AN OVERVIEW OF CLIMATE-SMART AGRICULTURE MODELS' REVIEW AND EVALUATION PROCESSES: A CASE STUDY IN THE SOUTH CENTRAL COAST

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Abtract

Adverse weather conditions and further climate change have had a strong impact on food production systems. Accordingly, the promotion of climate-smart agriculture (CSA) models is an approach to achieve sustainable development in agriculture, ensuring food security in the context of climate change. This study aims to (1) review the evaluation processes, categorize CSA models from different stakeholders to arrive at a common and appropriate consensus process; (2) indicate the basis for selecting suitable potential CSA models in each specific production condition; (3) applied to the review and identification of existing CSA models in the South-Central Coast. Research methods including desk research, field investigation, and expert consultation were used to achieve the research objectives. The results show that there are 18 potential CSA models in the South Central Coast that meet the requirements of a CSA model. However, in order to have a basis for proposing the replication of these models, detailed assessments are required to determine the effectiveness of the models and their suitability with local production conditions and resources.

Keywords: *assessment, climate change, CSA model, process, review, selection criteria*

1. Introduction

According to FAO (2010), an agricultural model is considered to be climate-smart (CSA) when it contributes to increasing the following three capabilities of agricultural production systems: (i) Adaptability respond to climate change (CC), ensuring productivity and income even under adverse climate change; (ii) Mitigation capacity: the ability to reduce the risk of CC occurrence and to reduce CC levels, by reducing or eliminating greenhouse gas emissions (GHGs), or recovering GHGs from the atmosphere; and (iii) The ability to increase productivity and economic efficiency, thereby contributing to food security in the long run. An agricultural model that meets all three of these goals is ideal. Because of the complexity of the CSA concept, in practice it is very difficult to achieve the three goals at the same time. In different contexts, the order of priority goals is also different. CC reduction is an important goal, but not a mandatory criterion; just practice that CSA does not emit more

GHGs, does not cause negative effects on the climate and the living environment. Therefore, the establishment of a decision support framework is necessary to facilitate the selection of a list of CSA models that are suitable for practice.

In Vietnam, in a series of important decisions such as Action Plan to Response to CC in agriculture and rural development (Decision No. 819/QD-BNN-KHCN) (MARD, 2016); Plan for the implementation of the Paris Agreement on climate change (Decision No. 2053/QD-TTg) (Prime Minister, 2016); Implementation plan of the Paris Agreement on CC of the Ministry of Agriculture and Rural Development (Decision No. 891/QD-BNN-KHCN) (MARD, 2020); The national plan to adapt to climate change for the period 2021 - 2030, with a vision to 2050 (Decision No. 1055/QD-TTg) (Prime Minister, 2020), all emphasize the importance of climate change adaptation. develop and replicate agricultural production models that are intelligently adaptable to CC.

In fact, there is a need of a common and most appropriate method to guide stakeholders to review and evaluate CSA models or potential CSAs;moreover, it is necessary to indicate the basis for selecting suitable potential CSA models in each specific production condition. This study aims to review all the different assessment methods which are available; thereby, consider the similarities and differences to propose a framework or a common review and evaluation process. This process will be applied to review the list of existing CSA models in the South-Central Coast.

2. Method

The methods used in this study include:

Data collection and synthesis method: This method is used to review and analyze different evaluation processes and methods of domestic and foreign agencies and organizations. This method is also applied to review all agricultural production models with CSA potential in Vietnam in general and the South-Central Coast in particular.

Field survey: This method is used to determine the presence or absence of CSA models in actual agricultural production in the study area, preliminary determination of the effectiveness and relevance of CSA models - the model that adapts to recent and future climate changes. Ninh Thuan and Binh Thuan are the two provinces selected for the field survey.

The method of consulting experts: This method is applied to select typical agricultural adaptation models according to 3 pillars (ensure food security, adaptability, and reduce climate change) and the feasibility of agricultural models that are highly adaptable to increasing drought conditions in the South-Central Coast.

