Food and Agriculture Organization of the United Nations

IPSARD

GACSA
GLOBAL ALLIANCE FOR CLIMATE-SMART AGRICULTURE

Country Case Study Reports

CLIMATE SMART AGRICULTURE (CSA): TOWARDS SELECTING SUITABLE MEASURES IN RESPONSE TO CLIMATE CHANGE IN VIETNAM

Dr. Tran Dai Nghia, ÍPARD

Hanoi, Jul 2016

TABLE OF CONTENT

LIST OF FIGURE

LIST OF TABLE

Acknowledgments

The report of the country case study on “Climate Smart Agriculture (CSA): Towards selecting suitable measures in response to Climate Change in Vietnam” is prepared by the team of Institute of Policy and Strategy for Agriculture and Rural Development (IPSARD). We would like to express our sincere thanks to GACSA and FAO for their support to this study and the completion of the report.

During the conduct of assignment, many agencies and experts have provided support and encouragement to the team. Special thanks and gratitude are addressed to:

- Mr. Mark Manis and Ms. Caitrin Martin from USDA and Mantilla Martinez, Silvia from FAO for their valuable comments and supports on our work.
- Dr. Chu Van Chuong, Deputy Director General of ICD of MARD who is in charge of coordinating CSA and other COP 21 agreement implementations within MARD of Vietnam for lending his outstanding logistical and technical supports to us during conducting the study and comments for this report.
- All stakeholders at national level for taking the time out of their busy schedules to join our seminars and consultation workshops.
- Departments, agencies and stakeholders of three provinces of Nam Dinh, Ninh Thuan, Binh Thuan and Bac Lieu provinces for sharing their knowledge and experiences in developing and scaling out valuable CSA practices in their locations.

IPSARD research team

Executive Summary

Agriculture plays a crucial role in sustainable socio-economic development of Vietnam, (contributed 18.39% of GDP, ensures national food security and exports, poverty alleviation etc.), however, Vietnam's agricultural growth has relied heavily on human, natural, and chemical factors of production, consequently causing environmental degradation exacerbated by climate change impacts making the problem worse. The application of Climate Smart Agriculture (CSA) as adaptation measures to CC was viewed as a key strategy for Restructuring Agriculture sector program of Vietnam.

This Country Case Study in Vietnam aimed at to support sharing and learning while simultaneously rallying inclusive dialogue on key drivers for accelerated scaling up of CSA within Vietnam and among GACSA with three main focuses: (i) country level policies and enabling environment; (ii) the investment climate into scaling out CSA practices; (iii) Technologies, practices, and services relevant to the Vietnam; (iv) extension services in relation to scalability of CSAs; (v) methodologies to measure the success and delivery. (vi) the country prioritization of CSA options in agriculture; (vii) the participation of Civil organization and private sector; and some specific CSA case studies on the field.

The results of the study show that to create an enabling environment for climate action in the agricultural sector is a priority for Viet Nam which can be achieved through measures focused on governance, policy frameworks and country readiness. Series of policies and planning frameworks have indicated this attention e.g., NAP-CC for period 2012-2020,the Climate Change Response Action Plans (CCR-Aps) etc., and most recently in the updated CCR-AP of the agricultural sector for the period 2016-2020 and in the Agriculture Restructuring Program of Agriculture sector. A rang of adaptations identified includes in various sub-sectors: water resources management, crop production, forest management, coastal zone management, livestock production, aquaculture and fisheries etc.

The CSA country prioritization and a national CSA policy frameworks have been under developing. The CSA practices stocktaking had been implemented with identification of more than 800 CSA application sites covering various type of agricultural activities/productions from selecting crop/animal climate stress tolerant varieties/breeders, changing crop/production patterns, bio-gas, ICM etc. the cost-benefit analyses, portfolio development and initially national prioritization framework for top 8 selected CSA options had been implemented to show the most potential CSA options (economically, socially and environmentally) for scaling out.

The results from in-depth studies of three case studies in three different ecological regions (One must five reductions (1M5Rs) in Nam Dinh province, Red River delta; Dragon fruit with solar power system to regulate irrigation system in Binh Thuan province, south central and Mangrove forest and aquaculture in Bac Lieu Mekong River Delta) show that identified CSA practices either have high scalability potential (widely applied) or bring higher triple benefits of increasing NPV (Rice-shrimp rotation),

adaptation capacity (higher risk tolerance potential, e.g., rice-shrimp) and mitigating GHG emission (biogas, solar power to regulate irrigation system for dragon fruits).

There are challenges to adopt CSA practices: the cost of climate change adaptation keeps increasing and is estimated to exceed 3-5% of GDP of Vietnam by 2030, Legal framework of integrated CSA practices as main CC adaptation measures into policies faced some drawbacks and limitations e.g., unbalanced policies on disaster prevention/mitigation than sustainable, non-structural adaptation measures (CSA). There is vague links between currently existing CSA practices/model and mitigation. The CSA concept is quite new and less perceived by policy makers and scientists as well as less imparted to businesses and communities and the majority of CC adaptation funds have been directed towards improving the climate resilience of high-cost, large-scale infrastructure projects. The cost to move to a low emission development is estimated of 0.2% GDP (WB. 2014) equivalent to US$ 400 millions in 2015 (excluding additional cost of adaptation).

Also, there are gaps that hinder the synchronization between agricultural policies and CC policies such as lack of solid scientific evidence and financial mechanism for integration; absence of criteria for environmental risk evaluation and level of integration; lack of compulsory regulation on integration of CC into the agricultural policies. CC policies have not encouraged private sector to apply advanced technologies and CSA.

The study concludes that Vietnam is very vulnerable to extreme climate risks and some half of Vietnam population is still at least partly reliant on agriculture for income and household subsistence. The majority of the population lives in coastal or low-lying deltas. Climate change and sea-level rise have been affecting yields and production of key agricultural commodities e.g., rice, aquaculture, coffee etc. Shifting Vietnam to a more environmentally sustainable path for economic growth will have trade-offs. One trade-off is in investing resources for building long-term resilience versus investments for short-term food security gains. Therefore investing in long-term resilient measures like CSA is vital for ensuring long-term food security, environmental sound and contributing for GHG reduction.

GACSA can play an important role in helping its member like Vietnam in addressing the knowledge needs, linking public and private research, extension and advisory services to generate, manage, blend and share indigenous and scientific knowledge, while facilitating learning processes and network-based innovation. The GACSA could seek to leverage on its capacity building activities to provide capacity building support at multiple levels for implementing adaptation measures in agricultural systems and scaling-up of efficient and cost-effective CSA options.

1. Introduction

1.1 General overview; agriculture and climate in context of national economy

Agriculture still plays a crucial role in sustainable socio-economic development of Vietnam. It contributed 18.39% of GDP (GSO, 2013), ensures national food security and exports of several major agricultural products (rice, coffee, rubber etc.)

Besides these achievements, a number of shortcomings and challenges have been identified such as (i) Vietnam agricultural growth tends to slow down and decrease over time from 4.5% (period 1995-2000) to 3.8% (2000-2005), 3.4% (2006-2011), 2.7% in 2012 and 2.67% in 2013 (IPSARD, 2014); (ii) As a result of Climate Change (CC), natural disasters and weather extremes such as abnormal storms, floods and droughts have been becoming more severe. (iii) CC has diminished agricultural lands, increasing the risk of food insecurity.

Also, Vietnam's agricultural growth has relied heavily on human, natural, and chemical factors of production, consequently causing environmental problems (forest, and land degradation, diversity losses, water scarcity, marine resources degradation, water contamination[1] etc.). The consequences of the environmental degradation exacerbated by climate change impacts[2] has requires the country take necessary adjustments.

Realizing the problem, Vietnam agriculture sector has been taken serious measures and fundamental changes. In large portions of the sector, the monitoring of agronomic practices against sustainability standards, natural resource management, waste management, and energy efficient have been mainstreamed, balancing between economic growth and ensuring environmental sustainability, as specifically stated in the Agricultural Restructuring Plan towards higher added value and sustainable development (ARP)[3]. The application of Climate Smart Agriculture (CSA) as adaptation measures to CC such as converting coastal saline rice land to aquaculture[4], or flexible paddy-land to less water use crops e.g., vegetable, ornamental, annual food/cash crops[5] or combining mangrove forests rehabilitation and aquaculture production viewed as very potential for scaling-up nationwide.

[1] Some 80 million tons of livestock waste are discharged directly and indirectly into the environment every year (Vietnam Development report, 2016)

[2] The drought and salinity intrusion in Central provinces and Mekong River delta haven't been seen in 90 years. Up to April 29, 2016, 16 provinces of Vietnam declared disaster with some 450,000 ha of rice, food crops and fruit trees have been affected by prolonged drought and salinity intrusion, the estimated losses of 9,020 billion VND ($410 million USD)

[3] The Decision No 899/QĐ-TTg of the Prime Minister dated on the 10/06/ 2013 on approving the Agricultural Restructuring Program

[4] 680,000 ha of rice-aquaculture in Mekong River Delta, 180,00 ha of mangrove-shrimp has been practiced, 350,000 biogas installed (IPSARD, 2015)

[5] Circular No 47/2013/TT-BNNPTNT of MARD dated on the 08/11/2013 on Guidance for conversion from paddy-rice to plant other annual crops combined with aquaculture on paddy-rice land.

