption and implementation of

National Green Growth Strategy (NGGS) principles, policies, programmes and practices and activities in the Lao Agriculture Sector. MAF has issued guidelines on Good Agriculture Practices (GAP) to guide farmers and agribusiness. MAF also issued phytosanitary certification, though it is not yet well recognized by importing countries. More efforts are needed to implement the GAP as a basic requirement at the field level and monitoring and evaluation by the responsible government agencies. In parallel and in coordination with the ADS, the GSAF was developed as a policy priority of the Government of Lao PDR and has been articulated in the NGGS and other policy statements. The GSAF elaborates on this policy priority and gives guidance for the development and implementation of green and sustainable agriculture programs. The GSAF includes crops, livestock, fisheries, and non-timber forest products and applies to all participants and stakeholders involved along value chains, including policy actors and researchers. It specifies five features of Green Agriculture: i) Integration of crop-livestock systems; ii) Agro-ecological landscape management; iii) Environmentally sustainable weed and pest control; (iv) Natural and sustainable nutrient inputs; (v) Post-harvest storage and processing facilities.

4.4. Challenges and constraints to innovation

The challenges in food and agriculture production are increasingly complex in terms of feeding the country's growing population due to climate change impacts, degrading natural resources and political economy. Agricultural activities in the country are already experiencing difficulties due to resource constraints and low investment in production improvement. At the same time, floods and drought are causing significant losses to farmers with consequences that are all the more devastating given that the country is characterized by the predominance of small farms and traditional farming systems. In the rice sector, farmers faced floods and droughts in 2018-2020 that reduced their yields by 20 percent.

To strengthen the Agriculture Innovation System, issues and challenges have been identified but they cannot be addressed at the local level without interventions at the national and provincial level. Creativity and innovation is needed due to rising consumer demands, population increase, and climate change impacts on yields. Food supplies are increasingly reliant on technological innovations to optimize and augment production and supply chains. Given our reliance on the agriculture sector, the government will support and foster innovative efforts and facilitate innovation processes for agriculture businesses, both industry actors and farmers. Such support for enabling innovation can only be done by the Government in close partnership and consultation with other relevant actors. Strengthening AIS will be an instrumental component in encouraging farmers to be more innovative, technologically-capable and proactive in seeking solutions when it comes to how they improve agriculture quality and productivity. But it is important to note that to increase impact of technological innovations, it needs to be coupled with organizational, social and institutional innovations.

To help farmers to address and contribute to supporting the AIS as well as addressing climate change adaptation and mitigation, the following challenges must be addressed:

- Most initiatives are donor funded and project driven. These are time bound activities with no sustainable mechanisms for follow up.
- Limited funding to support for the Provincial Agriculture and Forestry Office (PAFO) and the District Agriculture and Forestry Office (DAFO) to provide agricultural advisory services to farmers who are mostly in poor rural areas.
- Weakness in information sharing mechanisms to support farmers to be climate resilient such as improved seeds and breeds.
- Limited use of evidence-based research results.
- Farmers reluctance to change and try new things – they rely on traditional agriculture practices such as slash-and-burn, and mono cropping.
- Low capacity within farm communities for data collection, record keeping, planning, investing in new technologies and tools, participating in discussions, and identifying and analyzing risks to address climate change issues.

5. Overview of the AIS assessment process

5.1. Entry points and focus for the AIS assessment

The agriculture system is made up of different group of actors, interacting within an environment that is shaped by policies, institutions, and regulations. Thus, the AIS assessment process involved different actors and stakeholder groups within AIS to identify priority actions and workable solutions according to the expectations and functions of key AIS actors.

To help in identifying and addressing issues to supporting agriculture innovation in Lao PDR, the AIS Assessment focuses on four steps:

Figure 2: Overview of the AIS Assessment (FAO, 2021)



5.2. Case studies

This assessment emphasizes ways in which the agriculture sector can adapt to promote innovation for improving productivity and profitability of producers using two examples of agriculture innovation. Through consultation processes both informal and formal, two case studies were identified as entry point and examples for the AIS Assessment in Lao PDR based on a success story of innovation by considering different types of innovation processes (institutional, social ways of organization, technical). Two selected case studies are considered for more specific insights into the AIS assessment to get a picture of the agriculture innovation system. The following two case studies are known by the stakeholders involved in the AIS assessment:

- 1) **Lao Farmer Network (LFN):** LFN was formed in 2014 as a main national network of farmers with the aim to facilitate farmers to share ideas, knowledge and resources. The network has 59 Sub-National Farmer Organizations (SNFOs) with a total membership of 4,653 farmers. The LFN is very small taking into account that there are about 1,500 SNFOs at the present. In the agriculture sector, the LFN facilitates

exchange of production techniques and practices among farmers and helps them access information to transform smallholder agriculture from subsistence to sustained profits and income generation and help create a financial buffer against adverse conditions affecting agricultural production. LFN facilitates smallholder farmers to access credit with flexible financing options and reasonable interest rates and meet agriculture traders and consumers. It is noted that most experienced farmers still need to learn new skills to improve their production and may shift from traditional farming methods to a more sustainable farming system. LFN provides training to farmers on modern and new agricultural tools and practices. This includes training farmers on improving soil and different types of farming techniques to keep the ecosystem fit for sustainable use. Initiatives like these that focus on sharing information are key to ensuring farmers in rural areas are prepared to deal with the effects of climate change.

- 2) **Thong Mang Agricultural Cooperative (TMAC):** TMAC is a group of farmers collectively producing organic vegetables. Farmers started producing organic vegetables in family gardens in 2011. But they failed after eight months of producing organic vegetables as they were unable to meet the required quality standards due to poor quality control. The group restarted in 2015 with financial support from the District Agriculture and Forestry Office (DAFO), Xaythany district. The group received support from different development projects including CDAIS. The TMAC was officially established on 29 September 2020 with 44 family members from 5 villages (ThongMang village, Duangboudee village, Nakanthung village, Khoudsambard, and Nakoung village) in Xaythany District, Vientiane Capital. Currently, they now have 2 hectares for individual household gardens and a group cultivation area of 18 hectares. The total production area is 36.4 hectares and 116 greenhouses. TMAC was one of six niches supported by the CDAIS to facilitate innovation partnership in organic productions.

