Strengthening the climate resilience of small-scale farmers in the Central Highland and South-Central Coastal regions of Viet Nam (SACCR)

Sub-assessment report on climate-resilient agriculture

Developed by Dam Viet Bac, Nguyen Thanh Phuong

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List of Acronyms

ADB	Asian Development Bank
ARP	Agriculture Restructuring Plan
CBDRM	Community Based Disaster Risk Management
CCWG	Climate Change Working Group
CEMA	Committee for Ethnic Minority Affairs
CGIAR	Consultative Group for International Agricultural Research
CIP	Climate Innovation Platform
CPMB	Commune Project Management Board
CRA	Climate Resilient Agriculture
DAES	District Agricultural Extension Station
DMHCC	Department of Meteorology, Hydrology and Climate Change
ENSO	El Niño Southern Oscillation
F2F	Farmer to Farmer
FFS	Farmer Field Schools
FIG	Farmer Interest Group
FU	Farmers' Union
GoV	Government of Viet Nam
GSO	General Statistics Office
ha	Hectares
M/DARD	Ministry / Department of Agriculture and Rural Development
M/DONRE	Ministry/ Department of Natural Resources and Environment
MPI	Ministry of Planning and Investment
NGOs	Non-Governmental Organizations
NTP NRD	National Targeted Program on New Rural Development
PAEC	Provincial Agricultural Extension Centre
PPC	Provincial People's Committee
PPMU	Provincial Project Management Unit
TOF	Training of Facilitators
TOLF	Training of Lead Farmers
TOT	Training of Trainers
VBSP	Vietnam Bank for Social Policy
VBARD	Vietnam Bank for Agriculture and Rural Development
WEIDAP	Water Efficiency Improvement in Drought Affected Provinces project
WU	Women's Union

Executive summary

Over the past twenty-five years, Vietnam's agricultural sector has made immense progress. Steady advances in smallholder rice productivity and intensification through the 1990s and beyond have played a central role in Vietnam's successes in poverty reduction, national food security, and social advancement. Vietnam's performance in terms of agricultural yields, output, and exports, however, has been more impressive than its gains in efficiency, farmer welfare, and product quality. More output has come from more and more inputs, at increasing environmental cost. Environmental consequences of Vietnam's agricultural success have ranged from deforestation and fishery resource depletion, to a growing incidence of land degradation and water pollution.

Climate change presents a major challenge for agricultural production in Viet Nam. Crop productivity will be most impacted by reduced water and nutrient availability caused by increased extreme droughts, rainfall extremes with higher flood risk, heat waves, and more unpredictable and shifting wet and dry season variability. Crop yields in upland areas will be negatively impacted by seasonal changes and more unpredictable precipitation patterns. Prolonged droughts that occur more frequently will result in crop failure, and will alter the structure of the agricultural ecosystem. Extreme rainfall events and related floods will also cause destruction and damage to crops, including from water logging. The rise in temperature also negatively impacts land degradation, desertification and salinization of already arid and semi-arid lands.

Vietnamese agriculture now sits at a turning point. It will have to adapt to a fast-changing demographic, economic and environmental context framed by increasing climate change risks. Smallholder farmers, and women and marginalized populations in particular will struggle the most to undergo these changes. Their resilience to incremental risks and costs they face can be facilitated through shared efforts, from communities, Government, researchers and development partners.

Several initiatives are on-going to support strengthening livelihoods and climate resilient agricultural practices across both the Central Highlands and South-Central Coast, two of the regions severely affected by the recent extreme drought in 2015-2016. One includes a planned initiative to support resilient irrigation infrastructure development under a loan from ADB; the *Water Efficiency Improvement in Drought Affected Provinces* or WEIDAP project. UNDP in collaboration with the Ministry of Agriculture and Rural Development is developing a project proposal titled '*Strengthening the resilience of smallholder agriculture to climate change-induced water insecurity in the Central Highlands and South-Central Coast regions of Viet Nam*' to be submitted to the Green Climate Fund, directly complementing the WEIDAP project. The GCF-funded project aims to achieve two major objectives. The first objective is to improve access to water for vulnerable smallholder farmers in the face of climate-induced rainfall variability and droughts. The second objective is to strengthen capacities of smallholder farmers to apply climate and market information, technologies, and practices for climate-resilient water and agricultural management.

As part of the project formulation process, an agricultural assessment was conducted to ensure that the project will address agricultural resilience issues in the context of increasing climate change. This assessment not only reviews current policy frameworks to understand gaps and challenges in implementation but also highlights good practices and lessons learnt, proposes climate resilient agriculture packages that suit local agro-climate zones, and provides specific recommendations on how the project should be designed to build resilience of the most vulnerable groups of farmers.

For the GCF project, the agricultural assessment proposes the implementation of the following approach to building agricultural resilience to climate change that integrates three major components: i) Resilience and productivity of main agricultural systems with an emphasis on poor and near poor ethnic minorities and women farmers; ii) A focus on commercial production; and iii) Employing a combination of farmer field schools and innovation platforms. The approach is facilitated by the following recommended actions:

- Selection of appropriate project locations co-located or adjacent to current WEIDAP sites

- Development of sets of climate resilient packages from which farmers can ‘mix-and-match’ the most suitable solution for their specific conditions;
- Capacity building of sub-national level agricultural extension staff through Training of Facilitators;
- Capacity building of smallholder farmers through Farmer Field Schools;
- Training in farm business management and marketing skills for smallholder farmers, farmer interest groups, cooperatives, private sector and staff of local partners;
- Providing incentives though vouchers for start-up inputs for individual farmers, farmer interest groups and eligible cooperatives in developing CRA options across project sites.
- Facilitation of market linkages through innovation platforms.

Chapter 1: Methodology

Project Background

UNDP in collaboration with the Ministry of Agriculture and Rural Development (MARD) is developing a project proposal titled 'Strengthening the resilience of smallholder agriculture to climate change-induced water insecurity in the Central Highlands and South-Central Coast regions of Viet Nam' submitted to the Green Climate Fund. The project aims to directly complement a related ADB funded MARD project 'Water efficiency improvement in five drought affected provinces of the Central Highlands and South-Central Coast Regions (WEIDAP)'. Both projects target five provinces that were severely affected by extreme drought and saline water intrusion over the 2015-16 period: Dak Lak and Dak Nong in the Central Highlands, and Khanh Hoa, Ninh Thuan and Binh Thuan in the South-Central Coast. Within these provinces, eight sub-projects have been selected by MARD with technical support from ADB for upgrading of the existing irrigation systems and support to water use efficiency; sites have been selected for their exposure to climate risks and potential for shifts from lower-value to higher-value resilient crop systems.

The GCF-funded project aims to achieve two major objectives. The first objective is to improve access to water for vulnerable smallholder farmers in the face of climate-induced rainfall variability and droughts. The second objective is to strengthen capacities of smallholder farmers to apply climate and market information, technologies, and practices for climate-resilient water and agricultural management. The project facilitates empowering vulnerable smallholders in these two regions – particularly women and ethnic minority farmers - to manage increasing climate risks to agricultural production by securing water availability, adopting climate-resilient, water-efficient agricultural cropping systems, and using climate, agricultural and other information effectively for agroecosystem risk assessment and concomitant water and agricultural planning and management. The project will also support rain-fed smallholders around the irrigation areas to invest in supplementary water sources to cope with increasing water insecurity due to climate change. Furthermore, through Farmer Field Schools (FFS), smallholders will learn to adopt and scale-up appropriate climate risk mitigation measures to cope with water insecurity, as well as methods and practices of managing soil, water and crop genetic resources to ensure ongoing, iterative adaptation to evolving climate change risks.

As part of the project formulation process, the agricultural assessment was conducted to ensure that the project will address agricultural resilience to increasing climate change. This assessment not only reviews current policy frameworks to understand gaps and challenges in implementation but also highlight good practices and lessons learnt, proposes CRA packages that suit local agro-climate zones and provides specific recommendations on how the project should be designed to build resilience of the most vulnerable groups of farmers.

Methodology

The overall objective of the agricultural assessment is to provide additional technical analysis on effective *climate resilient agriculture* (CRA) practices and to contribute technical inputs to the proposal's design.

For this assessment, CRA is defined as an integrated approach to addressing climate change and food security concerns that considers the impacts of changing weather patterns and future estimated needs for increased agricultural production. It is an integrated adaptation approach that can advance more resilient, sustainable development outcomes while taking into consideration ongoing and future climate-related impacts. It explicitly aims to increase agricultural productivity while managing current and projected climate risks. CRA approaches enable farmers and policymakers at various levels to plan for and respond to environmental changes over the short and long term.

Considering this definition, the specific objectives of this agricultural assessment include:

- Review current agricultural and climate change policy frameworks;
- Review suitability of current cropping systems and propose CRA technical packages by clusters of communes to enhance resilience. Provide technical specifications, investment and management costs for proposed CRA practices including irrigation methods/timing/preventing soil erosion particularly in sloping areas, timing for fertilizer applications; pest/disease management; landscape design, etc.
- Provide recommendations on the design and implementation of training and capacity building activities to support the effectiveness and sustainability of interventions proposed.
- Provide recommendations on how to organize or facilitate public-private partnerships to support shifts to CRA at farm, market actor and value chain level.

The methodology for this technical assessment comprised a desk review, commune clustering exercise, expert interviews, multi-stakeholder consultation meetings, and focused discussions with special interest groups such as women and ethnic minorities. Findings were validated with key groups (Government and non-Government experts) as part of the wider proposal formulation and consultation process.

- *Desk review:* The desk review was conducted to collect all available data and baseline information of the two regions of the Central Highlands and South-Central Coast from a variety of sources, including policy documents, research studies, lessons learned publications and project evaluation reports from various sources including the Government, United Nations and non-government organizations.
- *Commune clustering:* Information and data on key cropping patterns, soil type and downscaled climate projections for all 60 communes was also collected from national and local authorities to guide a 'commune clustering process' (see annex 1). Communes were grouped for similar agro-climate characteristics to facilitate a harmonized CRA technical analysis. Draft CRA packages were developed for each cluster of communes based on available information and further validated during field consultations.
- *Multi-stakeholder consultation meetings:* Two field scoping missions were conducted in January and February 2018 to the two regions covering both ADB-WEIDAP sites as well as the proposed expanded rain fed areas for this GCF project. A third mission was conducted in May 2018 to validate the proposed CRA packages by clusters of communes based on multiple meetings with local authorities at district and communal level. Consultations were conducted with DARD and other relevant departments, mass organizations and private sector representatives as follows:

    - DARDs & its sub-divisions, relevant departments at provincial, district and communal level (DARD - Crops & Plant Protection Division, Agricultural Extension Centres/stations, Irrigation sub-departments, Rural Development Sub-Department, Planning Division); DOLISA, DPI, etc.
    - Provincial Ethnic Minority Committee, Women's Union, Farmer's Union at different levels
    - Local private sector (seed/fertiliser/equipment providers, output traders, selected small agribusiness households and companies)
    - In addition, consultations were also organized with local farmer groups of poor/near poor, ethnic and women-headed households.

- *Focus group discussions:* The focus group discussions (FGDs) were conducted with participation of all vulnerable targeted groups (poor, near poor, ethnic and women-headed households) at communal level covering all ADB-WEIDAP sub-projects and non-WEIDAP sites. At least 10-15 farmers participated in each discussion, covering at least 40% of women and at least 70% of ethnic households in communes where ethnic groups are dominant. The objectives of FGDs with farmers is to explore the changing trends in current systems, identify their response to climate change in general and level of agriculture resilience in particular. The FGDs also seeks to identify gaps in access to climate information and implement the climate change resilience solutions in agricultural production. A list of proposed CRA packages, and

descriptions of the voucher system, design of FFS trainings, and records of farmers groups have been consolidated.

Chapter 2: Agricultural context in Vietnam

Overall context[1]

Over the past twenty-five years, Vietnam's agricultural sector has made immense progress. Steady advances in smallholder rice productivity and intensification through the 1990s and beyond have played a central role in Vietnam's successes in poverty reduction, national food security, and social advancement. Vietnam's average rice yields now trail only those of China among Asia's emerging economies. The country has also achieved explosive growth in agricultural exports and now ranks among the top five global exporters in products as diverse as shrimp, coffee, cashews, rice, and pepper.

Vietnam's performance in terms of agricultural yields, output, and exports, however, has been more impressive than its gains in efficiency, farmer welfare, and product quality. Vietnam lags behind regional peers in relation to agricultural land, labor, and water productivity and has seen its once robust growth in total factor productivity decline in recent years. A gap is forming between farm and non-farm incomes, and income inequality is rising within rural areas.

More output has come from more and more inputs, at increasing environmental cost. A large proportion of Vietnam's agricultural growth has stemmed from expanded or more intensive use of land and other natural resources, and relatively heavy use of fertilizer and other agro-chemicals. As a result, aspects of Vietnam's agricultural success have come at the expense of environmental quality. Environmental consequences of Vietnam's agricultural success have ranged from deforestation and fishery resource depletion, to a growing incidence of land degradation and water pollution.

Vietnamese agriculture now sits at a turning point. Over the coming 10 to 15 years, an array of demographic, economic and other factors will alter the context in which Vietnam's agriculture will need to compete. Vietnam will experience further urbanization and a large expansion in its middle class. The dietary patterns and food expenditures of domestic consumers will continue to change with reduced consumption of rice and increased consumption of animal products, fruits and vegetables, and processed foods. Climate change is expected to give rise to more erratic weather patterns.

Vietnamese agriculture's potential vulnerability to climate change risks such as shifting rainfall patterns and temperature, and sea level rise, together with the fundamental uncertainty that is intrinsic to climate change, suggest at least three orientations when it comes to planning adaptation strategies and shaping a public sector response to climate change. These are to embrace the tenets of adaptive management, to cultivate resilience by strengthening capacity for innovation at every level of society and throughout the economy, and to privilege no-regrets strategies. Improved water resources management will be critical. With increasing competition around land-use, water, and budgetary resources, irrigation will need to become more efficient and accountable.

Agricultural policies and key institutional arrangements

The Government of Vietnam has a number of key strategies and policies that provide important guidance in setting priorities for the proposal to the Green Climate Fund:

Agriculture Restructuring Plan 2013-2020

The main strategy on agriculture is the Agriculture Restructuring Plan (ARP), approved by the Prime Minister in June 2014. The ARP aims for the agricultural sector to radically shift from central planning to market-led and consumer-driven drivers, with the government's role being facilitator of investments and services provided by others rather than being the primary investor or service provider. The ARP

[1] World Bank (April 2016). Transforming Vietnamese Agriculture: Gaining More for Less. Vietnam Development Report 2016.

defines sector goals in terms of the triple bottom line of economical, social, and environmental sustainability. It lays out expected changes in the roles and spending patterns of the government in the sector and discusses the need to work with other stakeholders, including in the private sector. It focuses on forging partnerships among government, the private sector, farmer or community organizations, and the scientific community in progressing agricultural transformation.

MARD's most recent Agricultural Master Plan's priorities are in line with the ARP and focus on:

- Sustaining the growth of the agriculture sector; raising its efficiency and competitiveness by increasing productivity, quality, and added value; satisfying the demands of consumers in Viet Nam and boosting exports.
- Moving from resource-intensive to technology-intensive agricultural growth, from fragmented to consolidated land holdings, and diversifying from agriculture to rural non-farm employment.
- Improving income and living standards of rural residents, ensuring food and nutrition security in both the short and long-terms, and contributing to the reduction of poverty.
- Enhancing natural resource management, reducing negative impacts on the environment and climate change, utilizing environmental benefits, raising capacity for risk management, enhancing disaster preparedness, increasing forest coverage to 45 percent by 2020, and contributing to the National Green Growth Strategy.

Agriculture sector laws, policies and strategies linked to the ARP

MARD has issued additional policies and regulations for particular sub-sectors, including among others:

- With the objective of transforming small-scale **livestock** into a comprehensive livestock industry meeting increasing domestic demand, in 2008, the Prime Minister issued Decision No. 10/2008/QD-TTg approving the *Livestock Development Strategy by 2020*;
- To harmonize **forestry** management, protection, development, rational use of resources from forests, forest regeneration and improve the efficiency, exploitation and processing of forest products as well as environmental services and tourism attractiveness, in 2007, the Prime Minister issued the Decision No.18/2007/QĐ-TTg approving the *Forestry Development Strategy in Vietnam 2008-2020*;
- In terms of **crop production**, with the objective of "developing cultivation towards modern, sustainable, large-scale commodity production, increasing productivity, quality, efficiency and competitiveness to meet the diverse needs of domestic and export markets; improve the efficiency of land use, water, labor and capital, and increase income and livelihood of farmers", in 2012, MARD issued a *Program to Develop the Cultivation Industry by 2020, vision to 2030*. Key measures include to promote and apply high yield varieties and manufacturing processes, high quality irrigation systems; accelerate mechanization; modernize industrial storage, processing, enhance the quality, hygiene and food safety and promote value-added agriculture;
- To guide the development of sustainable **aquaculture** towards enhancing value added and sustainable development and adaptation to climate change as well as ensuring the environmental and ecological protection and aquatic resources, in 2013, the Prime Minister issued the Decision No. 1445/QD-TTg approving the *Master Plan for Aquaculture Development by 2020, vision to 2030*;
- To build efficient and sustainable **irrigation** systems, serving agricultural production adapting to climate change and sea level rise, in 2012 the Prime Minister approved Decision No. 1397/QD-TTg approving the program *Irrigation Planning in the Mekong River Delta from 2012 to 2020 and orientations to 2050 under the conditions of climate change and sea level rise*. A similar program was approved for the Red River Delta;
- In 2013, the Government issues a revised *Land Law*, stipulating guidance and limitations of **land use for agriculture, forestry and aquaculture**. For example, this revised land law extended the time limit of agricultural land use for households to fifty years from the previous twenty years;

- MARD also issued a number of policies on **science and technology development**, such as Decision No. 3246/QD-BNN-KHCN on the *Strategy on Science and Technology in Agriculture and Rural Development in the period 2013-2020*. The Strategy sets specific targets for developing science and technology in agriculture and rural development to drive the industrialization and modernization of agriculture and rural development in the country;
- On cultivating **rice**, in 2017, MARD issued the *Rice Market Development Strategy* with one of the key objectives to gradually reduce rice export volume while increasing the value of exported rice;
- Agricultural policy objectives are pursued through the use of **output and input subsidies**, and payments for the provision of services to agriculture, generally. The main domestic policy instruments, in order of most used, include price support measures (mainly subsidies to control the rice market), irrigation service fee exemption, seed and livestock breeding subsidies, credit schemes, payment based on area (for rice farmers), (pilot) insurance, income support (exemption or reduction of agricultural land taxes) and extension services (top down, supply-driven). General services provided to the agricultural sector as a whole include irrigation (largest GoV expenditure in agriculture), and research and development (under the Viet Nam Academy of Agricultural Sciences). Key trade policy instruments are tariffs, import licensing, food safety regulations, export taxes and export licensing.[2]

Agroforestry development in Viet Nam

Supportive policies on development of agroforestry in Vietnam are found in five areas: Land and Forest tenure, Science and technology and forestry extension, Credit and investment, Market and products circulation, and Taxes and fees in agroforestry production and trading. Policy on agroforestry development in Vietnam has been mentioned in some important legal documents such as: Land Law (2003); Law on Forest Protection and Development (2004); Resolution No. 30a/2008/NQ-CP dated 27/12/2008 of the Government; Decree 02/CP dated 15/1/1994 of the Government; Decree No. 01/CP 4/1/1995 of the Government; Decision No. 135/1998/QD-TTg dated 31/7/1998 of the Prime Minister; and Decision No. 178/2001/QD-TTg dated 12/11/2001 of the Prime Minister, etc.

Action Plan in Response to Climate Change in Agriculture and Rural Development

In 2008, the *Action Plan Framework for Adaptation and Mitigation of Climate Change in the Agriculture and Rural Development Sector for 2008-2020* was issued. In 2016, MARD issued an updated action plan to address climate change in the agricultural sector for the period 2016-2020 and with a vision to 2050. The plan has three major sections on: strengthening the policy and institutional framework and capacities; adaptation and mitigation actions within the agricultural sector; and prevention and mitigation of disasters within the agricultural sector. Sections two and three of the action plan include priority actions such as:

- Promotion of integrated farming models: crop-livestock, crop-fish, agro-forestry, integrated food-energy systems, closed loop agriculture etc. with adaptation and mitigation co-benefits
- Development and use of climate-resilient high yield crop varieties and breeds
- Diversification of crops and farming techniques, combining intensive farming with protection of natural resources and management of climate risks
- Forest protection and afforestation
- Invest in multi-purpose irrigation systems
- Promote water and energy-efficient irrigation techniques such as drip irrigation, sprinkler, improved drainage management, particularly for high value crops
- Construction or upgrading of reservoirs, dyke and dam systems
- Automated multi-hazard early warning systems
- Continuation of the community-based disaster risk management program

Institutional set-up

[2] OECD (2015). Food and Agricultural Policies in Viet Nam.

The current Ministry of Agriculture and Rural Development or MARD has been established since 1995 after a merger of the then called Ministries of Agriculture and Food Industry, Forestry, and Irrigation. The overarching mandate of MARD is the state management of sectors such as agriculture, forestry, salt production, aquaculture, water resources and rural development in the country.

MARD is comprised of a number of departments, general offices or general departments, and units as seen in the organizational structure below.[3] At the provincial level, this is similar for the Departments of Agriculture and Rural Development.

A recent institutional restructuring resulted in the establishment of an additional general office, the General Department of Natural Disaster Prevention and Control.