1.2 Objective

This Country Case Study in Vietnam is intended to support sharing and learning while simultaneously rallying inclusive dialogue on key drivers for accelerated scaling up of CSA. **Case Studies will:**

(i) Highlight national policies, programs, and strategies pertaining to climate-smart agriculture (i.e. adaptation, mitigation, sustainable increases in productivity);

(ii) Identify strengths, challenges, and opportunities for advancing an inclusive and participatory framed climate-smart agriculture agenda in a given national, regional setting;

Demonstrate at the Annual forum how the GACSA platform, through the coordinated efforts of the three Action Groups (knowledge, investment, enabling environment) working in collaboration with the case study countries, can assist these countries in bolstering current CSA efforts.

1.3 Study framework and scope

Qualitative Case Study Methodology:

A multiple case study enables the drafters to examine several cases to understand the similarities and differences between cases (i.e. countries) (Yin, 2003). The three Action Groups will work with country points of contact to develop the research questions (generally “how” and/or “why” questions); conduct a literature review; inventory existing policies/programs/studies; consult key stakeholders from Agriculture and Environment Ministries, civil society, academia and industry; and develop criteria for interpreting findings before drawing out lessons through the drafting of case study reports and summary briefs.

2. Climate - Smart Agriculture interventions in Vietnam

2.1 Country level policies/enabling environment for CSA

Vietnam has paid its attention to CC since 1990, through the Agenda 21[6], participated in the United Nations Framework Convention on CC (UNFCCC) in 1992 and became a member of this Convention in 1994. At that time, CC was only one of nine aspects of the sustainable development strategy. Then, Vietnam issued a wide range of policies/strategies related directly and indirectly to responding to CC. In 2007, the National Target Program on Response to Climate Change (NTP-RCC)[7] was issued by the Prime Minister, this program represents a political commitment to integrate CC into development policies of Vietnam. Not until 2011 when the National Strategy on CC[8] and National Action Plan on CC 2012-2020[9] were issued, marking an important milestone in the CC response policies of Vietnam, proactive adaptations to climate change has been cough attention of high level of policy makers and political agenda of Vietnam.

[6]Decision 153/2004/QD-TTg of the Prime Minister dated 17 August 2004 on issuing Strategic orientation for sustainable development in Vietnam. Briefly describe Agenda 21?????

[7] Decision 158/2008/QD-TTg dated 2 December, 2008 approving the NTP to response to CC

[8] Issued under the Decision 2139 /QD-TTg of the Prime Minister on 5 December 2011.

[9] Issued under the Decision 1474/QD-TTg of the Prime Minister on 5 October 2012.

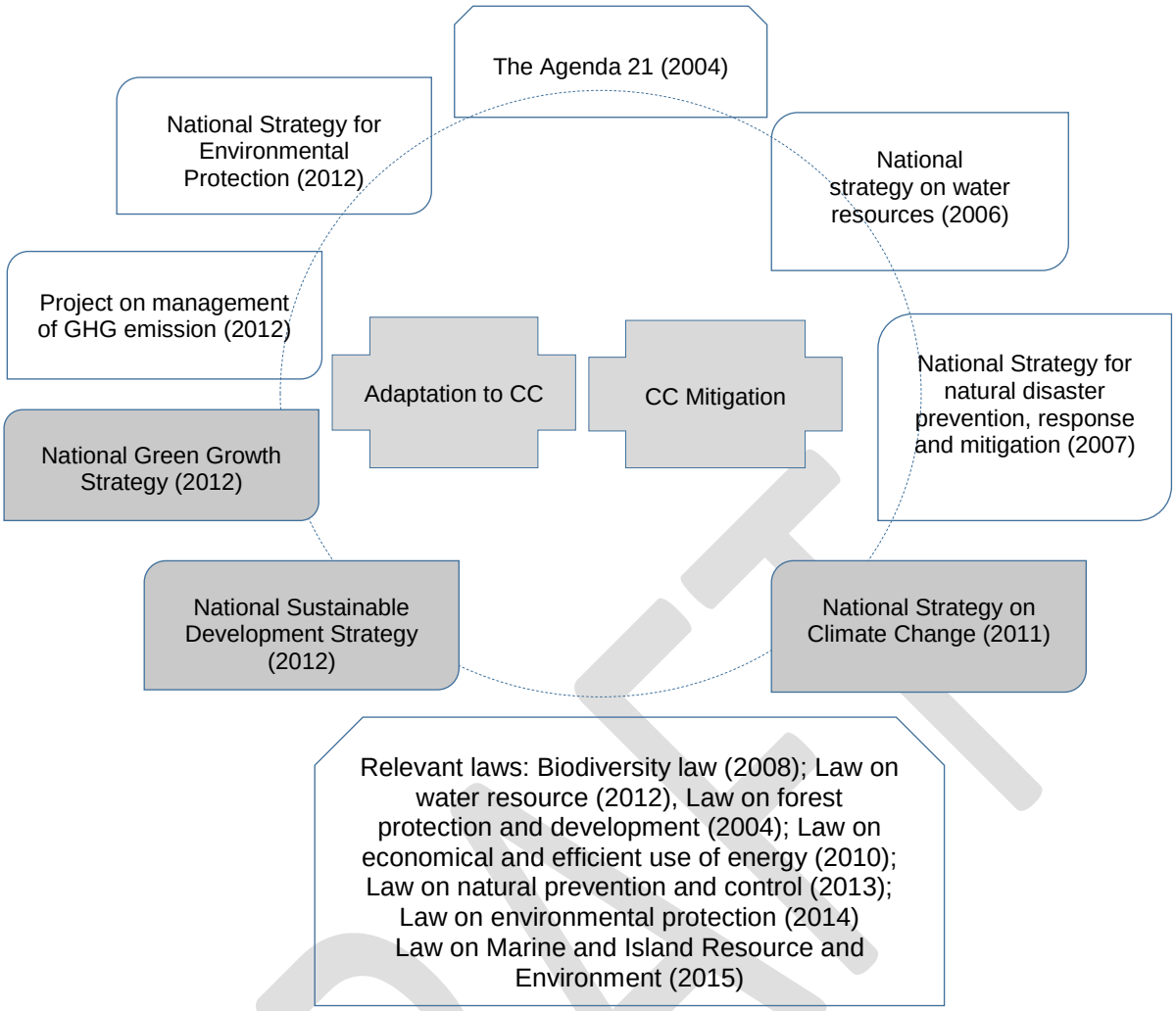

Figure 1. Enabling policy framework[10] on CC response in Vietnam

Source: IPSARD, 2015

Agriculture is one of the sectors most heavily affected by CC (MONRE, 2010). Therefore, Ministry of Agriculture and Rural Development (MARD) began focusing its attention on CC in agriculture quite early by issuing the Action plan framework for adaptation and mitigation of CC in the agriculture and rural development sector for the period 2008-2020[11] in September 2008, prior to the promulgation of the National Target Program (NTP) on CC in December 2008. Since 2008, MARD has issued 24 legal documents, including 9 Circulars, 1 Joint Circular, 13 Decisions and 1 Directive on implementing CC response plan (NCCC, 2014).

The flow of policies and strategies related to response to climate Change (RCC) in agriculture sector as presented in the Figure 2 below:

[10] Usually, the law passed by the National Assembly (NA) in 2015 would be in effect in middle of 2016

[11]Decision 2730/QD-BNN-KHCN dated 5 September 2008 on promulgating the Action plan framework for CC adaptation and mitigation in the agriculture and rural development sector for the period 2008-2020.

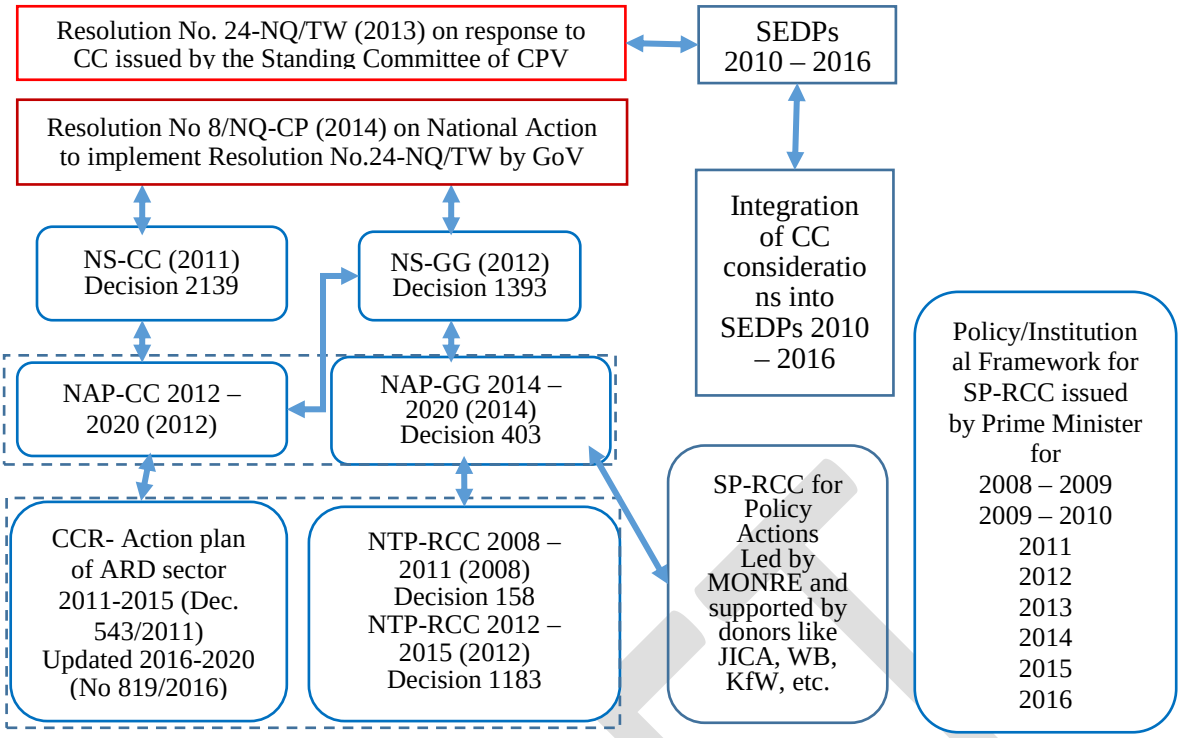

Figure 2. Agricultural RCC-Policy/strategy frameworks

Recognizing the importance of the inter-linkage between CC adaptation, sustainable development and shift a low-carbon economy-agriculture.

