Assessing the Potential of Climate Smart Agriculture in Large Rice Field Models in Vietnam

Working Paper No. 211

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

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Abstract

This study assesses the economic, social, and environmental impacts of Large Field Models (LFMs) and their potential for promoting Climate-Smart Agriculture (CSA). In Vietnam, the government introduced the Large Field Model (LFM), a type of production organization, in which enterprises or cooperatives establish a cooperative relationship with farmers to apply a unification production procedure by providing production inputs (including material and technical support) and/or buying outputs from producers. These LFMs can be classified under three different forms based on the extent of those linkages: (1) farmers contribute land and/or labour to farmer cooperatives; (2) farmers sign contracts with cooperatives or enterprises and receive inputs; and (3) farmers lease out/sell their land to cooperatives or enterprises. Although the key objectives of constructing LFMs come from requirements in improving rice quality and rice production efficiency, these models also have potential for applying CSA to achieve three CSA pillars: productivity, resilience and mitigation.

Productivity: the LFMs ensure integration between enterprises and farmers, wherein rice production is promoted, given that the output is sold at a more stable price. Therefore, farmers confidently manage their business to increase productivity. In addition, higher output price and lower production cost is observed from LFMs' production. Better output price comes from the commitments of enterprises and higher rice quality produced from LFMs. The reduction in production costs is also achieved by taking advantage of economy of scale to apply modern agricultural machinery (such as tractors) and thus reduce labour costs.

Resilience: this CSA pillar is created indirectly from LFMs. In general, as farmers use LFMs, they have a better chance to access certified seeds and follow the production procedures of enterprises under the direct support from technicians, and they are less likely to be exposed to disease epidemics than non-participant farmers. In addition, farmers who sign contracts with enterprises/cooperatives or work in LFMs tend to share their knowledge and discuss weather issues with technicians before deciding when to sow or harvest to reduce climate risks.

Mitigation: the LFM production contributes to reduced GHG emissions. LFMs created a foundation to apply advanced cultivation methods and to follow strictly modern techniques such as: One Must Five Reductions (1M5Rs), Three Reductions Three Gain (3R3G),

Alternate Wetting and Drying (AWD), System of Rice Intensification (SRI), and Deep Fertilizer Placement (DPF). The synchronized irrigation timing or flattened surface field of LFMs also contributes more efficient water use. Moreover, this model changes farmer behaviours toward more efficient and environmentally friendly paddy straw treatment to mitigate environmental impacts.

In sum, there are potentials for promoting CSA application in LFMs. The integration developed through LFMs will produce friendly and mutually beneficial networks of farmers to share knowledge and modern techniques. This also encourages farmers to improve cultivating skills and output quality to sustain their contracts with better enterprises in the long run. In addition, the pressure from climate risks will push farmers to act collectively to adapt and mitigate environmental impacts. These potentials should be accompanied by the strong support from the government through its response to climate changes in the Nationally Determined Contribution (NDCs).

However, there are still many constraints for expanding CSA application into LFMs. First, traditional cultivation and small landholding habits make it difficult for enterprises to accumulate land to form LFMs. Even when farmers agree to contribute their land to cooperatives, this model is still struggling to establish the appropriate benefit-sharing method in order to keep it working smoothly in the long run, especially due to land price fluctuations. Second, there are infrastructure-related issues. Some types of CSA practices require infrastructure support, for example irrigation systems for applying Alternate Wetting and Drying (AWD). Finally, there is a need for a legal mechanism to bind contracts between enterprises and farmers, especially under high price volatility.

Vietnam's policy system to enhance CSA application and expand LFMs is still characterized by limitations related to effectiveness, validation and public-private participation. This requires a change to attract the participation of local government, enterprises, and farmers. For example, experience from other countries shows that in the case of small scale production, legal measures would not be feasible because of high transaction costs. Therefore, using community value to bind farmers to contracts is the most feasible measure that has been proven. In addition, support for developing agricultural insurance and infrastructure investment is important. However, before expanding CSA application into LFMs, detailed

studies of LFMs in each region are required because each model might be more efficient for one specific region with a specific crop.

Keywords

Climate-Smart Agriculture; Climate Change; Agriculture; Food Security

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Contents

Acronyms

AGPPCJC	An Giang Plant Protection Chemical Joint Stock Company
AWD	Alternate Wetting and Drying
CSA	Climate Smart Agriculture
GAP	Good Agricultural Practices
GHG	Greenhouse Gases
IPM	Integrated Pest Management
LFM	Large Field Model
MARD	Ministry of Agriculture and Rural Development
MRD	Mekong River Delta
NDC	Nationally Determined Contribution
PIRCCA	Policy Information and Response Platform on Climate Change and Rice in ASEAN
VietGAP	Vietnamese Good Agricultural Practices

Introduction

Rice production is the most important sector of Vietnam's agriculture. It is the livelihood of thousands of farmers living in rural areas, especially in the Mekong River Delta and the Red River Delta. In addition, the rice industry makes an important contribution towards stabilizing the economy, society, and national food security. In recent decades, the rice industry of Vietnam has made tremendous increases in productivity that contributed to rapid poverty alleviation. In the global market, Vietnam is the second largest rice exporter, so Vietnam's rice industry also provides food for the world, with total contributions to global food security at an annual export volume of over six million tonnes.

Nevertheless, Vietnam's rice producers with small land areas are typically in a low-income bracket and face large obstacles to achieving sustainable development. First, the traditional rice cultivation methods constrain Vietnam's rice quality, resulting in an inability to achieve high value on global markets. The overly intensive use of chemical pesticides and fertilizers not only reduces Vietnam's rice quality but also increases production costs and causes environmental degradation. Second, rice production will be seriously affected by climate change. Rice production is predicted to decline by about 12% in the Mekong River Delta and 24% in the Red River Delta, with about 590,000 ha of rice lost due to inundation and saline intrusion (World Bank 2010).

In addition, the integration of Vietnam's rice value chain remains weak for sustainable development in the long run. Traders play a central role in Vietnam's rice supply chain; farmers mostly rely on traders to sell their outputs. As such, when rice prices increase, farmers are less likely to get this full benefit; conversely, when prices decrease, their losses are huge. Since farmers often have lower bargaining power in this supply chain, they are less motivated to enhance rice cultivation techniques. Moreover, the lack of financial resources to invest in drying and storage systems leads to more intermediaries in the rice supply chain, thereby pushing up the rice price and complicating rice quality management. All these factors contribute to increase the post-harvest loss and production cost, thus reducing the competitiveness of Vietnamese rice in the global market.

Given the weaknesses of the rice sector, Vietnam's government has issued different policies to encourage the development of cooperatives and associative production systems known as

"Large Field Models" (LFMs). The LFMs have achieved success in increasing productivity, and their development also endeavours to create friendly, mutually beneficial networks between farmers and enterprises/cooperatives, showing potential for applying Climate Smart Agriculture (CSA) practices.

The goal of this study is to assess the economic, social, and environmental impacts of LFMs and their potentials for promoting CSA. The remainder of this report is organized as follows. Section 2 describes policies related to the development of LFMs in Vietnam. Section 3 presents the development of LFMs and summarizes the different types of large field models. Section 4 analyses CSA aspects of these LFMs, while Section 5 shows the constraints and potentials for promoting CSA practices in the LFMs. Some recommendations are presented in Section 6.

Policy Review

1. LFMs Definitions and Policies

The term "Large Field Model" was first introduced by the Ministry of Agriculture and Rural Development (MARD) in a workshop organized in the Mekong River Delta on March 26th, 2011. The objective of this workshop was to discuss strategies to develop LFMs following Good Agricultural Practice (GAP), with the aim of establishing high-quality rice production zones for export. LFMs are believed to play a key role in food security and to serve as a foundation for promoting the application of new agricultural technologies.

During this workshop, the Department of Crop Production, MARD issued a handbook discussing indicators that characterize large field models (Pham & Le 2011). The handbook provided seven guidelines for developing LFMs following GAP and VietGAP[1]:

- Identify rice seed variety for regions and provinces.
- Apply new technologies and promote mechanization in every step of rice production.
- Identify specialized rice production areas and make short-term and long-term plans.
- Develop a production procedure for high quality rice for export.
- Evaluate the current supply chain and propose a suitable chain.
- Develop a concrete cooperation based on political, economic, social, and financially mutually beneficial trade factors.
- Expand production zones. Particularly, LFMs must be within the agricultural development plan of the region and have a production scale of 300-500ha

On October 25th, 2013, the Vietnamese government issued **Decision 62/2013/QD-TTg** to encourage the development and expansion of LFMs. In this decision, LFMs were defined as production organizations based on the establishment of linkages between farmers and their representatives or enterprises to develop production appending to processing and trading. Additionally, the decision describes LFMs as large production areas with the purpose of

[1] VietGAP consists of regulations, orders and procedures to guide individuals or organizations on production, harvest, drying and packaging to ensure safety and high quality; maintain social benefits and health; protect the environment and make products available for traceability (Decision 2998/QĐ-BNN-TT by Ministry of Agricultural and Rural Development, on VietGAP for rice, dated 09th September 2010).

producing large amounts of high-quality agricultural product, resulting in the improvement of farmers' competitiveness and effectiveness, while also increasing their incomes.