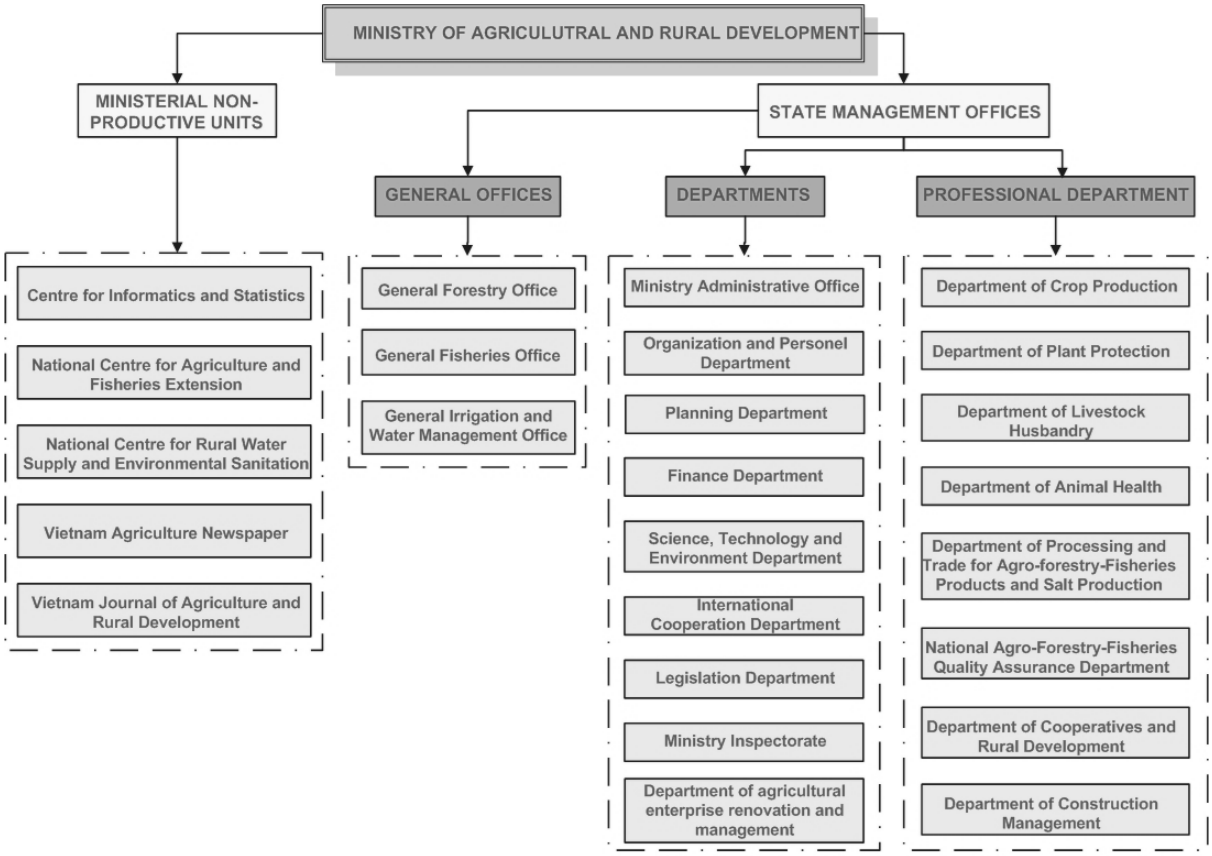


Figure 1: MARD organizational structure

Planning and implementation of policies and programs on CRA are the exclusive responsibility of MARD and are done through the MARD inter-departmental Steering Committee for Climate Change Adaptation and Mitigation. The MARD Science, Technology and Environment Department is the Standing Office of the Committee and coordinates all departments within MARD. The development of plans and allocation of resources is led by the MARD Department of Planning and Finance, with major technical input from all other departments such as the departments of crop production, plant protection, livestock and husbandry, animal health, forestry and cooperatives and rural development. Collaboration with international development partners is facilitated by the MARD International Cooperation Department.

[3] Source organizational chart: www.mard.gov.vn

Current cropping systems in the proposed project areas

The existing cropping patterns or systems in the Central Highlands and South-Central Coastal regions vary considerably from each other as a result of their different natural, historical and socio-cultural conditions.

In the Central Highlands, cropping systems consist mainly of a limited number of perennial cash crop varieties, most notably coffee and pepper. In the South-Central Coastal regions on the other hand, the cropping systems are more diverse and typified by a combination of subsistence and cash crop-based farming systems.

Agricultural profile of the Central Highlands

Before the country's reunification in 1975, the local population in the Central Highlands primarily practiced **swidden agriculture**, a type of shifting cultivation. Swidden agriculture is technically sustainable only with a low-density population such as prevailed in the Central Highlands prior to reunification. Under the swidden system, a household is a member of a kin group that claims rights to a large amount of land. In any one year the members of the kin group, under the direction of kin group leaders, cultivate only a small fraction of the lands over which the group has claims. When productivity of cultivated plots drops off, the group moves to other areas of their lands; they clear them and cultivate them until the soils become exhausted again, and then move on to other areas. By the end of about a 15 to 20-year cycle, the fertility of the first lands will have revived and the group is back to clearing and cultivating them again.

Reunification, collectivization of agricultural land and the planned migration of large number of Kinh undercut the swidden agricultural system in the Central Highlands and drove the region to **intensive agriculture**. By 1985, state plantations had absorbed seventy percent of the agricultural land in Dak Lak, Gia Lai and Kon Tum provinces. The land law of 1993 introduced the possibility of purchasing and selling land which furthered the expansion of intensive agriculture.

The Central Highlands of Viet Nam have a long tradition of **cash-crop production**. Rainfed agriculture is the predominant farming system in the Central Highlands. The area has low natural soil fertility. This means that high nutrient demanding industrial crops and fruit trees are not suitable economically for these regions.

Large areas are cultivated with the main cash crops, namely coffee and pepper. The existing coffee plantations in the Central Highlands are around 20 years old. There, production is comparatively low on a global scale, with the 3-year average of production below 2 tons/ha. Root rot disease is a key impediment to production. More recently additional cash crops such as durian and avocado have been introduced into region. These are being intercropped with coffee and pepper in different forms.

Agricultural profile of the South-Central Coast

In the South-Central Coast, the cropping systems and crop varieties are more diverse and **combine cash crop and subsistence farming.** The region has two distinct cropping zones: the mountainous South-Central regions and the more lowland South-Coastal region. In mountainous areas the main crops include cashew nut, rubber, cassava, beans and vegetables such as garlic and onions. In the lowland areas, annual crops such as paddy rice, maize and also vegetables, such as garlic and onion and beans/legumes are common. However, perennial crops are also grown such as apples, grapes, dragon fruit, other fruit trees.

In addition to crops, farmers also raise livestock, such as cows, goats, pigs and poultry. In most households this is limited to a few heads and as a contingency, but for some households, especially in the South-Central Coast, the number is higher and livestock is more sold for additional income.

Table 1 List of main cropping systems and soil types in the project regions

Project regions	Provinces	Main annual crops	Main perennial crops	Main soil types
South-Coastal region	Khanh Hoa	Maize, cassava, beans	Mango, banana	acrisols, ferralsols
	Ninh Thuan	Maize, beans, onion, garlic, cassava, sugarcane, sesame, rice	Fruit trees (grapefruit, pomelo, mango), soursop, cashewnut, banana, avocado	acrisols, ferralsols, fluvisols, leptosols
	Binh Thuan	Maize, cassava, beans, rice	Dragonfruit, cashewnut, coffee, pepper	acrisols, ferralsols, arenosols, rhodic
Central Highlands	Dak Lak	Maize, cassava	Coffee, pepper, durian, oranges, avocado, cocoa	ferralsols, rhodic
	Dak Nong	Maize, cassava, beans, peanuts, vegetables, rice	Coffee, pepper, cashewnut, cocoa	ferralsols, rhodic

Table 2: Crop calendar for most commonly grown crops

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Note
Perennial crops													
Coffee	blossom									harvesting			Perennial tree
Pepper		harvesting		blossom									Perennial tree
Dragon fruit			harvesting, but mixed schedule										Perennial tree
Mango		harvesting											Perennial tree
Avocado					planting		harvest						Perennial tree
Durian						planting and harvesting							Perennial tree
Banana	planting throughout the year										harvest		Perennial tree
Apple	3-4 crops per year, harvesting any time, but mainly August-September												Perennial tree
Grape	3-4 crops per year, harvesting any time, but mainly August-September												Perennial
Apple	3-4 crops per year, harvesting any time, but mainly August-September												Perennial tree
Citrus (pomelo/ orange)						planting		planting					3 planting seasons / year
Annual crops													
Maize				Planting and harvesting					planting and harvesting				2 crops / year
Cassava				planting					planting				2 crops / year
Rice	planting			harvesting		planting			harvesting				2 planting seasons / year
Onion	4-5 crops per year, harvesting any time, but mainly January-February												2-3 months / crop
Garlic	harvesting									planting			1 crop / year

Chapter 3: Climate risk and vulnerability in target areas

Observed and projected climate variability and change

Both the Central Highlands and South-Central Coast are located in the tropical savanna climate zone, but have several local sub-climate zones due to the varied topography: upland or mountainous areas are on average wetter, lowland and coastal areas are drier, and the plateau regions of the Highlands are in between. Overall, the Central Highlands can be described as a region with moderate temperatures but high rainfall, and the South-Central Coast as a region with high temperatures and low rainfall. 80 to 90 percent of the rainfall in both regions is in the rainy season, around May-October and both regions know a long dry period from December to April.

These distinct sub-climate zones result in specific climate change risks for each region, as specified in the table below:

Table 3: Current observed and projected changes in climate and weather-related events in the Central Highlands and South-Central Coast

Central Highlands	South-Central Coast
OBSERVED CHANGES:	
Temperature increase: ▪ A significant trend of about 0.04 to 0.35°C temperature increase per decade ▪ More hot days and fewer cool nights Changing precipitation patterns: ▪ Overall slight increase in annual rainfall but with variations per location ▪ Increased extreme rainfall amounts Drought and flood risk: ▪ The most frequent disaster events have been heavy rainfall-induced floods, storms, landslides and drought ▪ Droughts are becoming more severe and are impacting a larger area than before	Temperature increase: ▪ Annual temperature has slightly increased, with a trend of about 0.08 to 0.16°C increase per decade ▪ More hot days and no changes in cool nights Changing precipitation patterns: ▪ Annual rainfall has increased significantly, with local increases of up to 13 percent particularly in the southern parts of this region. However, there are differences between seasons, with the amount of rainfall reducing during the dry season but increasing during the rainy season. ▪ Increased extreme rainfall amounts Drought and flood risk: ▪ The most frequent disaster events have been floods, drought, heat waves and strong winds.
FUTURE CLIMATE SCENARIOS:	
Temperature increase: ▪ An increase in annual temperatures of about 1.2 to 2.6°C by mid-century and 2.2 to 4.5°C by end-of-century for the higher (RCP8.5) greenhouse gas scenario ▪ The number of hot days (days with maximum temperatures above 35°C) is projected to increase by 15 to 20 days a year in the lower lying parts of this region	Temperature increase: ▪ An increase in annual temperatures of about 1.2 to 2.5°C by mid-century and 2.4 to 4.3°C by end-of-century for the higher (RCP8.5) greenhouse gas scenario ▪ An increase in the number, length and intensity of heat waves and number of hot days (days with maximum temperatures above 35°C) by end-of-century Changing precipitation patterns:

Central Highlands	South-Central Coast
▪ The number of heat waves is projected to increase by a range of 3 to 6 days by end-of-century, especially for the southern part of this region Changing precipitation patterns: ▪ A 15 to 20 percent increase in rainfall in the wet season - which will start earlier and end later -, and 10 percent decrease and more irregular rainfall in the dry season ▪ In addition to a delayed onset, the length and intensity of the southwest monsoon are both expected to decrease slightly by mid-century and continue to decrease further by end-of-century, bringing less overall rainfall to the region and resulting in a drier dry season Overall drought and flood risk: ▪ The magnitude and frequency of floods during the wet season increases due to increased intense rainfall linked to longer and wetter monsoon conditions ▪ Droughts will become more severe due to rising temperatures and rainfall deficits in the dry season, particularly in the northern part of the region	▪ Rainfall in the wet season will increase by 20 percent, particularly in October-November, but rainfall in the monsoon months, June till September, will likely decrease. ▪ The wet season will likely be shorter, starting later (up to 15 days) and ending earlier (up to 30 days) ▪ In addition to a delayed onset, both the length and intensity of the southwest monsoon are expected to decrease significantly. By mid-century, the season length will be reduced by about two weeks and rainfall is reduced by 40 percent. Overall drought and flood risk: ▪ Droughts in general will occur less often as rainfall will increase during the dry season, but droughts will become more extreme and last longer due to rising temperatures, a changing monsoon and rainfall deficits in the dry season. ▪ Flood risk will also increase, but mainly in the upland areas and the northern part of the region

Impact of climate change on agriculture in the proposed project areas

Climate change presents a major challenge for agricultural production in Viet Nam. Crop productivity will be most impacted by reduced water and nutrient availability caused by increased extreme droughts, rainfall extremes with higher flood risk, heat waves, and more unpredictable and shifting wet and dry season variability.

Climate change can have direct or indirect impacts on agricultural production, possibly reducing agricultural productivity in Vietnam by 2 to 15 percent in the 2080s, with a potential 13.6 percent productivity reduction for rice, 5 percent for livestock and 7.4 for other crops.[4] Climate extremes such as floods, droughts, salinity, etc., can decrease rice production in Viet Nam by 2.7 million tons per year by 2050.[5]

Crop yields in upland areas will be negatively impacted by seasonal changes (for example a delayed onset of the rainy season) and more unpredictable precipitation patterns. Prolonged drought that occurs frequently will result in crop failure, and will alter the structure of the agricultural ecosystem. Without effective adaptation action, some high-value crops could disappear, and be replaced by drought-tolerant crops with low nutritional value. Extreme rainfall events and related floods will also cause destruction and damage to crops, including from water logging. The rise in temperature causes land degradation, desertification and salinization of already arid and semi-arid lands.

[4] Zhai, F., and J. Zhuang. 2009. Agricultural Impact of Climate Change: A General Equilibrium Analysis with Special Reference to Southeast Asia. ADBI Working Paper 131. Tokyo: Asian Development Bank Institute.
[5] B. Yu et al., Impacts of Climate Change on Agriculture and Policy Options for Adaptation: The Case of Vietnam, 2010.

The table below provides an overview of key cash crops and their specific vulnerabilities to climate extremes.

Table 4: Key crops and climate vulnerabilities

Key crops	Climate vulnerability
Perennial crops	
Coffee	- The resilience of coffee monoculture production systems to increasing evapotranspiration, drought periods or devastating extreme rainfall events is very low. In addition, suitability of growing conditions is projected to decrease from high to moderate in 2050.
Black pepper	- Black pepper is very vulnerable to increased temperature and extreme weather events such as heavy rainfall and droughts. An extreme drought can affect pepper production with 50 percent yield reduction over three years and 25 percent the following year.
Dragon fruit	- Dragon fruit is more robust and drought resilient so not particularly vulnerable. However, an extreme drought can affect yield production with 50 percent over three years and 25 percent the following year.
Mango	- Mangoes have low vulnerability, but they are susceptible to extreme rainfall events during the flowering and fruiting time (February to May, with peak in March-April). They are drought-tolerant and to a certain extent also flood-tolerant.
Avocado	- Avocadoes have low climate vulnerability but are very sensitive to pests and diseases and suffer from inadequate on-farm management, particularly during harvesting.
Durian	- Durian can be considered as having low vulnerability, except for rapid onset events such as floods, strong winds and storms.
Grapes	- Grapes are medium vulnerable, and primarily affected by heavy rainfall (and related flood) events during the flowering and harvest period. They are fairly resilient to dry conditions, but droughts also reduce the yield.
Cashews	- Cashews are considered to have low vulnerability, especially to the projected increase of temperature, number of hot days and heat waves. As with other crops, heavy rain during flowering or close to harvest can be harmful.
Annual crops	
Maize	- Maize is highly vulnerable with growing suitability reducing. It is very susceptible to small changes in temperature and rainfall, with significant reductions in yield as a result; each day above 30°C reduces the yield, with 35°C being the maximum tolerance.
Cassava	- Vulnerability is low, with cassava being a robust crop. It is slightly affected by increased rainfall, but benefiting from an increased temperature, particularly in uplands.
Rice	- Vulnerability is high but depending on the variety. Rice is very vulnerable to extreme droughts, heat waves, and to high temperatures during the dry season. Rain-fed rice is particularly vulnerable to changing precipitation and drought, with potential yield reductions of up to 40 percent.
Garlic	- Garlic is considered to have medium vulnerability to drought. Onion and vegetables are vulnerable to extreme rainfall events, particularly when unseasonal

Climate change impacts on agricultural production in the Central Highlands

Droughts are becoming more severe and are impacting a larger agricultural land area than before. For example, the area most severely impacted by the recent drought in 2015-2016 was 2.1 to 2.5 times larger than in 2010. In addition, farm areas that have never experienced drought are now also increasingly affected. The recent drought damaged or destroyed 90,744ha of crops, mainly perennial crops, in Dak Lak; and 18,525ha of crops, mainly perennials, in Dak Nong. The recent drought, with 40 percent less rainfall than normal in Dak Nong and 49 percent less than normal in Dak Lak for June-September, can be considered as a 1 in 100 years event. However, for the coming 25 years, there is a 22 percent chance that a similar event will occur.

Declines in productivity may be higher in the Central Highlands as production depends on rain. Coffee production, which is concentrated in the Central Highlands, is expected to be hit by intensive droughts, higher temperatures, more temperature extremes and increasing frequency of heat waves that cause increased evapotranspiration, and increased pest incidence. According to a CIAT study with a focus on Robusta coffee some areas are predicted to decrease in climatic suitability and thus adaptation measures will be crucial. These areas are mainly located in Lam Dong and Dak Nong. In addition, there will be production zones that become unsuitable for Robusta production in regards to climatic conditions. These zones are located in Dak Lak, Gia Lai and Dong Nai.[6]

Climate change impacts on agricultural production in the South-Coastal Regions

Similarly, as in the Central Highlands, drought is affecting an increasingly larger agricultural land area. The recent El-Niño-induced drought in 2015-2016 damaged or destroyed 12,102ha of crops, mainly fruit trees, in Binh Thuan; 1,215ha of crops, mainly perennial, in Ninh Thuan; and 36,400ha, mainly perennial and rice, in Khanh Hoa. This recent extreme drought, with 45 percent less rainfall than normal in Binh Thuan and 70 percent less than normal in Ninh Thuan and Khanh Hoa for the period June-September, can be considered as a 1 in 100 years event. However, for the coming 25 years, there is a 22 percent chance that a similar event will occur.

In the South-Coastal region, for example in Binh Thuan, less and less land is being cultivated during the dry season because of more severe weather conditions during the dry season, unpredictable precipitation and limited or unreliable irrigation capacity. Not having the opportunity for irrigation, land is increasingly lost to degradation processes, which makes it even less attractive for further cultivation. Similar trends are reported for Ninh Thuan and Khanh Hoa.

Additionally, the predominant sandy soils in Ninh Thuan are being degraded and dehydrated due to severe and frequent droughts, low water levels, increasing salt intrusion, high evaporation rates and unsustainable cultivation methods. Rice paddy fields are severely dehydrated due to harsh droughts resulting in insecure rice production, low efficiency and high risks.

Socio-economic aspects of climate vulnerability in target areas

Over the past two decades, a combination of government policy and programs, coupled with international development assistance has enabled many farmers to move out of poverty. However, these gains have been uneven, and in many areas, the remaining poorest population of farmers are still struggling, particularly in the face of increasing climate change risk.

A World Bank study looking at the social dimensions of climate change adaptation identifies the main social vulnerabilities for both regions. For the Central Highlands, these include a high number of ethnic minorities, high rates of poverty, many migrants (including the Kinh majority and ethnic minorities who have migrated in from other regions in the country), and a high number of farmers depending on rain-fed and subsistence agriculture. For the South-Central Coast, social vulnerability is largely determined

[6] Läderach, P. et al; Future Climate Scenarios for Vietnam's Robusta Coffee Growing Areas, CIAT 2012

by high rates of poverty, particularly among pockets of ethnic minority groups, and a dependency on rain-fed agriculture in many areas.[7]

Field visits for this study confirmed that a significant percentage of vulnerable groups have inter-cropping systems, but they are constrained by financial and technical issues, including a limited understanding of irrigation methods and prevention of soil erosion, particularly in sloping areas, timing of fertilizer applications; pest and disease management; landscape design, or just simply lacking capital to invest in more resilient seeds or techniques.

It is common for poor farmers to source inputs (fertilizers, seeds, seedlings) from local suppliers on credit. Farmers pay back the local suppliers when they harvest the products, either in cash or in harvested products. In most target areas, smallholder farmers sell their products through local middlemen (collectors of products) and agents at a low price rather than processing them for a premium in situ.

Farmers often have little or no capacity to bargain with traders. Instead, it is common for farmers to follow local trends in crop production: they increase growth of a certain number of crops for few years and then reduce production when prices go down.

In many areas, farmer common interest groups or cooperatives are weak and farmers lack mechanisms for peer-to-peer learning and information sharing on key issues such as changes or trends in markets. Although a network of Farmer Field Schools exists, it is not able to provide sufficient coverage, extension staff and champion famers lack information on key issues such as climate risk management, and it does not fulfil its potential as a way to galvanize learning between farmers or provide linkages to markets. Crop planning, market access, and climate information advice and technical training for poorer farmers are very limited.

[7] McElwee P. (December 2010). The Social Dimensions of Adaptation to Climate Change in Vietnam. World Bank Discussion Paper Number 17.

Chapter 4: Past and on-going support to improve agricultural practices in the Central Highlands and South-Central Coast

Several initiatives have worked or are continuing to support the strengthening of livelihoods and CRA practices across both regions, by MARD, research organizations, NGOs and private sector in Viet Nam. This is in addition to the various good practices implemented autonomously by the farmers themselves, as described in the next chapter. The following section provides a non-exhaustive list of a number of key initiatives.

Government programs and projects

The Government is actively supporting the transformation towards modernized and resilient agriculture through various programs and projects, funded through state budget, loans or grant funding:

National Target Programme on New Rural Development:

- The *National Targeted Program on New Rural Development* (NTP NRD) 2016-2020, coordinated by MARD, aims to modernize rural areas of Vietnam and improve living conditions by promoting a model-system of a 'new rural commune'. A commune attains this status when it delivers on 19 economic and social criteria in terms of socio-economic infrastructure, modernized agricultural production systems with links to industrial and services development, income generation and poverty reduction, clean water supply and sanitation, social protection, governance, cultural development, health improvements, etc. The objective is for 50 percent of all communes in the country to reach the 'new rural commune' status by 2020. Each set of criteria comes with specific policies and programs to achieve the overall status, the majority stemming from a continuation of previous sectoral targeted programs.
- From 2014 to 2017, FAO (lead), UNIDO, UNESCO, IOM and UNV, in partnership with MARD implemented the joint program *Support to the National Target Programme on the New Rural Development*. The program was implemented at national level with pilots in Son La and Quang Nam. The components were: (i) rural residents and producers' knowledge enhanced for modernizing agro-production, rural livelihoods and social development; (ii) capacity building in policy, strategy and public investment for creating new incentives for the new rural development process; and (iii) coordination and M&E of the NRP NRD. Activities included: development of new agricultural technologies, commune learning centers and cultural houses, value chain improvement, capacity building, policy advisory task force, participatory planning, and results-based M&E.

Productive Rural Infrastructure Sector in the Central Highlands

- From 2014 to 2019, MARD is implementing the irrigation and rural roads development project *Productive Rural Infrastructure Sector Project in the Central Highlands* in all five Central Highlands provinces, through a US$ 80 million loan from ADB. The objective is to increase rural and agricultural productivity, increase rural incomes and sustain livelihoods by regenerating and upgrading underdeveloped or outdated productive rural irrigation and road infrastructure in targeted areas with good potential for agricultural production with existing irrigation schemes. It directly supports the implementation of the NTP NRD.