Numerous climate change adaptation and disaster risk management measures have been implemented at national, subnational, local level.

The main adaptation measures proposed in AP-RCC of the agriculture and rural development sector (2016-2020) included CSA, Ecosystem based adaptation (EbA) and combination of structural/non-structural measures.

Main challenges and gaps identified

The majority of current investments in CC adaptation is directed towards improving high-cost, large-scale infrastructures (63%)[12]. The resource allocations to soft/non-structural adaptation measures like CSA, EBAs are very limited whereas the cost of adaptation keeps increasing and is estimated to exceed 3-5% of GDP by 2030[13] that is far from what the country could provide.

The current legal framework for integrating CSA practices as main CC adaptation measures into policies has been faced some drawbacks and limitations e.g., lack of concrete policies and legislation on CC; absence of operational mechanism suitable to Vietnam's conditions; unbalanced policies which focus more on disaster prevention and mitigation than sustainable, non-structural adaptation measures (CSA); vague links between currently existing CSA practices/model and mitigation; lack of long-term vision stated in policy papers; overlapping scopes of policies (NASC, 2014).

[12] MPI, WB & UNDP (2014), *Vietnam Climate Public Expenditure and Investment Review Report*.

[13] Vietnam INDC, September, 2015.

The CSA concept is quite new and less perceived by policy makers and scientists as well as less imparted to businesses and communities, therefore, there still lack of participation of the private sector.

2.2 The investment climate including the flow of public and private investments

At national level: *the total* funding allocated to the NTP-RCC was some 1,771 billion VND[14]. Since the implementation of the program until 2014, the Program had been allocated 950 billion VND, accounting for 54% of the total planned funding[15]. The Action Plan of MARD[16] had been developed with a huge expected budget of 72,402 billion VND (about 3.45 billion dollars) being disbursed in the period from 2011-2015 (of which 402 billion VND for policy tasks and 72,000 billion VND for field projects), out of 54 tasks proposed by MARD to implement the Plan for period 2011-2015 with the funding of 402 billion, only 21 tasks were fulfilled by 2015 with totaling to 47 billion VND implemented (OCCA, 2015). Majority of the fund of MARD (88%) was allocated to the infrastructure projects aimed at strengthening their tolerance, funding to mitigation was increasing at low rate of 3.9%. It can be seen that while the State budget allocation dedicated to CC projects may be small, budget allocation for projects/programs which are inclusive aspects of CC, such as disaster prevention and mitigation, is very large. Moreover, budget for CC activities is mainly related to public irrigation, infrastructure and natural disaster reduction, rather than to research and development of plant/crop varieties, animal breeding, policy research and farming system.

2.3 Technologies, practices, and services relevant to the country

The Vietnamese Government has ratified the National Strategy on CC[17], which mentions adaptation and mitigation measures. In the agricultural sector, the project on reduction of greenhouse gases emissions in agriculture has been adopted and implemented[18].

Many projects and programs which have been implemented contain adaptation and mitigation solutions linked to increased farmers' productivity and incomes such as models of 'One Must, Five (six) Reductions"[19] (1M-5R) 'Three Reductions, Three Gains'[20] (3R-3G), Alternate Wetting and Drying (AWD); System of Rice Intensification (SRI); 4C Program (Common Code for Coffee Community)[21];, Rainforest; Forest – Garden – Fish Pond - Livestock (RVAC); Garden – Fish Pond - Livestock (VAC); and linked to sustainable development.

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[14] Central state budget: 770 billion VND, local budget and others: 153 billion VND, foreign aids: 848 billion VND.

[15] 2011: 170.8 billion VND; 2012: 320.8 billion VND; 2013: 248.3 billion VND; 2014: 217 billion VND.

[16] Decision 543/QĐ-BNN-KHCN dated 23 March 2011 of the Minister of MARD promulgating Action Plan on Response to CC in agriculture and rural development period 2011-2015 and vision to 2050.

[17] Decision 2139/QĐ-TTg dated 05 December, 2011 of the Prime Minister approving the National Strategy on Climate Change.

[18] Decision 3119/QĐ-BNN-KHCN dated 16 December, 2011 of MARD approving the project "Reduction of GHG emissions in agriculture and rural areas by 2020".

[19] 1 must use of certified seed; 5 reductions refer to reducing use of water, energy, post-harvest lost, pesticides and fertilizers

[20] 3 Reductions refer to reducing use of seed, pesticides and fertilizer; 3 Gains mean increase in rice yield, quality and economic efficiency

[21] Program for sustainable coffee production under the general principle for the world coffee community, Nestle

+ SRI has been implemented in 29 provinces of Vietnam, mainly in the Northern region. In 2014 winter-spring crop, total SRI-based area was recorded at 394,894 ha (of which SRI area of direct seedling was 42.403ha) with participation of more than 1,813,201 farmer households. Results of applying SRI in 23 Northern provinces show that SRI outperformed traditional farming, such as: rice seed reduced by 70% to 90% (transplanting), by 39-65% (direct seedling); nitrogen fertilizers was reduced by 20-28%; average yield increased by 9-15%; expenditures on plant protection (pesticides, herbicides) were cut by 39-62%. Profits earned from SRI fields have grown up by 15-35% on average. SRI farming constitutes ecological field sub-region unfavorable for pest development (sheath blight, yellow snails, stuffy roots diseases, pests, etc.) while favorable to better resistance of rice plant to pests and diseases as well as water saving of about 30-35%. Moreover, SRI farming has reduced significantly GHG emissions compared that of traditional farming (CH_4 decreases by 21-24%, N_2O decreases by 15-22%, CO_2 decreases by 22-27%); global warming potential (GWP) of traditional fields is higher than SRI field from 26 to 32% (SFRI, 2013).

+ Agro-Forestry Model has been introduced and applied in mountainous region of Vietnam for a long time. Although this model does not encompass all features of CSA, it is an integrated farming system adaptable to CC, socio-economic conditions and agricultural ecology as well as potential contribution for food security.

+ Model “Three Reductions, Three Gains” for rice production (3R-3G): since 2005 when MARD issued the acknowledgement of 3R-3G as a method to raise economic efficiency of rice production in the Mekong River Delta, 3R-3G model has been applied nation wide with a higher concentration in Southern provinces (of about 770,000 – 800,000 ha equivalent to 45-48% total 3R-3G area applied in the country).

+ Model “One Must, Five Reductions” for rice production (1M5R): this model is developed based on the success of 3R-3G campaign. Additional studies were conducted to prove that reduced inputs (water, energy, seeds, fertilizers, and pesticides) and post-harvest loss without impacting yield could be realized by extending 3R-3G. This method encourages use of certified seeds (which is considered as “a must”). Five reductions refer to reducing use of water, energy, post-harvest loss, fertilizers, and pesticides. 1M-5R model has been replicated in 7 provinces of An Giang, Can Tho, Soc Trang, Bac Lieu, Binh Duong, Ninh Thuan and Lam Dong with a total 1M5R applied area of 4,000 ha (MARD, 2014).

+ Alternate Wetting and Drying (AWD) has also been practiced in different rice producing provinces of Vietnam. With efficient uses of nitrogen and application of organic inputs to dry soil, this practice can reduce GHG emission even further, enhance nutrient efficiency, and deter insect infestation. The AWD suitability map has been developed and the technique is highlighted as one of the improved cultivation techniques for rice production to be adopted for 0.5 - 1 million hectares of rice cultivation areas by 2020.

2.4 Status of extension services[22]

In January 2008, the united National Agriculture Extension Center (NAEC) was established based on the merging of the two centres: Agricultural Extension center and Fishery Extension Center (after merging two ministries: Ministry of Agriculture and

[22] http://www.khuyennongvn.gov.vn/

Ministry of Fishery). The NAEC is the public non-business unit under the Ministry of Agriculture and Rural Development. According to the current regulations, principles for agricultural extension are:

(i) To stem from farmers' demands and the State's agricultural development requirements.
(ii) To promote farmers' initiative and active role and voluntary participation in agricultural extension.
(iii) To ensure close association between managerial bodies, scientific research institutions, enterprises and farmers as well as among farmers.
(iv) To socialize agricultural extension and diversify agricultural extension services so as to mobilize resources from domestic and foreign organizations and individuals for agricultural extension.
(v) To exercise democracy and publicity with community oversight.
(vi) To ensure that agricultural extension contents and methods are suitable to each region, each locality and target groups of farmers and different ethnic communities.