5.3. AIS assessment approach and methodology

The AIS assessment in Lao PDR was conducted using a participatory approach throughout the assessment process to ensure ownership and involvement of relevant national stakeholders. The National AIS Assessment Team was established through a request from NAFRI to departments and ministries to allow their staff to participate in the assessment process and the National AIS Assessment Team was established accordingly. The National AIS Assessment Team was comprised of experts and officers nominated by their agencies such as MAF's key departments (NAFRI, DOPLA, DTEAP, DALaM), the Ministry of Industry and Commerce (MOIC), the Ministry of Science and Technology (MOST), the National University of Laos (NUoL), Lao Farmer Network and CLICK. The AIS Assessment was conducted according to the guidance provided by AIS Assessment Support Team from FAO Rome, Italy.

It was important to ensure that the national Assessment Team on Agriculture Innovation System Assessment has a good level of understanding on the assessment objectives and process and is familiar with the assessment tools. A three-day training

(12–14 January 2021) on AIS assessment was organized to help the National Assessment Team to familiarize themselves with approaches and tools for conducting the assessment in Vangvieng District, Vientiane Province (Annex 1: Agenda). The assessment is a key output of the project. The training was delivered by the FAO Rome team and facilitated by the National AIS Assessment Team Leader. The training was attended by 19 participants from MAF's departments (NAFRI, DOPLA, DTEAP, DALaM, DOPF), related ministries (MOIC, MOST), the National University of Laos, and CLICK, a local CSO. The training focused on approaches and tools for the AIS Assessment and group exercises to apply knowledge and feedback from resource persons on results from group work and exercises.

A review of national policies, particularly agriculture sector policies, was done to identify gaps and areas for improvement at enabling environment level. Official documents including strategies and reports such as National Social and Economic Development, ADS, and development strategy of the crop sector 2025 and vision 2030, from the central, provincial, and district governments and related projects were collected and reviewed to investigate the agriculture innovation system in Lao PDR. Previous research papers were also reviewed to understand the enabling environment and policy support, especially on the two identified case studies. At the same time, key informant interviews, including assessment forms, focused on gathering knowledge, experiences, and opinions from key informants in the agriculture sector such as senior officers and experts. In total, the AIS assessment at the national level obtained information and data from reviewing mandates and functions and interviewing people in 47 organizations and agencies. In addition, 20 key experts were interviewed for capacity gap analysis. At the case study level, 35 farmers were interviewed by using semi-structured interviews for production information including the constraints and opinions to develop and support agriculture innovation.

Below are several limitations to this assessment:

- The samples of key informants were limited, especially at province and district level to the knowledge and network of the data collectors as well as key informants' availability for an interview. Therefore, the interviewees are not representative of the whole AIS system and the agriculture sector in Laos.
- The questions probe the perceptions and opinions of the respondents rather than collecting more objective indicators from those potentially impacted by performance of the AIS. Thus, the bias of the respondents may affect the findings.
- The level of understanding of the capacity gap analysis and questionnaire were low which might affect accuracy of results. More detailed analysis with simpler but more rigorous methodology would be needed.
- Restrictions related to COVID-19 pandemic has limited in person interactions with stakeholder which also influenced the dynamics and findings of the study.

6. Main findings of the assessment

Considering innovation is a central driving force to achieve food security and sustainable agriculture development, it will help in transforming food systems, creating jobs and income to lift family farmers out of poverty. There are opportunities to enhance capacity of farmers through providing information and guidance on sustainable farming practices including climate-smart agriculture to increase productivity in an environmentally and socially sustainable manner. This should include strengthening farmers' resilience to climate change, and reducing agriculture's contribution to climate change and enhancing capacities of key organizations of the AIS to promote proven practice, techniques and tools, such as intercropping systems, agroforestry, conservation agriculture, crop rotation, integrated crop-livestock systems, improved grazing, and improved water resource management. In addition, farmers need to be supported with other services such as better weather forecasting, early warning systems, and agriculture risk insurance in order to take risk and innovate. The critical issue, however, is to put in place support services that help farmers to make decisions on which interventions give the greatest benefits in a timely manner yet are sustainable over the longer term.

6.1. Functional analysis

This functional analysis allows identification of service functions, services and activities supporting the agriculture innovation process which serves as entry points for identifying actors, institutions, cooperation networks, and infrastructure supporting agriculture innovative processes. The assessment identifies the following seven functions as necessary for supporting and facilitating innovation processes by the Agriculture Innovation System in Lao PDR.