Core Agriculture Support Program

- Since 2006, ADB, FAO and IFAD have supported countries in the Greater Mekong Sub-region (GMS) to reform their agricultural sector through the regional *Core Agriculture Support Program* or CASP. In Viet Nam the project is mainly implemented at national level, with pilot activities in Northern provinces.
- Phase I of the program – from 2006 to 2010 - focused on facilitating cross-border agricultural trade and investment, promoting public-private partnerships, enhancing capacity in agricultural science and technology, establishing emergency response mechanisms for agricultural and natural resources crises and strengthening institutional linkages and mechanisms for cooperation. Phase I achieved

various results. CASP Phase I moved forward several regional cooperation strategies. Measures related to facilitating cross-border agricultural trade and investment that include regional initiatives to strengthen human and institutional resources to implement sanitary and phytosanitary measures have been achieved. Public–private partnership initiatives have been launched to facilitate the sharing of agricultural information, including the GMS *Agriculture Information Network Service*. Progress has been made in preventing and controlling transboundary invasive species and animal diseases based on regional emergency response mechanisms to manage agricultural and natural resources crises in the GMS.

- Phase II – from 2011 to 2020 - focuses on promoting food safety and modernizing agricultural trade, promoting climate-friendly agriculture via market-based strategies (including carbon finance, climate-resilient farming systems, weather-based insurance) and promoting agriculture as a source of clean rural renewable energy. Support is provided to enhance access to the growing market opportunities for climate friendly agri-food products as well as financial incentives under the Clean Development Mechanism for the agriculture sector. Cross-border management of natural resource conservation, including protection against invasive species and animal diseases, will be promoted, particularly among smallholder farmers. The four building blocks under this component are (i) carbon finance for agriculture, (ii) climate-resilient farming systems, (iii) weather-based insurance system, and (iv) transboundary invasive species and animal disease control.

Integrating Agriculture in National Adaptation Planning

- From 2015 to 2018, UNDP and FAO are supporting MARD and MoNRE on agriculture and adaptation planning through the multi-country program *Integrating Agriculture in National Adaptation Plans (NAP-Ag)*, funded through the German Government's International Climate Initiative. The program aims to strengthen technical capacity on risk-informed investment planning and budgeting, develop integrated roadmaps for economically viable and gender-responsive national adaptation plans, improve the resilient agricultural impact evidence base to inform the adaptation plans, and promote agricultural national adaptation plans through advocacy and knowledge sharing.

Central Highlands Poverty Reduction

- From 2014 until 2019, the Ministry of Planning and Investment, in conjunction with local DARDs, is implementing the *Central Highlands Poverty Reduction Project*, in all five Central Highlands provinces, through a US$ 150 million loan from the World Bank. The overall objective of the project is to enhance living standards by improving livelihood opportunities in upland areas. The project has the following components: village and commune infrastructure development; sustainable livelihoods development by linking farmer groups and agricultural enterprises for investment in commercial agriculture or agroforestry; connective infrastructure development, capacity building and communication.
- The component on sustainable livelihoods supports ethnic minorities and other households in the targeted areas to enhance their food security and nutrition, their productive capacities for more diversified income sources, and their linkages to selected agricultural markets. It includes activities such as: (a) strengthening household and community food security and nutrition via improved practices for staple food crops and small livestock-raising, soil management on sloping land, home garden development, nutrition awareness etc.; and (b) sustaining and diversifying income sources by enhancing the productive capacities of beneficiaries on small-scale cash crop production, forestry management and development, livestock development, etc.; and (c) developing productive partnerships between farmer groups and agribusinesses operating in the targeted areas for proven commercially viable agriculture and agro-forestry endeavors.

Enhancing Agricultural Competitiveness in Viet Nam

- Started in 2017, MARD is implementing the project *Enhancing Agricultural Competitiveness in Viet Nam* in Khanh Hoa, Can Tho and Thai Binh, with a US$ 1.8 million grant from the Japan Fund for Poverty Reduction, administered by ADB. The project aims to establish public-private collaboration arrangements in agriculture value chains and strengthen public investment planning and expenditure management for agriculture commercialization.

- Output 1 on public–private collaboration arrangements in agriculture value chains will establish public and private collaboration arrangements to promote the development of agriculture value chains for selected commodities. It will also develop financing mechanisms for agribusiness development, taking climate risks into consideration. Activities under this output will include (i) identifying commodities in which the selected provinces have a comparative advantage; (ii) supporting dialogue between public (i.e. provincial agencies) and private entities (i.e. companies or business associations) to facilitate agribusiness engagements; (iii) undertaking value chain assessments, market condition surveys, demand assessments, and identifying technology gaps and opportunities to promote innovation; (iv) identifying gaps in the current access to finance and the formulation of climate-responsive agribusiness financing mechanisms for both investment and working capital; and (v) establishing collaborative arrangements for agribusiness development, including specifying arrangements between public and private entities.
- Activities under output 2 on public investment planning and expenditure management for agricultural commercialization will build capacity of the public sector to assume roles in facilitating agribusiness development as defined under output 1. The output will result in agribusiness-related investments in infrastructure, processing, post-harvest distribution, and quality assurance being prioritized for inclusion in provincial medium-term investment plans. It will also adopt a framework to promote innovation and technology adoption within agriculture value chains. Activities will include (i) conducting policy and institutional analysis on agribusiness enabling conditions, (ii) helping define roles and responsibilities of key public sector institutions in promoting innovation and technology adoption in selected agriculture value chains, (iii) developing a framework to prioritize agribusiness infrastructure and service investments, (iv) building capacity to establish an agribusiness perspective in medium-term investment plans and expenditure frameworks, and (v) developing provincial agribusiness value chain strategies and action plans.

Vietnam Sustainable Agriculture Transformation

- From 2015 to 2020, MARD is implementing the *Vietnam Sustainable Agriculture Transformation Project* or VnSAT project, funded through a US$ 238 million loan from the World Bank. The aim is to improve farming practices and value chains and promote institutional strengthening for the effective implementation of the agricultural restructuring plan.
- The program focuses on upgrading or modernizing rice cultivation for the Mekong Delta. For the Central Highlands, the project focuses on intensive coffee rejuvenation, replanting and sustainable production program, and capacity building of national and local Government and value chain partners to support agricultural transformation. The beneficiary target is 62,000 coffee-producing households. Activities include: training programs, farmer field schools, demonstration models, farmer group establishment, preferential loans for coffee replanting and rejuvenation, loans for farmers to invest in water efficiency technologies such as drip irrigation and roots watering, technical support on coffee certification, a virtual call center linked to mobile applications etc.

Private Sector Engagement for Agricultural Development

- Since 2013, the World Bank International Finance Corporation is implementing the *Private Sector Engagement for Agricultural Development* project, through a US$ 7.6 million grant from the Government of Canada. The project aims to improve sustainable rural growth for 7,500 farmers in the Mekong delta and Central Highlands of Vietnam, and focuses on: (i) increasing lending for agricultural activities by up to five private sector banks to give farmers the means to invest in the most profitable seeds, techniques and storage equipment and to give them the flexibility to wait for the ideal time to sell their goods at better prices; (ii) providing training to farmers to help them improve their agricultural practices by diversifying their income streams and improving their financial management; and (iii) improving the handling and storage of crops by farmers, agribusinesses and warehouses to ensure that the quality, quantity, and market value of crops are maintained.

Sustainable Economic Empowerment of Ethnic Minorities

- Between 2010 and 2016, IFAD supported Dak Nong DARD through the *Sustainable Economic Empowerment of Ethnic Minorities project*. The main objective was to contribute to the sustainable

improvement of the livelihoods of poor and ethnic minority households, with particular focus on women. The project had two components: (i) ethnic minority livelihood development; and (ii) rural financial services, with activities such as: development and promotion of livelihood models, enterprise-to-farmer and farmer-to-farmer extension services, training programs, set-up of farmer interest groups, a loan program based on joint liability, a Women's Union managed credit program, construction or upgrading of roads, bridge, drainage and waste management systems, irrigation canals and dams, water supply systems, and drying yards.

Agriculture, Farmers and Rural Areas Support

- Between 2011 and 2017, IFAD has also supported Ninh Thuan, Gia Lai and Tuyen Quang through the *Agriculture, Farmers and Rural Areas Support Project*. The objective of the project was to sustainably improve livelihoods among ethnic minority and rural poor households, with the following three major components: (i) institutional strengthening for implementation of pro-poor initiatives; (ii) pro-poor value chain development; and (iii) commune market-oriented socio-economic development planning and implementation. Activities included: value chain mapping and assessment, set up of farmer interest groups, development and promotion of livelihood models, competitive grant schemes for farmer groups and rural enterprises, a Women's Union managed credit program, training for farmers, extension workers, planners and other local authorities, construction or upgrading of roads, bridges, irrigation, water supply systems, electricity lines and markets.

Non-Government programs and projects

Complementing Government programs are the following key initiatives from the civil society and private sector:

Partnership for Sustainable Agriculture in Vietnam

- In 2015, as part of the regional 'Grow Asia' Initiative, over 60 partners from global and local companies, provincial governments, national research institutes, international organizations and NGOs established the *Partnership for Sustainable Agriculture in Vietnam*. Partners include, among others: MARD (Crop and Plant Protection Department, National Agriculture Extension Center, Western Highlands Agriculture and Forestry Science Institute, Northern Mountainous Agriculture and Forestry Science Institute, Institute of Policy and Strategy for Agriculture and Rural development, Directorate of Fisheries, Department of Planning, Vietnam Academy of Agricultural Sciences), Viet Nam Tea Association, GIZ, SNV, WWF, IDH's Sustainable Trade Initiative, Nestle, Jacobs Douwe Egberts, Olam, ACOM, Unilever, PepsiCo, Bayer, Syngenta, DuPont, Dow AgroSciences, Monsanto, Cargill, Metro Cash Carry, Intimex, Vina Fruit, EDE Consulting, Rainforest Alliance, 4C/Global Coffee Platform ea.
- The multi-stakeholder platform aims to support agricultural transformation by scaling solutions and supporting knowledge management – including through its 'Grow Asia Exchange' online portal - on inclusive finance, digital solutions and farmer aggregation. It focuses on six crops (coffee, tea, rice, corn, pepper and potatoes) and the cross-cutting issue of agrochemicals.
- Activities so far have included: farmer training on agrochemical use, development of national curricula on sustainable agriculture, pilots on improved on-farm management of agrochemicals, farmer group and cooperative establishment, demonstration farms, introduction of water-efficiency technology, certification of farms and rural enterprise, and support to sectoral coordination.

Sustainable Coffee

- From 2014 until 2019, the International Water Management Institute and E.D.E. Consulting, with US$ 2.2 million funding from Nestlé and the Swiss Agency for Development and Cooperation, partnered with the Hanoi University of Science and the local DARDs for the program *More coffee with less water – towards a reduction of the blue water footprint in coffee production*. The program targets 50,000 coffee farmers in the Central Highlands, and includes a large training program on

irrigation management and application of good agricultural practices, an online and SMS based weather information system and policy support on water management.

- From 2016 to 2018, Atlantic Commodities Vietnam Ltd., a Vietnamese coffee and cocoa exporter, with funding from Jacobs Douwe Egberts/Mondelez International, and in partnership with DARD, is implementing the *Cultivation Soil Management and Water Conservation project* in Dak Lak and Lam Dong. Through demonstration farms and farmer groups, the project aims to promote the adoption of agroforestry systems, improved soil and nutrient management, terrace farming, water conservation, coffee rejuvenation and certified coffee production, targeting over 2,000 farmers and 3,500ha.
- The above project builds on a previous project implemented by ACOM in 2013-2015 in Lam Dong, with co-funding from the Sustainable Trade Initiative or IDH and Mondelez International through their *Coffee Made Happy program*. The project provided trainings to 1,500 farmers on good agricultural practices, record keeping and business planning; seedlings, shade trees and other inputs; soil testing and fertilizer recommendations; and support on obtaining and sustaining coffee certification.
- From 2016 to 2018, SIMEXCO, a large state-owned coffee bean exporter, in partnership with UTZ, E.D.E. Consulting and the Western Highlands Agriculture and Forestry Science Institute, implemented the *Sustainable Coffee Landscape project* in Dak Lak. The project aims to raise awareness of 5,362 farmers (with 7,604ha of farm land) about climate change impacts on coffee production and possible adaptation options, including the need to reduce water consumption through more efficient technologies, improve the use of fertilizers without harming the environment, and the advantages of farmer groups. The project conducts Farmer Field Schools, demonstration plots and extensive data gathering through Farmer Field Books.
- All the above public-private partnerships are closely linked to the IDH flagship programs the *Initiative for Sustainable Landscapes* and the *Sustainable Coffee Program.* The initiative aims to bring the public, private and civil society sector together to co-invest in farm landscape improvement and sustainable production, through inter-cropping, agroforestry, improved fertilizer and water management etc. The program works mostly at the national level by providing a platform for dialogue between public, private and civil society partners. In Viet Nam, the platform is called the *Vietnam Coffee Coordination Board*, chaired by MARD.
- From 2017 to 2021, a research partnership led by the French Agricultural Research Centre for International Development, and including ICRAF World Agroforestry Centre, SNV, international and local universities and private sector partners such as the international company Illy, is implementing the *Breeding Coffee for Agroforestry Systems project*. The project is running in Viet Nam (including the Central Highlands), Nicaragua, El Salvador and Cameroon and is funded through a US$ 5.4million grant from the European Union *Horizon 2020* research and innovation program. It aims to diversify the range of varieties available and cropping practices integrated into agroforestry systems for a more sustainable coffee production.

Vietnamese Cooperative Enterprise Development

- Between 2015 and 2020, the NGO Société de Coopération pour le Développement International is implementing the *Vietnamese Cooperative Enterprise Development project* in five provinces (Ninh Thuan, Binh Thuan, Ben Tre, Lam Dong and Soc Trang), with US$ 12.9 million grant funding from the Government of Canada. The project aims to increase the competitiveness of Vietnamese agricultural cooperatives, helping create economic opportunities for over 10,000 smallholder farmers, particularly women.
- The project will develop a national strategy to scale up and replicate the success of high-performance cooperatives. It will assist cooperatives to create and implement business plans, while developing financing mechanisms to enable them to acquire new technology for the processing and marketing of agricultural products (such as dragon fruit and grapes in Binh Thuan and Ninh Thuan respectively). In addition, it will deliver Farmer Field School training programs on governance and gender equality, environmentally sustainable agricultural production techniques, such as safe application of fertilizer and pesticides, and post-harvest handling in order to meet quality certification standards and access new markets.

Enhancing Opportunities for Women's Enterprises

- From 2016 to 2020, SNV in partnership with MARD, the Viet Nam Chamber of Commerce and Industries and the local Women's Union, is implementing the *Enhancing Opportunities for Women's Enterprises project*. The project is implemented in Binh Thuan, Ninh Thuan, Binh Dinh and Quang Binh and focuses on strengthening women's entrepreneurship, improving access to inputs and business assets, and increasing women's leadership at all levels of the value chain. A similar project is implemented by SNV, CARE International and Oxfam in North Viet Nam (Lao Cai and Bac Kan), called '*Women's Economic Empowerment through Agriculture Value Chain Enhancement*' or WEAVE, from 2016 to 2019.

Chapter 5: Climate Resilient Agriculture Good Practices and Lessons Learned

Existing Farmer Good Practice on Climate Resilient Agriculture

The projects outlined above have provided a base of solid learning and good practice that is highly relevant to the development of future climate resilience building efforts being considered in the development of the GCF project. In the project's target provinces, a number of existing good practices are performed by farmers which can be scaled up to enhance climate resilience of cropping systems through improved soil, water and nutrient management, crop diversification, agroforestry and integrated farming. These include:

- **Water and input saving, moisture-preserving practices for efficient water management:** such as 1) Mulching is applying a layer of material to the surface of the soil. It protects the soil against rain splash, and maintains a favorable soil microclimate such as higher moisture or reduced heat by using vegetative residues and organic materials to form a protective surface layer; 2) Cover cropping is a crop planted primarily to manage soil erosion, soil fertility and quality, water, weeds, pests, diseases and biodiversity. Cover crop species may be chosen for nitrogen fixation capabilities, such as leguminous plants, or for economic diversification purposes and 3) Minimum tillage systems combined with a legume cover are also effective in controlling erosion in tropical regions. In contrast to intensive tillage of the soil, minimum tillage includes reduced disruption of the soil which improves soil fertility, structure and infiltration. Plants such as Guinea grass (*Panicum maximum*) can be used to create barriers while requiring only minimum tillage. This can be combined with *Arachis pintoi* as a cover crop, while other species such as Adzuki beans (*Phaseolus calcaratus*) can be used as an alternate year 'relay' crop with minimum tillage. This system has been shown to reduce erosion by 39-84% and by 93-100% with cover crop, while minimum tillage with relay cropping reduced soil loss by 94% compared to farmers' conventional maize cropping practice. This is relevant for particularly for highland areas at higher risk of flash-floods and erosion.

Mulching

Cover cropping in rice fields with legumes

Vegetables grown with minimum tillage

- **Inter-cropping or rotational cropping:** 1) intercropping is a multiple cropping practice involving growing two or more crops in proximity. The goal of intercropping is to produce a greater yield on a given piece of land by making use of resources or ecological processes that would otherwise not be utilized by a single crop. Benefits are, for example, natural resource (water, nutrients etc.) sharing between crops, yield enhancements, and pest management. 2) Crop rotation is the practice of growing a series of dissimilar or different types of crops in the same area in sequenced seasons. It is done so that the soil of farms is not exploited for only one set of nutrients. It helps in reducing soil erosion and increases soil fertility and crop yield.
- In the Central Highlands, multi-strata agroforestry systems with durian, pepper, coffee, green bean and maize are quite popular. During the first two years, income is earned mainly from green beans and maize, while coffee is harvested in the third year, and durian and pepper in the fifth year. The net income of this system is approximately 73 million VND/ha/yr. The combination of cashew, squash, green bean, and maize is another successful system currently being practiced. Other systems include cashew-squash-green bean-maize system. Cashew is harvested in the fifth year. The net income from this system is approximately 48 million VND/ha/yr.
- Other good practice on inter-cropping in the Central Highlands includes: intercropping of annual crops (maize, beans, cassava); intercropping of perennial industrial plants (coffee, cocoa, rubber, cinnamon, star anise, etc.; intercropping of annual crops with forest trees in the early stage of plantation; intercropping of agricultural plants in both stages of plantation, when the canopy is not yet closed (intercropping cassava, peanut) and closed (intercropping *Amomum spp* and/or cardamom under the forest canopy);
- Good inter-cropping practice in the coastal farming systems includes: intercropping annual crops (maize, beans, cassava) and fruit tree species (mango, pomelo orange, etc.); intercropping

food crops combined with afforestation on coastal sandy soil area (casuarina - paddy - potato - peanut - sesame - tuber - cassava); and integrated model of fishery, forestry and coastal mangroves (mangrove, shrimp, crab and fish).

Inter-cropping best practices in the target provinces

Coffee intercropped with pepper

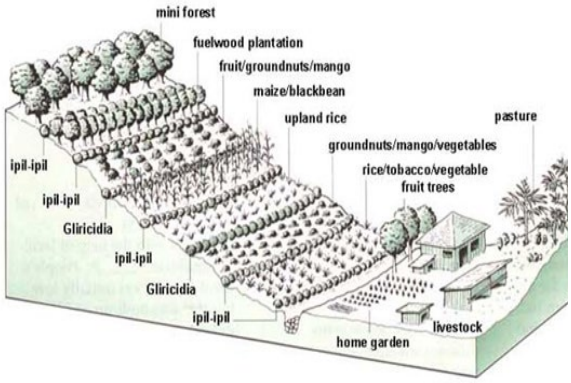
Coffee intercropped with fruit trees such as avocado and durian

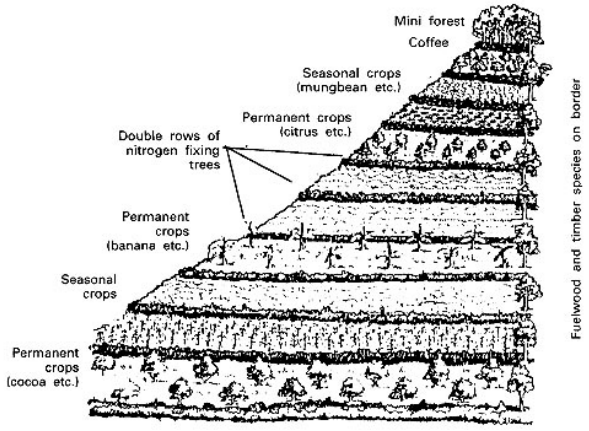
Maize and bean intercropping

Fruit trees and bean intercropping

- **Sloping Agricultural Land Technology** or SALT is a model of agroforestry technology with agricultural and forestry crops at a percentage of 75:25. It is a simple, applicable, low-cost and timely method of farming sloping land. The objectives are both agricultural and environmental as the technology aims to increase production over the long term while eliminating erosion and land degradation. Under a SALT system, degraded slopes are divided into strips of land for cultivation, separated by double hedgerows of nitrogen-fixing trees or bushes planted along contour lines. The hedgerows are the key element of the entire system and act as erosion barriers and stabilizers for hill slopes. They also contribute to soil fertility through nitrogen-fixation, and the biomass of the hedges is either used as mulch for soil cover and soil moisture conservation, or as animal fodder to be recycled back into the soil as compost. SALT as a biologically-based system is to be design to suit location-specific ecological conditions, considering the local value, availability and ideal combination of annual and perennial crops and the local micro-climate.

Sloping Agricultural Land Technology (with good practice from Northern Vietnam)





- **Closed loop agriculture systems and agricultural waste management:** Closed loop agriculture is farming practice that recycles all nutrients and organic matter material back to the soil that it grew in, strengthens the nutrient cycle and decreases dependence on external inputs. It forms part of an agricultural practice that preserves the nutrient and carbon levels within the soil and allows farming to be carried out on a sustainable basis.
- It has been practiced widely in Vietnam for example through the promotion and use of bio-fertilizers or bio-char, based on crop residues such as rice straw. Biochar can increase soil fertility of acidic soils (low pH soils), increase agricultural productivity, and provide protection against some foliar and soil-borne diseases. Biochar is also a water attractor and retainer because of its porous structure and high surface area. As a result, nutrients, phosphorus, and agrochemicals are retained for the plants' benefit. Plants are therefore healthier, and less fertilizer leaches into surface or groundwater.

Biochar use in Vietnam

- **Sustainable and resilient rice farming:** 1) Alternate Wetting and Drying (AWD) is a water-saving technology that farmers can apply to reduce their irrigation water consumption in rice

fields without decreasing its yield. In AWD, irrigation water is applied a few days after the disappearance of the ponded water. Hence, the field gets alternately flooded and non-flooded. The number of days of non-flooded soil between irrigations can vary from 1 to more than 10 days depending on the number of factors such as soil type, weather, and crop growth stage.

- 2) System of Rice Intensification (SRI) is a climate-smart, agroecological methodology for increasing the productivity of rice while reducing GHG emissions and requirements for water, seeds, synthetic fertilizers, pesticides, herbicides and labor. It applies five technical principles: use healthy young seedlings; transplant single seedlings; weed early; manage water and aerate soil; and apply manure and compost. When farmers follow these principles, their rice plants grow stronger roots and more easily resist pests and diseases, allowing farmers to reduce their use of expensive fertilizers and insecticides.
- 3) One-Must-Do-Five-Reductions (1P5G) is a technology package that 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. By applying these technologies, farmers can better adapt to climate change. Often a sixth reduction is added, ie. the reduction of greenhouse gas emissions as a further improvement of the practice.