However, the development of LFMs did not completely follow the above-mentioned guidelines. Several definitions of LFMs have emerged in the literature. Vu and Dang (2012) defined LFMs as fields with one or more owners but having the same production procedures and product selling plan. They provide equitable and stable products, in terms of both quality and quantity, to market under the same brand name (Vu & Dang 2012). Similarly, Do and Kim (2012) defined LFMs as fields with one or more types of crop with a large production area, having the same crop schedule and production procedure, and providing quality and quantity of product according to market demand. These authors also highlighted five major characteristics of LFMs: (1) produce an annual crop; (2) use a large production area; (3) have one or more households; (4) use one or more types of crops; and (5) have a close linkage between farmers and enterprises. Other classifications emphasize cooperation between a set of stakeholders for intensive rice production following Good Agricultural Practices (GAP). For instance, Chu and Le (2013) identified three types of LFMs: (1) farmers cooperate with enterprises to be provided with inputs, such as fertilizer, seed, materials, and technical support; (2) farmers cooperate with enterprises to sell products; and (3) close cooperation between farmers and enterprises on inputs and outputs.

A more elaborate definition is provided by Phuoc (2013), who defines LFM as a method of production based on the establishment of a linkage between farmers and enterprises to gather small-scale farmers into large, common production areas in order to create favourable conditions for the application of new technologies and stabilize output market for farmers. With the purpose of reviewing current LFMs in Vietnam, we consider an operational definition of LFMs as a type of production organization from which enterprises or cooperatives establish a cooperative relationship with farmers to: (1) apply a unified production procedure; (2) provide production inputs (including materials and technical support); and (3) buy outputs from producers. This relationship can be formal via official contract or informal via oral agreement.

2. LFMs Development Policies

The LFMs originated from **Decision 80/2002/QD-TTg**, a policy designed to encourage the contractual sale of farm products, and **Directive No. 24/2003/CT-TTg** on the development of

agricultural, forest and aquatic product-processing industries (Figure 1). In 2008, the Vietnamese government issued **Instruction No. 25/2008/CT-TTg** on strengthening the development of contract farming. After nearly eight years of implementation of **Decision 80/2002/QD-TTg**, results did not meet expectations. The purpose of **Decision 80/2002/QD-TTg** was to promote contract farming to at least 30% of agricultural production in 2005 and 50% in 2010 for all agricultural products. However, as of 2010, the amount of rice sold via contract farming only accounted for 6–9% of the production for rice, 10% for fisheries, and 2–5% for coffee (MARD 2010).

As a result, a more effective model emphasizing four stakeholder linkages emerged in the Mekong River Delta in 2010. This model was established in the Mekong River Delta by An Giang Plant Protection Chemical Joint Stock Company (AGPPCJSC), which converted to Loc Troi Group in 2014. The AGPPCJSC signed a contract with farmers in one large field to provide inputs and technical support and buy all production (Tran 2012). Realizing the potential of this model, MARD decided to scale it up. It was then referred to as the Large Field Model. MARD organized a workshop in Can Tho with the participation of Mekong River Delta (MRD) provincial leaders to initiate the development of LFMs following GAP with the expectation of establishing high-quality rice production zones for export. Following this workshop, the Department of Crop Production developed a handbook on "Indicators for developing LFMs", which indicated the foundation of the initiative, the components of LFMs following GAP and VietGAP, the roles of stakeholders involved, and the specific steps for establishing an LFM.

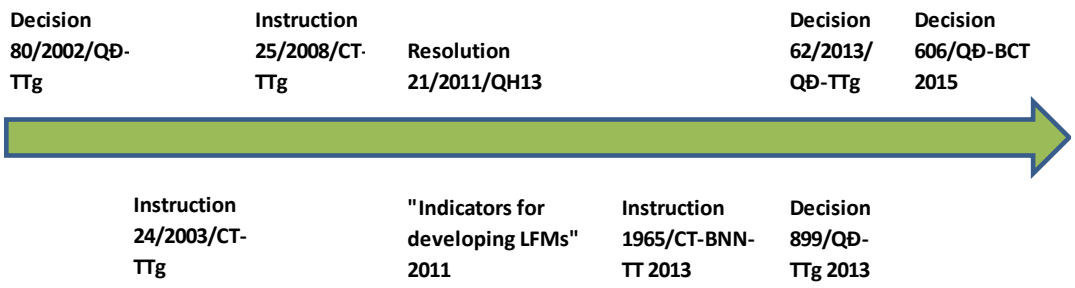

Figure 1 LFM Policies in Vietnam

Source: CAP 2017

In late 2011, the Vietnamese government officially put LFM development in the **Resolution 21/2011/QH13**, dated November 26, 2011, supporting the development of LFMs. This

resolution confirmed that establishing LFMs is one of the important long-term strategies to restructure the agricultural sector in order to increase added value and achieve sustainable development on agriculture. Therefore, MARD intends to expand 'Large Sample Field Models' across the nation and in a variety of crop types.

Following this resolution, **Decision 62/2013/QD-TTg** was issued to incentivize the development of cooperation in production and consumption of agricultural products and LFMs. The decision regulates a number of preferential and policy supports that aim to encourage the development of cooperation and associative production systems (coordinated with the consumption of agricultural products and the construction of large fields). It also creates foundations to encourage expanding and developing "small household LFMs" in Vietnam. The supports provided for each group are described as follows:

- **Enterprises**: (1) exempted from land use and land rental fees for building infrastructures involving LFMs; (2) prioritized when participating in government rice export contracts; (3) prioritized when participating in rice procurement program; and (4) support for up to 50% expenditure of training courses on contract farming for farmers.
- **Farmer Organizations**: (1) exempted from land use and land rental fees for projects building infrastructures for LFMs; (2) prioritized when participating in government rice export contracts; (3) prioritized when participating in rice procurement program; (4) support for up to 30% in the first year and 20% in second year for plant protection chemicals, labour cost, and machinery rental cost to apply plant protection jointly; (5) support for up to 50% expenditure of training courses on business management, business contract, and technical trainings for leaders of farmers' organization; and (6) support for up to 50% expenditure of training courses on contract farming for farmers.
- **Farmers**: (1) free technical training; (2) support for up to 30% expenditure for buying certified seed (only applies for the first season); and (3) support for 100% expenditure of storage at enterprises (up to three months in case of procurement programs).

In order to receive the above support, enterprises must have a direct contract with farmers/farmers' organizations, provide input materials and services for farmers, and buy their outputs, which fulfils at least 50% of their operational demand. They must also have drying, storage, and processing facilities and a detailed plan to implement the supported

activities, which is similar to requirements with farmers' organizations. For farmers, they only need to have contracts with enterprises/farmers' organizations and follow their production procedure. As a guide for this implementation, **Circular 15/2014/TT-BNNPTNT** was issued one year later.

In the Agricultural Restructuring Plan, approved in **Decision 899/2013/QD-TTg**, LFMs were also mentioned. Specifically, this plan encouraged the development of cooperation, commodities associations, and cooperation between enterprises, research scientists, and farmers following large field models.

After **Resolution 26** and **Decision 62**, LFMs have become a growing trend in agricultural development in Vietnam, and LFMs were mentioned in many different policies; namely,

- **Decision 713/2014/QĐ-BNN-TT** on the rice seed production plan for Mekong River Delta, period 2014–2015;
- **Decision 644/2014/QĐ-TTg** approved plan to support small- and medium-sized enterprises develop commodities linkage clusters in agricultural and rural value chain;
- **Decision 639/2014/QĐ-BNN-KH** approved as the master plan for agricultural and rural development of the Mekong River Delta to 2020–2030 in the context of climate change challenges;
- **Decision 1016/2014/QĐ-BNN-CB** approved action plan for improving the value added of agricultural, fishery, and forestry products through processing and reduction in post-harvest loss;
- **Decision 606/2015/QĐ-BCT** on developing material zones, production and consumption linkages for rice exporters, 2015–2020;
- **Decision 3642/QĐ-BNN-CP** on promoting the commercialization of agricultural products in accordance to Agricultural Restructuring Plan and its action plan in **Decision 4485/2015/QĐ-BNN-CB**;
- **Decision 2027/2015/QĐ-BNN-BVTV** on promoting Integrated Pest Management (IPM) in crop production, 2015–2020;
- **Decree 35/2015/NĐ-CP** on the management and utilization of rice land;
- **Decision 706/2015/QD-TTg** on the plan to develop a Vietnamese rice trademark, and its action plan in **Decision 3340/2015/QĐ-BNN-CB**;

- **Decision 1898/2016/QĐ-BNN-TT** approved restructuring plan for Vietnamese rice sector, 2020–2030.
- **Decision 606/QĐ-BCT** about roadmap for building material area or performing production linkage and consumption of rice, rice traders with rice exports during 2015-2020.

CSA Definitions and Policies

1. Definition of CSA

The most commonly used *definition* of CSA is provided by FAO (2010), which defines CSA as a form of agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes greenhouse gases (GHGs) (mitigation) where possible, and enhances achievement of national food security and development goals. Three interlinked pillars are necessary for achieving the CSA goals:

- **Food security:** CSA aims to sustainably increase agricultural productivity and income from crops, livestock, and fish without having a negative impact on the environment. This, in turn, will raise food and nutritional security;
- **Adaptation:** CSA aims to reduce the exposure of farmers to short-term risks, while also strengthening their resilience by building their capacity to adapt and prosper in situations of shock and longer-term stress; and
- **Mitigation:** CSA helps reduce and remove greenhouse gas (GHG) emissions.