All 63 provinces/cities in Vietnam have their own Extension Centers (provincial extension center). At the district level, only 596 districts out of total 955 districts have Extension Stations which are directly under the control of the provincial extension Centers or the District People Committees. The extension service provision has still heavily been top down and supply driven rather than market and demand driven and based on the farmers' needs[23]

- The provision of extension service is mostly done by public extension system with the lack of both quantity and quality. The professional staff accounts for only 1 people per 280 farming households (N.V Bo, 2012), The extension workers specialties are almost in crops production and husbandry and far from meeting requirements for improving production to achievable levels, other fields are lacking, especially in the processing and marketing of agriculture products or especially climate change resilient technologies.

The current extension policies and program are mainly focused on the government extension system, extension without any payment. Therefore, this does not create a motivation to mobilize and to promote the participation of other sectors such as private[24], associations[25], NGOs. Funding for extension system is also limited, in 2011-2012, total budget for all extension activities accounting for 20 millions USD, or 2USD/farming household/year[26]. The linkages among extension – research – education- farmers' needs are not yet well developed and lack of coordination. In

[23] Nguyen Van Bo, 2012. Paper presented at Roundtable Consultation on Agricultural Extension, Beijing, March 15 to 17, 2012

[24] The Loc Troi Group alone already has more than 1300 extensionists (Farmer Friends) who provide extension services to the Group's contractive farmers in both technical and marketing services (Loc Troi Group, 2015).

[25] The Soc Trang Crop Variety Company has been creating different kinds of climate resilient crop varieties, such as salinity tolerant rice varieties : ST5, ST10 or OM6976, OM6677, OM8232, OM2395, OM6677, OM5629, OM6162, OM5464, OM8923, OM4900, OM6976-41, OM7364, OM7347, OM3995, OM9577, OM9584, OM5953 rice varieties of the Rice Research Institute. Retrieved from http://www.vietlinh.vn/trong-trot/lua-giong-chiu-man.asp

[26]Nguyen Van Bo, 2012. Paper presented at Roundtable Consultation on Agricultural Extension, Beijing, March 15 to 17, 2012 and IPSARD's public investment in agriculture report, 2015.

addition, agriculture land is fragmented[27]and production is mostly in small-scale, this will be very challenging for providing climate, production and market information to individual households and hindering the process of transferring new technologies and increasing value added (no economies of scale)[28].

2.5 Methodologies to measure success and delivery

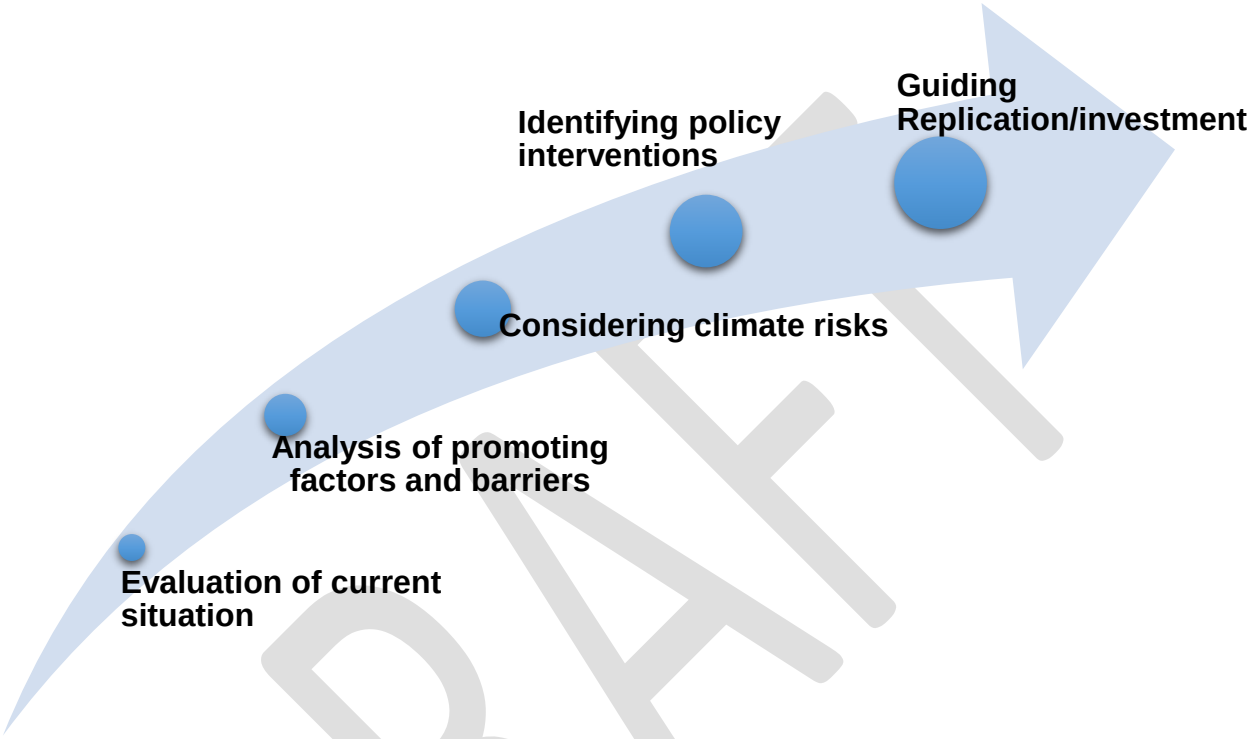

Figure 3. The process of measuring the success and delivery

Source: FAO, 2012

CSA is thought to have started as a form of farming practices that can increase crop-animal production systems to cope with and resilience to extreme weather events in Vietnam for maybe a long time ago. Although the concept was defined and presented by FAO in the Hague Conference on Agriculture, Food Security and Climate Change in 2010.

The process of measuring the success delivery the results of CSA has been followed the framework introduced by FAO (2012) as depicted in Figure 3 above.

In 2015, the Institute of Policy and Strategy for Agriculture and Rural Development (IPSARD), Green Growth office at MARD together with Vietnam Forest and Delta (VFD) project carried out the CSA stocktaking and mapped out more than 90

[27] Nguyen Van Bo, 2012 reported that average land/household in Vietnam was about 1.0 ha and in the lowland was only 0.3 ha/HH in 2011.

[28] Report from Central Farmer Association 2015, Vietnam has 10.169 million farmer households

different CSA like[29] practices and then later were mapped out using Web based mapping tool with the results in the Figure 4 below:

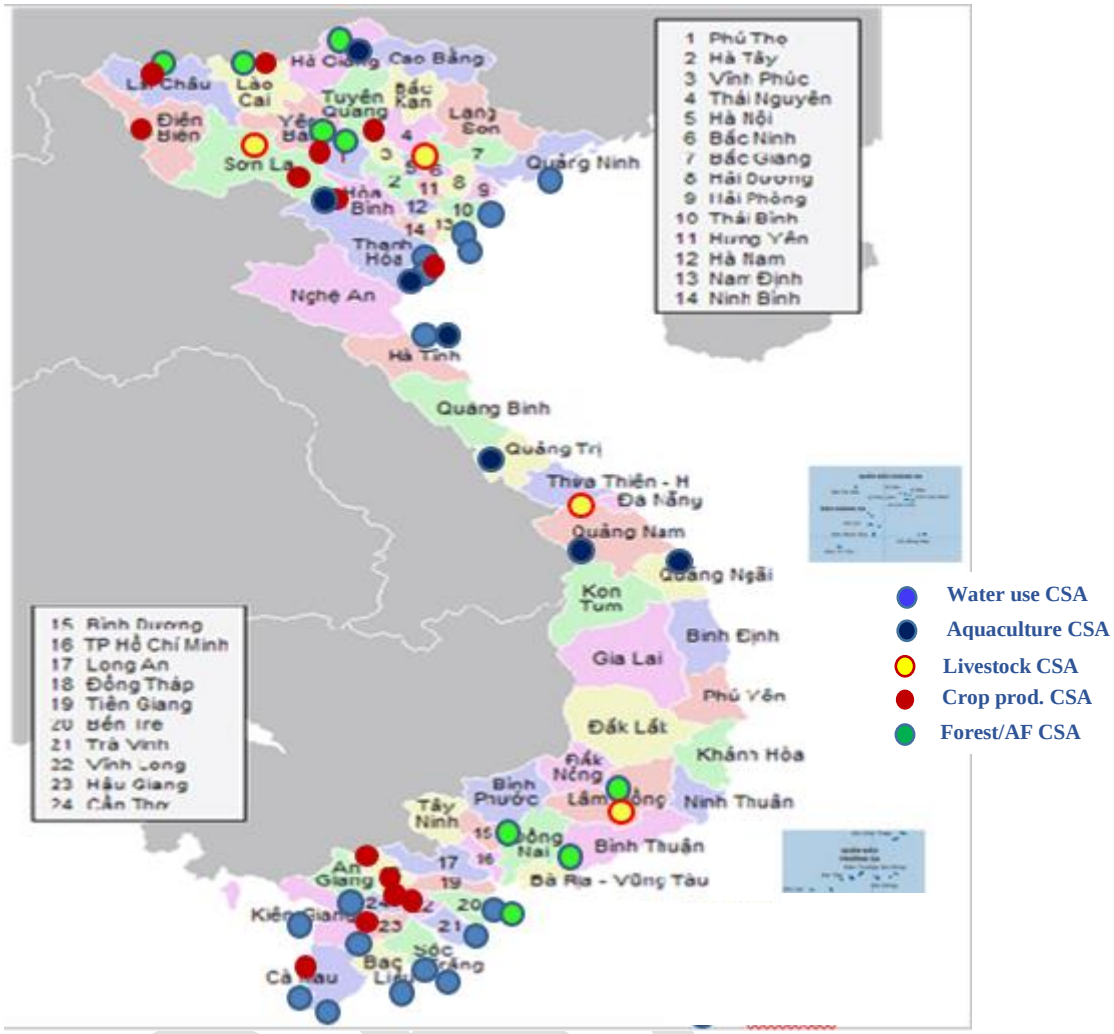

Figure 4. CSA stocktaking map

12 digesters installed in pig production some are highly climate risk tolerance. Some others show the medium risk tolerant (not very sensible to market or the production risks) such as practices of water saving irrigation for upland crops production and converting production pattern from two rice crops to jujube (local apple) production with less water demand.