Table 1: Key functions identified for AIS in Lao PDR

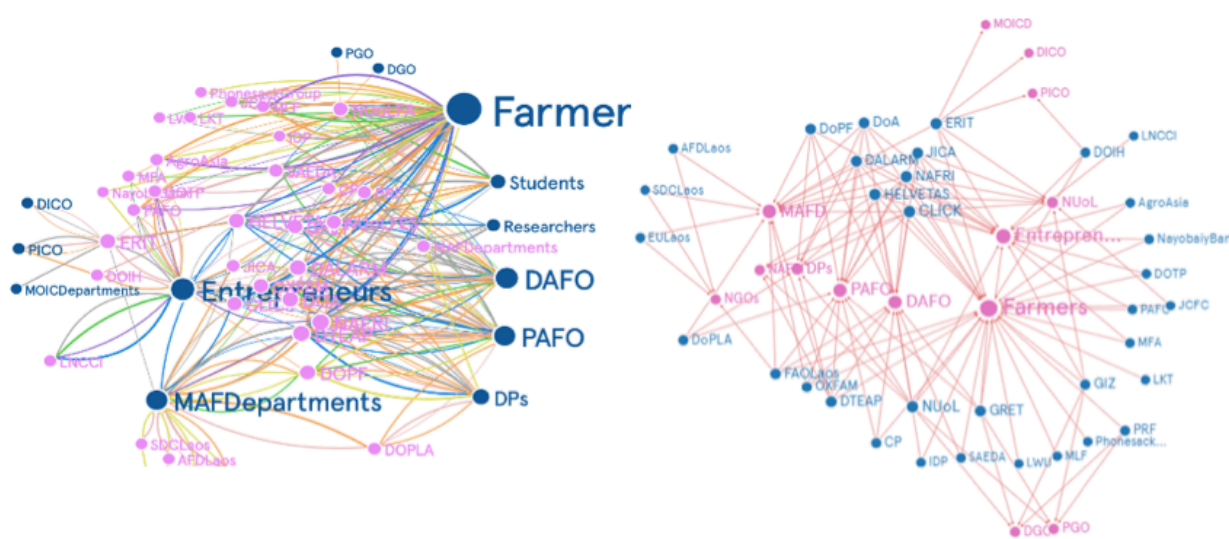
No.	Definition of the function	Description of the function
F1	Awareness, information sharing, advocacy	Preparing, documenting, and promotion of good practices and innovations among farmers and AIS actors (e.g. posters, official documents, data bases, brochures, banners, market and innovation fairs, field visits, policy briefs, guidelines, technical reports, theses, national seminars and dissertations).
F2	Advisory, consultancy, backstopping	Technical support on production related issues through trainings, site visits and advisory, on-the-job training, farmer field schools, group discussions and consultations.
F3	Demand articulation, market linkages and commercialization	Facilitation of access to market, price information, credit, and marketing linkages and deals between traders, contract farming, private, logistical support (storage, transportation) and farmers.
F4	Networking, facilitation, coordination, partnerships among stakeholders	Facilitation and coordination of network, thematic groups, platforms, working groups, and partnerships through policy dialogues, round tables, community engagements, and social networks, and mediation to resolve conflicts and find solutions to problems.
F5	Capacity Development	Strengthening of capacities, skills and abilities of the individuals, organizations and institutions through training, coaching and mentoring of functional and technical skills such as leadership, management, planning and facilitation of collective action, etc.
F6	Provision of resources and inputs	Provision of inputs: fertilizers, seeds, credits, etc., and facilitation of access to inputs for remote and disadvantaged farmers.

F7	Institutional and policy support	Creation of enabling environment for innovation through putting in place incentive mechanism for actors to collaborate effectively, increasing efficiency for registration and certification of businesses and entrepreneurship, support actors to comply with the procedures and process, facilitate partnerships through joint funding and implementation, and establishment organization of multi-stakeholder groups and processes including farmers.
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6.2. Structural analysis

The structural analysis was based on interviews and reviews of 47 organizations including government agencies, Development Partners (DPs), the private sector, producer groups, and Civil Society Organizations (CSOs) at national and provincial level. While seven functions to support innovation were identified, three different functions were frequently performed by organizations interviewed. Within AIS, actors interact and coordinate based on their main functions supporting farmers and entrepreneurs. The networks around agriculture innovation are complex with many actors in the agriculture innovation system, but the functional interactions control the relationships among actors in the system which then contributes to the broader impacts on agriculture production and livelihoods of rural producers. This assessment looked for the relations and processes in agriculture innovation with relevance to production among small-scale farmers in the country.

Figure 3: Net-maps depicting the Agriculture Innovation System in Lao PDR



The results in the maps above show mix of actors interacting and performing different functions to support innovation. The first map on the left shows interactions among all actors in the AIS in relation to the 7 functions identified, which indicates the complexity of the AIS and interactions required. The second map on the right, on other hand shows only primary connections between those who participated in the study. Both maps indicate that for many of the actors in the AIS, their primary connection is farmers. Based on the map, farmers are at the center of the AIS, followed by entrepreneurs and DAFO and PAFO. Among the seven functions, there are fewer actors performing function 3 related to demand articulation and commercialization.

The structural analysis also attempted to identify key actors that are performing specific functions and services in order to target recommendations for capacity development more specifically. The results indicate the main actors performing functions to support innovation as follows:

Function 1: Awareness, information sharing, advocacy - there are different actors (e.g., researchers, academia, MAF's departments) who have a mandate to perform this function. Respondents also expressed lack of availability of market information by farmers and entrepreneurs for the improvement of demand driven agriculture production.

Function 2: Advisory, consultancy, backstopping – while DTEAP, PAFO and DAFO interact closely with farmers and appear as the main actors to provide this function on advisory, consultancy, backstopping on production technical oriented technical support there are others like LFN who also perform this function for its members. However, more effort should be made to provide technical advisory support to improve agriculture productivity to inclusive access to relevant advisory services.

Function 3: Demand articulation, market linkages and commercialization - there are few actors (e.g. AgroAsia, LNCCI, CP) performing this function including contract farming and pricing. Respondents expressed a need for participation of government agencies or a third-party such as district authorities to help protect farmers during negotiations and implementation of contracts.

Function 4: Networking, facilitation, coordination, partnerships among stakeholders – in collaboration with MAP's departments, this function is mainly performed by NGOs and CSOs (e.g. Helvetas, GRET, SEADA). Actors said that networking is an unofficial coordination mechanism. The case study on the Lao Farmer Network indicates a lack of legal identity due to the absence of any regulatory framework on networks of farmers. The farmer network is supported by development projects. Questions were raised on sustainability after the end of project support, especially financing.

Function 5: Capacity development - this function is related to organizational capacity and is mainly provided by NGOs, CSOs and mass organizations such as LWU, FA, SEADA, Oxfam. Respondents expressed a need to strengthen organizational capacity for farmers, government staff (e.g. farmer group establishment and management, financial

management, monitoring and evaluation, and behavior change toward agriculture commercialization).

Function 6: Provision of resources and inputs - donors are key actors providing resources through government agencies and NGOs and CSOs. However, respondents are concerned about how much of the allocated resources are reaching farmers. At the same time, through contract farming arrangements, the private sector actors help farmers to access resources, especially production inputs such as seed, breeds, and fertilizers. Most production inputs are imported from neighboring countries.