Although the main purpose of LFMs is not to develop CSA, the outcomes of LFMs are closely aligned with CSA's objectives. In this report, we will analyse the CSA aspects of LFMs following the three main pillars: productivity, adaptation, and GHGs emission reduction.

2. CSA Development Policies

Vietnam's national policy governing climate change adaptation is the nationally targeted program on climate change adaptation. Aware of the severe impacts of climate change in Vietnam, Prime Minister Nguyen Tan Dung initiated **Resolution 60/2007/NQ-CP**, appointing the Ministry of Natural Resource and Environment to collaborate with related ministries to develop a nationally targeted program on climate change adaptation. This program was completed and approved in 2008 in **Decision 158/2008/QD-TTg** and aimed to improve awareness and resiliency to climate change, reduce GHG emissions, develop a low-carbon economy, and cooperate with the international community to protect the global climate.

In 2011, the National Strategy on Climate Change was approved in **Decision 2139/2011/QD-TTg**. CSA was a considerable focus and mentioned as one of the ten strategic missions to adapt to climate change. In this decision, the agricultural sector was required to change traditional production methods and consider more suitable management practices. These practices have been put in place with the goal of promoting green agriculture with low GHG emissions, ensuring sustainable development, maintaining food security, and contributing to poverty reduction. As a result of these actions, the agriculture sector is expected to reduce GHG emissions by 20%, increase gross outputs by 20%, and reduce the poverty rate by 20% every ten years.

Together with the national plan, MARD issued its own action plan to adapt to climate change in the agriculture sector in the 2011-2015 period, which was approved in **Decision 543/2011/BNN-KHCN** (Fig.2). The detailed objectives of this action plan are to: (1) improve the quality of climate change research and projections; (2) integrate climate change adaptation into other agricultural programs; (3) propose policy recommendations that maintain stable agricultural production to support vulnerable regions; (4) promote international integration to gain international experience in climate change adaptation; (5) seek technical assistance from experts in climate change adaptation in agriculture; (6) increase awareness of climate change adaption among agricultural staff; and (7) ensure equality in climate change adaptation activities. In sum, this plan specified the main focus for each economic sector. For the agriculture sector, the emphasis fell on being climate smart.

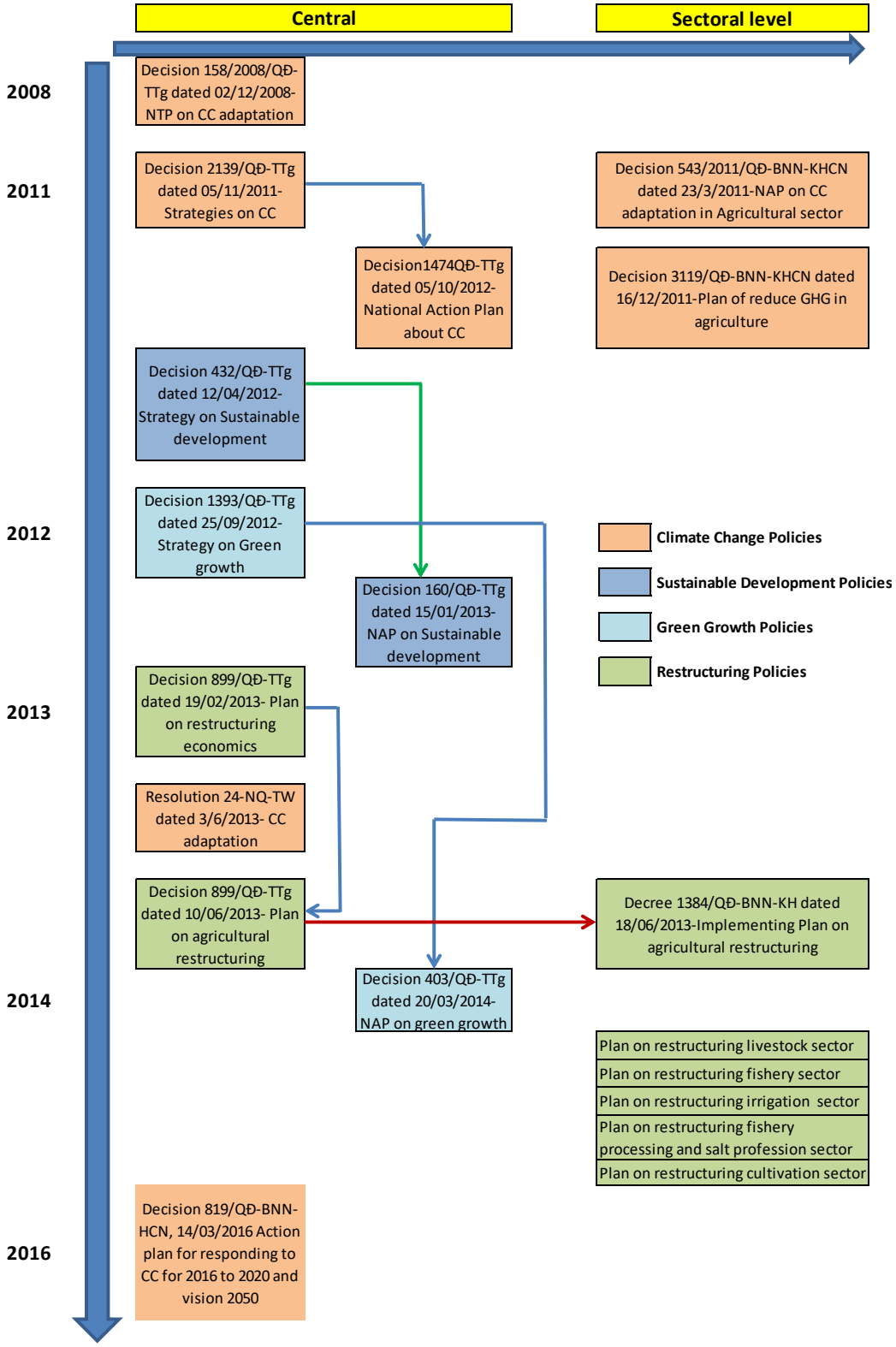

Figure 2 Development of CSA Policies in Vietnam

Source: CAP 2017

Following these documents, a series of national action plans, sectorial action plans, and restructuring plans have been issued to adapt to climate change, reduce GHG emissions, and develop CSA. These plans were as follows:

- **Decision 1474/2012/QĐ-TTg** (dated 05/10/2012) – National Action Plan on Climate Change Adaptation;
- **Decision 3119/2011/QĐ-BNN-KHCN** (dated 12/16/2011) – action plan to reduce GHG emission in agriculture;
- **Decision 432/2012/QĐ-TTg** (dated 12/04/2012) – strategy to implement sustainable development;
- **Decision 1393/2012/QĐ-TTg** (dated 09/25/2012) – national strategy to improve green growth;
- **Decision 160/2013/QĐ-TTg** (dated 01/15/2013) – national action plan on sustainable development for the 2013-2015 period;
- **Decision 899/QĐ-TTg** (dated 02/19/2013) – plan for restructuring the agricultural sector;
- **Resolution 24-NQ-TW** (dated 3/6/2013) – climate change adaptation plan;
- **Decision 403/2014/QĐ-TTg** (dated 03/20/2014) – national action plan to promote green growth;
- **Decision 819/QĐ-BNN-HCN** (dated 14/03/2016) – action plan for responding to climate change for 2016 to 2020 and vision 2050.

In its capacity as the main institution in charge since 2008, MARD has issued 24 legal documents, including nine Circulars, one Joint Circular, 13 Decisions and one Directive on implementing a climate change response plan (Tran 2016). In these documents, MARD encourages the development of a CSA model that is effective and produces less GHG emissions, such as the System of Rice Intensification (SRI), “Three Reductions, Three Gains’’ (3R3G), “One Must Do, Five Reductions’’ (1P5G), VietGAP, and others.[2]

[2] These are practices aiming at sustainability in rice production which increase (or do not reduce) yield while using certified seedlings, less water, labour, fertilizers and pesticides. "One Must Do, Five Reductions (1P5G)" is a technology package that was developed during Phase IV of the IRRI's Irrigated Rice Research Consortium (IRRC) and promoted by the Agricultural Competitiveness Project (ACP) of the World Bank. This technology package, which is predominant in Vietnam, recommends the use of certified seeds as the "One Must”. The "Five Reductions" refers to reductions in seed rate, nitrogen application, pesticide use, water use, and post-harvest losses. The “Three Reductions, Three Gains” (3R3G) campaign was developed as part of an international cooperation between the International Rice Research Institute (IRRI), Visayas State University (VSU) in the Philippines and Vietnam’s Ministry of Agriculture and Rural Development (MARD). 3R3G includes reduction of (i) the amount of seedlings; (ii) pesticide; and (iii) nitrogenous fertilizer. These reductions will induce gains on three major outcomes: yield, rice quality and profit.