Community consultation method: Community engagement for consultants is used to collect information from farmers who directly practice local production activities. The

information is qualitative and may indicate the potential suitability of the solution for specific local conditions.

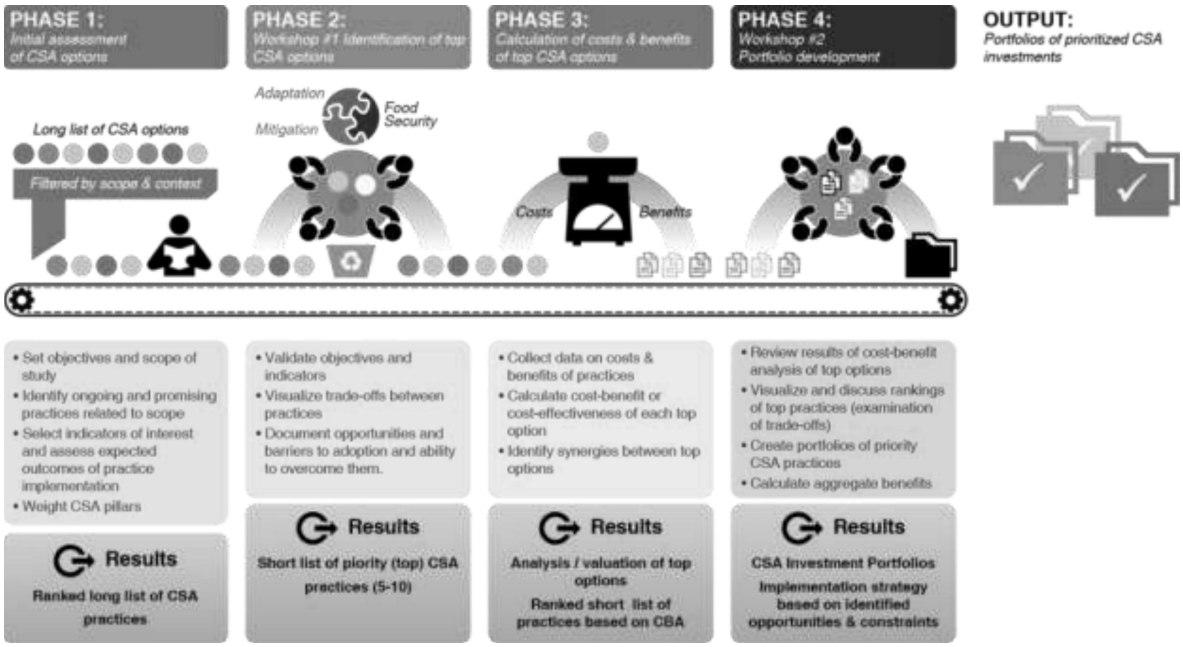
3. Results

3.1. Overview of processes for reviewing and evaluating potential CSA models

The inspection processes of different CSA models is mentioned below. Each given process represents different spatial levels from national, regional to local; for different audiences from policymakers, financial institutions to local managers.

In 2014, CIAT-CCAFS published the document "Climate-smart agriculture investment priority framework". The CSA prioritization framework is designed to meet the needs of managers at different levels (farm to policy, private and nonprofit organizations), and aims to identify determine the best cost to respond to climate change risks in the short and long term. In this document, the prioritization framework uses a four-phase approach to guide stakeholders through the process of filtering a long list of applicable CSA practices into portfolios of priority practices.

Figure 1. Description of the CSA Investment Prioritization Framework process



Source: CIAT, 2014

It can be seen that this process is more suitable for agencies, international organizations, national and regional policy makers, and financial institutions to consider and make decisions. Applying the above process, in 2015, the Institute for Agricultural Environment (IAE) in collaboration with CIAT conducted a review of CSA models in Vietnam (CIAT & IAE, 2015).