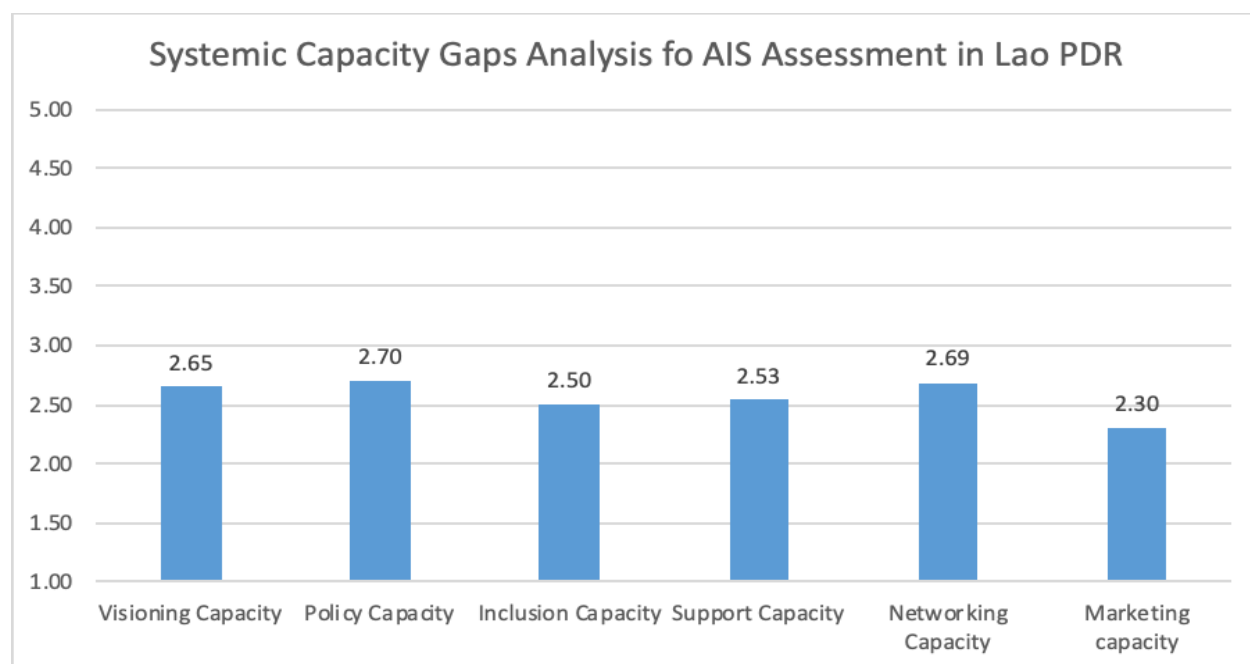
Function 7: Institutional and policy support - the government is the key actor performing the function related to Institutional and policy support. While government departments and donors (DPs) provide support to the government to develop policy and regulations, DPs are the main actors providing institutional and policy support to farmers. Farmers described the difficulties they encountered to comply with government procedures and processes (e.g. obtaining organic and GAP certification, procedures to import production and processing equipment for Lao Farmer Network). Thus, there is a great need to improve enabling environment and efficacy of institutional processes and regulatory frameworks that support innovation simplify procedures and processes.

6.3. Capacity analysis

There are different types of agriculture innovations on the ground, including technological, organizational, institutional and social innovations. The main actors interacting and supporting innovations are mainly donors, particularly those with projects related to farmer groups, agriculture production, and policy development. Capacity building has been an important element of support service functions to AIS. The aim of capacity gap analysis is to assess the awareness, knowledge, and skills of the main organizations that influence the way the AIS is organized and operating.

The assessment results indicate that capacity of AIS in Lao PDR is low to medium across all capacity domains; suggesting a strong need to strengthen the AIS in the country. AIS capacities were assessed using 4 questions across 6 domains as described below. The lowest capacity was identified in relation to creating new markets and making market linkages and the second lowest is the capacity to deliver demand-driven services that are relevant to the producers in a responsive and coordinated manner. Respondents identified challenges of qualified individuals and government staff to perform functions and services needed to support and facilitate innovation processes, especially at the PAFO and DAFO level.

Figure 3: Results of capacity gap analysis



The chart shows assessment results focusing on the following six CD domains: visioning capacity, policy capacity, inclusion capacity, support capacity, networking capacity, marketing capacity. Among the six CD domains, there is less capacity on marketing and inclusion capacity.

6.3.1. Summary of results on the following six capacity domains

Domain 1 (Visioning Capacity): Capacity to create a vision for improving innovators' environments.

A vision provides a picture of what could be and is considered a vehicle that can drive an organization to move toward that vision. The results indicate a need to enhance knowledge and understanding on the strengths and weaknesses of AIS that would help create a long-term vision which is critical for supporting and sustaining the AIS. Agriculture innovation data can also help the government effectively develop a vision to encourage and support innovation by stimulating the transfer of technology and building closer links between farmers, private firms, universities, government departments and research institutions.

Domain 2 (Policy Capacity): Capacity to formulate comprehensive and inclusive innovation policies and instruments.

Although Domain 2 appeared to have the highest score among the six domains. Respondents said although there are some policies related to AIS, the sector faced difficulties in developing and adopting those policies, strategies, and subordinate regulations to address some of the critical constraints in the sector. The results

highlighted a need to strengthen capacity to monitor and evaluate their actions and apply lessons learned. Thus, evidence-based research can help design policy and planning, facilitate implementation, and advocate for sustainable transitions with governments, farmers and the private sector.

Domain 3 (Inclusion Capacity): Capacity to lobby for changes in the AIS toward more demand-led and interactive multi-actor innovation processes.

Smallholders traditionally grow bulk staple crops such as rice, which sells for low prices. The focus of extension agencies has traditionally been on intensification and expansion to make up for price drops by scaling up production. As both land area and potential yields reach their natural limits, it becomes obvious that a more qualitative transformation is required. Consequently, the results indicate a need to strengthen skills and update knowledge on advocacy for improved enabling environment for innovation partnerships and niches. This need applies to both farmers and extension staff.

Domain 4 (Support Capacity): Capacity to deliver demand-driven innovation support services in a responsive and coordinated manner.