Development of Large Field Models in Vietnam

1. Overall Results

LFMs appeared early, but only started to prosper after the MARD movement in 2011. This model was established in the Mekong River Delta by the An Giang Plant Protection Chemical Joint Stock Company since 2008, but only operated on a small scale (Tran 2012). In 2011, MARD initiated a campaign to obtain feedback from provinces in the Mekong River Delta regarding the model. The objective of this initiative was to strengthen the linkages with stakeholders involved. After five years of implementation, LFMs achieved significant results, with the total area of LFMs increasing continuously every year. The area of LFMs in the Mekong River Delta in 2011 was 7.803 ha, and increased to 196,000 ha in 2015. Provinces with significant increases in areas under LFMs are: Can Tho, Soc Trang, and Bac Lieu (MARD 2015). In the Red River Delta, most of the LFMs prioritize rice seed and vegetable production.

LFM development programs have also attracted the participation of large rice production companies and farmer cooperatives. The major companies include Loc Troi group and Vinafood 2. They have been developing their own plans to promote LFMs and also support the establishment of cooperatives and cooperation groups. Specifically, the Loc Troi group in 2014 supported the establishment of 471 farmers' cooperation groups with a total production area of 40,000 ha. Technical support was also provided to farmers, and it has helped increase their profits by 2.5–4 million VND/ha ($110 USD–$180 USD/ha) (Dang 2016). LFMs initially created a trend of commercial production for Vietnamese farmers. Unlike traditional production, farmers who participate in LFMs have to follow company production procedures, activities, and apply advanced management practices. Tran (2012) confirms that farmers who participate in LFMs are more likely to apply suggested production procedures, such as: 1P5G, 3G3T, IPM, and SRI. LFMs have also contributed to stabilizing rice production for export. As farmers follow standard crop schedules, these enterprises can maintain harvesting dates in their production zones in succession, thereby optimizing storage, labour supply, and capital investment.

2. Classification of LFMs

Based on the extent of linkages between stakeholders involved in the model, we classify LFMs into three different models as shown in Table 1.

Table 1 Models of LFMs

Model	Description	Extent of Linkage	Decision of Production
1	Farmers contribute land and/or labour to cooperatives	Tight	Via shareholder meetings
2	Farmers sign contract with cooperatives or enterprises and receive inputs	Fairly tight	Partly
3	Farmers lease out/sell their land	Loose	None

Source: CAP 2017

In reference to the three LFM models described, the most popular model is contract farming (LFM Model 2), while Model 3 shows the most standardized design of LFMs. Model 1 is more efficient with small holders but raises issues on profit-sharing. Models 1 and 2 can be implemented in the same area, while Model 3 is usually implemented separately. Details on the advantages/incentives/opportunities, and disadvantages/constraints/risks associated with each of these types of models are presented in the following sections.

2.1 Model 1: Farmers contribute land and/or labour to farmer cooperatives

Characteristics and Operations

In most cases, farmers will contribute their land, but in some cases, especially with cooperatives, farmers may contribute machinery, production equipment, and even money. All contributions are priced and counted as shares. Farmers can choose to work in these enterprises/cooperatives as office staffs or as workers receiving monthly salaries not related to their contributions. Requirements on the land contributed by farmers to enterprises/ cooperatives maintain that the land must be certified, located in the production zones of these enterprises/cooperatives, not under any type of conflict, and should be large enough to meet the minimum requirement of the enterprises/cooperatives.

Based on the participation of farmers in the production process, this model can be divided into two sub-models. In Model 1.1 (Fig. 3), farmers participate in the production process via shareholder meetings, where they can provide their opinions and vote for different production plans, while in Model 1.2 (Fig. 3), farmers do not make decisions based on the production

procedures. In both models, apart from agricultural production activities, enterprises/ cooperatives also conduct other business activities, of which the most popular are: selling inputs such as fertilizer, pesticides, and herbicides, and providing agricultural services such as ploughing, sowing, harvesting, and milling.

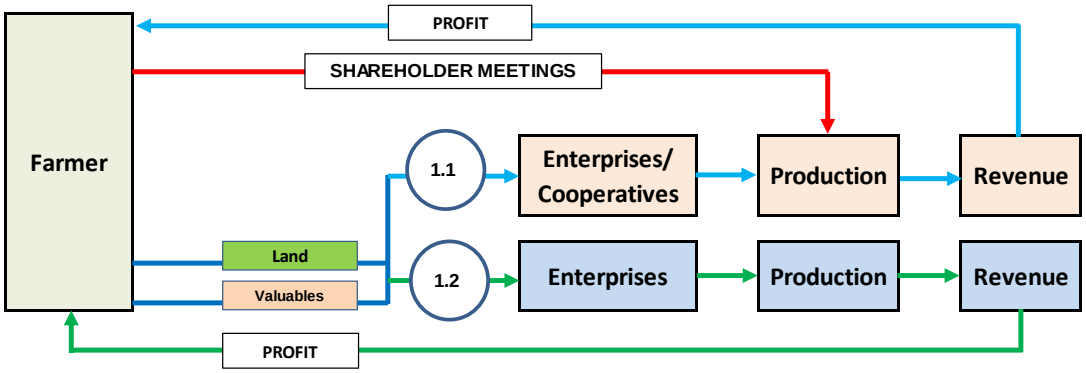

Figure 3 Operation of Model 1

Source: CAP 2017

This model can be regarded as a high-risk/high-payoff option. At the end of a financial year, the final profit will be divided among all shareholders based on their shares. Farmers' profits therefore will depend on both their contributions and the performance of the enterprises/ cooperatives. If the enterprises/cooperatives lose, farmers might also lose all their investments. Model 1.1 was more popular in vegetable production and industrial crops than in rice production. There is only one cooperative in Dong Thap province (Duc Hue Cooperative) that currently practices this model in rice production. Other examples of Model 1.1 and 1.2 include:

- Rubber production in Lai Chau, Son La, Dien Bien, and Ba Ria- Vung Tau (Model 1.2)
- Sugar cane production in Thanh Hoa (Lam Son Sugarcane Joint Stock Company) (Model 1.1)
- Tea production in Lai Chau (Model 1.1)
- Vegetable production in Nam Dinh province (Model 1.1)

Advantages and Incentives

In this model, farmers are shareholders of the enterprises/cooperatives and take part in the production operations. Farmers have the opportunity to learn from each other, to access new

technologies and varieties, to participate in training courses and to learn new business skills. This unified production process benefits farmers and enterprises/cooperatives in many ways. First, farmers will experience a lower input price as they buy larger amounts directly from producers. Secondly, they will use the same varieties and follow the same production processes; therefore, the quality of products is uniform and easier to sell. In this model, farmers are more in charge of their production because they get their share from the enterprises/cooperative profit.

The model also provides flexible options to farmers. They can choose to work for their enterprises/cooperatives on service groups (irrigation, ploughing, harvesting, sowing, applying fertilizer, spraying pesticides, etc.), work off-farm jobs, or perform other agricultural activities. For farmers who choose to work for enterprises/cooperatives, they will be in charge of one specific activity for which they have the highest comparative advantage. This makes the production system more specialized and effective. Farmers who participate in Model 1 can also access low interest rates on loans. The enterprises/cooperatives have a specific amount of idle capital that can be lent to shareholder farmers at a low interest rate. In this model, the chance of contract-breaking is low, and the legal aspects of contracts between exporter and the cooperatives are more concrete than with farmers because of the high transaction cost involved in legal proceedings and the low value of a contract. Furthermore, local government plays a supportive role in the establishment of this model. Enterprises work together with local governments to encourage farmers' participation and provide them support during the process. Government staffs are very supportive of the process, since developing LFMs is one of the main priorities for agricultural development.

Disadvantages and Constraints

The largest constraint of this model concerns attracting farmers to participate, because of its newness and their hesitance to participate. They have limited knowledge of the operations of this model, and some of them are concerned that the production value of their contributions will be under-priced or they will lose their land. Additionally, some farmers doubt the credibility of the accounting system of enterprises/cooperatives, and they are worried about scams and fraud. The second constraint is the size requirement of field areas and location. The minimum area to participate in the Duc Hue cooperative is 1.00 ha, which is larger than the average landholding in this location. Notably, due to the difficulties in operating machines,

the minimum area in a dyke-protected field is at least 20.00 ha. Third is the complicated decision-making mechanism, given that important decisions related to the operation of enterprises/cooperatives must be approved in stakeholder meetings, which can take quite a long time. As mentioned above, this model has a high payoff, but is also very risky. Farmers and enterprises/cooperatives will share the risk and in the worst-case scenario, farmers could lose their investments.

2.2 Model 2: Contract farming

Characteristics and Operations

In this model, LFMs are created under types of integrated contracts and their operations. These are divided into four sub-models (Fig. 4) namely, (1) Model 2.1 wherein enterprises agree on both input investment and output purchasing commitment directly with farmers; (2) Model 2.2 wherein similar types of contracts are signed with farmers, but indirectly through cooperatives; (3) Model 2.3 wherein enterprises sign only output purchasing commitment contracts without any advance investment; and lastly, (4) Model 2.4 is created based on the cooperation of groups of farmers who want to share their inputs and production services.

