FACTORS AFFECTING FARMER'S DECISION TO ADOPT CLIMATE-SMART AGRICULTURE TECHNOLOGIES AND PRACTICES IN A CLIMATE SMART VILLAGE: THE CASE OF MY LOI VILLAGE, HA TINH PROVINCE, VIETNAM

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November 2021

ABSTRACT

The study focused on the adoption of 17 CCAFS-introduced Climate Smart Agriculture Technology and Practices (CSA T & Ps) among farmers in My Loi village, Ha Tinh province, Viet Nam. Specifically, the study identified the factors influencing farmer's decision to adopt CSA T & Ps. Primary data from 215 farmers were collected through face-to-face interviews in September 2021. Results showed that 159 farmers have adopted at least one CSA T & Ps since 2014. Currently, they have adopted four CSA T & Ps, on average. Using logit regression, the factors identified to significantly and positively influence the ever adopt behavior of farmers were attendance to any training on CSA T & Ps, having a fellow farmer as source of information, growing rice, own farmer's experience as a source of information, and number of crops grown. On the other hand, the two factors that significantly and negatively influence adoption were having men in the family in the labor force and membership in farming organization. Using ordinary least squares, the factors identified to significantly and positively influence intensity or continuous adoption were attendance to any CSA T & Ps training, the agriculture extension officer as source of information, TV as a source of information, positive attitude of looking for better ways of farming, owns farmland, and number of crops grown. Significant but negatively influencing the decision to continuously adopt was having a male family member in the labor force and also ease in finding farm labor. The results highlight the importance of 1) training given for CSA T & Ps; 2). "champion farmers" that can promote new ways of farming; 3) well-informed and highly-skilled agricultural extension officer; 4) having TV at home; 5) favorable attitude of the farmer; 6) ownership of land and growing rice; and 7) number of crops grown. However, having more men family members in the labor force negatively influences adoption behavior. In the context of My Loi, this is understandable because men leave temporarily or permanently the village for work elsewhere. This suggests that farming in My Loi is a space and time for women.

ACKNOWLEDGEMENTS

This study received generous funding from the CGIAR Climate Change Agriculture and Food Security (CCAFS).

The authors would like to gratefully acknowledge the support from the CCAFS SEA, particularly from Ms. Dinh Thi Kim Dung, Dr. Sridhar Gummadi, and Mr. Eisen V. Bernard Bernardo.

To the members of the project team for their hard work and perseverance during the survey design and implementation, encoding, particularly to Mr. Nguyen Tuan Kiet (CanTho University), Mr. Pham Hong Chuong (National Economics University), and Ms.Vu Thu Trang (Vietnam Development Forum); to Jinky Hopanda (University of the Philippines Visayas Foundation, Inc.), and Benedict Mark Carmelita (University of the Philippines School of Economics) for the data collection instrument preparation and data processing.

To the staff from Farmer Association of Ha Tinh Province and the students in Economics from Ha Tinh University for their efficiency in data collection. For their generous collaboration, particularly to Mr. Le Dinh Hoa, field coordinator and the agricultural officer of Ky Son commune, the leader of the My Loi climate-smart village.

Most of all, special thanks to the households at the research sites for their great cooperation and support during the field survey as well as for their information shared to this study.

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1.0 INTRODUCTION

1.1 Background

Vietnam is a rich agricultural region and one of the largest rice-exporting countries in the world. Close to 40% of its total land area of 33.121 million hectares is agricultural land. Agriculture contributes 24% to the gross domestic product (GDP), 20% to total exports, and over 70% to total employment (Maitah et al 2020). With the agricultural sector as one of the strong pillars of Vietnam's economy, rice contributes 30% of the country's total agricultural production value.

Vietnam's agriculture sector, however, is challenged by climate change and natural disasters. Vietnam faces higher temperatures, an increased frequency of storms, sea level rise, salinity, and other effects of climate changes. An earlier study of Yu (2010:v) concluded that climate change will 'severely compromise' rice production. An earlier estimate using an integrated or multi-sector modelingby Arndt et al (2015) of the economic cost of climate change in Vietnam showed that by 2050 the negative impacts on agriculture and roads will be modest but the annual GDP growth rate will decline between 1% to 2% due to climate change. Carefully selected pre-emptive actions will bring positive results.