In order to have a more specific basis for selecting appropriate CSA models for each context as well as for replication, a study by MARD (2015) proposed a process (steps) for rapid review of The CSA model is as follows:

Step 1: Establish a list of models that are likely to be CSA models, or temporarily called CSA-oriented models based on analysis of secondary information including project reports, related programs related to CC mitigation/adaptive agricultural development, reports from DARDs, scientific reports, research results (both published and unpublished).

Step 2: Based on the CSA Basic Criteria to determine which models are CSA models, exclude non-CSA models. The result of this step is to make a list of CSA models that are being implemented in practice *(Table 1)*.

Table 1: List of CSA models in practice

No.	Model name and main features	Project/ Program	Location, scale of application (starting year, area, number of households …)	The main benefits and impacts of the model				Advantages and disadvantages in model implementation	Policies related to model development and replication
				Increase productivity and ensure food security	Climate change adaptation	GHG reduction	impacts of the model		
	…	…	…	…	…	…	…	…	…

Source: MARD, 2015

Step 3: Make a list of CSA models suitable to the local practical needs for food security, CC adaptation, and CC mitigation. To compile this list, additional information should be collected through expert consultation and consultation with the local community. The purpose is to build the bases for the suitability and non-conformity of the model with local practical needs.

Step 4: Identify suitable potential CSA models for replication based on the characteristics of natural conditions; infrastructure conditions; household characteristics; policy mechanisms related to the CSA model.

On a smaller scale, in the study of Duong MT et al (2016), the research team conducted a quick inventory and assessment of the "climate-smart" of the existing farming systems in practice at (Climate-Smart Village - CSV), My Loi village, Ky Son commune, Ky Anh district, Ha Tinh province). The process includes the following steps: (1) Inventory of CSA models that consider CSA performance indicators that have been adapted to the context; (2) Evaluate the effectiveness of CSA indicators based on high or low-performance indicators for each indicator; while considering the potential to improve and further extend the model.

Thus, through the above overview, it can be concluded that the process of reviewing CSA models is very diverse. The common point in these processes is that the inventory implementation, aggregation of all potential CSA models is based on the synthesis of primary and secondary documents. The next step is to use the preliminary evaluation criteria to establish a list of CSA models. Based on specific local conditions, a further set of criteria is used to assess the relevance and replicability of these models. The difference between the processes depends on: what is the purpose of the review; who is the subject of the review; the national, regional, or local level. Accordingly, for each process, the number of criteria and the level of detail used to evaluate each process is also different.

3.2. Overview of criteria for reviewing and evaluating potential CSA models

3.2.1. Criteria for review and evaluation from international organizations

In 2013, FAO published the document "Climate-Smart Agriculture - Sourcebook", which includes Module 18 - Impact Assessment, Monitoring, and Evaluation. This module lays out the CSA assessment criteria, but mainly at the national, regional, and project levels; Evaluation criteria at the model level are few and non-specific. At the model level, FAO (2013) provides 7 general criteria for evaluation as follows: (i) Reduce soil erosion and improve nitrogen fertilizer use efficiency from the application of tillage, cover crop and crop rotation techniques; (ii) Improve the availability of irrigation water from soil and water conservation activities; (iii) Improve crop productivity by using new varieties, changing care regimes (fertilizer, irrigation), or by providing and using early weather and climate forecasting information; (iv) Improved livestock productivity from the use of new breeds and improved breeding techniques; (v) Balancing output, market price, and household income through fertilizer support programs; (vi) Improved economic resilience from diversification of income sources; and (vii) Reduce greenhouse gas emissions (GHGs) or increase the carbon accumulation capacity of the soil by applying better crop management and care techniques..

In 2014, CIAT-CCAFS published the document "Climate-Smart Agriculture Investment Priority Framework". This document does not provide a specific set of criteria to evaluate CSA models/practices.