In most cases, the contracts are driven by enterprises' demands, i.e., Models 2.1, 2.2, and 2.3. In these models, enterprises visit several villages to investigate the potential for promoting high quality rice production. They work with local authorities, cooperatives, and households to decide on the appropriate type of integrating contracts. Enterprises then can sign these contracts with farmers directly or indirectly via cooperatives. In most cases, enterprises prefer signing contracts with cooperatives rather than individual contracts with multiple small farmers. However, this preference requires good management skills from cooperative leaders. If cooperative leaders show good management skills, the relationship between farmers and enterprises will be more stable and can function more smoothly in the long run. In addition, with cooperative leaders playing the role of intermediary between farmers and enterprises, the trust between farmers and enterprises is reinforced because they know most of the farmers in their communities. This process also encourages enterprises to get involved in the project at hand, reducing management costs given that enterprises work only with farmers' cooperatives, instead of individual farmers.

Some integrating contracts can be driven by the demand of a group of farmers. These groups of farmers can enjoy benefits such as large discounts on inputs and production services. With Model 2.4 (Fig. 4), a group of farmers discusses and signs purchasing input contracts with the enterprise. The enterprise supports farmers on improved production techniques and also on application of fertilizers and pesticides. All advance investment contracts are signed at the early stage of the season, and all costs are paid at the end of the season after farmers sell their outputs. If enterprises sign an output purchasing commitment, advance purchasing prices signed at the early stage of the season will be adjusted by the average market price at the time the output is collected.

To facilitate these contracts, some initial conditions are required. First, farmers need to agree to use the types of inputs, mostly seed, provided by enterprises. Second, groups of farmers are formed and they must agree to farm in a suitable location for transportation. If there are farmers who farm in separate fields, enterprises will not sign with them because of the additional cost for transportation and quality management. Normally, farmers in one large field grow similar types of seed, so the harvesting time will be same; therefore, enterprises can collect all their products at the same time and reduce transportation and management costs.

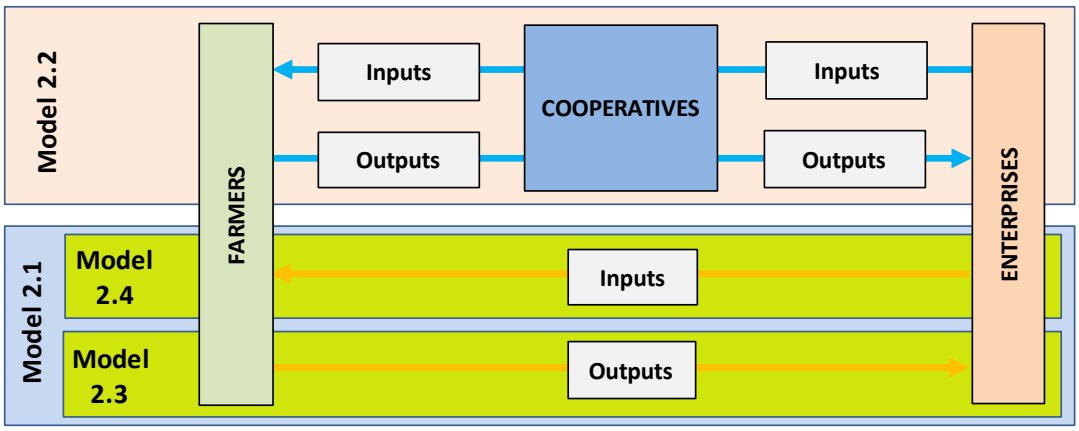

Figure 4 Operation of Model 2

Source: CAP 2017

Advantages and Incentives

In Model 2, farmers still make decisions based on their production processes, except for some strict contracts for Model 2.1. Also, apart from the specific inputs that farmers receive from

enterprises, they have the full power to decide on their production. This gives more flexibility to farmers on the market, and they can actively seek rice varieties that have a high market demand. Integrating contracts also allows enterprises to control for rice quality by advising farmers on the quantity of seed, fertilizers, and pesticides to be applied. On the farmer side, integrating contracts gives farmers more opportunities to access effective production techniques and better quality of seed, fertilizers and pesticides provided by enterprises. In addition, farmers' knowledge is enhanced through the opportunity of attending training courses offered by the enterprise. The advance investment also allows poor farmers to increase their production capacity if they do not have enough money to expand their farms. Enterprises with contract farming also enjoy prioritization in government procurement programs and government export contracts. The Procurement Program started in 2010 in **Decision 993/2010/QD-TTg** on Summer-Autumn Rice Procurement. In this Decision, the Vietnamese government decided to buy at least one million tonnes of rice in order to maintain a profitable rice price for farmers. These activities were carried out by qualified enterprises (including state and private enterprises), who received interest-free loans for a maximum of four months. The Vietnamese government also signed contracts with other countries, mainly Indonesia and the Philippines, where enterprises with contract farming are more likely to participate.

Disadvantages and Constraints

Despite being the most popular model of LFMs in Vietnam, there is little difference between participating farmers and non-participating farmers. Most of the time, farmers still follow their traditional production procedures, which involves overuse of fertilizers and pesticides. Our survey results in Dong Thap and Thai Binh showed no significant difference between participants and non-participants in Models 2.3 and 2.4. As seen in Models 2.1 and 2.2, only in the cases where companies provided all inputs (including technical support) and bought all outputs, would farmers follow the company production procedures. Even in these cases, enterprises have difficulties monitoring the production processes of farmers. Contract enforcement remains a major issue with the LFMs, which causes hesitation on both sides, enterprises and farmers. On average, the successful rate of rice contract farming is only 20–30% (Dang 2016). Our discussions with local governments and farmers reveal that integrating contracts is unstable and only works in short term. Many farmers ended their contracts after

working with enterprises for only one year or for one season, mostly because of the fluctuation of market prices. If market prices significantly increase, some farmers break their output purchasing commitments and sell their outputs to traders to get higher benefits. When market prices decrease dramatically, contracts are broken from the enterprise's side. Another constraint is the mistrust between farmers and enterprises regarding quality control during the process of moisture content measurement. So far, there is no organization serving as a third-party in the quality control process. Therefore, the quality control process is solely conducted by enterprises. In this way, farmers suspect that enterprises wrongfully measure moisture content on purpose to pressure price increases.

2.3 Model 3: Farmers lease out/sell land

Characteristics and Operations

In this model, farmers and local governments sell or rent out land to enterprises/cooperatives and do not participate in the production (Fig. 5). Normally, enterprises find a suitable area for their production and work with local governments to present their production plans and required production area. Local governments introduce their plans to farmers and provide support in the registration and contract certification. Enterprises sign contracts directly with farmers (Model 3.1). This model appeared in the following cases: (1) Cuong Tan Ltd. in Nam Dinh province for rice seedling production; (2) Vin Group in Xuan Hong commune, Xuan Truong District, Nam Dinh province for vegetable production; (3) Duc Hue cooperative in Thap Muoi District, Dong Thap province for rice production; (4) Phu Cuong commune in Tam Nong District; Dong Thap province for rice production; and (5) DKC agricultural investment and development in Vinh Phuc province for vegetable production.

In Model 3.2, local governments rent out common land directly to enterprises. The common land can be land recovered from ineffective projects, unused land, or low-productivity land. This model can be seen in Tam Dao district in Vinh Phuc, Dong Trieu district in Quang Ninh, Cu Chi district in Ho Chi Minh City, Long Thanh district in Dong Nai, (Vineco Agricultural Investment and Development Ltd), Tam Dao district in Vinh Phuc (DABACO high technology agriculture Ltd), Vu Thu district in Thai Binh, and Nghia Dan district.

Model 3.3 is a combination of Models 3.1 and 3.2, where local governments gather the land from farmers and build the required infrastructure (transportation, electricity, water, and

drainage). Enterprises will pay for the right to use the land (Model 3.3). Presidents of communes and districts and representatives from local government will sign contracts with farmers and the Department of Natural Resource and Environment on renting to enterprises. This model is practiced in Xuan Khe commune and Nhan Binh province in Ly Nhan District, Ha Nam province. The total recovered land was 110 ha and three enterprises were contracted, including Phuc Thanh Jsc., An Phu Jsc., and Vineco Agricultural Investment and Development Ltd.

In all three models, enterprises will decide on the production activities, from inputs to production to selling outputs. Normally, these activities will be conducted by their technical staff, but landowners and local labourers are prioritized when applying for jobs at these enterprises. In Model 3, the most typical crops are high-value crops that require large initial investments and application of high technologies (new variety, glasshouse, drip irrigation, etc.). Only in Model 3.1 can we see enterprises/cooperatives renting land to grow rice.