Sustainable and resilient rice farming

Alternate Wetting and Drying

System of Rice Intensification

One-Must-Do-Five-Reductions

- **Introduction of improved crop varieties:** i.e. drought, flood, salinity and disease tolerant seeds: various programs and projects from the Government, private sector and research organizations have introduced seed varieties resilient to a number of climate extremes.

Improved crop varieties

Testing drought-resistant maize varieties


Drought, flood or saltwater tolerant rice, being developed by the Cuu Long or Mekong Delta Rice Research Institute

Lessons Learned from the 2015-2016 Drought

An in-depth assessment completed by the CGIAR research consortium in the aftermath of the 2015-2016 El Nino-induced drought recommended the replication of the following good practices to improve the resilience of crop systems in the Central Highlands: [8]

- Deploy available drought-tolerant crop varieties during the dry season;
- Integrate appropriate drought-tolerant and economically useful tree species within existing farming systems and to stabilize slopes. At the farm level, these: (i) provide shade for crops and animals; (ii) ameliorate micro-climate conditions; and (iii) provide additional biomass and income for farmers;
- Develop crop-livestock–landscape simulation models that can demonstrate a range of scenarios and conduct landscape modeling with farm profitability scenarios. This helps farmers find optimal strategies for maintaining production and profits in the context of climate change;
- Feed crop residues to livestock when feed is scarce and external inputs are not accessible;
- Establish fodder banks in contour hedgerows. This provides additional biomass for livestock and at the same time helps maintain soil quality by reducing erosion and cushioning the impact of drought and other climate-related events from mono-cropping in the short term;
- Promote and incentivize broader private sector involvement. For instance, supply chain initiatives could be utilized as in-setting mechanisms where large buyers of agricultural commodities support farmers in adapting to climate change and reducing their emissions.

[8] CGIAR Research Centers in Southeast Asia (April 2016). The drought crisis in the Central Highlands of Vietnam. Assessment Report.

For the South-Central Coast, recommended good practices outlined in CGIAR report are as follows:[9]

- Promote crop diversification to market-oriented crops that are suitable for the different drought risk conditions. There is, however, a need to redesign the irrigation systems to facilitate crop diversification, for more efficient distribution of water, and for better drainage;
- To increase the resilience of the poor, who may have more limited capacity to diversify into commercial crops or are located in less productive degraded areas, integrated farming systems with inclusion of small ruminants can be promoted. Including small livestock for smallholders who have limited land also helps buffer the shocks from extreme weather-related events;
- Changing to direct dry seeding with the use of available irrigation facilities, using drought tolerant rice varieties and applying alternate wetting drying method can help optimize water use during the dry season;
- Opportunities to reduce demand and increase water productivity can be achieved through improved organic matter management, increasing the water holding capacity and fertility of the root zone soil, and minimizing leaching of water and nitrate to the groundwater. Utilization of organic soil amendments and mulching can increase soil water holding capacity, improve soil physical parameters, and ameliorate soil nutrient deficiencies;
- Farmer-managed natural tree regeneration could be promoted to allow for native tree species to regenerate on farmlands. Otherwise, intercropping with high-value tree species for timber, fruits, or fodder is also an option. Tree planting around farm plots should also be promoted to serve as windbreaks, thus protecting crop damage from strong winds and mitigating wind erosion.

Lessons Learned on Promoting Climate Resilient Agriculture

A number of lessons learned on strengthening climate resilient agriculture for smallholder farmers have been identified from the above listed programs and projects, feasibility study analysis and desk review, and have been verified by field and expert consultations in the GCF target provinces. These lessons are instrumental in informing the technical recommendations for the GCF proposal in the next chapter.

<u>On localization of CRA good practice</u>

CRA techniques are very location specific, and need to be adapted and prioritized through participatory processes to keep in mind suitability for:

- Climate resilience towards identified climate risks;
- Existing cropping patterns and suitability with local land and water conditions;
- Income diversification and multiplication;
- Yield diversification and multiplication;
- Market needs, including availability, quantity and quality value chain actors;
- Local and national policies;
- Farmer interest;
- Gender and aspects of marginalization.

<u>On diversification of farming practices</u>

At farm level, increasing the diversity of CRA practices can have benefits for both farmers and the environment. Increasing the diversity of a component of the farming system will also increase the diversity of income (products) to farmers and reduce the risk of depending on a single crop (product). For agriculture systems to withstand extreme weather events (drought, rainfall variability) across project sites, it is necessary to diversify the CRA practice components and technologies so that farmers can see increased efficiency and benefits.

<u>On replication of CRA good practice for the poor and marginalized.</u>

[9] CGIAR Research Program on Climate Change, Agriculture and Food Security - Southeast Asia (2017). Assessment of potential CSA options for future agriculture production in the South-Central region of Vietnam.

Lessons from successful and sustainable agricultural practices in ethnic minority areas show that the CRA practices outlined above work for the poor and marginalized when they are:

- Easy to do; use less labor and investment;
- Are suitable to local soil conditions and irrigation;
- Produce products that are easy to sell;
- Receive continuous support over the years, including close monitoring; and
- Promote farmer-to-farmer cooperation in the community.

In contrast, promoted practices that are difficult to sustain or replicate normally require intensive investment that is unaffordable to ethnic minority households, are not suitable to local soil and irrigation conditions, do not link to markets and receive onetime support without close monitoring and evaluation.

On effectively engaging women and ethnic minority farmers in CRA

Lessons learned show that considering specific suggestions and recommendations from ethnic minority farmers and women can be a highly effective strategy for understanding challenges in current climate resilience building efforts. To be effective, projects need to set up systems to:

- Integrate and monitor gender equality, including the collection of sex disaggregated data, use of indicators that measure changes in gender, and including women and men in project M&E;
- Consider how project activities may have impact on a range of gendered dimensions, such as on increase of workloads, levels of decision-making, roles and responsibilities etc.; and
- Apply 'do no harm' approaches.

For poor and near-poor farmers, particularly ethnic minority farmers, their perception of the risk involved in borrowing money to implement a series of new practices and cropping systems needs to be considered. Similarly, potential barriers in timing, language and accessibility that may limit their interest in engaging with the project and participating in the project's community activities need to be taken into account.

On farmer groups

Farmer Interest Groups and cooperatives are best practices that are being applied by development projects and programs, such as IFAD, SNV and other organizations in the target provinces such as Dak Nong and Ninh Thuan. Members' in-kind, time or financial contributions to these groups are important and recommended for operationability and sustainability. These can be variable depending on the farmer's socio-economic background.

On farmer capacity building through Farmer Field Schools

The Farmer Field Schools (FFS) approach was introduced in Vietnam by FAO to empower small-scale rice farmers to learn certain skills required for managing their paddy fields in a sustainable way. Since then, FFS has been one of the most common agricultural extension methods used by various organizations, but adapted to each particular context and project.

The Government runs a network of extension workers or facilitators that if properly trained can play a key role in FFS programs and disseminating information at the local level. However, this network should be trained in technical topics and community facilitation skills, including on gender and engaging with poor farmers, and existing Government training materials need to be adapted as Government materials are traditionally not interactive and very lecture-based. In addition, to ensure the sustainability of FFS, the continued backstopping from trained facilitators, lead famers and technical coaching by a technical assistant organization such as an NGO is identified as a good practice.

On Agricultural Innovation platforms for value chain enhancement

Innovation Platforms have been successfully tried in Vietnam. The platforms create space for relevant stakeholders (policy makers, local technical staff, private sector, researchers, credit providers, farmers) to develop new ideas, and receive feedback on the success of trials of new agricultural good practice. In this way, the platforms brings together stakeholders and farmer's knowledge and practices and enables successful modifications or innovations to be scaled up. Innovation Platforms can be used to

identify challenges and develop solutions to link small holder farmers into value chains – with a focus on resilient practices and technologies. Platforms can also be used to scale out good practice.

On vouchers as a tool to promote technology transfer for climate smart agriculture.

Given the need to localize CRA approaches based on local conditions and markets, a number of government and international support programs have employed voucher systems to enable effective dissemination of new technologies and techniques at the farm level. Through such voucher systems, smallholder farmers can adopt a suitable package of CRA practices and cropping systems. Learning from these have identified the following steps as good practice, among other:

- Develop a portfolio of localized CRA options;
- Develop a list of local suppliers and supplies that can be purchased (fully or partly with the vouchers, the rest with own resources) by the farmers at a pre-selected number of suppliers;
- Link the completion of FFS trainings to receiving vouchers for CRA so the technical knowledge transfer is linked to an investment incentive. Farmers should be requested to participate in all the training sessions to receive all vouchers, and the number of vouchers they get depends on the number of times they have participated;
- The amount per voucher can be the same, or can increase the more sessions they attend;
- Allow farmers to accumulate vouchers, so they can buy more expensive items, if needed.

On facilitating group access to capital for agricultural production

A number of successful projects have aimed to enhance technology transfer in agricultural production through improving access to credit based on so-called group business plans. Cooperatives and farmer interest groups have been proven to be valuable vehicles to access credit from the two main existing state credit institutions which are the Social Policy Bank and the Viet Nam Bank for Agricultural Development and Rural Development. The business plans are simple, developed consultatively and continuously updated to guide the group member's agricultural investment. The group-based approach allows for sharing risk and exchange of experience and good practice.

Chapter 5: Recommendations for the GCF proposal

The recommendations are based on the analysis of the baseline, past and on-going experiences in introducing CRA in Vietnam and the major lessons learned. The proposed CRA practices and implementation modalities were identified based on expert analysis and verified through local stakeholder consultations.

Overall approach

The GCF proposal should be designed and implemented based on the following overall approach to building agricultural resilience:

- **Climate resilience and productivity of main agricultural systems with an emphasis on the poor and near poor ethnic minorities and women farmers:** action should aim to facilitate the diversification of agricultural practices and the transfer of more efficient technologies. It should also aim to increase local people's understanding of how better management of trees and crops can enhance the climate resilience of smallholder livelihoods across the project sites. Actions should be specifically designed to be appropriate for application by women and different ethnic minority groups who make up a large proportion of the poorest farmers in target areas.
- **Focus on commercial production:** many major tree crops, such as cashew, coffee, pepper, durian, avocado, banana, grape, maize, beans, onions, rice are cultivated predominantly or significantly by smallholders for commercial resale. This means that the project will need to consider farmer's business plans, and should consider how investments for prioritized tree and crop species can ensure that incomes are less negatively impacted during years where climate extreme events occur. The approach will also likely call for co-investment, co-location and co-design of plans and solutions and actions amongst stakeholders including private sector actions and facilitating dialogue through vehicles like farmer interest groups.
- **Employing a combination of FFS and Innovation Platforms:** A lack of specific skills and knowledge of climate change trends and impacts is a key barrier to climate resilience for poor and near poor farmers in target areas. Therefore, skills training should be a key component of a future project approach. FFS which strengthen the capacity of local communities to support the production of crops and trees in a climate resilient way and can help facilitate market linkages can be useful in providing skills on practices and new technologies. To strengthen farmer understanding of climate trends and impacts *Climate Innovation Platforms* can help provide information, and facilitate the building of relationships and analysis that can result in joint solutions, including access to market. These platforms are also important in developing strategies which can make value chains more resilient to the identified climate impacts.

Recommended Actions

In line with this overall approach, the following actions are recommended:

1. Selection of appropriate project locations co-located or adjacent to current WEIDAP sites
2. Development of sets or packages of climate resilient practices from which farmers can 'mix-and-match' the most suitable solution for their specific conditions;
3. Capacity building of sub-national level extension staff through Training of Facilitators;
4. Capacity building of smallholder farmers through Farmer Field Schools;
5. Training in farm business management and marketing skills for smallholder farmers, farmer interest groups, cooperatives, private sector and staff of local partners;
6. Providing incentives though vouchers for start-up inputs for individual farmers, farmer interest groups and eligible cooperatives in developing CRA options across project sites.
7. Facilitation of market linkages through innovation platforms.

1. Selection of appropriate project locations co-located or adjacent to current WEIDAP sites

The project Concept Note proposed that interventions should focus on benefitting highly vulnerable communities. As per the analysis above, this suggests a focus on poor and near poor farmers with an emphasis on women and ethnic minority farmers in areas at high risk from climate change impacts.

Based on the pre-feasibility analysis, including discussions with the ADB, the WEIDAP provinces had already been identified as being at high climate risk. Within those five provinces and with the WEIDAP sub-projects as a starting point, an intersecting approach was used to guide the geographical targeting of the GCF project, with application of the following filters:

- Areas that are prone to identified climate risks: seasonal variability and drought and flood risk;
- Areas that are most affected by major climate change impacts on water and agriculture, currently and as projected: increasing imbalance in surface and ground water availability (for production); with longer periods of severe water scarcity during dry season and increased intensity of droughts; and reduced crop productivity (in terms of yields, incomes);
- A combination of rainfed and irrigated areas: with upland and lowland areas with rain-fed cultivation most vulnerable to wetter wet seasons and drier dry seasons and an increased risk of extreme droughts, with irrigated areas mainly impacted by extreme droughts. Both will be severely affected under the hottest climate change scenario;
- Areas with high social vulnerability factors or density of at-risk populations, such as ethnic minority population, poor and near-poor, and number of women-headed households.

The results of this filtering were 14 districts and 60 communes in the five target provinces.

As outlined in the methodology section of this report, the next step for the development of CRA packages for these 60 communes was to conduct a commune-clustering exercise (see annex) to group the 60 communes around similar climate risks, soil types and current annual and perennial cropping systems. The result is 14 'CRA clusters', grouping communes with similar characteristics as follows:

Table 5: CRA clusters

CRA clusters	Climate vulnerability:	Main perennial:	Main annual:	Soil types:	Communes (province):
1	Very severe to severe drought risk, with drier dry seasons and wetter wet seasons	None	Onion, garlic, maize and beans	Fluvisols and acrisols	Phương Hải; Tri Hải; Xuân Hải; Nhơn Hải *(Ninh Thuan)*
2		Apple	Maize, cassava, sugarcane, rice	Acrisols	Nhơn Sơn; Mỹ Sơn *(Ninh Thuan)*
3		Custard apple	Rice	Acrisols	Bắc Phong *(Ninh Thuan)*
4		Cashew nut, Custard apple	Maize, cassava, beans, rice	Ferralsols	Phước Kháng; Bắc Sơn; Lợi Hải *(Ninh Thuan)*
5		Mango, cashew nut	Maize, beans, sesame, rice	Ferralsols	Phước Trung *(Ninh Thuan)*
6	Very severe to severe drought risk, with wetter wet and wetter dry seasons	Mango	Maize, cassava, beans	Acrisols, Ferralsols	Cam Đức; Cam Tân; Cam Hải Tây; Cam Hoà; Cam Thành Bắc; Cam Hiệp Bắc; Cam Hiệp Nam *(Khanh Hoa)*
7		Mango	Maize, cassava, beans	Ferralsols	Suối Cát; Suối Tân *(Khanh Hoa)*

CRA clusters	Climate vulnerability:	Main perennial:	Main annual:	Soil types:	Communes (province):
8		Dragon fruit, cashewnut	Maize, cassava, rice	Ferralsols, Acrisol	Mỹ Thạnh; Hàm Cần; Tân Lập *(Binh Thuan)*
9		Dragon fruit, cashew nut	Rice	Arenosol, Acrisols	Thuận Quí; Tân Thành; Tân Thuận *(Binh Thuan)*
10		Coffee, pepper	Maize, cassava, rice, beans, vegetables	Rhodic, Ferralsols, Luvisols	Tân Hà; Thuận An; Đức Mạnh; Nam Nung; Nam Xuân; Tâm Thắng *(Binh Thuan)* / Đăk Drông; Đông Hà; Đức Minh; Long Sơn; Trà Tân; Dắk Sắk; Krông Buk; Quảng Tiến *(Dak Lak)*
11		Coffee, pepper, cashew nut	Maize, cassava, rice, beans, vegetables	Ferralsols, Rhodic	Nam Dong; Trúc Sơn; Ea T'Linh; Đăk Sôr; *(Dak Nong)* / Ea Sol; Đăk Drô; Cư Knia; Đliê Yang; Ea Sar; Ea Khal; Ea Sô *(Dak Lak)*
12		Coffee, pepper, avocado/ orange/ durian/ cocoa	Maize, beans	Rhodic	Xuân Phú; Ea Phê; Ea Kênh; Ea Yông *(Dak Lak)*
13	Medium to low drought risk, with wetter wet and wetter dry seasons	Cashew nut, pomelo	Maize, cassava, beans, rice	Ferralsols, Leptosols	Phước Thành; Phước Tân; Phước Chiến; Phước Thắng *(Ninh Thuan)*
14		Coffee, pepper, cocoa	Maize, cassava, rice	Rhodic	Đắk Lao *(Dak Nong)*

The selection of direct beneficiaries for the specific activities on CRA has been specified in section 6.1 of the Feasibility Study.

2. Development of a set of CRA packages from which farmers can 'mix-and-match' the most suitable solution for their specific conditions

Building on lessons learned outlined above and in local dialogue with stakeholders, CRA options were identified for each CRA cluster that are able to increase the climate resilience of agricultural systems in the face of agricultural drought risk, rainfall variability and flood. Based on their suitability for local conditions at the commune level, the packages combine two or more of the following climate resilient approaches:

- Improved crop varieties with drought, high rainfall variability (wetter wet seasons), and disease tolerant species;
- Use of high and stable yields of crops and providing farmers with certified germplasm (seeds, seedlings);

- Use of soil and land management technologies: mulching increases soil water holding capacity, improves soil physical parameters, and ameliorates soil nutrient deficiencies, etc.
- Intercropping: improved farming technologies with tree and crop combinations to increase drought resilience by providing benefits of windbreak and shading of cover trees in system vice versa crops (e.g. intercropping of avocado/durian and coffee);
- Use of rotational crops: appropriate technology essential to achieve sustainable agricultural production (i.e. maize and beans).
- Improved access to efficient irrigation technology: replacement of inefficient water saving schemes with drip and sprinkler systems (savings of 40 – 50 percent of water volume compared to traditional irrigation methods);
- Use of manure and bio-organic fertilizers, biological plant protection pest and disease controls
- Integrated Crop Management (ICM) and Integrated Pest Management (IPM), including practices that avoid waste, enhance energy efficiency and minimize pollution; careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment.

Based on this analysis for each cluster, a set of 13 climate resilient agriculture packages were identified and matched with suitable locations. The proposed CRA packages were verified with local stakeholders through consultation meetings in May 2018. It is anticipated that these packages would be re-reviewed with communities during Farmer Field School trainings outlined below to both ensure correct understanding and adjustment of the packages if required following project approach.

A summary of each package is provided below, with more details in the annex:

Table 6: CRA packages per commune and CRA cluster

CRA clusters	Main perennial:	Main annual:	Communes (province):	CRA package:
1	None	Onion, garlic, maize and beans	Phương Hải; Tri Hải; Xuân Hải; Nhơn Hải *(Ninh Thuan)*	1/ Safe vegetable: onion 2/ Safe vegetable: garlic 4/ Intercropping: apples + beans 12/ Intercropping: cassava + bean
2	Apple	Maize, cassava, sugarcane, rice	Nhơn Sơn; Mỹ Sơn *(Ninh Thuan)*	4/ Intercropping: apples + beans 12/ Intercropping: cassava + bean
3	Custard apple	Rice	Bắc Phong *(Ninh Thuan)*	3/ Intercropping: custard apple + bean
4	Cashew nut, Custard apple	Maize, cassava, beans, rice	Phước Kháng; Bắc Sơn; Lợi Hải *(Ninh Thuan)*	3/ Intercropping: custard apple + bean 5/ Intercropping: cashew nut + bean
5	Mango, cashew nut	Maize, beans, sesame, rice	Phước Trung *(Ninh Thuan)*	5/ Intercropping: cashew nut + bean 13/ Rotational crop: maize - bean
6	Mango	Maize, cassava, beans	Cam Đức; Cam Tân; Cam Hải Tây; Cam Hoà; Cam Thành Bắc; Cam Hiệp Bắc; Cam Hiệp Nam *(Khanh Hoa)*	6/ Intercropping: mango + bean 7/ Intercropping: mango + banana

CRA clusters	Main perennial:	Main annual:	Communes (province):	CRA package:
7	Mango	Maize, cassava, beans	Suối Cát; Suối Tân *(Khanh Hoa)*	6/ Intercropping: mango + bean 7/ Intercropping: mango + banana
8	Dragon fruit, cashewnut	Maize, cassava, rice	Mỹ Thạnh; Hàm Cần; Tân Lập *(Binh Thuan)*	8/ Intercropping: dragon fruit (VietGap) + bean
9	Dragon fruit, cashew nut	Rice	Thuận Quí; Tân Thành; Tân Thuận *(Binh Thuan)*	8/ Intercropping: dragon fruit (VietGap) + bean
10	Coffee, pepper	Maize, cassava, rice, beans, vegetables	Tân Hà; Thuận An; Đức Mạnh; Nam Nung; Nam Xuân; Tâm Thắng *(Binh Thuan)* / Đăk Drông; Đông Hà; Đức Minh; Long Sơn; Trà Tân; Dắk Sắk; Krông Buk; Quảng Tiến *(Dak Lak)*	9/ Improved inter-cropping: coffee + pepper 10/ Improved inter-cropping: coffee + avocado
11	Coffee, pepper, cashew nut	Maize, cassava, rice, beans, vegetables	Nam Dong; Trúc Sơn; Ea T'Linh; Đăk Sôr; *(Dak Nong)* / Ea Sol; Đăk Drô; Cư Knia; Đliê Yang; Ea Sar; Ea Khal; Ea Sô *(Dak Lak)*	9/ Improved inter-cropping: coffee + pepper 11/ Improved inter-cropping: coffee + durian
12	Coffee, pepper, avocado/ orange/ durian/ cocoa	Maize, beans	Xuân Phú; Ea Phê; Ea Kênh; Ea Yông *(Dak Lak)*	10/ Improved inter-cropping: coffee + avocado 11/ Improved inter-cropping: coffee + durian
13	Cashew nut, pomelo	Maize, cassava, beans, rice	Phước Thành; Phước Tân; Phước Chiến; Phước Thắng *(Ninh Thuan)*	5/ Intercropping: cashew nut + bean 13/ Rotational crop: maize - bean
14	Coffee, pepper, cocoa	Maize, cassava, rice	Đắk Lao *(Dak Nong)*	11/ Improved inter-cropping: coffee + durian

In regards to the investment needed to adopt these CRA packages, on average, the establishment costs for one year per hectare on average are 4,500 USD/ha, excluding irrigation costs. Each household can be supported to develop the CRA packages on their farm (0.15 ha) through vouchers. Beneficiaries should contribute at least 20% of total establishment costs for the first year and 30 percent of maintenance costs in the second year, including cash and non-cash contributions. The contribution by group members (farmers) is important to ensure the commitment of group beneficiaries and thus ensure sustained success of the project. An estimate of **8,621 poor and near poor households across five project provinces** are expected to benefit from the project's voucher grants for CRA packages.