The highest prioritized CSA option is the practice of Rice- Shrimp Rotation in coastal area of MRD and in fact, this practice has shown the effective measure to cope with severely prolonged drought and salinity intrusion problem in MRD recently. Others have high potential for scale out including water saving irrigation, selecting climate stress tolerance varieties (saline tolerance), rice-mushroom from rice straws and biogas generation from pig raising

Adding value to above study selected 3 representative CSA options as the case studies

[29] The identified CSAs from this stocktaking exercise were perceived workshop participants (government staffs/officials, NGOs. Projects/programs officers, researchers, extension staffs and agricultural experts) to meet at least one of the three criteria of CSA: CC adaptive/resilient capacity, ensuring food security and reducing GHG emission

from the above CSA stock[30].

1) One must five reductions (1M5Rs) in Nam Dinh province (RRD)

Commonly, rice is cultivated two crops per year in RRD in general and in Nam Dinh province specifically. The main benefits of applying 1M5Rs are reduction certified rice seed, fertilizers uses, water use and labor. However, the rice productivity did not increase significantly compared to productivity of traditional rice cultivation.

The CBA done for the model in Nam Dinh (annex 1) shows that NPV for 1M5Rs system is positive, while NPV for traditional rice farming is negative (if family labors counted), due to the amount of seeds, fertilizers, pesticides, as well as family labor used in the 1M5Rs practice are mush lower than that in conventional system. The reductions of chemical inputs (nitrogen fertilizers) therefore contributed also for reducing HG emission from 1M5R practice (estimated of 5.3 tons $CO_{2\text{-}e}$/ha/year) as in the case study presented in annex 1.

Figure 5. Dragon fruit plantation with solar power to regulate irrigation system

2) Dragon fruit with solar power system to regulate irrigation system in Binh Thuan province

Việt Nam is a country that has the largest planted area and the highest production of dragon fruits in Asia and also a top dragon fruit exporters in the world (35,665 ha and the production of 614,246 tones, Vinafruits, 2014). Dragon fruit has been planted in more than 32 provinces, however, this fruit is mostly produced in Binh Thuan province with the area of 26,026 ha and about 500,000 tones in 2015 accounted for about 80 of the country's dragon fruit productions (Binh Thuan DARD, 2016). Although dragon fruit planted in Binh Thuan is a cacti that can resist to drought condition, in the intensive

[30] These case studies were not among what have been studied within CIAT supported framework

dragon fruit production system, irrigation water requirement is still high[31]. Besides, dragon fruit production requires lot of electricity for creating artificial light to simulate off-season flowering to increase harvests.

The model of using solar power system to regulate the drip irrigation system on dragon field of 2 ha has been tested in Thuan Quy commune, Ham Thuan Nam district, Binh Thuan province with the purpose of reducing electricity uses for pumping and saving water, increase the profits for dragon fruit farming farmers. The CBA calculation of this model shows that the system can save 50-70% of water needed for irrigation (due to using drip irrigation system) and replacing pumping energy by solar power contributing for reducing GHG emission. The investment is profitable in the long-term (project span of 15 years) with IRR of 39% (See details in the annex 2).

With the high vulnerability of drought in central provinces and concentration of commercialized dragon fruit production areas like Binh Thuan province, this CSA option is very promising.

3) Mangrove forest and aquaculture in Bac Lieu

The mangrove forest ecosystem in Ca Mau, Kien Giang, Bac Lieu, Soc Trang, Tra Vinh, etc. plays very crucial role in socio-economic development, balancing ecosystem and environmental safeguard protection of the MRD. MRD has only about 347.500 ha of forest areas equivalent to less than 10% forest cover. Of which, mangrove forest was less than 100.000 ha[32] (Pham D. Don, 2007).

According to the Decision No 116/1999/ QD-TTg[33] of the Prime Minister, the coastal mangrove forests were classified into three main areas: (i) the strictly protected area, (ii) buffer zone, and (iii) economic area. In the buffer zone, 60% were persevered for mangrove forest plantation and 40% for aquaculture and other agricultural development, however, due to the pressure from population growth and higher short-term economic gains from aquaculture production as compared to forest exploitation, the mangrove forest areas was sunken due to aquaculture encroachment (Lewis, et al. 2003). To mitigate risks from mono-shrimp production under mangrove forest, in recent years, farmers in the coastal areas of MRD have been diversifying their aquaculture production with different marine products e.g., shrimps, crabs, muscles etc. The ecological aquaculture-mangrove forest system in coastal provinces has increased sustainably farmers' income, protect environment, biodiversity and reducing GHG emission. Some areas even receive organic certifications and ASC for their aquaculture products (Minh Phu Company in Ca Mau province) and get premium prices for high food safety standards. More than 180,000 ha have been practiced along the coastal areas of MRD. This system also adapts significantly to climate change and ensure sustainable livelihood for coastal communities (VIFEP and IPSARD, 2015). The case study in Vinh

[31] According to Nguyen V.Ke (2015), In Binh Thuan, during the dry season from Nov-May, dragon plantation requires irrigation from 3-7 times/day depending on the soil and weather conditions. All interviewed farmers said they have to irrigate their dragon fruit farm during the sunny days when they used electricity to simulate off season flowering.

[32] The mangrove forests are mainly in Ca Mau: 58.285 ha, Bạc Lieu: 4.142 ha, Soc Trang: 2.943 ha, Tra Vinh: 8.582 ha, Ben Tre: 7.153 ha, Kien Giang: 322 ha, Long An: 400 ha.

Hau commune, Hoa Binh district, Bac Lieu province shows that the system can bring direct extra income from aquaculture of 33,9 mil vnd/ha/year (about US$1600), while mangrove forests are protected and improved. The system could also provide an indirect income from coastal protection value of about 18.1 million/ha/year and value of carbon storage and sequestration at 4.3 million/ha/year (VT Phuong, 2012)[34].

The livelihood diversification for the forest owners of mangrove forests in the coastal areas is considered as a key measure to ensure the success of the coastal forest protection and development, especially for the mangrove forests.

2.7 Examples of ongoing action by Civil Social Organization and private sector

According to the United Nations Food and Agriculture Organisation (FAO), the private sector includes enterprises, companies or businesses, regardless of size, ownership and structure. They may operate at a local, national, regional or international level, in rural or urban areas. Rrecently, the government of Vietnam has recognized the key role of the enterprises and private sector played in the economic development of Vietnam in general and in investing in CC adaptations in agriculture in particular[35]. More attention of investment in agriculture has been seen, some big business groups have been started up their projects in agricultural production and food supply chains such as FPT, Hoang Anh Gia Lai, VinGroup, Hoa Phat v.v.

In 2014, FPT Group signed an agreement with Japanese company Fujitsu who provides cloud services, equipment, and expertise to FPT for setting up a 400 m^2 greenhouse to cultivate tomatoes and other vegetables, Gia Lam district, Hanoi city.

Vingroup has also entered the agriculture sector under the brand name VinEco aiming at providing safe and clean food resources and exporting some of Vietnam's dominant agricultural products. VinEco would invest high technology to grow organic vegetables or vegetables with certified VietGAP and GlobalGAP standards.

The implementation of many of these practices will not be aimed at, nor achieve, GHG emissions reduction. However, the uptake of many others can be done so with the direct objective of achieving co-benefits, including emissions reduction, in mind, or could realise lower emissions indirectly. For example, the need to safeguard and improve increasingly scarce water supplies may result in private sector actors making the decision to afforest key areas of their production land, in order to enhance the generation of the water regulatory services provided by forest ecosystems. While the main aim of such afforestation may not be related to GHG, its implementation would result in some sequestration. For many private agricultural actors in Vietnam, especially smallholder farmers, improved food security, economic benefits and adaptation to climate change are more fundamental incentives that should accompany GHG mitigation.

Many of Vietnam’s national and sub-national policies acknowledge the importance of private sector involvement. However, the extent of, or opportunities for, the private sector’s participation in their implementation vary.

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[33] Decision No 116/1999/ QD-TTg of the Prime Minister of Vietnam dated on 03/05/1999 on "Approving the mangrove forest rehabilitation planning of Cam au, Bac Lieu, Soc Trang and tra Vinh

[34] This estimation was based on the study done by Vu Tan Phuong (2012) of estimating values of environmental services of the forests.

[35] "Businesses and enterprises are a momentum for the economic development of Vietnam" said by Prime Minister Nguyen Xuan Phuc at the first cabinet meeting in April, 2016.

3. Projected impacts of existing CSA interventions

3.1 Effects on productivity and income and implications for food security

To create an enabling environment for climate action in the agricultural sector is a priority for Viet Nam. This can be achieved through measures focused on governance, policy frameworks and country readiness. Viet Nam has identified adaptation to climate change as one of the key targets of its national development strategy (NAP-CC for period 2012-2020[36]). Guidance for prioritizing climate change adaptation measures integrated into Socio-economic Development Plans (SEDPs)[37] serves to achieve the NAP-CC's objectives[38]. The Ministry of Natural Resources and Environment (MONRE) guided ministries and provinces on their Climate Change Response Action Plans (CCR-APs)[39], emphasizing the need to integrate adaptation measures into on-going and upcoming projects and programs. In addition, the ASEAN Climate Resilience Network, through the ASEAN Technical Working Group on Agriculture Research and Development (ATWGARD), developed the "ASEAN Guidelines on Promoting Climate Smart Agriculture Practices", which was subsequently endorsed by the Ministers of Agriculture and Forestry of the 10 ASEAN Member States. These policy frameworks show the support by Viet Nam to the implementation and scaling up of adaptation measures in the agricultural sector.