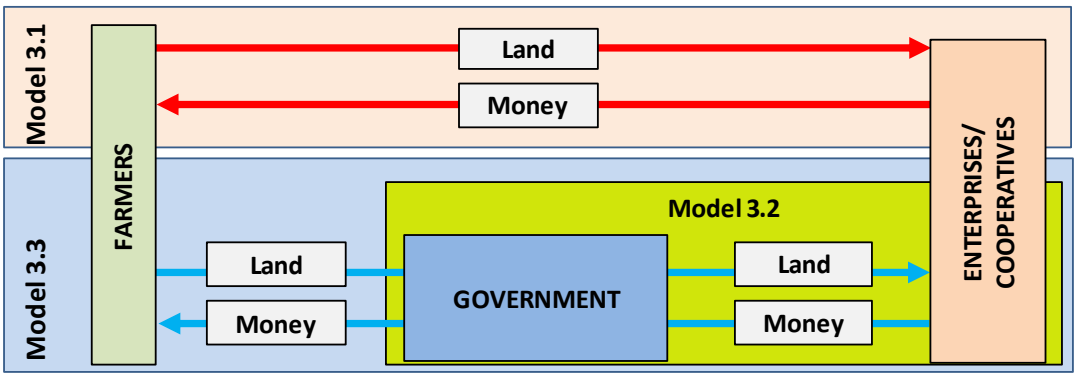

Figure 5 Operation of Model 3

Source: CAP 2017

Advantages and Incentives

Given the active participation of the government, procedures for Models 3.2 and 3.3 are much quicker and simpler than in Models 1 and 2. Instead of working with each individual farmer, enterprises only have to work with local governments and sign contracts with or through them. In practice, as in Model 1, while Duc Hue Cooperative took nearly one year to attract farmer participation, it only took Thai Huong true MILK Joint Stock Company less than one month from when they first met the government of Thai Binh province until they finished all the procedures and began to construct their farm in Vu Thu district. Enterprises/cooperatives

have easier access to supporting policies. Article 6, Chapter 2 of **Decree 210/2012/ND-CP** specified that investors with eligible agricultural projects for investment promotion[3] shall be entitled to exemption on land or surface water renting within the first 11 years from the date of completion and commissioning of the project.

Cooperatives/enterprises in Model 3 are better at applying new technologies and varieties than other models for many reasons. First, they have better access to new technologies and varieties from their partners and government/private extension services. Second, they enjoy the assistance of experienced technical staff that are well trained and have the capacity to apply new technologies. Third, they have enough capital for the initial investment on the new facilities and also are capable of withstanding risk, which is always a part of pioneer activities. Lastly, their application of new technologies has the advantage of economy of scale, which is not feasible for small households. This option is a no-risk choice for farmers in that no matter what the performance of the enterprise/cooperative is, farmers still receive their annual rent at the beginning of the year. This model contributes to the process of drawing labour out of agriculture and promoting land accumulation, which is one of the guidelines of the Vietnamese government from **Resolution 26** to **Decision 899**, approving the Agricultural Restructuring Plan. Notably, only skilled labour is hired to work for the companies, which creates a more professional agricultural sector in Vietnam.

Disadvantages

Model 3 requires a large amount of investment all at once. In Model 1, farm rental is considered a share of the enterprise/cooperative, and payment is only made at the end of the fiscal year, while in Model 2, enterprises/cooperatives only sign contracts to sell inputs and buy outputs from farmers. Land rental is already included in the buying price. Model 3 is more successfully constructed in communes with available non-farm jobs. There are only a few skilled labourers who are employed in the company; other labourers will have to find alternate agricultural activities or non-farm jobs. For this reason, this model is more popular in provinces near large cities (Vinh Phuc, Thai Binh, and Ha Nam). In the case of Duc Hue cooperative in Dong Thap, farmers who rent out their land usually switch to coconut

[3] Includes construction and development of the concentrated material areas for the processing industry, development of big fields and/or applications of biotechnology, high technology in production of agriculture, forestry, and fishery products.

production. In the case of enterprises working directly with farmers, it takes a long time to finalize the process, even with the support of the local government. Like the case in Xuan Hong commune (Xuan Truong – Nam Dinh), in order to rent 140 ha for vegetable production, VinGroup had to negotiate with 3,000 local farmers and some of them did not agree to rent out their land.

2.4 Conclusion

The comparison of the three LFM models is displayed in Table 2. Model 1 is the most complicated model and has difficulty attracting farmers' participation. Lack of knowledge on business management and understanding the operation of this model are the main constraints. Based on its advantages, this model is expected to grow in popularity in the future. In order to participate in all three models, farmers' fields must be located in a specific location favourable for enterprises/cooperatives production and transportation. In addition to the requirement for location, farmers who want to become shareholders in Model 1 must have a rather large production area.

Table 2 Comparison of three types of LFMs

Model	1	2	3
Type of crop	Rubber Vegetable Rice	Rice Industrial crops Vegetable	Vegetable Rice
Extent of Production Linkage	Tight	Low	No
Complexity	High	Average	Low
Decision of Production	Indirect	Direct	None
Requirement	Strict	Flexible	Average
Role of Government	Active	Average	Very active
Impacts in Production	Large	Small	N/A
Seed	Certified	Certified/ Not-Certified	Certified
	Less	Less/Same	Less
Fertilizer	Less	Less/Same	Less
Pesticide	Less	Less/Same	Less
Intermediate	No	Yes/No	No
Contract Break	Rare	Popular	No
Risks	Average	Average	No
Profit	High	Average	Low

In general, rice LFMs appeared in all three models, and mostly in Model 2. In Models 1 and 3, vegetable production accounts for the vast majority of production. Regarding the level of linkages between enterprises and cooperatives, Model 1 has the tightest linkage, where farmers participate in making the production decisions via shareholder meetings. In Model 2, farmers still make most of their decisions on rice production, except for the use of inputs, which is provided by contracted enterprises/cooperatives. In Model 3, farmers give up their land and enterprises/cooperatives but carry out all the production activities.

In most cases, local government plays a very active role since developing LFMs is one of their main targets. They not only play the supportive role to connect farmers and enterprises/cooperatives as in Models 1 and 2, but also directly recover land from farmers and sign contracts with enterprises/cooperatives (Models 3.2 and 3.3). Model 2, the most popular form, had little impacts on the production techniques of participants. Only in some specific sub-models of Model 2 did farmers change their production practices following instructions from contracted organizations. In Model 1, farmers have chances to access new technologies and they can apply it even when they leave the enterprise or the cooperative. In Model 3, enterprises/cooperatives use the advanced technologies in their production. However, farmers play a small role in this production process.

Farmers/enterprises/cooperatives who participate in LFMs in all models use certified seed (except for Sub-model 2.3). In Models 1 and 3, enterprises mostly produce their own certified seed while in Model 2, farmers are provided with seed by enterprises/cooperatives or are required to use certificated seed. Even in Sub-model 2.3, contracted enterprises/cooperatives prefer to sign contracts with farmers who use certified seed. Overall, about 80% of farmers in LFMs use certified seed, while the average for the whole Mekong River Delta is just about 50% (Phong 2015). Regarding fertilizer and pesticide reduction, farms use reliable sources of inputs. Farms in Models 1, 2.1, 2.2, and 3 used lower amounts of seed, fertilizer, and pesticide. Information sharing is also more prominent in LFMs than in individual farming households. Typically, farmers get warning information from the enterprises in cases of disease outbreaks. These enterprises have technical staff scattered all throughout the regions and provide prompt warning when disease outbreaks happen. The chance of contract breaking in Model 2 is also the highest.

In general, Model 1 has a high risk – high payoff option where farmers benefit not only from rice production but also from other business activities of the companies/cooperatives. However, they have to bear all the risks. In Model 3, farmers receive a fixed amount of land rental income regardless of enterprise/cooperative performance. However, this land rental income is lower than the average profit of rice production, and this can be considered as a low risk – low payoff option. Model 2 is the mixture of the two other models. Farmers bear most of the risks, but sometimes they get support from the contracted enterprises/cooperatives.

CSA Aspects of Large Field Models

1. Economic Benefit and Productivity

CSA aims to sustainably increase agricultural productivity and income from crops, livestock and fish, without having a negative impact on the environment, which is similar to LFMs' objectives. Studies and reports have confirmed that LFMs help increase farmers' productivity at different levels, from 15 to 20% (Vietnamese Government 2015); 7% (Sim 2015), 5% (Dat 2014) or they also help reduce production cost by reducing inputs (Model 2). First, because of the integration between enterprises and farmers in LFMs, rice production is promoted because the output is often sold at more stable prices, so farmers can confidently manage their farming business to increase productivity. Mechanization is also applied into production, thereby reducing production cost and savings on labour. In addition, the accumulation scheme allows low skilled farmers to rent their land, and thus productivity is improved by keeping only good farmers in the fields (Ngoc & Anh 2014).

Since overall evaluation of LFMs' efficiency is lacking, financial analyses were conducted in some regions. The results show that in the Mekong River Delta, farmers are involved in LFMs according to Models 2.1 and 2.2. In this region, LFMs farmers achieved higher productivity and more profit than those farming small fields. In addition, LFMs allowed farmers to construct a special rice production zone for exporting high quality rice products (Vietnamese Government 2015). A study on rice production efficiency of Large Sample Field Models during the summer–autumn season in 2011 also showed that producing on large-scale farms helps farmers reduce production costs of land preparation, irrigation, pesticide, harvesting and drying (Ngoc 2012). Specifically, the study shows a reduction of 250 thousand VND per ha on land preparation cost; 10kg per ha on seed quantity; 480 thousand VND per ha on fertilizer cost; and 110 thousand VND per ha on pesticide cost (Table 3).[4]

[4] 250,000 VND = USD 11.13; 480,000 VND = USD 21.36; 110,000 VND = USD 4.90 [based on 1 USD = 22,468 VND (State Bank of Vietnam, October, 5 2017)].