3. Capacity building of sub-national level agricultural extension staff, lead farmers and relevant mass organisations through Training of Facilitators

Effective application of the CRA packages will require technical assistance for farmers. Lessons learned from previous projects have shown that this can be effectively achieved by providing a graduated series of financial incentives to poor and near-poor farmers to participate in Farmer Field School "courses" or classes (4-5) aimed at adopting a particular package of CRA practices, systems and technologies.

The first step of this process will require training of sub-national level government agricultural system staff as well as development of a network of farmer champions who can promote peer-to-peer learning more effectively. Specifically:

Training of facilitators (TOF) courses should aim to strengthen local capacity through training of local staff in terms of CRA technologies and adult teaching methods (facilitation skills). In each project province, trainees of this TOF course will come from the technical staff of AEC/Center for Agricultural Techniques Support (CATS) and other relevant DARD sub-departments, as well as other interested parties (local NGOs, INGOs, Farmer's and Women's Union).

he AEC/CATS in each province will organize TOF courses on CRA packages. The provincial AEC/CATS could also employ third parties (academic institutions/individual experts or NGOs/local NGOs with appropriate competencies) as trainers to deliver such TOF training services. During the first year, in each project province. about **25-30 facilitators** will be trained on CRA packages and refresher training courses will be conducted in the third and fifth year. About 150 staff in 5 provinces will be capacitated to be facilitators.

Directly after the completion of the training of the TOF course in each project province, a training course for lead farmers (TOLF) would also be conducted. The activities on training of TOLF will be conducted for selected lead farmers with competence capacities. About 30 lead farmers per one FFS course will be trained on CRA packages and at least 2 FFS courses per each year 1, 3 and 5, by project commune will be conducted, come together to study a particularly topic of the CRA packages. Once, the lead farmers graduated and got the certification they will be the trainers (facilitators) on training of F2F in support (technical coaching) by trained facilitators who graduated from (TOF) and consultancy unit (NGO).About **1,800** lead farmers will be trained in support of technical assistance from NGOs.

Conducting FFS in the field should be along the following steps:

- Identification of farmers' problems and needs to find solutions to identified problems;
- Identification of FFS learning sites, establishment of FFS groups and implementation of season long training in FFS activities in the field;
- At the end of the FFS the lead farmers are awarded certificates;
- Lead farmers graduate with the knowledge and confidence to run an FFS. However, it is necessary that the trained facilitators provide coaching to lead farmers who will run the FFSs;
- Monitoring and evaluation.

4. Capacity building of smallholder farmers through Farmer Field Schools

The FFS would apply innovative, participatory and interactive learning approaches that emphasize problem solving and discovery-based learning. FFS would aim to build farmers' capacity to analyze their agricultural practices and systems, identify problems, test possible solutions, and eventually encourage the participants to adapt their farming systems in suitable ways to cope with climate change-driven rainfall variability and extreme weather events.

- In terms of capacity building, FFS will strengthen local technical capacities on CRA technologies, training skills for local AEC staff in particular and other staff (FU, WU, Plant Protection & Crop Department, Private Sector) who are coming from different agencies at provincial, district and commune level.
- At farm level, FFS aims to empower farmers with knowledge and skills for on-farm climate risk management, including (i) building the expertise of farmers on CRA packages); sharpening farmers' abilities for critical and informed decision-making; (ii) sensitizing farmers to address and solve problems related to extreme weather events; and (iii) helping farmers to organize and manage farmer associations for climate resilient agricultural development.

The FFS program will cover the following main contents and steps:

(i) Sensitization and establishment/ re-activation of FFS;

(ii) Enhance existing agricultural extension and training materials to incorporate climate risk;

(iii) Participatory finalization of CRA packages through FFS;

(iv) Training of facilitators (TOF), and training of lead farmers (TOLF);

(v) Training of farmers-to-farmers (TOLF, F2F) and value chain actors through FFS on scaling up CRA;

(vi) Sensitization and establishment of performance-based system (vouchers) for implementation of CRA packages;

(vii) Investment through vouchers for acquisition of inputs and technologies for CRA;

(viii) Participatory monitoring of FFS and CRA

One FFS includes a group of 25-30 farmers with common interests. Farmers will receive guidance on specific CRA practices and technologies at learning sites. Learning sites for a group of people are ideally representative of local conditions e.g. less than one hectare, and there are about three learning sites per each project commune. Learning sites are established by consultations and agreements with participating farmers. Farmers will meet regularly to learn-by-doing e.g. new climate resilient practices and technologies, and observe, analyze, and identify problems that arise and propose solutions.

Enhancing existing agricultural extension and training materials to incorporate climate risk

In first and second year of the GCF project implementation, the project will facilitate activities to review and develop CRA training documents (training modules, leaflets, handbooks) to support technical assistance by resource organization (NGOs).

The FFS training documents will provide guidance for agricultural extension workers, and local NGOs. Tentative topics for FFS program will cover the CRA practices and technologies, specifically, training modules will address: introduction of intercropping and rotational crops systems: (i) combination of industrial trees and annual crops; (ii) combination of fruit trees and annual crops; (iii) annual crop and annual crop; (iv) crop rotation; (iv) soil and land management techniques; (v) adult training skills.

Periodically, the project will review and refine training documents developed in the first and second year in order to disseminate the information to a wider audience (other communes, districts and provinces) for scaling out purposes through seminars, workshops and meetings where it is suitable.

Participatory finalization of climate resilient agricultural packages through FFS

The project will conduct stakeholder consultation workshops to adjust and confirm the CRA packages previously identified from the project formulation process and then discussed at several stakeholder consultations at national and local levels.

The project will periodically review and assess CRA packages to document good learning sources and disseminate best practices to other communes, districts and provinces. Activities for dissemination can also be carried out in project workshops and fairs.

Training of farmers and value chain actors through FFS:

Once lead farmers "graduate" from their training, they will carry out farmer-to-farmer (F2F) training courses in their communes. One trained lead farmer and one trained facilitator will work with each group of local farmers (**10-12 farmers/FFS**). The group should ideally involve 30% non poor farmers/local value chain actors and at least 40% women-headed households to promote peer-to-peer learning and linkages with poor farmers.

Conducting FFS in the field includes:

- Identification of FFS learning sites, establishment of FFS groups and implementation of seasonal FFS training activities.

F2F activities will take place in accordance with seasonal agricultural activities and learning needs.

5. Training in farm business management and marketing skills for smallholder farmers, FIGs, cooperatives, the private sector and staff of local partners.

In the first year of project implementation, the project will organize training sessions on business development for farmers and key local government staff (FFS core facilitators) at commune and district

level. Subsequently, the core facilitators can provide technical backup to CRA groups and individual farmers who will implement CRA packages. Two trainings per each project commune will be organized in the first year with a refresher training in the third year. At the same time, the project will also re-verify the input providers and market actors that the project identified through local consultations and market analysis activities during project preparation. The activities will be implemented with technical assistance on developing trainings by NGOs.

6. Providing incentives through vouchers as initial inputs for individual farmers in developing CRA options across project sites.

Based on market surveys and household financial analyses, poor and near-poor farmers would receive a voucher upon successful completion of each "course" that would be redeemable for seed, fertilizer, tools, technologies, etc. The vouchers would be restricted to those inputs that are appropriate to full adoption of the climate-resilient agriculture packages.

The voucher system will include requirements for farmers to produce simple business plans as a performance milestone for receiving further vouchers to support the implementation plan on-farm (**voucher option 1**). Another option would be to provide a set of vouchers to groups of farmers based on their successful completion of the FFS coursework and an approved business plan (**voucher option 2**). Farmers could also simply pool their vouchers to support a collective investment using the CRA practices, systems and technologies learned in the FFS.

Benefiting farmer groups will be required to include all selected poor, near-poor households and ethnic minority and at least 40 percent female members. However, the size of each group can vary from 7 to 12 households with each group an average of 10 households. The benefiting farmer groups should submit a simple report on CRA implementation progress, under overall guidance/technical coaching of facilitators/lead farmers. In cases in which a group or its members do not follow the co-invested CRA contracts and meet the agreed targets, the voucher grant to the groups should stop immediately and the project commune authorities should request the repayment of all co-investment voucher grants issued to the group. This group-based system for co-investment into CRA has been successfully demonstrated by IFAD in some of the project target provinces.

In addition to the project voucher system for investment in improved CRA practices and technologies, the project will also improve further access to credit for lenders by organizing **FFS farmer-level agricultural credit information sessions**. The key Government credit providers are the VBARD and VBSP, and credit intermediaries are the local mass organizations (WU, FU, Fatherland Front, Youth Union). The mass organizations such as WU should organize a platform for sharing updated information directly with farmers on credit products accessible by the poor and near-poor. Farmers will thereby receive better information and have an opportunity to discuss barriers to access credit directly.

The project aims to provide creditors with better information on farmer needs with the aim of having them develop tailored, pro-poor and improved credit products for CRA investments. The activity will be implemented with technical assistance on developing trainings and conducting the trainings by NGO.

7. Facilitation of market linkages through climate innovation platforms.

As outlined in the good practice chapter above, a Climate Innovation Platform (CIP) is a forum which is established to facilitate interaction and learning among stakeholders with a common challenge to address. The joint efforts of the stakeholders lead to participatory diagnosis of problems; analysis of opportunities and solutions, harnessing innovation and scaling out successfully demonstrated pilots. The aim of the CIPs in the GCF project would therefore be two-fold: i) make the agricultural value chains and their agro-ecological systems more resilient to rainfall variability and extreme weather events and ii) increase the active participation and benefits for currently under-represented poor, ethnic minorities and women farmers from these value chains.

CIPs should be created at provincial level and at sub-project level. Ideally, the sub-project CIPs should be located at the agro-ecological zone level and group the different selected communes within the province that have similar climate risks and agricultural profiles (key annual and perennial cropping

systems, soil types and rainfed/irrigated areas), i.e. in line with the CRA clusters. Due to geographical constraints, some CRA clusters could be combined under one sub-project CIP.

Provincial CIPs

In each project province, the Provincial CIP will be a platform for coordinated action and to develop a common vision for more resilient agriculture. The CIP will be convened biennially and consist of a larger, more varied group of stakeholders (AEC, WU, FU, Plant Protection Department, hydromet staff, private companies, credit providers, research institutions and/or NGOs) than at the sub-project level.

The purpose of the formation of a CIP at provincial level is to enhance knowledge sharing and co-ordination amongst key actors in the value chain, to create supporting institutions and policies, to facilitate linkages between stakeholders to market, buyers and service suppliers, to strengthen local capacity to access, interpret and disseminate agro-climate advisories for various end users.

The specific objectives of the provincial level CIPs will comprise: (i) Coordination and synergy of various project activities dealing with issues related to capacity building, access to input and services, local policies for promoting CRA options with linkages to market and engagement of potential private sectors; (ii) Periodic exchange of experiences and knowledge to promote learning and refine project activities among the stakeholders. (iii) Scaling out of best practices and lessons from the project's sites through meetings, fairs and other networks; and (iv) Undertake advocacy on key issues regarding operations of value chains (e.g., inputs, services and market information provision by private and public sectors; market policies and regulations).

Sub-project CIPs

The specific objectives of the sub-project CIPs will comprise: (i) Improve collaboration among stakeholders across the value chain (buyers, suppliers) on key commodities at local level; *(ii)* Identify solutions to challenges and bottlenecks in regards to climate resilience of the value chains, based on participatory analysis and mutual interests; and (iii) Scaling out of best practices and lessons from the project's sites through meetings and fairs.

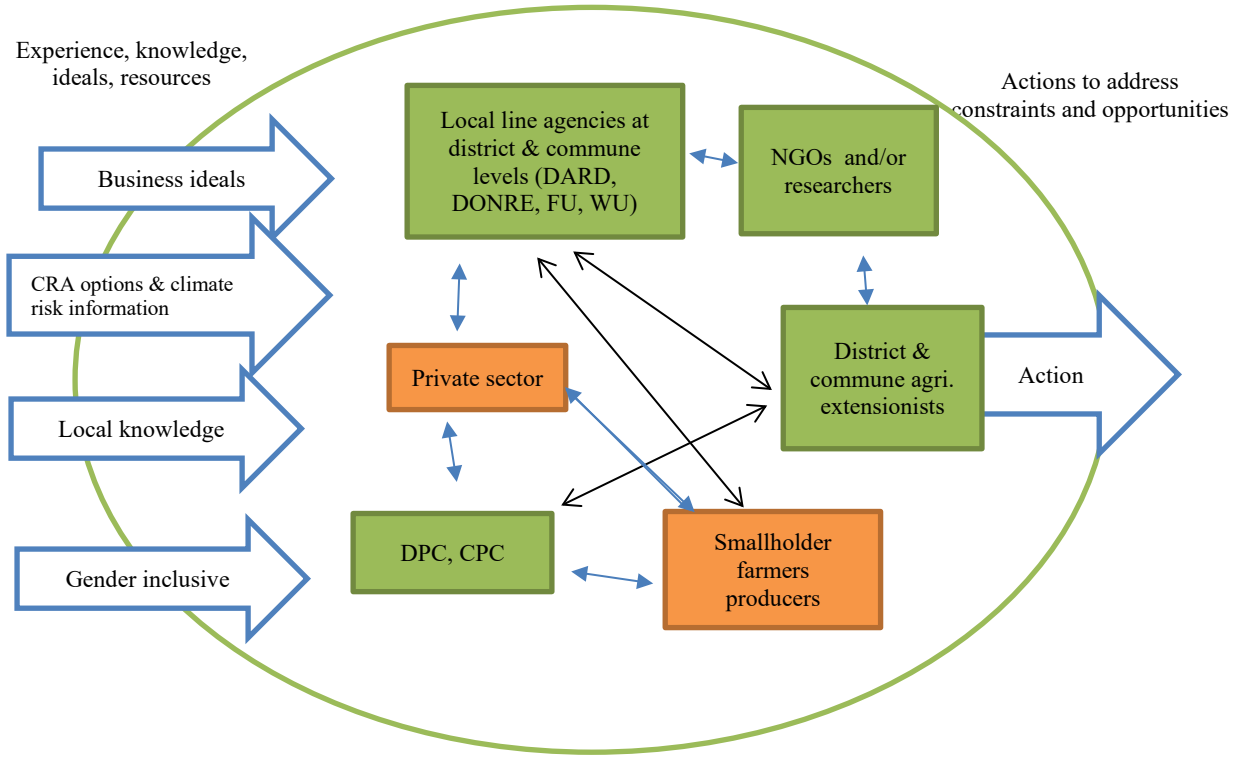


Figure 2: Sub-project CIP

Considering the geographical constraints for travel by stakeholders from district to district to attend meetings the sub-project CIPs should meet no more than twice per year.

The main activities of CIPs might include; (i) Conduct biennial fairs with participants from different stakeholders (private sector, representatives from local line agencies (AEC, FU, WU), research organizations/institutions), communes in CRA clusters and farmers; (ii) Facilitate the linkages to market for smallholder producers by engaging the private sector, buyers, including sharing of the agro-climate information products among stakeholders; iii) Jointly track progress on the transformational shifts from existing agricultural practice to CRA cropping systems.

To enable market linkages with input and technology suppliers and buyers for resilient agricultural products and to stimulate farmer-to-farmer and farmer-to-trader learning across scale, the project should organize sub-project CIP level **farmer trade fairs**. The fairs should be organized biennially and chaired by the district DARD AEC. By organizing the fairs, suppliers, traders and buyers should be able to present resilient crop varieties, advances in irrigation or water-efficiency technologies, machinery, post-harvest and food processing techniques etc. In addition, farmers should be able to present the successfully implemented CRA packages and encourage scaling by other farmers or private sector investment.

Potential implementation arrangements and structures

The following roles for the key actors or institutions at each administrative level are proposed to manage the CRA components of the project, i.e. the CIPs, FFS program, voucher system and the development of farmer business plans. These are aligned with the overall project structure comprised of project management units at each level.

Actors	Level	Role
Provincial Project Management Unit (PPMU)	Province	The PPMUs support the Central Project Management Unit (CPMU) and ensures collaboration with academic, research and/or NGOs. They lead the CIP formation and functioning and M&E and ensure that they are aligned with the overall project work plan and M&E framework. The Provincial AEC/CATS in each project province is an executing organization. The FFS program manager takes the administrative coordination role in organizing the training of facilitators (TOF). The trained facilitators are charged with responsibilities of trainings on TOLF and must have undergone a training of facilitators (TOF) course organized and trained by resource organizations (NGO). However, the CPMU will support the PAEC to open for calls for technical assistance in delivering the training of facilitators and providing continued technical coaching in delivering the TOLF and F2F. For each year, the PAEC will develop annual workplans and budget and submit it to the PPMU for revision and approval.
Sub-project cluster coordination units (SPCUs)	District	The SPCUs are responsible for overseeing the facilitation and M&E of CIPs at the district (sub-project) level; this includes data management and simple data analysis (number of CIP participants, types of stakeholders attending meetings per month, quarter year etc.). The DAES is the lead organization in facilitating and organizing trainings of farmers to farmers (TOLF) in each project commune. In order to realize the TOLF, the DAES will need to collaborate with DARD as technical unit and Commune Project Management Board (CPMB) in organizing and monitoring the F2F trainings. Once the project communes have completed the review of the CRA business plans of the farmer groups and eligible cooperatives, the DAES will evaluate CRA business plans by using CRA evaluation forms that will be developed by the project.
Commune Project Management Board (CPMB)	Commune	The Commune Project Management Board (CPMB) organizes the training of F2F. The CPMB will also facilitate administrative and coordination tasks. In order to organize the F2F training the service providers (trained facilitators and lead farmers) and farmers need to negotiate, agree and sign performance-based contracts to ensure that F2F courses will be delivered in time and meet the training's requirements. The project communes together with District Agricultural Extension Stations and project communes will facilitate the procurement process of inputs to CRA packages for groups of CRA farmers. In addition, the project communes will receive technical assistance through an NGO to set up the voucher systems and user manuals. The CPMB will take the lead in facilitating the farmer groups to develop CRA business plans, where appropriate. The CPMB will receive, screen and review all CRA business plans first and work with farmer groups to complement if necessary. After this step, the CPMB will summit the group business plans to the District Agriculture Extension Stations (DAES) and district DARD for

		evaluation and approval of the plans. Every two years, all project communes will hold participatory stakeholder meetings at commune level. This aims to review and evaluate the implementation of CRA business plans of groups in general and voucher grants and individual farmers in particular. The activity will take place in six years project life cycle.
Academic, Research Organization and/or NGOs as technical assistance	General	Backstop the overall process, including facilitation of provincial and sub-project CIPs, regular visits and feedback, and coaching of the M&E and national coordinator of the NPCU; it may also take the lead in data analysis on specific topics. For each project target province, the NPCU should sign contractual agreements with an NGO or similar resource organization that specializes in climate resilient agriculture, value chain development, marketing, and other sectors relevant to the project areas of intervention and can provide technical assistance in facilitating the CIPs. They will also ensure the quality of FFS trainings. Local NGOs will be highly valuable for implementing FFS trainings, as they have a lot of experience in training, research and good practices. The project considers engaging NGOs to deliver technical assistance packages as follows: (i) provide technical assistance in developing training documents, (ii) conduct vulnerability assessments, (iii) deliver trainings on TOF in each project province and continue providing technical coaching activities on TOLF and F2F.

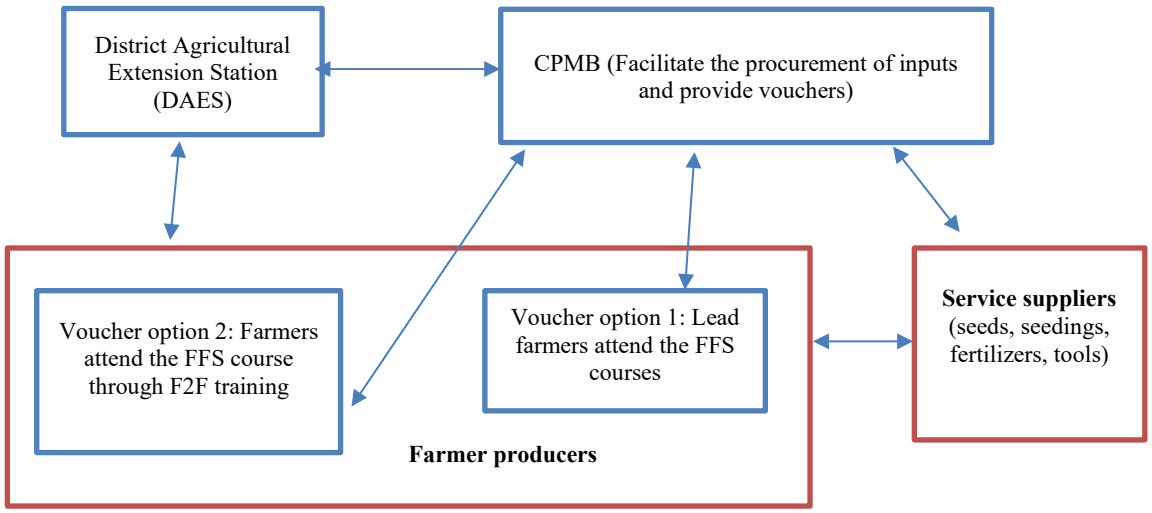
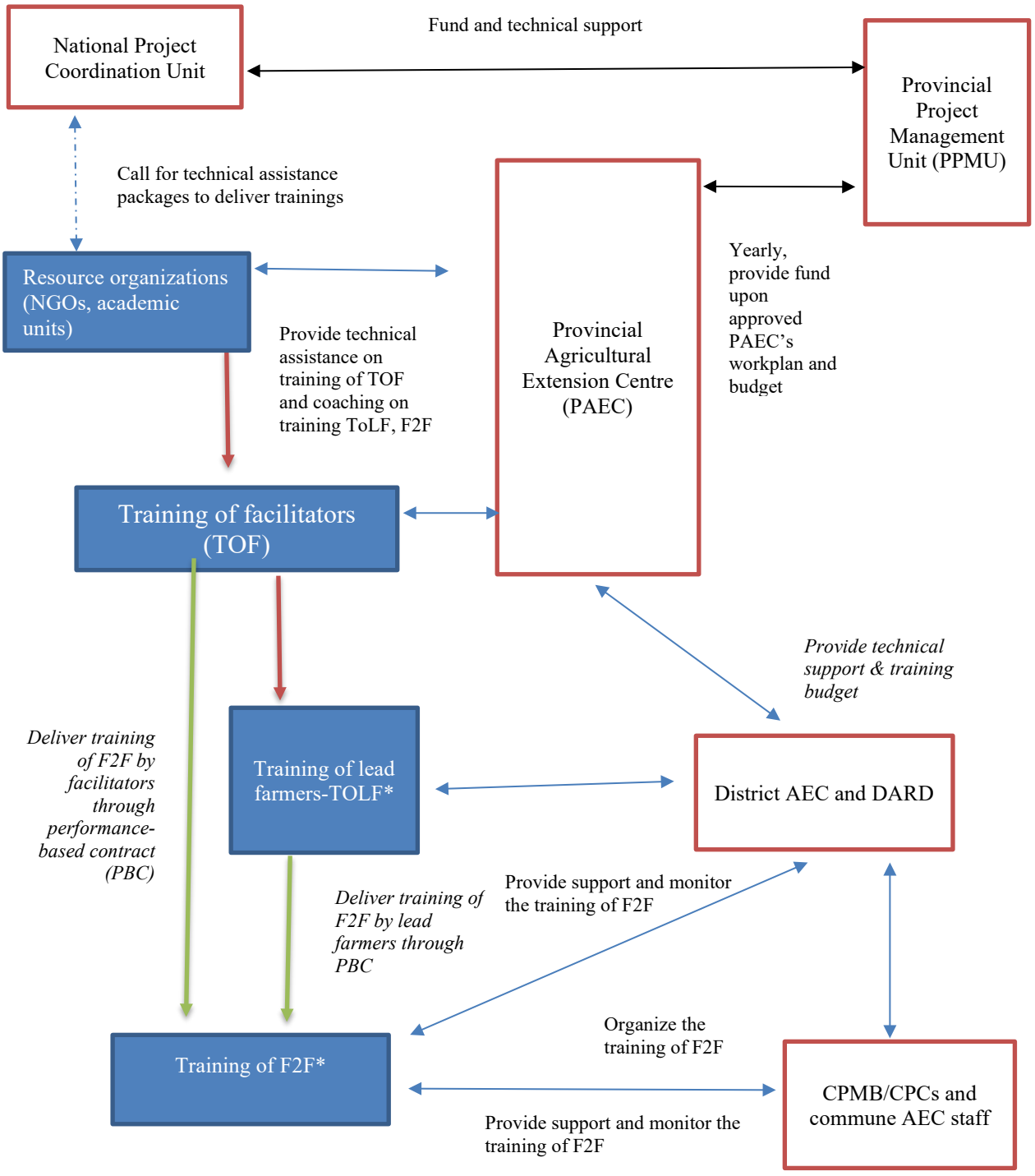