During the expansion of modern infrastructure, needs and wants have emerged that can only be satisfied through market participation. Science, technology, and innovation have the potential to support smallholder transformation in various ways. At the farm level, producers and others need to be supported to innovate in order to overcome efficiency bottlenecks, evaluate possible options, and adapt technical solutions for productivity enhancements and value addition opportunities, while at the same time identifying new technology and techniques for diversifying and improving their livelihoods. Although there was concern about clarity of questions on this domain, the most respondents expressed low capacity to support innovation processes at local level and monitor the progress.

Domain 5 (Networking Capacity): Capacity to sustain networking and brokering among AIS actors.

The results highlight the need to strengthen skills and update practices on how to facilitate innovation networks and platforms, knowledge sharing and networking, and capacity to monitor and evaluate brokering activities. Developing networks is a challenging task, requiring actors, especially farmers and farmer groups, to actively engage in relevant agriculture forums with other practitioners and policy-makers. Although most networks are not legally recognized (e.g. Lao Farmer Network), informal networks are as important as formal institutional setups. Networking, partnerships and collaboration among actors can take place in many ways. However, coordinating actors and facilitating partnerships within AIS is a crucial role to be played by relevant stakeholders.

Domain 6 (Marketing Capacity): Capacity to create new markets.

This capacity domain was rated the lowest among the six domains. This implies an urgent need to strengthen capacity to make market linkages and create opportunities for marketing. In recent years, some farmers have started to shift their focus from a subsistence to a market orientation. However, farmers face constraints such as high production costs leading to high prices and price is one of the key factors buyers consider. They also have difficulty accessing market information and data. The results highlight constraints such as difficulty in accessing market data and information, and the need to strengthen capacity to support farmers with marketing and monitor market information and the ability to apply lessons learned.

6.3.2. Prioritized areas of capacity development needs for AIS

- 1) Low capacity to formulate agriculture innovation policy and implement (formulation of inclusive strategy, road map, action plan development) especially incentives to encourage and enhance innovative agriculture innovation.
- 2) Low institutional and organizational capacity with a focus on soft skills for farmer group management, financial management, commercialization, monitoring and evaluation of applying new knowledge and skills in practice.
- 3) Low capacity to provide evidence-based data, technology, and options to support smallholder transformation in various ways. A data and information system for agriculture innovation could contribute to making informed decisions on investment, policy and capacity development. An AIS data and information management system could be used for identifying priority areas and activities as well as for monitoring and reporting AIS achievements through implementation.
- 4) Lack of institutional support for AIS (e.g. no responsible agency for agriculture innovation within MAF), therefore, there is poor understanding of agriculture innovation and limited agriculture innovation projects in Lao PDR.

6.4. Enabling environment analysis

The enabling environment analysis looks at a broad range of factors that promote innovation in general. The areas of focus can be divided into two general categories: i) climate change and practices and ii) Policy review:

6.4.1. Natural resources and climate change

Considering the focus of the project and importance of the climate change in the context of Lao farming, the assessment included some specific questions regarding natural resources and climate change. Water is a critical input for agricultural production and plays an important role in agriculture sector food security. Water is also used for pesticide and fertilizer applications and post-harvest processing. Improving agricultural productivity, while conserving and enhancing natural resources, such as water, is an essential requirement for farmers to increase food production on a sustainable basis, especially in the upland area. In addition to mega investment projects on water, the increase of temperature and the change in seasonal rainfall does not accommodate water access by farmers. When groundwater cannot be recharged and when extraordinary rainfall events occur, the soil is dry and its water-absorbing properties become limited.

Agricultural intensification is leading to increasing soil degradation and loss of ecosystem services in Lao PDR, especially in the upland communities, leading to reduced yields and ever-decreasing resilience. Climate change is expected to exacerbate these problems and to reduce community resilience further. Farmers expressed concerns about unpredictable access to water which presents a serious problem for upland communities and changes in resource management have led to increasing pressure, requiring more integrated approaches. An integrated approach to share and sustain resource management could be the first step towards more resilient communities.

“We (farmers) need water to grow vegetables and to feed our family. Groundwater is the source of water for our vegetable production and household’s use. However, we lack water in the dry season decreasing vegetable productions. Thus, this is a factor increasing prices of vegetables during dry season.” - Mrs. Khammone Luanglath, Head of Thongmang Agricultural Cooperative.

Strengthening AIS requires capacity development and tools for planning economic and social development measures for communities and actors as well as environmental safeguards which provide for (i) sustainable and resilient use of shared natural resources (land/soil, water, forests, biodiversity) and the environmental services they provide, and (ii) contribute to reduced anthropogenic climate change drivers. Other knowledge tools, such as information about hydro-meteorology, biodiversity, the status of forests, and water needs assessments must also be considered as pathways to achieving objectives.

6.4.2. Policy review

The government has developed and implemented a number of policies and strategies to ensure national food self-sufficiency and stable agricultural production. These include the promotion of climate-resilient agricultural practices, agriculture innovations to promote sustainable production for niche markets, the development of technological capacities, storage and warehouses to ensure food security, and a risk reduction fund. At the implementation level, policy support for agriculture research, innovation, and information services have been limited and challenging. The main challenges include, a) limited quantity and quality of human resources in planning and promoting innovation

in the agriculture and related sectors; b) limited availability and allocation of financial resources; c) tracking and monitoring of expenditures and progress on research, innovation, and service provision; and d) finally analysis and facilitation of multi-sectoral research, information and processes also remains challenging.

The sector faced difficulties in developing and adopting policies and enacting laws and sub-ordinate regulations to address some of the fundamental constraints in the sector. In addition, the sector is also facing serious constraints in the development of a consolidated and cohesive long-term vision and strategy for the different sub-sectors, i.e. food security, forestry, rural development and economic growth for smallholder farmers under its mandate. Lack of data and knowledge gaps are impeding policy-practice links. When data is available and accessible, its reliability is often questionable and even if quality is acceptable, data is often not in a form that is suitable for policy-makers or practitioners.