In 2015, a group of experts from the World Bank (WB) in association with the International Food Policy Research Institute (IFPRI) developed a draft of the CSA evaluation criteria and indicators. The draft results were presented at the 2015 Global Scientific Conference on CSA in Montpellier, France. In 2016, WB officially published the document "Climate-Smart Agriculture Indicators". Accordingly, the World Bank divides CSA evaluation criteria into 3 main groups:

(i) Criteria on policy and institutions - CSA-Pol Index (assessment of the policy environment in facilitating and supporting CSA promotion), including policies to support CSA; improve infrastructure to support CSA; how to coordinate and implement CSA.

(ii) Group of criteria on technology/engineering - CSA-Tech Index (used to measure changes in productivity, adaptation, and mitigation to CC when applying technology); Evaluation is based on a baseline, that is, when no technique is applied.

(iii) Criteria for successful outcomes - CSA-Results Index (to measure application or non-applicability), including curricula indicators of direct results of CSA intervention implementation; CSA-allowed environmental metrics; indicators measuring the medium and long-term consequences of implementing a CSA intervention)

CCAFS has created a database of more than 378 CSA-related indicators collected from several international development agencies (FAO, DFID, GIZ, IFAD-ASAP, World Bank, USAID) to develop the CCAFS. CSA counter-programming and indicator tool (Quinney et al., 2016) for the purpose of monitoring outcomes and impacts. The tool proposes a shared framework/framework for agricultural programs to i) review current or planned levels of intervention for each CSA pillar, ii) compare the scope and intentions of the CSA between different project designs to program a climate-smarter future, and iii) assist in the identification and selection of an appropriate set of indicators to measure and track outcomes related to CSA..

3.2.2. Criteria for review and evaluation from organizations in Vietnam

a. Criteria for reviewing, evaluating, and ranking agricultural models adapting to climate change in general

In Vietnam, a number of research projects and projects have developed sets of criteria for evaluating and reviewing CC adaptation models such as CCWG, VNGO&CC, and SRD (2011); CARE (2013); Le Van Thang (2015), Truong Quang Hoc, et al (2018).

According to research by CCWG, VNGO&CC and SRD (2011) released in the report "Models to respond to climate change: experience of NGOs in Vietnam", there are 5 criteria for selection. climate change adaptation models, including (1) The effectiveness of the practice/model's response (adaptation and mitigation) to CC; (2) Involvement of the local community; (3) Sustainability (Economic, social and environmental performance); (4) Originality/creativity; and (5) Scalability.

Research by CARE (2013) proposed a set of criteria to identify and select livelihoods that can adapt to climate changes, including 5 groups of criteria (i) Economic compatibility, (ii) Institutional compatibility, (iii) Socio-cultural compatibility; (iV) Climate compatibility and (v) Environmental compatibility with a total of 18 criteria. As a result, there are 11 potential livelihood models to adapt to climate change. These models are classified

according to the livelihood quadrilateral framework, then scored and ranked according to CC adaptation criteria.

In order to provide a scientific basis for the selection of climate change adaptation models in the central provinces, Le Van Thang (2015) proposed a set of criteria for assessing the adaptability to CC. including 4 criteria with 14 indicators. On the basis of survey results in 14 provinces (Thanh Hoa to Binh Thuan) on models with potential to adapt to CC, 16 models have been selected, evaluated, scored and classified the level of adaptation by each factor. In which, 03 models have high adaptability to CC, 08 models are quite adaptive and 05 models are moderately adaptive, none of which is low or less adaptive.