Figure 3: Voucher system



(*) *Technical assistance and coaching (backstopping) by consultancy unit (NGOs and/or academic or research organizations)*

Figure 4: FFS training program

Overall cost and budget estimates

Investment costs	Total (USD)
2.1. Investments in inputs and capacities to scale up climate-resilient cropping systems and practices (soil, crop, land management) among smallholders through Farmer Field Schools	*9,703,291*
2.1.1 Sensitize smallholders to establish/re-activate 900 Farmer Field Schools	90,060
2.1.2 Train DARD personnel and lead farmers, as well as other interested parties (NGOs, Farmers and Women's Unions, etc.) to build a cadre of farmer champions to galvanize adoption and application of CRA packages (15 provincial level workshops for 30 DARD staff in years 1,3 and 5; 28 district and 120 commune level trainings for 30 lead farmers in years 1 and 5)	1,165,449
2.1.3 Train farmers and value chain actors – particularly private sector input providers, buyers, processors, transporters - through 900 FFS on scaling up of climate resilient cropping systems and practices. (Each FFS will conduct 1-day trainings twice per year)	1,677,240
2.1.4 Investment support 8621 to targeted poor/near poor smallholders to acquire inputs and technologies for implementation of the CRA packages through vouchers.	6,471,892
2.1.5 Participatory auditing of implementation of voucher systems for climate resilient cropping systems and practices (One 1-day meeting for 100 participants in each of the 60 communes in Years 1, 3 and 5)	298,650
2.2. Technical assistance for enhancing access to markets and credit for sustained climate-resilient agricultural investments by smallholders and value chain actors	*1,669,875*
2.2.1. Establish and operationalize multi-stakeholder Climate Innovation Platforms (CIP) in each province and at the level of agro-ecological zones (Annual stakeholder meetings organized once every two years in each of the 5 provinces)	134,227
2.2.2 Provide technical assistance and training to enable market linkages with input, information and technology providers and buyers for climate-resilient agricultural production (two trainings, two networking workshops and three trade fairs in each of the 14 districts over four years)	466,031
2.2.3 Provide technical assistance and train farmers to enable access to credit through financial intermediaries (One workshop in each of the 60 communes in years 1 and 3)	770,968
Total (USD)	**11,074,516**

Sustainability and exit strategy

The project approach will provide sustainable background to ensure that climate resilient agriculture investment options will be sustained. The tools used in the project will lead to (i) Enhanced capacity of government staff and farmers to analyze and prioritize investment choices; (ii) Rigorous scrutiny of business proposals by FIGs, individual farmers and the commitment of a substantial proportion of co-investment from individual farmers, the FIG member's own financial resources; and outputs that are designed to support climate-resilient agricultural practices, enhance project beneficiaries and provide protection from extreme weather events.

The sustainability and exit strategy on CRA packages depends on the ability of public and private stakeholders to continue to engage and adapt to changing climate conditions. The project should work

with local partners in five provinces to develop local support to farmers' on-going development and adaptation and link them to local government budgets aimed at scaling out best practices of CRA packages and use of FFS training materials. In the last year of the project life cycle, the project could facilitate signature of the agreement letters between local partners to ensure that the continual adaptation of CRA packages will be supported by commune agricultural extension staff, farmer's union, district agricultural extension stations and district DARDs.

Knowledge management

The Project's knowledge management program should be an important element for delivery of Project objectives, especially for climate resilient agriculture-related learning. Two approaches should be taken: (i) a knowledge management program within the provinces for purposes of supporting learning and (ii) support for a broader program of knowledge management aimed at informing government decision-makers and influencing policy.

The "within province" knowledge management activities could include (i) exchange visits to GCF-funded provinces (ii) sharing of success stories through newspapers, CIPs, fairs, provincial and district television stations; (iii) "information corners" in project communes; and; (iv) development and maintenance of online information. To manage the knowledge and information of the project, the following activities will be conducted: (i) Documenting lessons learnt, best practices and cases of success; and development of material for dissemination (portfolio of climate resilient agriculture practices, technical guide lines, handbook, leaflet) and display and distribution at workshops; (ii) presentation of lessons learned portfolios to district, provincial and national authorities.

Chapter 6: ANNEXES

Annex 1. Clustering of communes

To guide the development of CRA packages a commune clustering exercise was conducted for the selected 60 communes in 14 districts. These 60 communes were the starting point and already a result of a first geographical targeting applying an intersecting approach as described above.

The 60 communes were clustered for similar characteristics as follows:

(i) Agricultural drought risk (low to medium and severe to very severe);
(ii) Rainfall variability: projections (RCP4.5 -2050) compared to baseline (1986-2005); and
(iii) Flood risk.
(iv) Major soil type;
(v) Key crops (perennial and annual crops);

Agricultural drought risk information was analyzed and interpreted from Moderate-Resolution Imaging Spectroradiometer (MODIS) satellite image for the period of 2001-2016. The Land Surface Water Index (LSWI) method was used for calculating the drought indices (1 low drought risk; 2 medium drought risks; 3 severe drought risk and 4 very severe drought risk). To simplify the drought risk indices, we grouped the drought risk indices of severe and very severe as very severe to severe drought risk and the indices of low and medium drought risks as medium to low drought risk.

Rainfall variability was calculated from time series of historical data which were obtained from meteorological stations (Climate Hazards Group InfraRed Precipitation with Station data) for the period 1980-2016. We computed the wet and dry seasons based on the number of months with less than 100 mm/month (dry-season precipitation) or with more than 100 mm/month (wet-season precipitation) of rain. In the Central Highlands, the wet season is from May-October and the dry season lasts from November to April of the next year. In the South Coastal region, the wet season lasts from August to December and dry season from January to July. *Flood risk* comprises four levels of flood risk (none, low, medium, severe, and very severe) and was calculated based on historical occurrence and topography maps for each project province as evidence for examining the flood risk.

Soil types were interpreted according to the soil classification map of the Institute of Agricultural National Planning and Projection of Vietnam (NIAPP, 2000).

Information on current agricultural crops (perennial and annual crops) was collected from the local Departments of Agriculture and Rural Development in 2018.

Communes were first grouped for the key indicators on climate vulnerability: drought, rainfall variability and flood risk (see table below); and hereafter again grouped for agricultural systems based on cropping patterns and soil types. A detailed spreadsheet is available, indicating the following results:

Clustering of 60 communes for climate risks:

Drought risk:	Very severe to severe drought risk				Medium to low drought risk	
Rainfall variability:	Drier dry seasons and wetter wet seasons		Wetter wet seasons and wetter dry seasons		Wetter dry season and drier wet seasons	Wetter wet seasons and wetter dry seasons
Flood risk:	Low flood risk	No flood risk	Low flood risk	No flood risk	No flood risk	No flood risk
Khánh Hòa			Cam Đức Cam Hải Tây Cam Hiệp Bắc Cam Tân Suối Cát Suối Tân	Cam Hiệp Nam Cam Thành Bắc Cam Hoà		
Ninh Thuận	Phương Hải Xuân Hải Tri Hải Nhơn Sơn Bắc Phong	Nhơn Hải Mỹ Sơn Phước Kháng Bắc Sơn Phước Trung Lợi Hải				Phước Chiến Phước Tân Phước Thắng Phước Thành
Bình Thuận			Hàm Cần Thuận Quí	Tân Thuận Tân Thành Tân Hà Đông Hà Trà Tân		Mỹ Thạnh Tân Lập
Đăk Lăk			Ea Sol Ea Sar Xuân Phú Krông Buk Ea Phê Ea Yông Ea Kênh	Ea Khal Đliê Yang Quảng Tiến	Ea Sô	
Dak Nong			Ea T'Linh Nam Dong Tâm Thắng Đăk Sôr	Đăk Drông Cư Knia Trúc Sơn Đức Mạnh Long Sơn Đắk Sắk Thuận An Đức Minh Nam Xuân Đăk Drô Nam Nung		Đắk Lao

Clustering of the 60 communes into **CRA clusters**: (*numbers on top indicate the CRA cluster*)

		1		2	3	4		5
Climate vulnerability:		Very severe to severe drought risk, with drier dry seasons and wetter wet seasons						
Cropping system:	***perennial:***	-	Grapefruit, green pomelo	Soursop	Avocado	Cashewnut		Mango, banana
	annual:	Onion, garlic, maize, beans	Onion, garlic	Maize, cassava, sugarcane, rice	Rice	Maize, rice	Maize, cassava, beans	Maize, beans, sesame, rice
	Soil types:	Fluvisols	Acrisols	Acrisols	Acrisols	Ferralsols		Ferralsols
Rainfed/irrigated:		Irrigated		Irrigated	Irrigated	Rainfed	Irrigated	Irrigated
		Phương Hải Tri Hải Xuân Hải Nhơn Hải		Nhơn Sơn Mỹ Sơn	Bắc Phong	Phước Kháng Bắc Sơn Lợi Hải		Phước Trung

		6		7	8			9	
Climate vulnerability:		Very severe to severe drought risk, with wetter wet and wetter dry seasons							
Cropping system:	***perennial:***	Mango		Mango, banana	Dragonfruit, cashewnut	Dragonfruit		Dragonfruit	Dragonfruit, cashewnut
	annual:	Maize, cassava, beans		Maize, cassava, beans	Maize, cassava, rice		Maize, rice	-	Rice
	Soil types:	Acrisols	Ferralsols	Ferralsols	Ferralsols	Acrisol		Arenosol	Acrisols
Rainfed/irrigated:		Irrigated		Irrigated	Rainfed		Irrigated	Rainfed	Irrigated
		Cam Đức	Cam Tân	Suối Cát	Mỹ Thạnh	Hàm Cần	Tân Lập	Thuận Quí	Tân Thành	Tân Thuận
		Cam Hải Tây	Cam Hoà	Suối Tân						
		Cam Thành Bắc	Cam Hiệp Bắc							
			Cam							

10							11					12			
Very severe to severe drought risk, with wetter wet and wetter dry seasons															
Coffee, pepper							Coffee, pepper, cashewnut					Coffee, pepper, avocado	Coffee, pepper, oranges	Coffee, pepper, durian,	Coffee, durian
Maize, cassava	Maize, rice	Maize, beans, cassava, rice	Maize, cassava, rice	Maize, rice	Maize, vegetables, rice	Maize, beans, peanuts, rice	Maize, beans, peanuts, rice	Maize, cassava, vegetables	Maize, cassava, beans	Maize, cassava, vegetables	Maize, rice	Maize, beans		Maize	
Rhodic			Ferralsols	Ferralsols	Luvisols	Ferralsols	Ferralsols		Rhodic	Ferralsols	Rhodic	Ferralsols	Rhodic		
Irrigated			Rainfed	Irrigated			Irrigated			Rainfed		Irrigated			
Tân Hà	Thuận An	Đức Mạnh	Nam Nung	Nam Xuân	Tâm Thắng	Đăk Drông	Nam Dong	Trúc Sơn	Ea T'Linh	Đăk Sôr	Ea Sol	Đăk Drô	Xuân Phú	Ea Phê	Ea Kênh	Ea Yông
Đông Hà	Đức Minh	Long Sơn					Cư Knia		Đliê Yang	Ea Sar						
Trà Tân		Đắk Sắk							Ea Khal	Ea Sô						
		Krông Buk													

		13				14
Climate vulnerability:		Medium to low drought risk, with wetter wet and wetter dry seasons				
Cropping system:	***perennial:***	Banana	Banana, cashewnut	Banana, cashewnut, pomelo	-	Coffee, pepper, cocoa
	annual:	Maize, beans	Maize, rice		Maize, cassava, beans	Maize, cassava, rice
	Soil types:	Ferralsols	Leptosols	Ferralsols	Leptosols	Rhodic
Rainfed/irrigated:		Rainfed				Irrigated
		Phước Thành	Phước Tân	Phước Chiến	Phước Thắng	Đắk Lao

Annex 2. CRA packages apply for each project province

This annex provides the details for all CRA packages, linked to the respective communes and CRA clusters as described in the previous annex:

Provinces	CRA packages	CRA clusters	Commune
Khanh Hoa	Package 5: intercropping of Cashew nuts and beans	4, 5	Suoi Cat, Suoi Tan, Cam Hiep Nam
	Package 6: intercropping of Mango trees and beans	6; 7	Cam Đức, Cam Tân, Cam Hoà. Cam Hải Tây, Cam Hiệp Bắc, Cam Hiệp Nam, Cam Thành Bắc, Suối Cát, Suối Tân
	Package 7: Intercropping of Mango and banana trees	6; 7	Cam Đức, Cam Tân, Cam Hoà. Cam Hải Tây, Cam Hiệp Bắc, Cam Hiệp Nam, Cam Thành Bắc, Suối Cát, Suối Tân
Ninh Thuan	Package 1: safe vegetables (onions)	1	Nhon Hai
	Package 2: safe vegetables (garlic)	1	Nhon Hai
	Package 3: Intercropping of custard apple and beans	3	Bac Phong, bac son, loi hai
	Package 4: intercropping of apple + beans	2	My Son, Nhon Son, Xuan Hai
	Package 5: intercropping of Cashew nuts and beans	13	Phuoc chien, Phuoc khang, Loi Hai, Bac Son in Thuan Bac; Phuoc Tan, Phuoc Thanh, Phuoc Thanh, Phuoc Trung in Bac Ai
	Package 12: Crop rotation of maize and beans	2	My Son, Nhon Son, Xuan Hai
	Package 13: Intercropping of cassava and beans	13	Phuoc Tan, Phuoc Thanh, Phuoc Thanh, Phuoc Trung in Bac Ai
Binh Thuan	Package 8: Intercropping of dragon fruit and beans	8; 9	Mỹ Thạnh, Hàm Cần , Tân Lập, Thuận Nam, Tân Thuận, Tân Thành
	Package 10: Inter-cropping of coffee and avocado	10	Tân Hà, Đông Hà, Trà Tân
	Package 11: inter-cropping of coffee and durian	10	Tân Hà, Đông Hà, Trà Tân
Dak Nong	Package 9: Inter-cropping of coffee and pepper	10; 11; 12; 14	Ea T'Linh, Nam Dong, Đăk DRông, Tâm Thắng, Cư Knia, Trúc Sơn, Đắk Lao, Đức Mạnh, Long Sơn, Đắk Sắk, Thuận An, Đức Minh, Đăk Sôr , Nam Xuân, Đăk Drô , Nam Nung
	Package 10: Inter-cropping of coffee and avocado	10; 11, 12; 14	Ea T'Linh, Nam Dong, Đăk DRông, Tâm Thắng, Cư Knia, Trúc Sơn, Đắk Lao, Đức Mạnh, Long Sơn, Đắk Sắk, Thuận An, Đức Minh, Đăk Sôr , Nam Xuân, Đăk Drô , Nam Nung
	Package 11: inter-cropping of coffee and durian	10; 11; 12; 14	Ea T'Linh, Nam Dong, Đăk DRông, Tâm Thắng, Cư Knia, Trúc Sơn, Đắk Lao, Đức Mạnh, Long Sơn, Đắk Sắk, Thuận An, Đức Minh, Đăk Sôr , Nam Xuân, Đăk Drô , Nam Nung

Provinces	CRA packages	CRA clusters	Commune
Dak Lak	Package 9: Inter-cropping of coffee and pepper	10; 11; 12; 14	Ea Drang, EaSol, Đliê Yang, Quảng Tiến, Ea Sô, Ea Sar, Xuân Phú, Krông Buk, Ea Phê, Ea Yông, Ea Kênh
	Package 10: Inter-cropping of coffee and avocado	10; 11; 12; 14	Ea Drang, EaSol, Đliê Yang, Quảng Tiến, Ea Sô, Ea Sar, Xuân Phú, Krông Buk, Ea Phê, Ea Yông, Ea Kênh
	Package 11: inter-cropping of coffee and durian	10; 12; 14	Ea Drang, EaSol, Đliê Yang, Quảng Tiến, Ea Sô, Ea Sar, Xuân Phú, Krông Buk, Ea Phê, Ea Yông, Ea Kênh

CRA package no. 1.		
CRA package name:	**Safe vegetable: onion** On the irrigated flatland with existing onion cultivation	
Expected results compared to baseline:	Climate resilience (for identified climate vulnerability):	Improve resilient of current agricultural practice towards very severe to severe drought risk; Wetter dry and wetter wet seasons
	Baseline yield (tons) per ha:	20 tons/ha/winter-spring crop; 12 tons/ha/summer-autumn crop
	Baseline yield (tons) per ha:	25 tons/ha/winter-spring crop; 15 tons/ha/summer-autumn crop
	Expected income (USD) per ha:	22,026 USD (VND 500 million)/ha/winter-spring crop and VND 300 million/ha/summer-autumn crop
CRA specifications:	Detailed description of techniques:	**1. Onion** **a. Component of crops in the system: Onion- onion - .... - Onions (monoculture)** Purple onion; growth period: 70 - 75 days (winter-spring), 50-60 days (summer-autumn), adapted to condition of Ninh Thuan province, drought-resistant, salt-tolerant; supplying onion seeds and being accepted by the market. **b. Applied techniques in the system:** - Planting period: Planted year-round. - Preparation of land (seed bed). Grow with distance between plants: The row distance is 20 cm; the plant distance is 10 cm. Amount of seedlings needed: 3.000 - 4.000 kg/ha. - Spilling irrigation along the furrows. - Fertilizer (1 ha): Composted manure: 60 tons + Lime 500 kg + NPK 500 kg + KCl 100 kg. - Safe and integrated pest management (IPM) with the aim of reducing pesticide spraying costs as much as possible, ensuring productivity, product quality, consumer safety and environmental protection.
	Target groups:	At least 40% of participants are women, at least 15% of participants are ethnic minorities
	Key partners in support to develop the CRA package	Lead Farmers; District Agricultural Extension Station; Provincial Extension Center; Ninh Thuan Onion and Garlic Association, Fertilizer & Seedling Suppliers: Duyen Sang, Nguyen Thi Phuong, Vo Thi Mai, Pham Thi Phuong, Nguyen Long. Potential credit providers (VBSP, VBARD).
	One-off investment costs:	12,943USD (VND 293.8 million)/ha/crop
	Regular inputs/O&M required:	NA
CRA clusters so apply this package:	1 Commune: Nhon Hai	

CRA package no. 2.		
CRA package name:	**Safe vegetable: Garlic** On the irrigated flatland with existing garlic cultivation	
Expected results compared to baseline:	Climate resilience (for identified climate vulnerability):	Improve resilient of current agricultural practice towards very severe to severe drought risk; Wetter dry and wetter wet seasons
	Baseline yield (tons) per ha:	6 tons/ha/crop
	Baseline yield (tons) per ha:	10 tons/ha/crop
	Expected income (USD) per ha:	19,824USD (VND 450 million)/ha/crop (VND 45,000/kg)
CRA specifications:	Detailed description of techniques:	**1. Garlic** **a. Component of crops in the system:** Garlic planted in monoculture in the rotation of winter-spring garlic - onion - onion - winter-spring garlic Phan Rang garlic (Ninh Thuan garlic), having small pieces, but very fragrant and pungent. Growth period 130-150 days. **b. Applied techniques in the system:** - Suitable season: Seed sowing for garlic plantation from September to November, harvest from February to April the next year. - Preparation of seedbed. Grow with distance between plants: rows 13-15 cm, plants 5-7 cm. Amount of seedlings needed: 900 - 1.000 kg/ha. - Spilling irrigation along the furrows. - Fertilizer: 60 tons of composted manure + 500 kg of NPK + 200 kg of KCl + 500 kg of lime. - Safe and integrated pest management (IPM) with the aim of reducing pesticide spraying costs to the maximum, ensuring productivity, product quality, consumer safety and environmental protection. .
	Target groups:	At least 40% of participants are women, at least 15% of participants are ethnic minorities
	Key partners in support to develop the CRA package	Excellent farmers; District Agricultural Extension Station; Provincial Extension Center; Ninh Thuan Onion and Garlic Association Fertiliser, seedling suppliers: Duyen Sang, Nguyen Thi Phuong, Vo Thi Mai, Pham Thi Phuong, Nguyen Long. Potential credit providers (VBSP, VBARD).
	One-off investment costs:	12,802USD (VND 290.6 million)/ha/crop
	Regular inputs/O&M required:	NA
CRA clusters to apply this package:	1 Commune: Nhon Hai	