Viet Nam recognizes the importance of the linkage between climate change adaptation, sustainable development and the transition towards a low-carbon economy, to ensure a systematic, joint, interdisciplinary, interregional approach, and incorporate gender equality, hunger eradication and poverty reduction. Numerous climate change adaptation and disaster risk management measures have been carried out on both national and subnational scales[40]. In the updated CCR-AP of the agricultural sector for the period 2016-2020[41] and in the Agriculture Restructuring Program[42], a range of adaptation measures have been identified, as follows:

Water resources management: Planning for sustainable development of water resources in river basins with development of new regulation scheme of reservoirs, lakes, dams and dykes to serve multiple purposes (irrigation and drainage for agriculture, aquaculture, water supply, human and ecosystem protection, hydro-electricity generation, transport, etc.) has been in effect. This also includes the

[36] Decision 1474/QD-TTg of the Prime Minister of Vietnam on the 5th, October 2012.

[37] Decision 1485/QĐ-KHĐT of the Ministry of Planning and Investment, 17 October 2013 on "Guiding framework for selection of prioritized climate change adaptation measures in planning of SEDP"

[38] The 7 objectives in Decision 1474/QĐ-TTg/2012 are: (i) improving capacity in monitoring climate change and early warning; (ii) ensure food and energy security; (iii) proactively response and mitigate impact of CC and climate risks; (iv) improving CC response policies and institutions; (v) protecting CC vulnerable groups; (vi) awareness raising and capacity building for CC response; (vii) development of technologies in response to CC.

[39] Official Memo No 990/BTNMT-KTTVBDDKH of the Ministry of Natural Resources and Environment, 14 March 2014, to all Line Ministries and provinces to guide on updating of climate change response action plans (2015-2020).

[40] INDC of Vietnam submitted to the UNFCCC Secretariat in September, 2015.

[41] Recently submitted to the Minister of MARD for approval

[42] The Agricultural Restructuring Plan towards increasing added values and sustainable development was approved by the Prime Minister as Decision No 899/QĐ-TTg, 10 June 2013

application of water saving irrigation techniques and community management of irrigation systems.

Crop production: there have been widely application of measures to prevent soil erosion, soil protection; crop irrigation; selection of climate stress-tolerant crop varieties (drought, flood, heat, and salinity); adjustment of cropping patterns and cropping calendars; integrated crop management practices (System of Rice Intensification, SRI; alternate wetting and drying, AWD; "1 must, five reductions", etc.)[43]. International cooperation has assisted with selection of the most feasible climate smart agriculture (CSA) practices for scaling-up.

Forest management: there have been the applications of the integrated forest management approaches with community participation; agroforestry; mixed aquaculture-forest practices to increase carbon sinks, controlling soil erosion and protecting water sources; nationwide scaling-up of Payment for forest ecosystems (PFES). The integration of REDD+ principles into commodity planning and supply chain development is being piloted regarding 4 commodities.[44]

Coastal zone management: there are Strengthening and elevating embankments nationwide, emphasising cost-sharing; and investing in innovative coastal protection measures; developing agricultural techniques for the saline / brackish zones; relocating exposed households and elevating houses above flood levels. Scaling-up models of combining infrastructure measures with mangrove forests and protection forest along and outside sea dikes[45].

Livestock production: modernizing livestock breeding techniques; developing new crop-livestock systems; scaling-up "integrated food-energy systems" (IFES) in livestock production with biogas digesters and (thus) reducing GHG emission and protecting the environment[46].

Aquaculture and fisheries: Applying eco-aquaculture techniques, combining fish and shrimp raising and mangrove forests; changing from rice-rice cultivation in salinity affected areas to rice-fish or rice-shrimp farming to mitigate the impacts of sea level rise and salinity intrusion[47].

Other adaptation measures include change in production patterns in areas severely affected by draught conditions, shifting from crops that require irrigation to crops and livestock production that requires much less water.

3.2 Adaptation potential achieved

The results from the country prioritization frame work done by IAE and IPSARD shown in the Table 1 below illustrate that some CSA practices have high adaptation potential such as Biogas from pig production, Integrated Crop Management (ICM) on rice,

[43] IPSARD & Department of Crop Production - MARD, Hanoi, August, 2015

[44] This is under the UN-REDD program phase II (2013-2018)

[45] Decision No 120/QĐ-TTg of the Prime Minister dated on Jan. 22/2015 on approval of the proposal " Coastal Forest Protection and Management in response to climate change in the period from 2015-2020.

[46] IPSARD & Department of Livestock Husbandry-MARD, Hanoi, August, 2015

[47] IPSARD & VIFEP - MARD, Hanoi, August, 2015

Biological bedding for animal husbandry and Rice- Shrimp rotation, etc. (high score for scalability). Statistics of actual application of these practices also show the consistent with experts' opinions shown in the Table??. By the end of 2014 about 350,000 biogas digesters had been installed in 58 provinces of the country. Besides, 725,000 people had enjoyed benefits associated with biogas technology; 1,668 masons and 1,064 technicians have been trained, thousand of workshops and training courses were organized for hundred thousand of biogas end-users (MARD, 2015). For biological bedding, in whole country, about 62,213 livestock premises have been applied with total of 5,319,183 m2 bio-bedding used. In terms of adaptation of ICM48, the stocktaking results show that 88/807 identified CSA applied plots are ICM practices. As planned, by 2020, 3.2 million ha of rice cultivation areas will apply SRI, 3G3T, 1P5G, AWD49.

Table 1. Results selected relevant CSA practices to Vietnam from expert's ranked

CSA option	Scalability	Resilient capacity	Total	Pre. ranked	New ranked
Biogas from pig production	2.8	2.5	5.3	1	1
ICM on rice	2.8	2.4	5.2	2	2
Biological bedding for animal husbandry	2.7	0	3.7	3	10
Saving water irrigation for upland crop	2.5	2.4	4.9	4	4
Mushroom from rice straw	2.2	1.9	4.1	5	8
Rice- Shrimp Rotation	2.5	2.7	5.2	6	2
Two rice - upland crop	2.2	2.7	4.9	7	4
Salt tolerance rice variety	2.3	2.6	4.9	8	4
Shifting two rice season to one rice and fish	2.4	2.4	4.8	9	7
Shifting tobacco to Vietnamese Apple and Sheep /goat raising	1.3	2.3	3.6	10	9

Source: IAE-IPSARD, 2015

3.3 Mitigation benefits

The results of the case studies show that the two main pillars of the CSA (food security and climate change adaptation capacity) are prominent as initial purposes while GHG mitigation is quite blurry. However, agriculture has contributed 43.1% of GHG emissions in Vietnam and rice production alone would still account for about 39.1% of total GHG emission in agriculture sector by 2020 (Trinh M.X, 2015).

The Agriculture Restructuring Program (ARP) aims at both ensuring food security, reducing GHG emissions and the adverse impacts on environment. The Program of GHG emissions reduction in the agricultural sector has also applied different mitigation measures to save energy and to reduce GHG emissions and to improve soil fertility and water retention. CSA looks at multiple objectives and potential benefits that cut across food production/security and CC adaptation/mitigation. This program suggests demonstrating the advantages of the CSA approach for further up-scaling. The program also determines 32 priority projects including pilot/demonstration of selected farming

[48] ICM in this research includes but not limited to 1 must, 5 reductions (1M5Rs); 3 reductions, 3 gains (3R3G), etc.

[49]No: 3119 /QD-BNN-KHCN of the MARD dated on the 16/December, 2011 on approving programme of Green House Gas (GHG) emissions reduction in the Agriculture and Rural Development sector up to 2020

systems of low carbon emission such as the SRI, IPM, ICM, 3R-3G, 1M-5R, minimum tillage. Trinh M.X (2015) show that the applying AWD, 1M5R, 3R3G and SRI could potentially reduce GHG emission from rice cultivation from 15 up to 45%; biogas system in livestock production can contribute to reduce GHG emission up to 6.34 million tone $CO_{2\text{-}e}$ by 2030.

3.4 Other co-benefits

All CSA case studies have shown their potentials of bringing the co-benefits or win-win options, some even provide triple benefits (economic, environmental protection, adaptation and GHG reduction, See annexes 1, 2, 3) such as 1M5R, rice-shrimps, converting two rice crops to rice-fish etc. These CSA options have shown higher profitable, reducing environmental externalities (use less fertilizers, pesticides, water) and reducing GHG emission

4. Challenges and opportunities for further implementation of CSA

4.1 Challenges to adoption of CSA

Climate change adaptation benefits go beyond the locality. Adaptation measures help Vietnam increase its resilience to climate change and can sometimes also reduce greenhouse gas (GHG) emissions. However, adaptation measures are locally specific. The implementation of plans depends on national resources and particularly on international support[50].