In a recent study, Truong Quang Hoc et al (2018) proposed a set of criteria for assessing climate change adaptation models (including 7 criteria with 29 criteria). These criteria are then scored and ranked for adaptability according to 5 levels: very low adaptability, low adaptability, medium adaptation, high adaptability and very high adaptability. Seven evaluation criteria include: (1) Adaptation to CC (5 indicators/40 points); (2) Reducing greenhouse gas emissions (4 indicators/10 points); (3) Economic efficiency and sustainability (4 indicators/10 points); (4) Social efficiency and sustainability (4 indicators/10 points); (5) Environmental efficiency and sustainability (4 indicators/10 points); (6) Conformity with local institutions and policies on CC and natural disasters (4 indicators/10 points); and (7) Scalability (4 indicators/10 points). The adaptability of the models is divided according to the score levels: less than 50 points - very low adaptability; 50 - 70 points - low adaptation; 71 - 80 points - highly adaptive; 81 - 90 points - highly adaptive; 91 - 100 points - very adaptive. After reviewing and evaluating, this study has shown a list of 33 climate change adaptation models.

b. Criteria for reviewing, evaluating and ranking climate-smart agriculture (CSA) models

In the report "*National prioritization of climate-smart agriculture practices in Viet Nam*", CIAT & IAE (2015) used the CSA Index to score according to the 3 CSA pillars below to screen out 19 representative CSA models for 3 agro-ecological regions (Red River Delta, South Central Coast, and Mekong River Delta).

Pillar 1 emphasizes productivity (including the ability to increase productivity, improve food security; ability to improve economic efficiency; suitability with farmers' ability to invest in CSA and with existing infrastructure) to help local managers and farmers understand the benefits of CSA. Considered the importance of this production pillar with other pillars in Vietnam, the expert's committee agreed to allocate 40 points shared in 100 points in the total for this pillar.

Pillar 2 focuses on adaptation capacity (including the adopted capacity to climate and weather, ecological conditions, natural resources exploitation and use; environmental protection. The expert's committee agreed to allocate 30 points.

Pillar 3 focuses on mitigation potential (including saving input in use, potential mitigation from a technical aspect, potential GHG emission reduction). GHG emission could not be quantified hence, experts based on the knowledge and potential footprint of carbon to give the points at a maximum of 30 points in remaining.

To rank the priority order of 19 models, the study uses the method of scoring by experts. The scoring criteria are as shown in Table 2.

Table 2. Set up the criteria for ranking comprehensive list of ongoing CSA practices

No	Selected criteria	Maximum points
1.	**Production pillar**	**25**
	Adopted capacity of relevant ecology	5
	Saving input in use	10
	Marketable output	10
2.	**Climate change adaptation pillar**	**30**
	Adaptation capacity to climate change	10
	Impact of gender balance	10
	Environmental effectiveness	5
	Social effectiveness	5
	Food security ensure	5
3.	**Climate change mitigation pillar**	**30**
	Mitigation potential	15
	Mitigation economic effectiveness (cost efficiency)	15
4.	**In line with local and sectoral plans/strategies**	**15**
	TOTAL	**100**

Source: CIAT & IAE (2015)

For the project of MARD (2015), in step 2, to determine which model is the CSA model, the project used the following basic set of criteria (Table 3):

Table 3: Basic set of criteria to evaluate the CSA model

Objectives of the CSA	Evaluation criteria
1. Increasing productivity, contribute to ensuring food security	1.1. Increased income per unit area compared to the control model (*) 1.2. Increased economic efficiency compared to the control model (*)
2. Adaptation to Climate Change	2.1. Increased stability (in terms of income) across seasons and years compared to the control model (*) 2.2. Increased resilience of crops/animals after being impacted by extreme weather events compared to control model (*) 2.3. Increased diversity of revenue sources compared to the control model (*) 2.4. Increased biodiversity compared to the control model (*) 2.5. Positive impact on restoring natural resources (soil fertility, reducing soil erosion, restoring biodiversity, etc.)
3. GHG emission reduction	3.1. Reduces GHG emissions compared to the control model (*) 3.2. Increased carbon capture/accumulation compared to the control model (*)
(*): The control model is a model where no new techniques are applied	

Source: MARD, 2015

In step 4, to identify CSA models with potential for replication, the study used a 1 to 5 scoring method by experts, local managers, and farmer communities. Evaluation criteria to consider the fit of the model with the characteristics of natural conditions; infrastructure conditions; household characteristics; policy mechanisms related to the CSA model (Table 4).