CRA package no . 3.		
CRA package name:	**Intercropping: Custard apple + Bean** On irrigated flatlands	
Expected results compared to baseline:	Climate resilience (for identified climate vulnerability):	Improve resilient of agricultural practice towards very severe to severe drought risk; Drier dry and wetter wet seasons
	Baseline yield (tons) per ha:	On low-yielding, inefficient paddy land (productivity <5 tons/ha/crop)
	Expected yield (tons) per ha:	- Custard apple: Plantation with good care bears fruits after 18 months, yield of about 1 ton/crop/ha. Productivity: 4-5 tons/crop/ha, 2 crops per year: commercialization stage - Green bean: 700 - 800 kg/ha.
	Expected income (USD) per ha:	- Custard apple: 2nd year: 1,101USD (VND 25 million); From the third year onwards: 8,811-11,013 USD (VND 200 -250 million)/ha - Green bean: 925-1,057USD (VND 21 -24 million)/ha
CRA specifications:	Detailed description of techniques:	**Inter-cropping: Custard apple - Bean** **a. Component of crops in the system: Custard apple and green beans** -Custard apple: Thin shell, easy to peel off, less seeds, more and firm flesh, very sweet and delicious. Seeds are small and are easy to separate from the flesh Green bean DX208 **b. Applied techniques in the system:** ***(i) For Custard apple:*** - Cover the bottom of tree trunks to keep the moisture in the summer by bean stalks, straw, rice husks, 20 cm from the bottom. This method also prevents the development of weeds, and at the same time when the materials are decomposed, they will give the soil a considerable amount of nutrients. - Efficient dripping irrigation by mini-pan (water control): Save 40-50% of irrigation water compared to traditional spilling irrigation onto the bottom of trunk; watering at the right time, at right growth stage, and in right amount. - Plantation period: Grows from September to October, before the rainy season ends; In case of water availability, it can be planted in any crop times. -Density of plantation: 1,100 trees/ha (3m x 3m). -Fertilizer: In the first 2 years, 20 kg/year, then 30 kg/year from the third year. In the first year, use NPK 16: 16: 8 with 0.5 kg per tree. From the second year onwards, for every additional year, adding 0.5 kg of fertilizer up until the 8th year and increase no further. - Manual pollination to increase the density of ripe fruits to serve the harvest purpose. ***(ii) for Green bean***

CRA package no . 3.		
		- Planting winter-spring and summer- autumn crops. - Sowing seeds with distances of 40cm row-to-row, 10cm tree-to-tree, trimming the tree when 1 to 2 true leaves, ensuring density of 25 plants/m $^{2.}$ - Distance from custard apple tree of at least 40cm; The area of green bean cultivation is about 70-80% of the land area for custard apple. - Fertilizer for 1 ha: 640 kg of bio-organic fertilizer +80 kg Ure + 320 kg of phosphate + 80 kg of KCl. - Harvest at least 3 times, first round when 40-50% of the fruits are ripe; 2nd time is when 50% of ripe fruits (leaves turn yellow); and third time when all the fruits are fully ripe. Green bean stalks are cut and used to cover the bottom of trunk of custard apple trees.
	Target groups:	At least 40% of participants are women, at least 15% of participants are ethnic minorities
	Key partners in support to develop the CRA package	Excellent farmers, District Agricultural Extension Station, Provincial Extension Center, Southern Fruit Research Institute, South Central Coastal Agricultural Science Institute. Suppliers of fertilizer, pumping machines, pipelines in the commune and district. Nha Ho Seed Center, Ninh Son. Potential credit providers (VBSP, VBARD).
	One-off investment costs:	3,348USD (VND 76.025 million)/ha; excluding the cost of irrigation and intercropping systems (the cost of inter-cropped green beans is 793USD (18 million VND)/ha/crop).
	Regular inputs/O&M required:	2nd year: 1,454 (VND 33 million)/year
CRA clusters to apply this package:	3. Commune: Bac Phong, Bac Son, Loi Hai	

CRA package no . 4.		
CRA package name:	**Intercropping: Apples + Beans** On irrigated flatlands	
Expected results compared to baseline:	Climate resilience (for identified climate vulnerability):	Improve resilience of agricultural practice towards very severe to severe drought risk; Drier dry and wetter wet seasons
	Baseline yield (tons) per ha:	On low-yielding, inefficient crop or paddy land (productivity <4 tons/ha/crop)
	Expected yield (tons) per ha:	- Apples: With good care, bearing fruits after 9-12 months, yield of about 10 ton/crop/ha. From the 2nd year: Stable output of 40 - 60 tons / ha - Green bean: 700 - -800 kg/ha.
	Expected income (USD) per ha:	- Apples: First year: 3,084USD (VND 70 million); From the 2nd year onwards: 12, 335-18,502USD (VND 280- 420 million/ha) - Green bean: 925-1,057USD (VND 21 -24 million)/ha
CRA specifications:	Detailed description of techniques:	**Inter-cropping: Apple - Bean** **a. Component of crops in the system: Apples and green beans (inter-cropping in Year 1)** - Ninh Thuan grafted apple variety: delicious, competitive with other varieties of apple, drought tolerant and adaptable to some localities in Ninh Thuan, after planting 9-12 months, bearing 1st time fruits with yield of 10 tons/ha - Green bean DX208 **b. Applied techniques in the system:** ***(i) For Apple:*** - Cover the bottom of tree trunks to keep the moisture in the summer by bean stalks, straw, rice husks, 20 cm from the bottom. This method also prevents the development of weeds, and at the same time when the materials are decomposed, they will give the soil a considerable amount of nutrients. - Efficient dripping irrigation by mini-pan (water evaporating pan): Save 40-50% of irrigation water compared to traditional spilling irrigation onto the bottom of tree trunk; watering at the right time, at right growth stage, and in right amount. - Plantation period: Grows from September to October, before the rainy season ends; In case of good water availability, it can be planted in any crop time year round. -At a density of 400 trees/ha (5m x 5m). -Fertilizer: mainly manure and bio-organic fertilizer. + Year 1: 60 tons of composted manure (to improve soil) + 400 kg of lime + 100 kg of urea + 300 kg of NPK;

CRA package no . 4.		
		+ Year 2: 3 tons of bio-organic fertilizer + 200 kg of lime + 250 kg of KCl + 600 kg of NPK. - From 2nd year, apple branches must be cut. - Integrated Crop Management (ICM). Safe and integrated pest management (IPM) with the aim of reducing pesticide spraying costs to the maximum, ensuring productivity, product quality, consumer safety and environmental protection. ***(ii) for Green bean*** - Planting winter-spring crop and summer-autumn crop after planting apples (one-crop planting) - Sowing at distances of 40cm row-to-row, 10cm tree-to-tree, trimming the tree when 1 to 2 true leaves, ensuring density of 25 plants/$m^{2.}$ - Distance from apple trees of at least 40cm; the area of green bean cultivation is about 80% of the land area for apples. - Fertilizer for 1 ha: 640 kg of bio-organic fertilizer +80 kg Urea + 320 kg of phosphate + 80 kg of KCl. - Harvest at least 3 times, first round when 40-50% of the fruits are ripe; 2nd time is when there is 50% of ripe fruits (leaves turn yellow); and third time when all the fruits are fully ripe (leaves have fully fallen). Green bean stalks are cut and used to cover the bottom of trunk of apple trees. **c. Participants:**
	Target groups:	At least 40% of participants are women and 40 % are ethnic minorities
	Key partners in support to develop the CRA package	Excellent farmers, District Extension Station, Provincial Extension Center, South Central Coastal Agricultural Science Institute, Research Institute for Cotton and Rural Development. Nha Ho Seed Center, Ninh Son. Suppliers on (fertilizers, materials) in communes. Potential credit providers (VBSP, VBARD).
	One-off investment costs:	10,088USD (VND 229.95 million)/ha; excluding the cost of irrigation and intercropping systems (the cost of planting green beans is 705USD (16 million VND)/ha/crop).
	Regular inputs/O&M required:	2nd year: 4,214USD (VND 95.65 million)/year
CRA clusters to apply this package:	2. Commune: My Son, Nhon Son, Xuan Hai	

CRA package no. 5.		
CRA package name:	**Intercropping: Cashew nut + Bean** Rain-fed sloping land or flatland, no water available for irrigation	
Expected results compared to baseline:	Climate resilience (for identified climate vulnerability):	Improve resilience of agricultural practice towards medium to low drought risk; wetter dry and wetter wet seasons
	Baseline yield (tons) per ha:	Maize yield 3-4 tons/ha/crop; Re-cultivating old cashew nut gardens of low productivity.
	Expected yield (tons) per ha:	- Cashew nuts: 3rd year: 500 kg/ha; 4th year: 1,200 kg/ha; 5th year: 1,700 kg/ha; 6th-15th year: 2.000 - 2.500 kg/ha. - Beans for seeds: 700-800 kg/ha (inter-cropping in first 1-3 years, planting 1 crop/year)
	Expected income (USD) per ha:	- Cashew nuts: Year 3: USD 881 year; 4th year: USD 2,115/year; 5th year: USD 2996/year; 6th-12th year: USD 3,524 – 4,405/ha - Beans for seeds: USD 925-1,057/ha
CRA specifications:	Detailed description of techniques:	**Inter-cropping: Cashew nut + Bean** **a. Component of crops in the system: Cashews and green beans; inter-cropping green beans in the first 2 years** -Grafted cashew nut varieties: ĐDH102-293, in addition to some varieties of DDSH67-15, AB05-08; PN1 has adapted to the regions - Green bean DX208 - Inter-cropping to increase income, limit soil erosion, maintain soil moisture, improve soil fertility and diversify crops. **b. Applied techniques in the system:** ***(i) For Cashew nut:*** - Planting season: September to November - Plantation at distance of 8m row-to-row and 6m tree-to-tree (208 trees/ha). -Fertilizer: + Initial application before planting: Decomposed crop residues 10 - 20 kg/hole + Superphosphate 0.5 kg / hole + Basic design stage: Application of 20-30 kg/composted manure or decomposed crop residues and all the amount of phosphate at the beginning of rainy season. First year: Application of 20g Urea + 20g Super-phosphate + 10g KCl; 2nd year: 200g Urea + 200g Superphosphate + 50g KCl + Business stage: In the 3rd Year, apply 1.08 kg Urea + 1.4 kg Super-phosphate + 0.4 kg KCl; From the 4th- 7th years, every year apply 20-30% increase in fertilizer volume depending on productivity

CRA package no. 5.		
		increase; from the 8th year onwards: Adjust the amount of fertilizer by the condition and yield of the orchard. ***(ii) for Green bean*** - Plantation at winter-spring crop and summer-autumn crop (mainly rain-fed) - Sowing at distances of 40cm row-to-row, 10cm tree-to-tree, trimming the tree when 1 to 2 true leaves, ensuring density of 25 plants/$m^{2.}$ - Distance from cashew nut trees of at least 40cm; The area of green bean cultivation is about 70-80% of the land area for cashew nuts. - Fertilizer for 1 ha: 640 kg of bio-organic fertilizer +80 kg Urea + 320 kg of phosphate + 80 kg of KCl. - Harvest at least 3 times, first round when 40-50% of the fruits are ripe; 2nd time is when there is 50% of ripe fruits (yellow sage leaf); and third time when all the fruits are fully ripe (leaves have fully fallen). Green bean stalks are cut and used to cover the bottom of trunk of cashew nut trees.
	Target groups:	At least 40% of participants are women, at least 50% of participants are ethnic minorities
	Key partners in support to develop the CRA package:	Lead farmers, District Extension Station, Provincial Extension Center, South Central Coastal Agricultural Science Institute (South Central region), Central Highland Research Institute for Agro-forestry (Central Highlands region), Southern Research Institute of Agriculture Agent of Phu My Fertilizers Company in District and other Suppliers on (fertilizers, materials) in communes (i.e. Suppliers: Ha Loc, Hanh Thuy, Lan Anh). Potential credit providers (VBSP, VBARD).
	One-off investment costs:	USD 2,063, excluding inter-cropped plantation costs of beans (USD 705/ha).
	Regular inputs/O&M required:	2nd year: USD 1,057/ha
CRA clusters to apply this package:	4, 5, 13 Commune: Phuoc Chien, Phuoc Khang, Loi Hai, Bac Son in Thuan Bac; Phuoc Tan, Phuoc Thanh, Phuoc Thanh, Phuoc Trung in Bac Ai	

CRA package no. 6		
CRA package name:	**Intercropping: Mango + Bean** On irrigated flatlands	
Expected results compared to baseline:	Climate resilience (for identified climate vulnerability):	Improve resilience of agricultural practice towards very severe to severe drought risk; wetter dry and wetter wet seasons; flood risk
	Baseline yield (tons) per ha:	Maize: 3-5 tons/ha/crop
	Expected yield (tons) per ha:	(i) For Mango: 3rd year: 5-7 kg of fruit/tree (2-3 tons/ha), commercialization period from year 5 to year 15: 10-12 tons/ha/year. - Beans for seeds: The productivity is 700-800 kg/ha/crop
	Expected income (USD) per ha:	- Mango: Year 3, 4: USD 1,762-2,643/ha; 5th-11th year: USD8,811-10,573/ha - Beans for seeds: USD925-1,057/ha
CRA specifications:	Detailed description of techniques:	**Inter-cropping: Mango + Bean** **a. Component of crops in the system: Mangos and green beans; inter-cropping green beans in the first 2 years** -Grafted mango varieties: Australian mango R2E2 and Taiwanese mango; there should be 10% of other species planted in the garden to increase the rate of fruit bearing; Green beans DX208; - Inter-cropping to increase income, limit soil erosion, maintain soil moisture, improve soil fertility. **b. Applied techniques in the system:** **(i) For Mango:** - Efficient dripping irrigation by mini-pan (water evaporating pan): Save 40-50% of irrigation water compared to traditional spilling irrigation onto the bottom of tree trunk; watering at the right time, at right growth stage, and in right amount. - Planting season: September to November - Planting distance: Semi-intensive: 6m row-to-row and 6m tree-to-tree (278 trees/ha) and intensive: 5m row-to-row and 5m tree-to-tree (400 trees/ha). -Fertilizer: + Basic construction stage: Year 1: 150 kg Urea + 400 kg Super- phosphate + 120 kg KCl + 400 kg lime powder; Year 2: 150g Urea + 400g Super-phosphate + 120 kg KCl; Year 3: 200g Urea + 400g Superphosphate + 280 kg KCl. In addition, use 20 liters of bio-fertilizer sprayed through the leaves. + Commercialization stage commences when cashew nut trees are of 5-7 years old: Annual application: 570 kg Urea + 620 kg Super-phosphate + 330 kg KCl. In addition, use 20 liters of bio-fertilizer sprayed through the leaves.

CRA package no. 6		
		+ Heavily water the plants after each application of fertilizers (ii) for Green bean - Plantation of winter-spring crop and summer- autumn crop (mainly rain-fed) - Sowing at distances of 40cm row-to-row, 10cm tree-to-tree, trimming the tree when 1 to 2 true leaves, ensuring density of 25 plants/m $^{2.}$ - Distance from mango trees of at least 40cm; The area of green bean cultivation is about 70-80% of the land area for mangos. - Fertilizer for 1 ha: 8 tons of manure (or 800 kg of bio-organic fertilizer) +100 kg Urea + 400 kg of phosphate + 100 kg of KCl. Adjust the amount of fertilizer according to specific conditions. - Harvest at least 3 times, first round when 40-50% of the fruits are ripe; 2nd time is when there is 50% of ripe fruits (leaves turn yellow); and third time when all the fruits are fully ripe (leaves have fully fallen). Green bean stalks are cut and used to cover the bottom of trunk of mango trees.
	Target groups:	At least 40% of participants are women, at least 20 % of participants are ethnic minorities
	Key partners in support to develop the CRA package:	Excellent farmers, District Extension Station, Provincial Extension Center, South Central Coastal Agricultural Science Institute, Cam Lam Mango Plantation Association, Van Huong and Chanh Thu companies Suoi Cat hi-tech centre. Suppliers on (fertilizers, materials) in communes. Potential credit providers (VBSP, VBARD).
	One-off investment costs:	USD2,159, excluding inter-cropped plantation costs (705USD/ha) and irrigation system.
	Regular inputs/O&M required:	Year 2: USD1,490/year
CRA clusters to apply this package:	6, 7 Commune: Cam Đức, Cam Tân, Cam Hoà. Cam Hải Tây, Cam Hiệp Bắc, Cam Hiệp Nam, Cam Thành Bắc, Suối Cát, Suối Tân	

CRA package no. 7		
CRA package name:	**Intercropping: Mango + Banana** On irrigated flatlands	
Expected results compared to baseline:	Climate resilience (for identified climate vulnerability):	Improve resilience of agricultural practice towards very severe to severe drought risk; wetter dry and wetter wet seasons; flood risk
	Baseline yield (tons) per ha:	Maize: 3-5 tons/ha/crop
	Expected yield (tons) per ha:	(i) For Mango: 3rd year: 5-7.5 kg of fruits/tree (2-3 tons/ha), commercialization period from year 5 to year 15: 10-12 tons/ha/year. - Bananas: The productivity is 20 tons/ha/year
	Expected income (USD) per ha:	- Mango: Year 3: USD1,762-2,643/year; 5th-15th year: USD8,811-10,573/ha - Bananas: USD3,965 /ha
CRA specifications:	Detailed description of techniques:	**Inter-cropping: Mango + Banana** **a. Component of crops in the system: Mangos and green beans; inter-cropping green beans in the first 2 years** New mango varieties R2E2, Taiwanese mango - Inter-cropping to increase income, limit soil erosion, maintain soil moisture, improve soil fertility. **b. Applied techniques in the system:** ***(i) For Mango:*** - Efficient dripping irrigation by mini-pan (water evaporating pan) for environmental and economical efficiency (save 40-50% of irrigation water compared to traditional spilling irrigation onto the bottom of trunk; watering at the right time, at right growth stage, and in right amount). - Planting season: September to November - Density: Semi-intensive cultivation: 278 trees/ha (6m x 6m) and intensive cultivation: 400 trees/ha (5m x 5m). -Fertilizer: + Basic construction stage: Year 1: 150 kg Urea + 400 kg Super- phosphate + 120 kg KCl + 400 kg lime powder; Year 2: 150g Urea + 400g Super-phosphate + 120 kg KCl; Year 3: 200 kg Urea + 400 kg Super-phosphate + 280 kg KCl. In addition, use 20 liters of bio-fertilizer sprayed through the leaves. + Commercialization period commences when cashew nut trees are of 5-7 years old: Annual application: 570 kg Urea + 620 kg Super-phosphate + 330 kg KCl In addition, use 20 liters of bio-fertilizer sprayed through the leaves. + Heavily water the plants after each application of fertilizers

CRA package no. 7		
		Integrated Crop Management (ICM) and Integrated Pest Management (ICM) ***(i) For Banana:*** - Planting season: It is best to plant at the beginning of the rainy season for high growth and survival rates. - Inter-cropping 800 trees/ha (between two rows of mango, plant one row of bananas and at 2.5m tree-to-tree distance). - Tending: Planting windbreaks around the garden to limit leaf tears causing yield reduction. Watering: In the seedling stage, water 1-2 times/week; the grown-up plants twice a week. -Fertilizer: - Fertilizer application: 150-200g N; 50 g P_2O and 200-250 g K_2O/tree/crop. + Initial fertilizer application (before planting): Apply the whole amount of P_2O into holes before planting; for next crops, apply after harvest or early in rainy season. + Top dressing of fertilizers: The remaining fertilizers are applied 2-3 times/year.
	Target groups:	At least 40% of participants are women, at least 20 % of participants are ethnic minorities
	Key partners in support to develop the CRA package:	Excellent farmers, District Extension Station, Provincial Extension Center, South Central Coastal Agricultural Science Institute. Suoi Cat hi-tech centre. Suppliers on (fertilizers, materials) in communes. Potential credit providers (VBSP, VBARD).
	One-off investment costs:	USD4,405/ha, excluding irrigation system (USD1,540/ha)
	Regular inputs/O&M required:	Year 2: USD2,700/year; Year 3: USD2,876/ha
CRA clusters to apply this package:	6, 7 Commune: Cam Đức, Cam Tân, Cam Hoà. Cam Hải Tây, Cam Hiệp Bắc, Cam Hiệp Nam, Cam Thành Bắc, Suối Cát, Suối Tân	

CRA package no. 8		
CRA package name:	**Intercropping: dragon Fruit (VietGap) + Bean** On irrigated flatlands	
Expected results compared to baseline:	Climate resilience (for identified climate vulnerability):	Improve resilience of agricultural practice towards very severe to severe drought risk; wetter dry and wetter wet seasons; and medium to low drought risk; wetter dry and wetter wet seasons
	Baseline yield (tons) per ha:	Paddy: 4-5 tons/ha/crop
	Expected yield (tons) per ha:	- Dragon fruit: Year 2: 40 tons/ha/year; Year 3 onwards: 60 tons/ha/year. - Beans: 700 - 800 kg/ha.
	Expected income (USD) per ha:	- Dragon fruit: Year 3: USD26,432//ha/year; from Year 4 onwards: USD39,648/ha/year - Beans for seeds: USD925-1,057/ha
CRA specifications:	Detailed description of techniques:	**a. Component of crops in the system: Dragon fruit and beans for seed collection (Spring-autumn crop in the first year)** Commonly grown variety is the white flesh dragon fruit. The flowering time is from April to September (the main season), from fruit bearing to harvest is about 28 - 32 days. **b. Applied techniques in the system:** ***(i) Planting dragon fruit (VietGap)*** - Efficient dripping irrigation by mini-pan (water evaporating pan) for environmental and economical efficiency (save 40-50% of irrigation water compared to traditional spilling irrigation, to be done at the right time, at right growth stage, and in right amount). - In the sunny season, straw, dry grasses, coconut skins, inter-cropped bean stalks should be used to cover the bottom of tree trunks. In addition to holding moisture for the plants, this measure also helps to limit the growth of weeds. - Planting seasons: There are two major timings for seed sowing: October- November and May-June. - Distance between plants: 3m x 3m, density of 1,100 pillars/ha (plant 4 trees/pillar). - Wooden, brick or reinforced cement pillars can be used to grow dragon fruit. -Fertilizer: using manure and/or compost fertilizer *+ Basic design stage:* Year 1: Organic fertilizer: 10 kg of composted animal manure (or 1 kg of bio-organic fertilizer) + 0.5 kg of Van Dien super- phosphate or phosphate for each pillar. Chemical fertilizer: 25g Urea + 25g DAP/pillar, or 80g NPK 20-20-15/pillar; Periodically apply once a month