From a policy perspective related to an Agriculture Innovation System, Lao PDR has laws and regulations that require impact assessment and improvement, which begins with policy to ensure that poor farmers are covered by investment and trade promotion laws so they get benefits such as access to credit. Despite existing policy to promote SMEs, they have been facing constraints to grow and provide employment opportunities to their communities but there are no specific provisions of funding for farmers. Some policies are in place, including MAF's 13 national rice policies for food security, and 8 national policies on terrestrial and aquatic animal production for food security and commodity.

Interest rates are high to facilitate and encourage innovation. There are Notices No. 527/BoL and No. 662/MPD that set the interest-rate spread at a maximum 4 percent, based on weighted-averages. Procedures and conditions for lending or access to credit and establishing farmer groups are not easy for poor farmers, which hinders opportunities for innovation by rural producers.

A comparison of official documents shows that all strategies emphasize three components: research, integration, and technical support. The development plans include fair distribution of support among seven functions identified through this assessment. Based on the stocktaking in the policy support exercise (CDAIS 2019), policy and legal documents put a great emphasis on technical support, which accounted for more than 80 percent of the total reviews. Only 9 percent of legal documents include provision for innovation support (e.g. less indications of supports on production inputs). This exercise shows difficulties imposed by the fact that policy processes are not systematically followed through or maintained at the implementation level. The lack of policy coordination can be due to institutional resistance and inactivity. The results from stocktaking exercise will contribute to the promotion and support AIS in Lao PDR through identifying and understanding gaps and opportunities in the policy making structure. Any sudden policy shifts that do not promote a sustainable agriculture innovation as a continuous process might lead to policy inconsistency because they do not offer a consistent and reliable level of support to the transformation process.

In addition, policies and strategies does not clearly address social and economic inclusion of women, young and disadvantaged groups in remote areas. This inclusion aspects should be mainstreamed well across the sectors at the national policy level in order to ensure no-one is left behind.

7. Discussion and synthesis of results

There is great potential for agricultural innovation to increase farmer incomes, improve food and nutrition security and allow for sustainable management of natural resources. Indeed, farmers are willing and able to innovate through adoption of improved practices and technologies in crop production, livestock breeding, seed varieties, water management and more.

Farmers in Lao PDR are facing a rapidly changing world, in particular with regards to farming technologies, farm employment, access to credit, and market orientation. The sector is shifting towards more commercial agriculture and thus, the number of farming households producing crops primarily for market is growing. To meet market demand, farmers expressed a need for improvements in terms of crop quality and productivity. However, some farmers still do not acknowledge the need to improve their technical capacities and soft skills. In addition, their access to credit remains limited, which inhibits their ability to improve their farms.

Providing support to farmers to access credit requires financial institutions to design their services in liaison with local authorities, to reduce incidences of Non-Performance Loan (NPL) and provide legal advice including on contract farming to help farmers make more informed decisions and have greater negotiating power.

“We need credit for increasing and improving vegetable production. In the past, we faced difficulties to access credit from financial institutes. After we set up our farmer group as Thong Mang Agricultural Cooperative, we gained trust from finance institutes and business partners. Our cooperative helps us to access credit.” - Mrs. Khammone Luanglath, Head of Thongmang Agricultural Cooperative.

Generally, Lao smallholder farmers still use traditional low-intensity practices for production for domestic consumption, and they have limited experience with modern agriculture technologies and low exposure to the market. Thus, a main challenge for farmers is their lack of understanding of commercialization and organization, which leads to high transaction costs and low bargaining power for individual farmers. Despite lower productivity, Lao farmers' continued use of traditional agricultural production practices also has a positive side with regards to producing low-cost, clean and safe foods. Indeed, in this area Laos has a comparative advantage compared with neighboring countries, which have been using agricultural chemicals intensively for decades, including increasingly expensive petroleum-based pesticides and chemical fertilizers.

Another major challenge for many Lao farmers is their lack of legally recognized land-use rights. This struggle is coupled with the widespread urbanization and rural-urban migration of young people, which has increased the labour shortage in the agriculture sector. Sector progress has also been affected by natural disasters and this impact has been worsened by poorly functioning early warning systems and response mechanisms,

including lack of access to crop insurance. However, some efforts have been made by the government to allocate funds for disaster recovery including the recent development of a National Disaster Recovery Framework, which is a positive step forward.

Neither government nor private sector providers of advisory services have sufficient capacity to provide full coverage of the agriculture sector with regards to supporting innovation, this is in large part due to limitations such as a lack of competent staff members to provide services. Moreover, it is not clear which public agency is responsible for agriculture innovation. And, although a wide variety of official documents emphasize “innovation,” a closer look at these policies reveals that while some policies are promising, others often refer to “innovation” but are not comprehensive enough to tackle the difficulties of fostering and scaling out innovation.

Overall, the analysis suggests that government agencies are the biggest providers of services, and focus more on information sharing, technical advice and institutional support, while access to resources (inputs & credit) is addressed more by the private sector. However, networking, demand articulation and capacity building are less supported by all service providers.

Government services can at times be difficult for farmers to navigate, for example, when trying to register and operate commercially-oriented groups or micro-enterprises, they face complex procedural barriers. The establishment of such formal groups and enterprises among farmers can increase organizational capacity allowing farmers to gain equitable terms from key market actors and potentially access credit and other services.

“The importation process is complicated for importing new technology for agriculture production. E.g. I want to import the solar dryer equipment/machines for drying the agriculture raw products from abroad but it takes too long to get required papers completed. On the other hand, the funders have a timeframe to pay. It was very difficult as part of the importation process I have to get clearance from MAF- MOIC-MOF, etc.”- Mr. Khammoune Xaymany, Chairperson of LFN, says

Despite some shortcomings, the government has launched important actions that have positively affected the agriculture sector. It has targeted, for example, commodity production and commercialization along with more sustainable practices guided by the Green Growth principle. Recent years have also seen increased private sector involvement that has made many farming communities more food secure through investment in new products and value chains. However, some private investments in agriculture, forestry, mining and hydropower had negative environmental and social impacts on rural communities. These include possible loss of access to resources by local communities (e.g., encroachments into cultivated areas or forests) and damage to the environment. Intensive mono-cropping with a considerable level of chemical use, for example, cassava, maize, bananas, eucalyptus, rubber, and intensive livestock pig and poultry production result in soil fertility loss, erosion, spread of diseases due to reduced biodiversity and ultimately loss in productivity (Kenney-Lazar, 2016). The policy framework of MAF has been reinforced to address these issues. However, the extent to

which the policy framework is successfully implemented with effective monitoring and reporting mechanisms is questionable.