Table 4: Evaluation of the suitability of CSA models for manufacturers to apply in local conditions

No.	CSA model	In line with infrastructure	In line with soil conditions, irrigation water	In line with farmer's condition	In line with local policies to promote the model	Total
	(1)	(2)	(3)	(4)	(5)	(6)
	…	…	…	…	…	…

Source: MARD, 2015

Columns 2, 3, 4: Score on a scale of 1 to 5

Column 5: Score with 3 points as follows: Point 1: if there is a policy that hinders the application of the model; Point 2: if no policy hinders; no policy promotes the model; Point 3: if there is no policy to hinder; there is a policy to promote the model.

Research by Duong MT et al (2016) has established high or low-high indicators for each indicator. Specific criteria and indicators include (1) Economic criteria (Total output; Income; Labor input; Food security); (2) Adaptability (sensitivity to the effects of weather); (3) Mitigation potential (carbon accumulation; GHG emissions; Fertilizers; Energy); (4) Environmental impacts (Application of farming techniques on sloping land; Soil erosion; Ecosystem functions).

3.3. Review and evaluation

3.3.1. In term of the process of reviewing CSA models

Although there are differences in the subject and scope of implementation, in general, the process of reviewing CSA models for a particular region includes a number of general steps. Based on the synthesis of review procedures and other evaluation criteria for each step, the process of reviewing CSA models in the South-Central Coast region applies the following steps and evaluation criteria:

Step 1: Inventorying and listing all models with potential CSA (Desk research)

Step 2: Using the CSA model evaluation criteria to identify the model as a CSA model and re-establish the list of CSA models (desk research). The study used the set of criteria in Table 3 of MARD (2015).

Step 3: Conducting field survey to identify existing CSA models in production and collect information on models and local production conditions.

Step 4: Evaluating the effectiveness of the models according to the 3 CSA pillars, and at the same time assess the suitability to local production conditions. In this step, the study proposes to use a combination of methods to quickly evaluate the effectiveness of the models in Table 2 (CIAT & IAE, 2015) and the criteria for assessing the suitability of CSA models in the context of conditions. localities in Table 4 (MARD, 2015)

Step 5: Ranking the order of priority CSA models to propose development and replication.

3.3.2. In term of evaluation criteria of CSA models

There are two groups of criteria used for the review process, including:

(1) use preliminary evaluation criteria to determine which model is a CSA model (Table 3);

(2) using CSA's three-pillar performance evaluation criteria (Table 2); criteria to evaluate the ability to replicate and be suitable for specific local conditions (Table 4).

3.4. Results of reviewing CSA models in the South-Central Coast region

3.4.1. South Central Coast in the context of climate change

The South-Central Coast region includes the provinces located along the South-Central Coast extending from Da Nang to Binh Thuan. According to Pham Quang Ha et al. (2013), the South-Central Coast has a vulnerability index (0.536) is the third-highest in the country after the Mekong Delta (0.679) and the Southeast (0.602). This is an important indicator for identifying agricultural areas vulnerable to climate change. In fact, every year, the South-Central Coast is affected by many natural disasters and unfavorable weather conditions. Besides natural disasters such as storms and floods, the risk of drought is also assessed at a serious level (SRVN, 2004). Although it is a coastal area, in fact, the situation of prolonged drought and water shortage for agricultural production is happening in many provinces due to the characteristics of topography and other climatic factors. Research by Nguyen Lap Dan (2010) and Truong Duc Tri (2015) have shown the drought situation as well as predicted the trend of drought change in the South-Central Coast in the coming years. Under the impact of climate change, drought is likely to occur with more frequency and severity. Therefore, the implementation and application of CSA models have a very important role and significance in responding to increasingly adverse weather conditions and future climate change in South Central Coast.