CRA package no. 8		
		Year 2: Organic fertilizer: 20 kg of composted animal manure (or 2 kg of bio-organic fertilizer) + 1 kg of Van Dien super- phosphate or phosphate for each pillar. Chemical fertilizer: Apply fertilizer once a month with 50 g Urea + 50 g DAP/time, or 150 g NPK 20-20-15/pillar. *+ Commercialization stage (From 2nd year onwards):* Organic fertilizer: 30 kg of decomposed animal manure (or 3kg of bio-organic fertilizer) + 1 kg of Van Dien super- phosphate or phosphate for each pillar. Chemical fertilizer: 1.1 kg Urea + 3.6 kg Van Dien super phosphate or phosphate + 0.55-0.8 kg KCl/pillar/year. Or 2.4- 3.6 kg NPK 20-20-15 + 0.16-0.2 kg KCl/pillar/year Integrated crop management (ICM) and IPM- pest control. **(ii) for Green bean** - Planting winter-spring crop (or summer- autumn crop). - Sowing at distances of 40cm row-to-row, 10cm tree-to-tree, trimming the tree when 1 to 2 true leaves, ensuring density of 25 plants/m $^{2.}$ - Distance from dragon fruits of at least 40cm; The area of green bean cultivation is about 70-80% of the land area for dragon fruits. - Fertilizer for 1 ha: 640 kg of bio-organic fertilizer +80 kg Urea + 320 kg of phosphate + 80 kg of KCl. - Harvest at least 3 times, first round when 40-50% of the fruits are ripe; 2nd time is when there is 50% of ripe fruits (leaves turn yellow); and third time when all the fruits are fully ripe (leaves have fully fallen). Green bean stalks are cut and used to cover the bottom of trunk of mango trees.
	Target groups:	At least 40% of participants are women, at least 40 % of participants are ethnic minorities
	Key partners in support to develop the CRA package:	Excellent farmers, District Extension Station, Provincial Agricultural Extension Center, Binh Thuan Dragon Fruit Center, Binh Thuan Dragon Fruit Association, South Central Coastal Agricultural Science Institute, Southern Fruit Research Institute for supplying of seeds. 18 Dragon VietGap groups Ferilizers and Materials Suppliers: Hữu Nghị, Thanh Lan, Tư Lơi, Phú Hưng, Hữu Hưng Trung Nhân, Minh Thế, Ngọc Đạt, Thông Minh (located in nearby commune of Hàm Thạnh), Potential credit providers (VBSP, VBARD).
	One-off investment costs:	USD9,731/ha; excluding the cost of irrigation and intercropping systems (the cost of inter-cropping USD705 VND/ha/crop).
	Regular inputs/O&M required:	Year 2: USD7,599/ha
CRA clusters to apply this package:	8, 9 Commune: Mỹ Thạnh, Hàm Cần , Tân Lập, Thuận Nam, Tân Thuận, Tân Thành	

CRA package no. 9		
CRA package name:	**Improved inter-cropping: Coffee + Pepper** Land for re-planting of coffee trees or crop cultivation and irrigated land	
Expected results compared to baseline:	Climate resilience (for identified climate vulnerability):	Improve resilience of agricultural practice towards very severe to severe drought risk; wetter dry and wetter wet seasons
	Baseline yield (tons) per ha:	Coffee <2 tons of beans/ha for 3 consecutive years
	Expected yield (tons) per ha:	- Coffee: 1,878 kg of coffee beans/ ha (2.3 kg/tree) from Year 4 with a 20-year business cycle - Pepper: 2,040 kg/ha (2.55 kg/pillar) from Year 4 with a 20-year business cycle
	Expected income (USD) per ha:	Total revenue: USD9,175 (of which: coffee: USD3,513; Pepper: USD5,662 from the 4th year with a 20- year business cycle
CRA specifications:	Detailed description of techniques:	**Improved inter-cropping: Coffee – Pepper** **a. Component of crops in the system: coffee and pepper** - Grafted coffee variety with TR4; TR9, ... - Pepper varieties: Vinh Linh pepper, Loc Ninh pepper, Sri Lanka pepper, etc. Advantages of the system: Diversify crops, increase income, reduce price risks; Limiting disease spread when doing extensive mono-culture (fast speed, low- speed lethal diseases ...); Reduction of labor cost for each stage; Grow peppers as living pillars for shade and windbreak for coffee, water savings in irrigation; the plants grow stronger. **b. Applied techniques in the system:** - Immediate re-cultivation without the need of crop rotation, and re-cultivation of coffee must apply crop rotation for 1-2 years when coffee plants contract diseases. - Efficient dripping irrigation by mini-pan (water evaporating pan) for environmental and economic efficiency (save 40-50% of irrigation water compared to traditional spilling irrigation onto the bottom of trunk; watering at the right time, at right growth stage, and in right amount). - Cover the bottom of tree trunks to keep the moisture in the summer by straw and rice husks, 20- 30 cm from the bottom of trunk. This method also prevents the development of weeds, and at the same time when the straw and rice husks are decomposed, they will give the soil a considerable amount of nutrients and prevent soil erosion. - The best season to start the plantation is at the beginning of the rainy season and ends 1.5 - 2 months before the dry season begins, from May 15th to August 15th every year.

CRA package no. 9		
		-Density and planting distance: Inter- cropping in rows with 2 coffee rows and 2 pepper rows for ease of cultivation (1,616 trees/ha, of which 816 coffee trees and 800 trees). Coffee: 2,5x2,5 m; Pepper: 2.5 x 2.5 m ***(I) Coffee:*** - Digging holes 80x80x80 cm -Fertilizer: + Year 1: 100 kg of urea + 500 kg of phosphate + 75 kg of potassium + 1,500 kg of bio-organic+ 500 kg of lime. + Year 2: 200 kg of urea + 500 kg of phosphate + 150 kg of potassium + 1,500 kg of bio-organic + Year 3: 200 kg of urea + 500 kg of phosphate + 250 kg of potassium + 1,500 kg of microbial organic - Application of Integrated Pest Management (IPM), Integrated Crop Management (ICM) to reduce the use of pesticides. ***(ii) Pepper*** - Hole digging: digging holes with size of 60cm x 60cm x 60cm (plant 2 bags a hole). Initial fertilizer application (before planting): 15kg of composted manure + 0.3 - 0.5kg of phosphate + 0.3kg of lime powder. - Use nets for sunscreen purpose, ensuring that the seedlings are exposed to 50% direct sunlight. -Fertilizer: + Year 1: 225 kg Urea + 300 kg phosphate + 375 kg Kali + Year 2: 225 kg of urea + 300 kg of phosphate + 375 kg of potassium + bio-organic+ Trichoderma + Year 3: 300 kg of urea + 400 kg of phosphate + 450 kg of potassium + bio-organic+ Trichoderma - Application of Integrated Pest Management (IPM), Integrated Crop Management (ICM) to reduce the use of pesticides.
	Target groups:	At least 40% of participants are women, at least 50 % of participants are ethnic minorities
	Key partners in support to develop the CRA package:	Lead Farmers, DAE Station, Provincial AEC, Central Highlands Agriculture and Forestry Science Institute (Central Highlands), Provincial Coffee / Pepper Association. Tin Nghia Company (4C coffee investment), Intrax (Dak Nong), DakMan Company, Nurseries of VNSAT project in Ea Phe, Suppliers on (fertilizers, materials) in communes. Potential credit providers (VBSP, VBARD).
	One-off investment costs:	USD8,666/ha, excluded irrigation system cost (USD1,542/ha)
	Regular inputs/O&M required:	Year 2: USD3,971/ha; Year 3: USD5,231/ha
CRA clusters to apply this package:	10, 11, 12, 14 Commune: Dak Nong: Ea T'Linh, Nam Dong, Đăk DRông, Tâm Thắng, Cư Knia, Trúc Sơn, Đắk Lao, Đức Mạnh, Long Sơn, Đắk Sắk, Thuận An, Đức Minh, Đăk Sôr , Nam Xuân, Đăk Drô , Nam Nung.	

CRA package no. 10		
CRA package name:	**Improved inter-cropping: Coffee + Avocado** Land for re-planting of coffee trees or crop cultivation and irrigated land	
Expected results compared to baseline:	Climate resilience (for identified climate vulnerability):	Improve resilience of agricultural practice towards very severe to severe drought risk; wetter dry and wetter wet seasons
	Baseline yield (tons) per ha:	Coffee: <2 tons of coffee beans/ha for 3 consecutive years
	Expected yield (tons) per ha:	- Coffee: 2,157 kg of coffee beans/ ha (2.35 kg coffee beans/tree) from Year 4 with a 20-year business cycle - Avocado: 18,400 kg/ha (200 kg/tree) from Year 4 with a 20-year business cycle
	Expected income (USD) per ha:	Total revenue: USD10,524 (of which: coffee: USD4,039; Avocado: USD6,485 from the 4th year with a 20- year business cycle
CRA specifications:	Detailed description of techniques:	**Improved inter-cropping: Coffee + Avocado** **a. Component of crops in the system: coffee and avocado** - Grafted coffee variety with TR4; TR9, ... - Booth 7 variety of avocado , in addition to some other varieties such as Hass, Reed, Tu Quy, etc. **b. Applied techniques in the system:** - Immediate re-cultivation without the need of crop rotation, and re-cultivation of coffee must apply crop rotation for 1-2 years when coffee plants contract diseases. - Efficient dripping irrigation by mini-pan (water evaporating pan) for environmental and economical efficiency (save 40-50% of irrigation water compared to traditional spilling irrigation onto the bottom of trunk; watering at the right time, at right growth stage, and in right amount). - Cover the bottom of tree trunks to keep the moisture in the summer by straw and rice husks, 20 cm from the bottom. This method also prevents the development of weeds, and at the same time when the straw and rice husks are decomposed, they will give the soil a considerable amount of nutrients and prevent soil erosion. - The best season to start the plantation is at the beginning of the rainy season and ends 1.5 - 2 months before the dry season begins, from May 15th to August 15th every year. -Density and planting distance: Inter- cropping in rows with 3 coffee rows and 1 avocado row (1010 trees/ha, with 918 coffee trees and 92 avocado trees). Coffee: Distance 3x3 m; Avocado: Distance 9 x 9m ***(I) Coffee:*** - Digging holes of 80x80x80 cm -Fertilizer:

CRA package no. 10		
		+ Year 1: 100 kg of urea + 500 kg of phosphate + 75 kg of potassium + 1,500 kg of bio-organic+ 500 kg of lime. + Year 2: 200 kg of urea + 500 kg of phosphate + 150 kg of potassium + 1,500 kg of bio-organic + Year 3: 200 kg of urea + 500 kg of phosphate + 250 kg of potassium + 1,500 kg of microbial organic - Application of Integrated Pest Management (IPM), Integrated Crop Management (ICM) to reduce the use of pesticides. ***(ii) Avocado*** - Digging holes of 60x60x60 cm, initial fertilizing (before planting): Use treated decomposed manure, apply 15-30 kg/hole, combined with 0.5-1 kg phosphate and 0.5 kg lime well-mixed before planting 10-15 days. -Fertilizer: + Year 1: 100 kg of phosphate + 180 kg of bio-organic+ 50 kg of lime. + Year 2: 20 kg Urea + 60 kg phosphate + 20 kg Kali + Year 3: 20 kg of urea + 60 kg of phosphate + 20 kg of potassium + 1,500 kg of microbial organic - Application of Integrated Pest Management (IPM), Integrated Crop Management (ICM) to reduce the use of pesticides.
	Target groups:	At least 40% of participants are women, at least 50 % of participants are ethnic minorities
	Key partners in support to develop the CRA package:	Excellent Farmers, District Agricultural Extension Station, Provincial Agricultural Extension Center, Central Highlands Agriculture and Forestry Science Institute (Central Highlands), Provincial Coffee Association. An Vinh LTD Company (4C coffee), Highlands Avocado Joint-stock Company in building avocado value chain, Phuoc An Coffee Company, Hanh Phuc Company (coffee trading), Anh Tuan Company Roaster in Nha Trang), Suppliers on (fertilizers, materials) in communes. Potential credit providers (VBSP, VBARD).
	One-off investment costs:	USD 3,710/ha/crop, excluding irrigation system cost
	Regular inputs/O&M required:	Year 2: USD3,399/year; Year 3: USD3,685/ha
CRA clusters to apply this package:	10, 11, 12, 14 Commune: Dak Nong: Ea T'Linh, Nam Dong, Đăk DRông, Tâm Thắng, Cư Knia, Trúc Sơn, Đắk Lao, Đức Mạnh, Long Sơn, Đắk Sắk, Thuận An, Đức Minh, Đăk Sôr , Nam Xuân, Đăk Drô , Nam Nung. Dak Lak: Ea Drang, EaSol. Đliê Yang, Quảng Tiến, Ea Sô, Ea Sar, Xuân Phú, Krông Buk, Ea Phê, Ea Yông, Ea Kênh. Binh Thuan: Tân Hà, Đông Hà, Trà Tân	

CRA package no. 11		
CRA package name:	**Improved inter-cropping: Coffee + Durian** Land for re-planting of coffee trees or crop cultivation and irrigated land	
Expected results compared to baseline:	Climate resilience (for identified climate vulnerability):	Improve resilience of agricultural practice towards very severe to severe drought risk; wetter dry and wetter wet seasons and medium to low drought risk; wetter dry and wetter wet seasons
	Baseline yield (tons) per ha:	Coffee: <2 tons of coffee beans/ha for 3 consecutive years
	Expected yield (tons) per ha:	- Coffee: 2,157 kg of coffee beans/ ha (2.35 kg/tree) from Year 4 with a 20-year business cycle - Durian: 5,980 kg/ha (65 kg/tree) from Year 4 with a 20-year business cycle
	Expected income (USD) per ha:	Total revenue: USD11,942 (of which: coffee: USD4039; Durian: USD7,903 from the 4th year with a 20- year business cycle
CRA specifications:	Detailed description of techniques:	**Improved inter-cropping: Coffee + Durian** **a. Component of crops in the system: coffee and durian** - Grafted coffee variety with TR4; TR9, ... - Ri-6 durian grafted variety, Monthong durian, Chin Hoa durian. **b. Applied techniques in the system:** - Immediate re-cultivation without the need of crop rotation, and re-cultivation of coffee must apply crop rotation for 1-2 years when coffee plants contract diseases. - Efficient dripping irrigation by mini-pan (water evaporating pan) for environmental and economical efficiency (save 40-50% of irrigation water compared to traditional spilling irrigation onto the bottom of trunk; watering at the right time, at right growth stage, and in right amount). - Cover the bottom of tree trunks to keep the moisture in summer by straw and rice husks, 40-50 cm from the bottom. This method also prevents the development of weeds, and at the same time when the straw and rice husks are decomposed, they will give the soil a considerable amount of nutrients and prevent soil erosion. - The best time to start the plantation is at the beginning of the rainy season and ends 1.5 - 2 months before the dry season begins, from May 15th to August 15th every year. -Density and planting distance: Inter- cropping in rows with 3 coffee rows and 1 durian row (1,010 trees/ha, with 918 coffee trees and 92 durian trees). Coffee: Distance 3x3 m; Durian: Distance 9 x 9 m ***(I) Coffee:*** - Digging holes 80x80x80 cm -Fertilizer:

CRA package no. 11		
		+ Year 1: 100 kg of urea + 500 kg of phosphate + 75 kg of potassium + 1,500 kg of bio-organic+ 500 kg of lime. + Year 2: 200 kg of urea + 500 kg of phosphate + 150 kg of potassium + 1,500 kg of bio-organic + Year 3: 200 kg of urea + 500 kg of phosphate + 250 kg of potassium + 1,500 kg of microbial organic - Application of Integrated Pest Management (IPM), Integrated Crop Management (ICM) to reduce the use of pesticides. ***(ii) Durian*** - The size of the planting hole is 60x60x60 cm, the planted soil needs to be porous, rich in nutrients, combined with 1kg of decomposed animal manure, 50g of NPK 16:16:8 or 20:15:15 for each empty hole. Mix well and cover up for incubation for 10-15 days before planting. -Fertilizer: + Year 1: 100 kg of phosphate + 100 kg of microbial organic. + Year 2: 20 kg of urea + 80 kg of phosphate + 10 kg of potassium + 100 kg of microbial organic + Year 3: 40 kg of urea + 100 kg of phosphate + 10 kg of potassium + 200 kg of microbial organic - Application of Integrated Pest Management (IPM), Integrated Crop Management (ICM) to reduce the use of pesticides.
	Target groups:	At least 40% of participants are women, at least 50 % of participants are ethnic minorities
	Key partners in support to develop the CRA package:	Excellent Farmers, District Agricultural Extension Station, Provincial Agricultural Extension Center, Central Highlands Agriculture and Forestry Science Institute (Central Highlands), Provincial Coffee Association. An Vinh LTD Company (4C coffee), Phước An coffee Company, Hanh Phuc Company (coffee trading), Anh Tuan Company Ea Tling town, Phuoc An Joint Stock Company, An Thai Roaster in Nha Trang), Suppliers on (fertilizers, materials) in communes. Potential credit providers (VBSP, VBARD).
	One-off investment costs:	USD 3,912/ha/, excluding irrigation system cost (USD1,542/ha)
	Regular inputs/O&M required:	Year 2: USD2,976/year; and Year 3: USD3,718/ha
CRA clusters recommended to apply this package:	10, 11, 12, 14 Commune: Dak Nong: Ea T'Linh, Nam Dong, Đăk DRông, Tâm Thắng, Cư Knia, Trúc Sơn, Đắk Lao, Đức Mạnh, Long Sơn, Đắk Sắk, Thuận An, Đức Minh, Đăk Sôr , Nam Xuân, Đăk Drô , Nam Nung. Dak Lak: Ea Drang, EaSol. Đliê Yang, Quảng Tiến, Ea Sô, Ea Sar, Xuân Phú, Krông Buk, Ea Phê, Ea Yông, Ea Kênh. Binh Thuan: Tân Hà, Đông Hà, Trà Tân	

CRA package no. 12		
CRA package name:	**Intercropping: Cassava + Bean** Crop land or 1-crop-a-year paddy land of low economical efficiency and unreliable irrigation	
Expected results compared to baseline:	Climate resilience (for identified climate vulnerability):	
	Baseline yield (tons) per ha:	Maize 30-40 quintals/ha/crop or paddy land with water shortage: 3-5 tons
	Expected yield (tons) per ha:	Cassava 25 tons/ha/crop Green Beans (summer- autumn crop) 700-800kg/ha
	Expected income (USD) per ha:	- Cassava: USD2,203 - Green bean: USD991
CRA specifications:	Detailed description of techniques:	**a. Component of crops in the system: Cassava and green beans in the summer-autumn crop** - Cassava KM140; KM419; KM7; Green beans DX208 are high- yield, drought tolerant and adapted to the plantation area. - Inter-cropping model of cassava and green beans in summer-autumn crop to improve soil, diversify crops and diversify products, save water resources, adapt to dry conditions. - Green bean leaves are used as cattle feed (buffalo, cow, goat, sheep) **b. Applied techniques in the system:** Use of manure or compost to improve soil and sustainable farming **(i) For Cassava:** - Planting season: Summer- Autumn crop - Density: 12,500 trees / ha (1.0m row-to-row, 0.8m tree-to-tree); Between 2 rows of cassava, plant 2 rows of green beans - Fertilizer for 1 ha: 800 kg of bio-organic fertilizer+ 200 kg Urea + 350 kg of phosphate + 200 kg of KCl. - Application of Integrated Pest Management (IPM), Integrated Crop Management (ICM) to reduce the use of pesticides. **(ii) for Green bean** - Plantation in the summer- autumn crop - Sowing at distances of 40cm row-to-row, 10cm tree-to-tree, thinning the tree when 1 to 2 true leaves, ensuring density of 25 plants/$m^{2.}$ - Fertilizer for 1 ha: 640 kg of bio-organic fertilizer + 80 kg Urea + 320 kg of phosphate + 80 kg of lime. - How to apply: Apply all organic fertilizer, phosphate, lime, 1/2 of urea, 1/2 of potassium before planting.

CRA package no. 12		
		+ Initial fertilizer application (before planting): All chemical fertilizers are mixed and applied to the designed rows, then add organic fertilizer. After applying the soil, cover the fertilizers with a light layer of soil before sowing to avoid them to be in contact with seeds, which reduces germination. + Apply once more when trees have 5 to 6 true leaves: 1/2 urea, 1/2 of potassium. - Keep the regular soil moisture of about 70-75% of the maximum moisture in the field, if the soil is dry, provide extra water. - Application of Integrated Pest Management (IPM), Integrated Crop Management (ICM) to reduce the use of pesticides.
	Target groups:	At least 40% of participants are women, at least 50% of participants are ethnic minorities
	Key partners in support to develop the CRA package:	Excellent farmers, District Extension Station, Provincial Extension Center, South Central Coastal Agricultural Science Institute. Suppliers on (fertilizers, materials) in communes. Potential credit providers (VBSP, VBARD).
	One-off investment costs:	USD2,013/ha
	Regular inputs/O&M required:	NA
CRA clusters to apply this package:	13 Commune: My Son, Nhon Son, Xuan Hai	

CRA package no. 13		
CRA package name:	**Rotational crop: Maize - Bean** One-crop-per-year paddy land of low economic efficiency, but with access to irrigation	
Expected results compared to baseline:	Climate resilience (for identified climate vulnerability):	
	Baseline yield (tons) per ha:	Maize 30-40 quintals/ha/crop or paddy with water shortage: 3-5 tons
	Expected yield (tons) per ha:	- Monoculture (winter- spring): maize 65 tons / ha / crop - Single-crop summer- autumn green beans: 15 quintals/ha
	Expected income (USD) per ha:	- Maize: USD1,718 /ha/crop - Green bean: USD1,982/ha/crop
CRA specifications:	Detailed description of techniques:	**a. Component of crops in the system: Winter- spring crop maize and and summer- autumn crop green beans** - Maize CP333; LVN61; Green beans DX208 are high- yield, drought- tolerant and adapted to the plantation area. - Crop rotation model of winter- spring maize and and summer- autumn green beans to improve soil, diversify crops and diversify products, save water resources, adapt to dry conditions. - Maize stalks and green bean leaves are used as cattle feed (buffalo, cow, goat, sheep) **b. Applied techniques in the system:** Use of manure or compost to improve soil and sustainable farming **(i) For Maize:** - Planting season: Winter- spring crop - Density: 70 cm x 20 cm (20 kg seeds / ha) - Fertilizer for 1 ha: 800 kg of bio-organicfertilizer + 450 kg of urea + 600 kg of phosphate + 200 kg of KCl + 500 kg of lime - Application of Integrated Pest Management (IPM), Integrated Crop Management (ICM) to reduce the use of pesticides. **(ii) for Green bean** - Planting in summer- autumn crop - Sowing at distances of 40cm row-to-row, 10cm tree-to-tree, thinning the tree when 1 to 2 true leaves, ensuring density of 25 plants/$m^{2.}$ - Fertilizer for 1 ha: 800 kg of bio-organic fertilizer + 100 kg of urea + 400 kg of phosphate + 100 kg of KCl + 500 kg of lime - How to apply: Apply all organic fertilizer, phosphate, lime, 1/2 of urea, 1/2 of potassium before planting.

CRA package no. 13		
		+ Initial fertilizer application (before planting): All chemical fertilizers are mixed and applied to the designed rows, then add organic fertilizer. After applying the soil, cover the fertilizers with a light layer of soil before sowing to avoid them to be in contact with seeds, which reduces germination. + Apply once more when trees have 5 to 6 true leaves: 1/2 urea, 1/2 of potassium. - Keep the regular soil moisture of about 70-75% of the maximum moisture in the field, if the soil is dry, provide extra water. - Application of Integrated Pest Management (IPM), Integrated Crop Management (ICM) to reduce the use of pesticides.
	Target groups:	At least 40% of participants are women, at least 40 % of participants are ethnic minorities
	Key partners in support to develop the CRA package:	Excellent farmers, District Extension Station, Provincial Extension Center, South Central Coastal Agricultural Science Institute. Suppliers on (fertilizers, materials) in communes. Potential credit providers (VBSP, VBARD).
	One-off investment costs:	Winter- spring maize: USD1,286/ha crop; Summer- autumn green beans; USD969/ha/crop
	Regular inputs/O&M required:	NA
CRA clusters to apply this package:	2 Commune: Phuoc Tan, Phuoc Thanh, Phuoc Thanh, Phuoc Trung in Bac Ai	