Table 3 Comparisons of Rice Production Efficiency

Province	Productivity (tonnes/ha)	Income (million VND /ha)		Output Price (VND/kg)	
		Large-scale sample field models	Higher than small scale farms	Large-scale sample field models	Higher than small scale farms
Đồng Tháp	6.00	17.00	2.50	2,493	300
Long An	7.00	17.50	3.00	2,860	250
Bạc Liêu	6.00	19.50	3.00	2,763	360
Tây Ninh	5.00	15.50	2.40	3,100	200
Trà Vinh	7.23	26.50	7.50	2,300	600

Source: Ngoc 2012

In the north, a study of rice production efficiency of the LFMs in Vu Thu district, Thai Binh province showed that efficiency of LFMs is better than those of small field farms. Income of farmers involved in LFMs was 8 million VND per hectare higher than those who worked with smaller fields. These results are from LFMs' benefits on cost reduction and high productivity. Specifically, the total production cost of LFMs is around 26.88-29.1 million VND/ha and 26.74-28.98 million VND/ha, approximately 1.92-2.20 and 1.91-2.22 million VND/ha lower than those of small fields during the spring season and autumn-winter season, respectively. The productivity of LFMs is also 2 tonnes/ha and 3 tonnes/ha higher than those of small fields on spring season and autumn-winter season, respectively. Higher selling output price of rice produced in LFMs is also recognized at around 50 VND/kg (Sim 2015).

For a specific model of LFMs on surveyed sites in Dong Thap and Thai Binh, the three types of LFMs show potential in improving productivity by reducing post-harvested losses (Table 4). Higher productivity achieved by the combination of advanced cultivation methods, qualified seed and motivated skilled farmers is shown under the model of LFMs 2, where integrating contracts are signed along the supply chain (Models 2.1 and 2.2). In some cases, when we compared the productivity of the LFM models directly with the traditional model, we noticed no difference in productivity. The reason is that some areas where companies rent land from farmers are located in inconvenient locations for irrigation or have low production quality (i.e. the case of LFMs in Hung Cuc company in Thai Binh). If land quality is controlled for, higher productivity can be observed under this model of LFMs. In terms of price, higher output price is committed through output purchasing commitment contracts between farmers and enterprises (Models 2.1 and 2.3, Table 4). In general, enterprises will

confirm the purchasing price 15 days before harvest and commit 50-250 VND/kg above the average price from local traders. However, the LFM Model 1 achieves the highest output price (approximately 10% above average price) because of the strong bargaining power of companies and farmer cooperatives.

Table 4 CSA productivity aspects of LFMs

<table>
<tr><td colspan="4">Model 1. Farmers contribute land and/or labourers to farmer cooperatives</td></tr>
<tr><td colspan="4">• Reduce post-harvested losses in case farmer cooperatives have enough capacity for building a store
• Reduce production costs by taking advantage of economy of scale (i.e. apply modern agricultural machinery to reduce labour costs)
• Reduce production costs by using less and more efficient inputs (seed, pesticides)</td></tr>
<tr><td colspan="4">Model 2. Farmer cooperatives/enterprises/exporters sign integrating contracts with farmers</td></tr>
<tr><td>Model 2.1. Enterprises/exporters provide inputs (i.e. seed, fertilizer, and production services, and buy outputs directly from farmers</td><td>Model 2.2. Enterprises/ exporters provide inputs (i.e. seed, fertilizers, and production services) and buy outputs indirectly via farmer cooperatives</td><td>Model 2.3. Cooperatives/ enterprises/ exporters buy outputs</td><td>Model 2.4. Farming cooperation shares inputs (seed, fertilizer, production techniques, and service)</td></tr>
<tr><td>• Higher productivity produced by a combination of advanced cultivation methods, qualified seed, and motivated skilled farmers in maintaining the integrated contracts for a long time
• Reduce post-harvest losses by selling fresh paddy directly to enterprise
• Higher output prices are committed through output purchasing commitment contracts between farmers and enterprises</td><td>• Higher productivity produced by a combination of advanced cultivation methods, qualified seed, and motivated skilled farmers in maintaining the integrated contracts for a long time
• Reduce post-harvest losses by selling fresh paddy directly to enterprises
• Reduce production costs by using services from farmer cooperatives</td><td>• Reduce post-harvest losses by selling fresh paddy directly to enterprises
• Higher output price is committed through output purchasing commitment contracts between farmers and enterprises</td><td>• Higher productivity produced by combination of advanced cultivation methods and qualified seed, pesticides, and fertilizers.
• Lower production costs by getting discounts due to large amounts of inputs and services purchased</td></tr>
<tr><td colspan="4">Model 3. Farmers lend out/sell their land to cooperatives/enterprises/exporters/other farmers</td></tr>
<tr><td colspan="4">• Higher productivity produced by combination of advanced cultivation methods, qualified seed and fertilizer
• Reduce post-harvested losses by constructing a store
• Reduce production cost by taking advantage of economy of scale (apply machines to reduce labour cost)
• Reduce production costs by using less and efficient inputs (seed, pesticides)</td></tr>
</table>

For total production costs, a reduction in production costs would be achieved by taking advantage of economy of scale to apply modern agricultural machinery (such as tractors) and

thus reducing labour costs. Lower production cost is also achieved as farmers work together into one large field and sign an input purchasing contract with an enterprise to get discounts (Model 2.4, Table 4). Under LFM Models 1 and 3, lower production cost is achieved by using fewer and more efficient inputs. On average, this LFM model uses 5kg/ha seed and fewer pesticide application than traditional farmer's practice in small fields.

2. Adapting and Building Resilience of Agriculture to Climate Change

Our survey results showed that there was no convincing evidence on the relationship between LFM development and adapting and building resilience of rice production to climate change. There is no clear mechanism on risk-sharing between farmers within these models and their integrated parties. If disaster happens, farmers would still have to pay for the inputs that are provided by companies. Nevertheless, there are some indirect features of LFMs related to this CSA pillar. For example, as farmers are involved in LFMs, they have a better chance of accessing certified seed and following the production procedures of enterprises under direct support from enterprise/cooperatives' technicians, e.g., suitable time spent on pesticide and fertilizer application. In turn, they are less likely to be exposed to disease epidemics than non-participant households. Farmers who sign contracts with enterprises/cooperatives, or who work in one large field, tend to share their knowledge and discuss weather issues with enterprise/cooperative's technicians before deciding when to sow or harvest, thereby reducing climate risks.

3. Environmental Improvement

Besides financial efficiency, LFMs also have positive impacts on the environment. First, production from LFMs is a response to the need for improving pest management to reduce the environmental impacts and health effects of chemical pesticides. A comparison between conventional and large-scale rice farmers in the Mekong River Delta shows that large-scale rice farmers tend to be more concerned about agro-chemicals' environmental impacts. Large-scale rice farmers are more open-minded in trying alternative pest control methods, and they recycle empty pesticide containers more consistently than conventional rice farmers (Roslund 2015).

Second, LFMs help reduce GHG emissions due to the difference in using input combination and suitable production methods as shown in Table 5 (Phong & Tam 2015). In general, by applying modern techniques such as Three Reduction Three Gain, One Must Five Reduction, and SRI, the large field models used a better combination of NPK. In some cases, the LFMs started switching to organic fertilizers and biological pesticides. Study results using lifecycle assessment methods show that the environmental impact of the conventional farming model is higher than those of LFMs and good agricultural practices (GAP). GHG emissions per kg of rice produced by LFMs is 1008.56 g of CO2 equivalent, lower than those made by conventional farming (Phong & Tam 2015). In northern Vietnam, an analysis of balance in applying fertilizers on rice production between farmers in LFMs and farmers in conventional farms with small fields in Thai Binh province, compared to Bo' standard (2000), indicated that the production procedure of farmers under LFMs helped reduce soil erosion. These were the results of new cultivation methods with higher technical progress that reduced nitrogen fertilizers (Sim 2015).

Table 5: Contribution to global warming of different phases in rice production (%)

Source of Emission	Large Rice Field Models	Vietnamese Good Agricultural Practices models	Traditional production
CH_4 from rice land	76.5	77.5	75.3
N fertilizer	14.9	12.1	16.1
P_2O_5 fertilizer	1	0.8	1
K_2O fertilizer	0.5	0.4	0.3
Herbicide	0.1	0.1	0.1
Energy for cultivation	0.4	2	0.3
Energy for milling	5.9	6.4	6.4
Transportation to miller	0.7	0.7	0.5
Total	**100**	**100**	**100**

Source: Phong and Tam 2015

In addition, the environmental impact would be lessened by farmers' behavioural changes toward paddy straw treatment, such as switching from burning to incubating and selling. Water saving also contributes to the improvement of environmental quality and the reduction of GHG emissions. The LFMs encourage farmers to use one large field in applying a similar type of seed so the timing of irrigation is synchronized. This process, on average, reduces irrigation time from five to three times per season (Table 6). In addition, some LFMs, where

land areas are located conveniently, were flattened by enterprises after renting these large-scale land areas, thereby allowing water reduction.

Table 6 Reduction in Time of Pesticide and Water Use of LFMs

Province	Reduction in time of pesticide application (times/crop)	Reduction in water use (%)
Dong Thap	1.7-2.5	30
Long An	2.2-2.6	35
Bac Lieu	1.8-2.0	30
Tay Ninh	1.2-4.0	25
Tra Vinh	1.5-2.0	25

Source: Khoi 2013

Finally, LFM development tends to create friendly, mutually beneficial networks of farmers, thereby having the potential to apply CSA models widely. Farmers who are under contracts farming with companies frequently share their knowledge with each other. In addition, farmers need to improve their management skills and output quality to sustain their contracts with better companies. However, when we compare each model of existing LFMs, the level of mitigation aspects of each model is achieved differently. If enterprises/exporters/ cooperatives are involved in purchasing output only, it does not help improve environmental CSA aspects of LFMs, shown in Model 2.3 (Table 7). There is no difference when comparing CSA mitigation aspects of this model to the traditional farms. This indicates that if integrating contracts only works on purchasing output commitment, it helps farmers create stable markets but not on changing their behaviours toward producing in order to mitigate GHG emission.