Figure 6. Rice – Aquaculture Model

Although climate change response expenditure is heavily focused on adaptation (about 90%) and the agriculture, livestock and forestry sector accounts for 82%, the majority of current investment and expenditure is directed towards improving high-cost, large-scale infrastructure projects **(**sustainable infrastructure 63%)[51]. The resource allocation to soft/non-structural adaptation measures is still very limited whereas the cost of

[50] INDC of Vietnam submitted to UNFCCC, September, 2015.

[51] MPI, WB & UNDP (2014), Vietnam Climate Public Expenditure and Investment Review Report.

adaptation keeps increasing and is estimated to exceed 3-5% of GDP by 2030[52].

Legal framework of integrated CSA practices as main CC adaptation measures into policies faced some drawbacks and limitations (lack of concrete policies on CC; unbalanced policies (focus more on disaster prevention/mitigation than sustainable, non-structural adaptation measures (CSA)

- Vague links between currently existing CSA practices/model and mitigation
- The CSA concept is quite new and less perceived by policy makers and scientists as well as less imparted to businesses and communities
- CSA framework is now under developing at national level
- Adaptation cost keeps increasing and far from what the country could provide agricultural value chains.
- The majority of CC adaptation funds have been directed towards improving the climate resilience of high-cost, large-scale infrastructure projects **(**sustainable infrastructure 63%). The cost of adaptation keeps increasing and is estimated to exceed 3-5% of GDP by 2030 (INDC).
- Cost to move from a BAU to a LED is 0.2 GDP (WB. 2014)~ $ US 400 millions in 2015 (excluding additional cost of adaptation)

4.1.1 Challenges identified from the specific case studies:

There are existing conflicts and trade-offs between environment protection, CC adaptation and improvement of livelihood and income, between ensuring national food security and GHG emissions reduction. In addition, the overlapping in institutional organization, roles and policy content has led to divergence in policy implementation. There are gaps that hinder the synchronization between agricultural policies and CC policies such as lack of solid scientific evidence and financial mechanism for integration; absence of criteria for environmental risk evaluation and level of integration; lack of compulsory regulation on integration of CC into the agricultural policies. CC policies have not encouraged private sector to apply advanced technologies and CSA.

Budget for implementation of agricultural and CC policies in general and investing in adaptation of selected CSA options is allocated through two channels: i) State budget; ii) Budget from National target programs, development programs and projects and not having a separate budget line specifically for CC response measures. Other financial sources such as from private sector investment and businesses are very limited while application of CSA, in many cases, is costly and technology intensive.

There lack of the involvement and incentives for private sector and businesses to invest in development and application of CSA options, especially those that require upfront costs such as water saving irrigation system, Solar power to regulate irrigation system for dragon fruit etc.

[52] Vietnam INDC, September, 2015.

4.1.2 Possible solutions to address the challenges identified drawn from Case studies

Based on these overarching priorities, within the agricultural sector, the following actions/needs have been identified:

a) Review agricultural development plans in the context of climate change, including a comprehensive evaluation of current adaptation capacity and projections of the decrease in productivity under business as usual scenarios, particularly of paddy rice and coffee
b) Change/shift cropping patterns and schedules, develop and use seed varieties resistant to climate change conditions in different ecological zones
c) Study, select, upgrade and modernize crop and livestock production techniques which increase resilience and may also minimize GHG emissions as co-benefit
d) Utilize good agricultural practices in crop cultivation such as: fertilizer and pesticide saving measures; water saving measures; minimizing time for land preparation; intercropping of cash crops (coffee, pepper, rubber etc.) with leguminous trees, fruit trees etc.; scaled-up CSA practices such as agro-forestry, mangrove forest-aquaculture, rice-fish/shrimp etc.
e) Finalize production standards and regulations to ensure that complete value chains from agriculture production to waste management apply ways to increase resilience to climate change effects;
f) Apply Good Agricultural Practices (GAP) in livestock production to improve feed utilization coefficients, reduce GHG emissions and cost; link animal husbandry practices with the feed processing industry and treatment of animal waste; and produce bio-gas
g) Build capacity of institutions at multiple levels (local, regional, national) to effectively implement adaptation measures;
h) Establish mechanisms for technology transfer and promote technology development at the national level, including the development of indigenous knowledge based technologies;
i) Develop a unified CSA policy framework that will guide to the identification, prioritization and scaling-out enabling policy environment.

4.2 Opportunities for improvement and scaling-up CSA practices

Adaptation measures in agricultural systems are costly and knowledge intensive, the cooperation among GACSA members can play an important role in addressing the knowledge needs of each member by linking public and private research, extension and advisory services to generate, manage, blend and share indigenous and scientific knowledge, while facilitating learning processes and network-based innovation. The GACSA could seek to leverage on its capacity building activities to provide capacity building support at multiple levels for implementing adaptation measures in agricultural systems and scaling-up of efficient and cost-effective CSA options in Viet Nam.

Figure 7. Mangrove forest and aquaculture model in Bac Lieu

5. Outlooks/conclusion

5.1 Addressing policies challenges/gaps

Viet Nam needs to increase its capacity in the agricultural sector to develop and implement priority adaptation practices and technologies. Many pilot projects in Viet Nam fail being executed beyond the experimental stage because local partners lack financial and human capital to upscale projects and mainstream results. GACSA can help addressing this by facilitating capacity building. This can partly be achieved through processes such as National Adaptation Planning, but dedicated sectoral focus should also be a consideration

Vietnam is very vulnerable to extreme climate risks, such as flooding and prolonged drought, and sea-level rise. Around 47% of the population is still at least partly reliant on agriculture for income and household subsistence. The majority of the population lives in coastal or low-lying deltas. Without considering potential changes in temperature, rainfall, and other climatic variables, old and inefficient infrastructure and current social development paths could lead to greater economic vulnerability.

Climate change and sea-level rise will affect yields and production of key crops, such as rice, maize, cassava, sugarcane, and coffee. Shifting Vietnam to a more environmentally sustainable path for economic growth will have trade-offs. One trade-off is in investing resources for building long-term resilience versus investments for short-term food security gains.

For rice, the worst yield reductions are predicted about 12% in the Mekong River Delta and about 24% in the Red River Delta. In the Mekong River Delta, a 30 cm sea-level rise by 2050 would result in a loss of 193,000 ha of rice area due to inundation. Some 294,000 ha will be lost due to salinity intrusion, without adaptation in both cases. Lost rice area would lead to a rice-production decline of about 2.6 million tons a year, based on current yields (World Bank 2016). Given the recent rice export volume of 6-7

million tons a year (GSO 2016), this expected loss would not threaten the national food security. Therefore investing in long-term resilient measures is vital for ensuring long-term food security of the nation even Vietnam has to accept the trade-off of short-term productivity gains.

Investments in enhancing resilience or adapting to climate change will be central for a sustainable growth path. The major investment is in new technologies and policy measures for sustainable growth. These will yield long-term benefits and leave open options for new types of growth, such as nature-based and cultural tourism. They will also help retain uncontaminated water resources for fish production. Some examples of converting from rice-rice production pattern to rice-aquaculture (rice-shrimp, rice-fish) to cope with salinity intrusion in Mekong River delta provinces (Soc Trang, Kien Giang, Bac Lieu etc.) have already shown fruitful results.

5.2 Institutional arrangements

The Decision No. 62/2013-QD-TTg regulates a number of preferential and support policies of the State aiming to encourage the production coordination between the processing and consumption of agricultural products which belong to large field projects under the planning and approved by competent authorities. According to this decision, the large field is a form of production organization on the basis of cooperation and association between farmers and enterprises; it is the representative organization of farmers in the production linked with the processing and consumption of agricultural products in localities; has the large scale of fields aiming to create centralized commodity farm product productivity with high quality for increasing the competitiveness of agricultural products on markets in order to improve the production effectiveness, increased incomes of famers and the attendants. These policies and institutional arrangements contribute to creating incentives for both enterprises and farmers in agricultural production and business in applying CSA as long term, sustainable commodity development.

5.3 Investment and financial flows challenges/gaps

The limited availability of finance is a key challenge and limits implementation and scaling up of adaptive agricultural practices and technologies in general and CSAs in particular in Viet Nam. Viet Nam has identified the following priority areas for investment: research for crop improvement, improving delivery mechanisms for stress tolerant seeds, decision-support to identify suitable areas for application, scaling up of priority CSA and technologies, institutional strengthening, and addressing gender inequalities in agriculture.

Climate change adaptation benefits go beyond the locality. Adaptation measures in general and CSA in particular help Vietnam increase its resilience to climate change and can sometimes also reduce greenhouse gas (GHG) emissions. However, CSA options are locally specific. The implementation of plans depends on national resources and particularly on private sector investment and international support[53].

[53] INDC of Vietnam submitted to UNFCCC, September, 2015.

Although climate change response expenditure is heavily focused on adaptation (about 90%) and the agriculture, livestock and forestry sector accounts for 82%, the majority of current investment and expenditure is directed towards improving high-cost, large-scale infrastructure projects **(**sustainable infrastructure 63%)[54]. The resource allocation to soft/non-structural adaptation measures like CSA is still very limited whereas the cost of adaptation keeps increasing and is estimated to exceed 3-5% of GDP by 2030[55].

Viet Nam is mobilizing both international climate finance and national development finance to scale up adaptation measures. In addition, Vietnam encourages and creates favourable conditions for private sector investment in climate change adaptation activities, including approaches to make value chains more sustainable in the face of climate change effects, and applying the landscape approach to developing agricultural value chains.