Women and young farmers have great roles in the agriculture sector and they are the key drivers of agricultural innovation. However, there is a lack of specific focus on gender equality in agriculture policies and regulations. A particular challenge is how to translate gender policies from the national level to local contexts; one barrier is that Lao PDR has many ethnic groups with different gender-related traditions. Some ethnic groups, for instance, are matriarchal societies.

8. Conclusion and recommendations

In the context of a growing world population and climate change, agricultural innovation has a high potential to increase farmers' income, improve food and nutrition security and allow for a sustainable management of natural resources. Given that the Government of Lao PDR has had a policy of promoting foreign direct investment (FDI) in all sectors of the economy since launching the New Economic Mechanism in the late 1980s. Changes in public governance towards the decentralization and privatization of public services have led to various transformations in the supply of investment including agricultural services. Similar to other sectors, agriculture services have been moving towards more privatized structures. More efforts to promote and support agriculture innovation are needed to make the agriculture sector more resilient and competitive.

Key stakeholders including government, private sector, farmer's organizations and development partners need to work together to promote and strengthen Agriculture Innovation Systems (AIS) for sustainable, resilient and inclusive agriculture and food transformation. Innovations are needed to address weaknesses and reduce threats. Developing a conducive environment for innovation through market integration is important in achieving significant impacts in agriculture and rural development. It is fundamental to increase investment in research and extension to underpin agricultural innovation.

Relevant Ministries and MAF's Departments show their commitments and interest in supporting the agriculture innovation systems. This inter-sectoral commitment could improve the institutional and enabling environment of agriculture innovation. In addition, the role of the private sector is increasing. The active involvement of the private sector in conducting research and development (R&D) is an important step to promote agriculture innovation. To gain wider adoption of new practices and innovative ways of working, it is important to develop enabling policies and institutional mechanisms for cross-sectoral, multi-stakeholder coordination and collaboration at national and local level. Such a mechanism will support profitable, climate-smart, socially inclusive, and environmentally sound agricultural innovation processes that meet the demands of farmers and consumers.

There is a significant need and potential to improve capacities for AIS in Lao PDR. The results from this study suggests concrete approaches to strengthen AIS to create a well-functioning “enabling environment” for agricultural innovation. The study also shows that innovation is a result of interactions among multiple actors and multiple services and functions. This approach highlights that all these actors, services and functions perform well and can succeed in facilitating innovations, it is therefore of upmost importance to develop necessary and related skills to unleash that potential.

Enhanced climate resilient agriculture is beyond just food security, but also includes livelihood, forestry and livestock restoration. Strengthening and investing in systems and mechanisms for developing climate resilient seed and breeds; rural infrastructure including the design and maintenance and related information services such as early warning, weather forecasting and weather insurance must be prioritized to address and prevent risks from climate change. There are very few initiatives to support farmers e.g. Laos Climate Services for Agriculture (LaCSA). Investment in R&D and extension and advisory services should also consider the introduction and application of new and modern technologies or techniques to support and enhance farmers to be more resilient to climate change.

The development of an understanding of innovation at all levels will encourage innovation in the agriculture sector. Creation of an enabling environment for agricultural innovations requires not only operational implementation, but it also requires an overall improvement of knowledge and understanding of innovation concepts, processes, opportunities and challenges by all actors of AIS. A group of individuals were trained to be ‘National Innovation Facilitators’ –NIF at local level through CDAIS project to facilitate innovation partnerships among local actors to work together to overcome their challenges and document the process for innovative solutions. Capitalizing on such resources and developing an institutionalizing mechanism to support them is important for scaling innovation and developing a database or repository of innovations in Lao PDR. It can help coordinating support for local innovation processes and making evidence-based decisions.

Integration of AIS concept and capacity development framework for AIS in the education system in Lao PDR is another important area to consider. Introducing the system’s approach to capacity development within the concept of agricultural innovation can be developed into a educational curriculum to promote these skills and concepts to future professionals of Lao PDR. This academic approach can be coupled with a practical coaching by NAFRI, DTEAP, DAFO, PAFO and/or involving NIFs.

Creating a space for different stakeholders and actors in the AIS to exchange, learn and share is very crucial in enabling innovation. Such an agricultural innovation platform will facilitate co-creation of innovations for addressing common agricultural issues since the platform will enable actors to discuss together (not just disseminating information) and seek joint solutions.

Table 2: Specific recommendations

Expected Change	Possible way forward	Responsible Agency
Functions		
Enhanced knowledge and understanding of the strengths and weaknesses of the AIS.	<ul style="list-style-type: none"> Develop an understanding of innovation and innovation system concept at all levels to encourage innovation in the agriculture development sector Develop curriculum/training materials on agricultural innovation at training center, college, university 	<ul style="list-style-type: none"> MAF (PS, NAFRI, DTEAP, DOPLA) NUoL (FOA, FES)
Integrated agriculture services and functions to support innovation processes in the mandate and responsible of departments/divisions within MAF	<ul style="list-style-type: none"> Identify a responsible division/department within MAF to be responsible or focal point for promotion and support on agricultural innovation Develop a clear mandate or TOR for the responsible agency 	<ul style="list-style-type: none"> MAF (PS)
Structure		
Coordination mechanism strengthened between actors	Develop multi-stakeholder coordination platform and/or mechanisms to allow and facilitate stakeholders (government, private sector, farmers/associations and development partners) to work together to promote innovation.	<ul style="list-style-type: none"> MAF (DOPF) LNCCI MPI (DOIP)
A formal mechanism established to recognize and support NIFs	Establish a national agriculture innovation facilitators platform/network to facilitate and develop facilitation skills at local level (District and Provinces)	<ul style="list-style-type: none"> MAF (PS, NAFRI, DTEAP, DOPLA) NUoL (FOA, FES)
Capacities for AIS		
Commercially oriented farmer groups established and market-oriented services and support mechanisms are in place	<ul style="list-style-type: none"> Strengthen capacity of key organizations on necessary skills to facilitate innovation processes successfully (e.g. group management, financial management, facilitation, negotiation, marketing, application of new knowledge and skills, as well as monitoring progress) Create opportunities to exchange knowledge and lessons learned (e.g. 	<ul style="list-style-type: none"> MAF (DTEAP, NAFRI, DOPF, DRDC) NUoL (FA) LFN