In addition, if the cooperation is worked out under cooperative management, water use is more likely reduced as farmers produce the same seed in one large field such as under Models 1, 2.2, and 3. This is because farmer cooperatives are in charge of water use service in their commune, and thus, if they have the chance to get involved in managing the production of LFMs, they better understand the water demand for specific types of seed. Therefore, the timing of irrigation is synchronized (Model 1 and Model 2.2, Table 7). Especially under LFM Model 3, some lands are flattened, which helps reduce water usage for irrigation.

Table 7 CSA Mitigation Aspect of LFMs

<table>
<tr><td colspan="4">Model 1. Farmers contribute land and/or labour to farmer cooperatives</td></tr>
<tr><td colspan="4">•Reduce water used by encouraging farmers into one of the LFMs to apply similar types of seed, so that the timing of irrigation is synchronized
•Farmers change their behaviour toward paddy straw treatment such as switching from burning to incubating and selling
•Reduce GHGs by substituting parts of chemical fertilizers to bio-chemical fertilizers</td></tr>
<tr><td colspan="4">Model 2. Farmer cooperatives/ enterprises/ exporters sign integrating contracts with farmers</td></tr>
<tr><td>Model 2.1. Enterprises/exporters provide input (i.e. seed/fertilizer /production services) and buy outputs directly from farmers</td><td>Model 2.2. Enterprises/ exporters provide inputs (i.e. seed, fertilizers and production services) and buy outputs indirectly via farmer cooperatives</td><td>Model 2.3. Cooperatives/ enterprises/ exporters buy outputs</td><td>Model 2.4. Farming cooperation to share inputs (seed, fertilizer, production techniques, and service)</td></tr>
<tr><td>• Reduce GHGs by substituting part of the chemical fertilizers with bio-chemical fertilizers</td><td>• Reduce GHGs by substituting part of chemical fertilizers with bio-chemical fertilizers
• Reduce water use by producing the same seed in one large field, or by flattening the land into one large field</td><td>No difference</td><td>• Reduce GHGs by substituting part of chemical fertilizers with bio-chemical fertilizers</td></tr>
<tr><td colspan="4">Model 3. Farmers lend out/sell their land to cooperatives/enterprises/exporters/other farmers</td></tr>
<tr><td colspan="4">• Reduce water use by producing the same seed in one large field or by flattening the land into one large field
• Reduce CO2 by changing rice straw treatment method (enterprise apply high technique in this process)
• Reduce GHGs by substituting parts of chemical fertilizers to bio-chemical fertilizers</td></tr>
</table>

Constraints and Potential

1. Potential

An overview of the three types of LFMs shows some potential CSA features. By applying improved management practices, LFMs have the potential to achieve the three CSA pillars: productivity, resilience and mitigation. LFMs development allows the creation of friendly networks of farmers, thereby creating opportunities for outscaling CSA. Farmers involved in farming contracts in LFMs frequently share knowledge with each other. They also are motivated to improve their management skills and output quality to sustain their contracts with better enterprises. Although the level of CSA development in each current model of LFMs is different, the survey results show that the stronger the rice cultivation procedure is integrated, the better CSA application is achieved. For example, LFMs, where all farming procedures are controlled by enterprises/cooperatives (such as Models 1 and 3), are closely related to CSA development's objectives.

Our study shows that although most farmers in LFMs are not aware of CSA terms, their production methods were actually related to CSA practices. Most farmers knew about 1M5Rs and 3R3G practices and were aware of salt/drought/flood tolerant rice varieties. More than half of them were applying those practices.

Expanding CSA practice in LFMs would induce greater economic development in Vietnam for several reasons:

- Cambodia and Myanmar are two potential competitors of Vietnamese rice in the international market. In order to maintain competitiveness, the Vietnamese rice sector needs to progress to commercial agricultural production. The critical barrier to this progress in Vietnam is the current small scale and fragmented agricultural system. Therefore, in order to promote commercialized agriculture, developing LFMs is the most effective option to promote large scale concentrated production.
- The negative impacts of climate change also pose majors threats to the Vietnamese agriculture sector. These challenges could be reduced by the development of LFMs. The unexpected extreme weather events make agriculture production riskier. Besides agricultural insurance, contract farming represents an effective risk sharing mechanism that could allow farmers to ensure their welfare and livelihood.

- Developing LFMs is the central guideline of agricultural development in Vietnam. The Vietnamese government encourages production processes and economic technologies that efficiently use seedlings, feed, agricultural materials, soil, water, and other inputs and reduce GHG emissions.

2. Constraints

Despite all the inherent potential and government support, the growth rate of LFMs is still low. The total area of LFMs only accounts for less than 11% of the total cultivation area (Dang 2016). The sluggish development of LFMs exists for many reasons. First, it is difficult to change farmers' small landholding practices. On the one hand, the production style where farmers make all the decisions about their production constrains them to rely on enterprises, or follow enterprises' production procedures despite knowing that joining LFMs will increase their productivity and reduce production costs. On the other hand, for those who do not want to work on agriculture, diversity in land holding tenure makes it difficult for enterprises to accumulate land to create large field models. Most farmers want to keep land to secure their future. Although the option with the most potential is to encourage farmers to contribute their land to cooperatives, this model is still struggling to identify the appropriate benefit sharing method that will work in the long run, due to land price fluctuations.

Second, the infrastructure-related issues are also major constraints. The LFMs require a certain level of infrastructure development in the production area for transportation. Some types of CSA practice also require a supported irrigation system. For example, to apply AWD into LFMs, the fields need to be managed separately. Thus, there is less potential to apply it into rice production in the Mekong River Delta, where the LFMs are mostly sharing irrigation water with other small farms.

Third, both farmers and enterprises/cooperatives show a lack of commitment to the implications of farming contracts. The LFMs that are modelled based on integrating contracts are quite unstable. There is a lack of a legal mechanism to bind enterprises and farmers. In some areas, developing large fields was just initiated by the local government. They encourage farmers' participation without the farmers knowing the true benefits of the model and therefore, farmers are more likely to break contracts with enterprises. In other cases, they introduce farmers to non-qualified enterprises which could not sustain contracts with farmers

in situations when the market price is lower or when farmers cannot borrow enough money from the bank.

Another constraint to developing LFMs is the severe impact of climate change on upstream activities in the Mekong River. This caused serious sea water intrusion in 2015–2016 and damaged hundreds of thousands of hectares of rice in coastal provinces. Upstream activities also reduced more than 50% of the annual amount of alluvial to the Mekong River Delta (estimated at approximately 80 million tonnes/year). This problem has caused many difficulties for agricultural development in Vietnam, especially in the Mekong River Delta.

Price volatility is one of the main causes of contract violation. Unfortunately, rice prices in Vietnam will still fluctuate in the future with the emergence of more and more countries joining this market. The self-sufficiency policies promoted in the main importing countries such as the Philippines and Indonesia are also predicted to have negative impacts on the stability of global rice prices. Tight state budgets and large public debt are also a large constraint when providing government support to farmers, enterprises, and cooperatives. Large rice production provinces are also poor provinces and have to rely on state budgets. Therefore, in many cases, even when enterprises are eligible and submit all required documents, local government cannot find any sources of support.

Recommendations

In general, most LFMs exhibit CSA features to a certain extent. Therefore, developing LFMs is a key recommendation to promote CSA in Vietnam in the context of favourable government support. With this in mind, we would like to propose these recommendations:

1. **Develop tailored LFMs for different regions**. As presented in section 4.2, there are many different forms of LFMs. Each of them might only be suitable for one specific region with one specific crop. Therefore, local government needs to study different LFMs and their operations to develop the most suitable one.

2. **Attract the participation of enterprises**. In the context of international integration and technology development, these enterprises will respond faster than government and will play the leading role. Their main constraint is land, and the current role of the government is to gather land from farmers to rent out to enterprises.

3. **Encourage farmer participation in LFMs**. This can be done by raising their awareness of potential risks as well as benefits. This needs to be conducted synchronously using different channels, e.g., via telecommunication (TV, radio, local speakers), training courses, or consultations from extension workers.

4. **Develop contract farming with the participation of communities.** The literature review shows that in the case of small-scale production, legal measures would not be feasible because of the high transaction cost. Therefore, using community value to bind farmers to contracts is the most feasible proven measure.

5. **Develop an agricultural insurance market** to help stabilize the income of farmers and enterprises. With income at a stable level, farmers and enterprises will be more confident to invest in high-tech agricultural production.

6. **Infrastructure investment will create the foundation to expand LFMs and promote CSA practice in the LFMs**. For example, the AWD technology requires an irrigation infrastructure that allows for active irrigation and drainage with high accuracy to meet specific crop needs. This problem can be solved by establishing a public-private partnership mechanism to build large fields, commercial and production infrastructure, or

supplement the **Decree 15/2015/ND-CP** on investment under the model of public-private partnerships if enterprises join the large field projects.

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