3.4.2. Results of reviewing CSA models in the South-Central Coast region

Within the framework of this paper, the research has only focused and stopped at steps 1 to3 for the purpose of reviewing and defining a list of existing CSA models in the South-Central Coast.

Through reviewing and synthesizing from different data sources, a long list of potential CSA models is listed in the South Central Coast. Based on the set of evaluation criteria in Table 3 for preliminary assessment and selection of CSA models. The results of the review determined that the whole region has 18 models/technologies with 68 places being implemented in actual production. (Table 5)

Table 5. List of 18 CSA models/technologies in the South Central Coast region

No.	Code	Names of CSA	No.	Code	Names of CSA
1	TTK	Saving water irrigation	10	LC	Rotating green beans/corn on rice land
2	CDC	Shifting rice to upland crop	11	QLBV	Community-based sustainable forest management model
3	CTDC	Cultivation on sandy soil	12	SRI	System of rice intensification
4	1P5G	Applying “One must and Five reductions”	13	TC	Sugarcane Intensification
5	3G3T	Applying “3 reductions and 3gains”	14	DL	Biomat in animal husbandry
6	CS	Using LED light to off season dragon tree	15	BIO	Biogas

7	XC	Intercropping	16	XD	Growing and processing coconut fiber
8	VG	Vietgap	17	CPSH	Using Bioproducts
9	GTN	Drought tolerant rice varieties	18	TH	Mixed models

Source: Authors' synthesized, 2018

The above review results are just the first steps; therefore, in order to evaluate and prioritize CSA models, further studies need to clearly show the effectiveness of the models; co-benefits; scalability; technically feasible; inline with local and sectoral plans and strategies, in line with available local resources (financial, human, farming qualifications, institutional arrangements, and infrastructure); even further can meet the implementation of MRV and monitoring and evaluation (M&E).

4. Discussion and Conclusion

In the context of increasingly erratic weather events, the impact of CC is becoming more and more obvious. It is important to identify suitable livelihood models that are able to adapt to adverse weather conditions. However, to do this, it is necessary to have a suitable process, the criteria for evaluation and screening must be consistent and clear not only on the national level but also in accordance with local production conditions.

This study has contributed to an overview of the review processes, evaluation criteria, and classification of CSA models that have been implemented in Vietnam. Thereby, inherit and apply to the review of existing CSA models in the South Central Coast. This result is the basis for the author to continue to carry out further studies to evaluate the effectiveness of the models according to the CSA's pillars while ensuring the suitability and availability of resources. and natural, socio-economic and policy characteristics at the local level. With a no-regret approach, the application of climate-smart agriculture (CSA) models will contribute to minimizing risks if it occurs in the future.

5. References

1. Central Steering Committee on Disaster Prevention (2016), *Report on the situation of drought, salinity intrusion and response solutions.*

2. CARE International in Vietnam (2013), *Action Research on Climate-resilient Livelihoods for Land-poor and Landless people*. Avaiable at: https://careclimatechange.org/wp-content/uploads/2013/08/Action-Research-on-Climate-resilient-Livelihoods-for-Land-poor-and-Land-less-People-Vietnamese.pdf

3. CIAT (2014), *Climate-Smart Agriculture Investment Prioritization Framework*. Cali, Colombia: CIAT.

4. CIAT, IAE (2015), *Report: National Prioritization of Climate-Smart Agriculture Practices in Viet Nam*, Hanoi, Vietnam.

5. Nguyen Lap Dan (2010), Zone 08-23/06-10: *"Study on the scientific basis of drought and desertification management to build a management system and propose proposals strategic solutions and overall harm reduction: a case study for the Red River Delta and the South Central Coast*" conducted by the Institute of Geography, Vietnam Academy of Science and Technology 2008-2010, chairperson Nguyen Lap Dan.