6. Possible contributions from GACSA

Viet Nam is of the view that the GACSA networks and mechanisms should help to identify initiatives on technology transfer and knowledge sharing in the agricultural sector, and where possible achieve synergies with these initiatives and systems. Vietnam also views the GACSA as an important global initiative for knowledge sharing. At the regional level, the ASEAN Climate Resilience Network and APEC facilitate knowledge sharing amongst ASEAN Member States and APEC economies is important.

To address challenges and limitations and based on experiences and lessons learnt from implementing adaptation measures, Viet Nam sees potential roles for the Convention in the following areas.

[54] MPI, WB & UNDP (2014), *Vietnam Climate Public Expenditure and Investment Review Report*.

[55] Vietnam INDC, September, 2015.

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Annexes

ANNEX 1: One must five reductions (1M5Rs) in Nam Dinh province (RRD)

Cash flow for traditional rice farming and 1 must 5 reductions*

Unit: 1,000 VND/ha/year

	Traditional practice	CSA practice (1M5R)
Outflows	**95,644**	**66,648**
Seeds	2,688	2,016
Fertilizer	13,280	7,056
Pesticides	3,600	3,000
Fertilizer and Pesticide application	2,100	2,100
Irrigation	1,176	1,176
Harvesting	11,200	11,200
Land rent (Opportunity Cost)[56]	11,200	12,100
Family labor (Opp. cost)	50,400	28,000
Inflows	**96,080**	**96,668**
Sales revenue from Rice	94,080	94,080
Sales revenue from Straw	2,000	2,000
GHG emission savings*	-	588
NPV**	**-1,827**	**27,687**
IRR		**14%**

* GHG emission savings from 1M5R compared to conventional rice cultivation are 5.342 ton CO_{2-e} per ha per year (the table below) with the price of one ton of CO_2 is assumed as 5USD (1USD=22,000VNĐ)

[56]Land Rent price is calculated based on Decree No 46/2014/NĐ-CP of Prime Minister dated May 15, 2014 on regulations on land and surface water rent collection and Decree 104/2014/NĐ-CP dated November 14,2014 on regulations on the land price brackets

**The cycle of system is 12 months with discount rate of 0.65% per month

ANNEX 2: Dragon fruit with solar power system to regulate irrigation system in Binh Thuan province

2.1. Summary for cash flow of dragon fruit with solar power system in 1 ha

Unit: 1,000 VND

	Traditional practice	CSA practice
Outflows	**5,010,050**	**3,918,050**
Initial investment	***231,600***	***534,600***
Solar-powered battery	-	146,000
Pipes	-	157,000
Pumps	16,000	16,000
Well drilling	39,600	39,600
Water reservoir building	41,600	41,600
Pillar setting	134,400	134,400
Annual cost	***3,941,450***	***3,221,450***
Annual fertilizer	735,750	735,750
Fertilizer per crop (Growmore, Miraclegrowth …; 3 crops per year)	1,627,700	1,627,700
Electricity for lighting	858,000	858,000
Electricity for irrigation	720,000	-
Labour	***837,000***	***162,000***
Inflow	**6,380,000**	**150,375**
Upland crops	6,380,000	150,375
NPV	**619,869**	**1,177,018**
IRR	**29%**	**39%**
BC Ratio	**-**	**1**

2.2. Detail for cash flow of dragon Fruit Model

2.2.1. Dragon Fruit Model in Traditional Cultivation

Unit: 1,000 VND

Cycle		Cycle of 15 year															
Year		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Outflows	**5,010,050**	**306,550**	**199,950**	**347,350**	**345,350**	**347,350**	**345,350**	**347,350**	**345,350**	**347,350**	**345,350**	**347,350**	**345,350**	**347,350**	**345,350**	**347,350**
Initial investment	**231,600**	***114,000***	***7,400***	***9,400***	***7,400***	***9,400***	***7,400***	***9,400***	***7,400***	***9,400***	***7,400***	***9,400***	***7,400***	***9,400***	***7,400***	***9,400***
Solar-powered battery	**-**	-														
Pipes	**-**															
Pumps	16,000	2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000
Well drilling	39,600	20,000	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Water reservoi building	41,600	22,000	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Pillar setting	134,400	70,000	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600
Annual cost	***3,941,450***	***136,750***	***136,750***	***282,150***	***282,150***	***282,150***	***282,150***	***282,150***	***282,150***	***282,150***	***282,150***	***282,150***	***282,150***	***282,150***	***282,150***	***282,150***
Annual fertilizer	735,750	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050
Fertilizer per crop (Growmore, Miraclegrowth …; 3 crops per year)	1,627,700	39,700	39,700	119,100	119,100	119,100	119,100	119,100	119,100	119,100	119,100	119,100	119,100	119,100	119,100	119,100
Electricity for lighting	858,000	-	-	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000
Electricity for irrigation	720,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000
Labor	**837,000**	***55,800***	***55,800***	***55,800***	***55,800***	***55,800***	***55,800***	***55,800***	***55,800***	***55,800***	***55,800***	***55,800***	***55,800***	***55,800***	***55,800***	***55,800***
Inflows	**6,380,000**	**60,000**	**80,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**
Sales revenue at farm	**6,380,000**	60,000	80,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000
Net Value	1,369,950	(246,550)	(119,950)	132,650	134,650	132,650	134,650	132,650	134,650	132,650	134,650	132,650	134,650	132,650	134,650	132,650
NPV	**619,869**															
IRR	**29%**															

2.2.2. Dragon Fruit Cultivation used solar-powered drip irrigation

Cash flow for Dragon Fruit Cultivation used solar-powered drip irrigation

Unit: 1,000 VND

Cycle		Cycle of 15 year															
Year		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Outflows	**3,918,050**	**369,550**	**117,450**	**264,850**	**262,850**	**264,850**	**262,850**	**264,850**	**262,850**	**264,850**	**262,850**	**264,850**	**262,850**	**264,850**	**262,850**	**264,850**
Initial investment	***534,600***	***270,000***	***17,900***	***19,900***	***17,900***	***19,900***	***17,900***	***19,900***	***17,900***	***19,900***	***17,900***	***19,900***	***17,900***	***19,900***	***17,900***	***19,900***
Solar-powered battery	146,000	76,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Pipes	157,000	80,000	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,500
Pumps	16,000	2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000
Well drilling	39,600	20,000	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Water reservoi building	41,600	22,000	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Pillar setting	134,400	70,000	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600
Annual cost	***3,221,450***	***88,750***	***88,750***	***234,150***	***234,150***	***234,150***	***234,150***	***234,150***	***234,150***	***234,150***	***234,150***	***234,150***	***234,150***	***234,150***	***234,150***	***234,150***
Annual fertilizer	735,750	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050	49,050
Fertilizer per crop (Growmore, Miraclegrowth …; 3 crops per year)	1,627,700	39,700	39,700	119,100	119,100	119,100	119,100	119,100	119,100	119,100	119,100	119,100	119,100	119,100	119,100	119,100
Electricity for lighting	858,000			66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000
Electricity for irrigation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Labor	**162,000**	***10,800***	***10,800***	***10,800***	***10,800***	***10,800***	***10,800***	***10,800***	***10,800***	***10,800***	***10,800***	***10,800***	***10,800***	***10,800***	***10,800***	***10,800***
Inflows	**-**	**-**	**80,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**	**480,000**
Sales revenue at farm	150,375	60,000	80,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000	480,000
Net Value	**(3,918,050)**	(369,550)	(37,450)	215,150	217,150	215,150	217,150	215,150	217,150	215,150	217,150	215,150	217,150	215,150	217,150	215,150
NPV	**1,177,018**															
IRR	**39%**															
Benefit Cost Ratio	**1.3**															

ANNEX 3: The statistical data on the mangrove wood exploitation of household in Tan An commune, Ngoc Hien district

Wood from protection forest	Frequence (day/ year)	Volume (ster/ time)	Volume (ster/ year)	Price (1.000 VND/ ster)	Revernue per houshold (1.000 VND/year)
Average	**16**	**0,7**	**10,8**	**540**	**5,832**
Mininmum	12	0,4	6,4	540	3,456
Maximum	30	1,0	18,0	540	9,720
Standard Deviations	5	0,2	3,5	0	1,908

Source: Vu Tuan Phuong. (2012)

ANNEX 4: Fishing operations of households in researched commune of Ngoc Hien and Phu Tan districts

No	Kind of aquacultures	Average production (kg/year)	Average price (VND/kg)	Average income (VND/year)	Average income of mangrove forest per ha per year (VND/ha/year)
1	***Cai Duoi Vam***	***4,069***		***198,895,412***	***14,917,156***
-	Shrimp	550	60,000	32,989,412	2,474,206
-	Fish	551	60,000	33,068,000	2,480,100
-	Swamp ceriths	1,273	30,000	38,200,000	2,865,000
-	Squid	493	60,000	29,600,000	2,220,000
-	Clam	401	8,000	3,208,000	240,000
-	Acetes	495	14,000	6,930,000	519,750
-	Crab	305	180,000	54,900,000	4,117,500
2	***Tan An***	***2,023***		***86,034,000***	***6,452,550***
-	Shrimp	355	60,000	21,300,000	1,597,500
-	Fish	280	60,000	16,800,000	1,260,000
-	Swamp ceriths	489	30,000	14,664,000	1,099,000
-	Squid	42	60,000	7,560,000	576,000
-	Clam (Vộp)	857	30,000	25,710,000	1,928,250
3	***Nguyen Viet Khai***	***1,700***		***51,000,000***	***3,825,000***
-	Swamp ceriths	1,700	30,000	51,000,000	3,825,000
	Total	**7,791**		**335,929,412**	**25,194,706**

Source: Vu Tuan Phuong. (2012)