	organizing production fairs to bring producers-customers/buyers-policy makers-supporters together)	
Agriculture extension workers/service providers have necessary skills to support agriculture innovation	<ul style="list-style-type: none"> • Enhance brokering and facilitation skills • Develop more national innovation facilitators at provincial and district level 	<ul style="list-style-type: none"> • MAF (DTEAP, NAFRI, DOPF, DRDC) • NUoL (FA)
	Policy and institutional environment	
Policy and planning are developed based on evidence with effective implementation	<p>Increase investment in evidence-based research to help design policy and planning; and facilitate implementation</p> <p>Develop M&E system/mechanism for policy implementation and enforcement. It can be used for identifying issues and recommendations</p>	<ul style="list-style-type: none"> • MPI, MOF, MAF (DOPF) • MAF (DOPLA, DOPF, PS)
Active involvement of private sector in conducting research and development in agriculture sector	Introduce incentive mechanism (e.g. tax incentives, recognition certificates, opportunities to showcase) to encourage private sector to invest in research and development	<ul style="list-style-type: none"> • MPI, MOF, MAF
Active involvement of youth and women in AIS and developing agriculture innovation	Introduce mechanism and practical steps to promote and focus on youth and women agri-entrepreneurs /farmers by creating opportunities. Engage educated youth who might want to return to the village – in agriculture innovation processes.	<ul style="list-style-type: none"> • MOF (DTEAP, DRDC, PS) • LNCCI • LWU • MOIC (DSME)
Continued and effective policy dialogue to create more conducive environment for innovation (e.g. address issues, provide recommendations/solutions)	Use existing policy dialogue platforms to discuss the issues and make policy recommendations to support agriculture innovation: MAF's annual meeting, Sector Working Group on Agriculture and Rural Development (SWGARD), Sub-sector working groups (SSWGs), National research events by NUoL; and Inter-ministerial platforms	<ul style="list-style-type: none"> • MAF (DOPLA, DOPF, PS)
Farmers have improved	<ul style="list-style-type: none"> • Enhance effective management and 	<ul style="list-style-type: none"> • MAF (DOI)

access to water and other productive resources for agriculture production	use of water and land through new and efficient technologies and practices e.g. drip irrigation, equipment to monitor moisture and nutrients in soil <ul style="list-style-type: none"> • Introduce new equipment/technology to access water e.g. upland areas • Organize stakeholder dialogue/consultation meetings on water sharing and develop a joint water use planning among different economic sectors 	<ul style="list-style-type: none"> • MONRE (DOW) • LFN
Lao agriculture sector becomes more competitive and resilient	<ul style="list-style-type: none"> • Develop policy to promote and support a local production of agriculture inputs (e.g. seed/breed, fertilizer) • Promote local processing and marketing of agricultural products, and develop policies or regulations to control and limit import of agriculture products which can be produced locally 	<ul style="list-style-type: none"> • MAF (DOPF, DOPLA, DLARM) • MAF (DOPF, DOPLA) • MOIC (DOTP, DOIE)

8.1. Policy-level capacity development/ TAP-AIS policy dialogue

In order to avoid any burden and increase effectiveness of meetings, it is best to utilize existing policy dialogue platforms to present the issues and follow up the policy recommendations to support agriculture innovation. During the CDAIS, policy dialogues and policy briefs have been developed for each specific innovation case. Now that a comprehensive AIS assessment gives an overall view of the country situation, regular policy dialogues will be developed to improve the overall country support to innovations (introducing innovation concepts into policies, inter-sectorial mechanisms, educational programs on CDAIS facilitation skills...). The existing platforms that can be used to make overall policy shift, include Sector Working Group on Agriculture and Rural Development (SWGARD) and its Sub-sector working groups (SSWGs), and other inter-ministerial platforms. Lao PDR skilled partners could be involved in a scaling-out of the TAP framework at the ASEAN level, through the existing partnerships between ASEAN Sector Working Group on Crops, and other relevant regional actors such as the Asia-Pacific Islands Rural Advisory Services Network (APIRAS) and the Asia-Pacific Association of Agricultural Research Institutions (APAARI).

All stakeholders have to be engaged in the policy dialogue process, and have to develop related skills. Particularly, farmers and entrepreneurs need to be facilitated and guided to involve and participate in the policy dialogue. Thus, it is important to ensure that they have adequate capacity to actively involve and participate in the policy dialogues.

8.2. Target organizations for TAP-AIS capacity development activities

Capacity development approach should focus on market demand and farmers' needs, rather than focus only on introducing modern technologies that do not always match farmers' needs. This approach should aim to bring new capacities and incentives for farmers, advisory staff, researchers, and private sector actors and enable them to work together to co-create innovation. All actors need to learn new behaviors, skills and forms of partnership. More than financial incentives, new incentives such as recognition, reward, opportunity, and flexibility should be identified. Promoting market and business oriented advisory services in which farmers and entrepreneurs can be facilitated with information, knowledge and capacity to develop even simple business plans for small-scale agricultural investments is recommended.

Capacity development interventions of the project will aim to address key challenges of a coherent institutional capacity development approach to support overall agriculture innovation processes in Lao PDR. The emphasis is given to adult learning methods and competency- based approaches in learning. Based on budget limitations, priority will be given to three key organizations:

1. National Agriculture and Forestry Research Institute (NAFRI)
2. Department of Technical Extension and Agriculture Processing (DTEAP)
3. Lao Farmers Organization Network

During the actual capacity development process, the project will seek opportunities to involve other stakeholders or actors. This will be based on training and capacity development topic.

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