6. Duong MT, Simelton E and Le VH (2016), *Prefer participatory climate-smart agricultural practices*. CCAFS Technical Report No. 175. Wageningen, Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Available at: www.ccafs.cgiar.org

7. Embassy of Finland, CCWG, VNGO&CC, SRD (2011), *Climate change adaptation models - Experiences of NGOs in Vietnam*, under the project "Building CC capacity for Vietnamese civil society organizations".Ijeoma, E., Rawlins, Maurice Andres, Christine Heumesser, Yuxuan Zhao, Ademola Braimoh (2015) *Developing Indicators for Climate-Smart Agriculture (CSA)*. The World Bank Group. Paper presented at the Global Science Conference on Climate Smart Agriculture 2015, Montpellie, France.

8. FAO (2010) *"Climate-Smart" Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation*. Rome: Food and Agriculture Organization (FAO).

9. FAO (2013), *Climate-smart agriculture - Sourcebook*. Page 570. Food and Agriculture Organization of the United Nations, Rome.

10. Le Van Thang (2015), *Scientific evidence for the selection and completion of community-based climate change adaptation models in the Central region and proposed replication*, Science and Technology Program for the Target Program national response to climate change, Code KHCN-CC/11-15, Institute of Natural Resources, Environment and Biotechnology - Hue University.

11. Le Trung Tuan (2009), *Research and application of scientific and technological solutions to drought prevention for sustainable agricultural development in central provinces*, 2007 - 2009 by Le Trung Tuan, Institute Water, Irrigation and Environment, Vietnam Institute of Irrigation Science is in charge.

12. Ministry of Agriculture and Rural Development (2015), *Criteria for evaluating CSA model (climate-smart agriculture) in Vietnam*, under the Project of Capacity Building for the Implementation of the National Strategy on Climate Change - the Ministry Agriculture and Rural Development (CBICS-MARD) package "Support to review and evaluate smart agricultural models adapting to climate change in Vietnam, from which to select and propose suitable models for replication" .

13. Ministry of Agriculture and Rural Development (2016), *Decision No. 819/QD-BNN-KHCN on approving the Action Plan to respond to climate change in agriculture and rural development for the period 2016-2020, with a vision to year 2050.*

14. Pham Thi Sen et al (2017), *Climate-Smart Agricultural Practices In Vietnam*. CGIAR Climate Change, Agriculture and Food Security Program (CCAFS), Wageningen, The Netherlands. Available at: www.ccafs.cgiar.org

15. Pham Quang Ha et al (2013), *Impact assessment, identification of response solutions and implementation of action plans in the fields of agriculture and fisheries*.

16. Truong Quang Hoc et al (2018), *Report on reviewing and evaluating CC adaptation models supported by social organizations and GEF-SGP*, under the Project "Strengthening the role of social organizations" National Plan on Climate Change Adaptation (NAP-CORE3)" funded by the Global Environment Facility (GEF-SGP), UNDP, Final Report.

17. Nguyen Quang Kim (2005), State-level project*: "Study and forecast drought in the South Central Coast and Central Highlands and develop prevention solutions",* code KC.08.22, done in 2003 - 2005.

18. Tran Chan Nam (2014), Research on the impact of climate change on drought in the South Central region, Master thesis.Quinney M, Bonilla-Findji O, Jarvis A. (2016), *CSA Programming and Indicator Tool: 3 Steps for increasing programming effectiveness and outcome tracking of CSA interventions.* CCAFS Tool Beta version. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

19. Truong Duc Tri (2015), *Research on drought in the South Central region in terms of climate change, estimated results and response solutions*, LATS.

20. Socialist Republic of Viet Nam (SRVN), (2004). *National Report on Disaster Reduction in Viet Nam* (For the World Conference on Disaster Reduction, Kobe-Hyogo, Japan, 18-22 January 2005), Hanoi.