In 2013, the CGIAR Research Program on Climate Change Agriculture and Food Security in Southeast Asia (CCAFS SEA) was launched with base office in Vietnam to help the government and smallholder farmers cope with the impacts of climate change in agriculture. In 2015, three CSVs were implemented by CCAFS SEA in Vietnam: Ma CSV in Yen Bai Province (North), My Loi CSV in Ha Thinh Province (central), and Tra Hat CSV in Bac Lieu Province (South). A CSV is an R4D approach using participatory action research where different stakeholders are engaged in identifying and addressing the technological priorities and related concerns of farmers.

The CSVs have served as a multi-sectoral platform for testing the technological and institutional options for climate change adaptation and mitigation in agriculture (Campbell et al 2016). The CSVs in Vietnam have also served as the convergence points of different interventions that are implemented by CCAFS-funded projects, other CGIAR research programs, and other development projects that operate in the villages. The aim is to generate practical, appropriate and location specific adaptation and

mitigation strategies to improve food security, nutrition and climate resilience (Pramod et al 2018).

CCAFS SEA has been actively working to generate evidence and support for the adoption of climate-smart agriculture (CSA) policies, practices, and services that will help in alleviating poverty, increasing gender equity, and supporting sustainable landscapes. With the goal of making smallholder farmers' productive and resilient to climate change impacts, CCAFS SEA has promoted CSA to offer a wide array of options of technologies and practices that can be applied at the farm level implementation of these CSA practices was a long process that started with baseline surveys, CSA prioritization workshops, skills training, among other activities. One important intermediate outcome is the adoption of a number of CSA technologies and practices by farmers in CSVs as a result of their enhanced knowledge and favorable attitude (Ferrer and Bernardo 2020).

From the 2017 inventory (Bonilla-Findji& Bui Tan 2018), it was clear that there was a low response in the adoption of CSAs. For example, 17 different CSA technologies and practices (T & Ps) were tested and evaluated in My Loi CSV with 213 households but the highest number of adopters for one CSA practice was only 26 households. In Tra Hat CSV with 248 households, there were 4 tested and evaluated and 1 tested CSA practice but the highest number of adopters for one CSV was only 48. Similarly, in Ma CSV with 192 households, the highest number of adopters of a CSV was 80 households. The low response to the adoption of CSA among small-scale farmers raises questions as to the factors influencing its adoption in the small-scale farming system.

This study fills the gap by identifying the factors that influence the farmer's decision to adopt CCAFS-introduced CSA T & Ps in My Loi CSV at any one time using binary logit regression model (for the early uptake) and then ordinary least squares for the (continuance of adoption or intensity of adoption). Primary data collected from the farmers were collected through face-to-face interviews in September 2021.

1.2 Objective

The objective of this study is two-fold. One is to identify the factors affecting the decision of farmers to adopt CSA practices at any one time since CCAFS introduced CSA T & Ps in MyLoi CSV as an adaptive strategy to climate change.Second is to

identify the factors that influence the continuance of adoption or the intensity of adoption. The latter will look at the factors affecting the farmer's decision to continue or discontinue the use of the CSAT & Ps and the number of CSAT & Ps currently adopted after five years since the My Loi CSV was established. This is linked to the need of exploring farmers' choices in a longer perspective, considering that climate change adaptation is a long-term process which requires not only that farmers adopt CSA T & Ps but also that they do not discard them in the short-to-medium run.

1.3 Significance

The study will inform about the adoption behavior of climate smart agriculture (CSA) practices by the farmers. This is important input in making sure of the sustainability of agricultural growth in Vietnam amidst climate change. Specifically, this study will analyze the factors that influence the adoption of CSAT & Ps as well as the intensity or continuance of adoption. The identification of relevant drivers of adoption and continuation can be then be operationalized in some policy recommendations. The information can guide policymakers in developing plans and programs for disseminating appropriate CSAs and mitigate the detrimental impacts of climate change on the agricultural sector.

1.4 Scope

The study covers the farmers in My Loi village, the CCAFS-introduced CSA T & Ps, and the behavior of farmers on the adoption and the continuance of adoption of the CCAFS CSA T & Ps. Data was collected in September 2021.

2.0 STUDY AREA: MY LOI CLIMATE SMART VILLAGE

My Loi village is located in the uplands of Ky Son commune, Ky Anh district, Ha Tinh province in the north central coast of Viet Nam (Figure 1). There were 213 households in the village in 2017, each with 3 to 4 members.

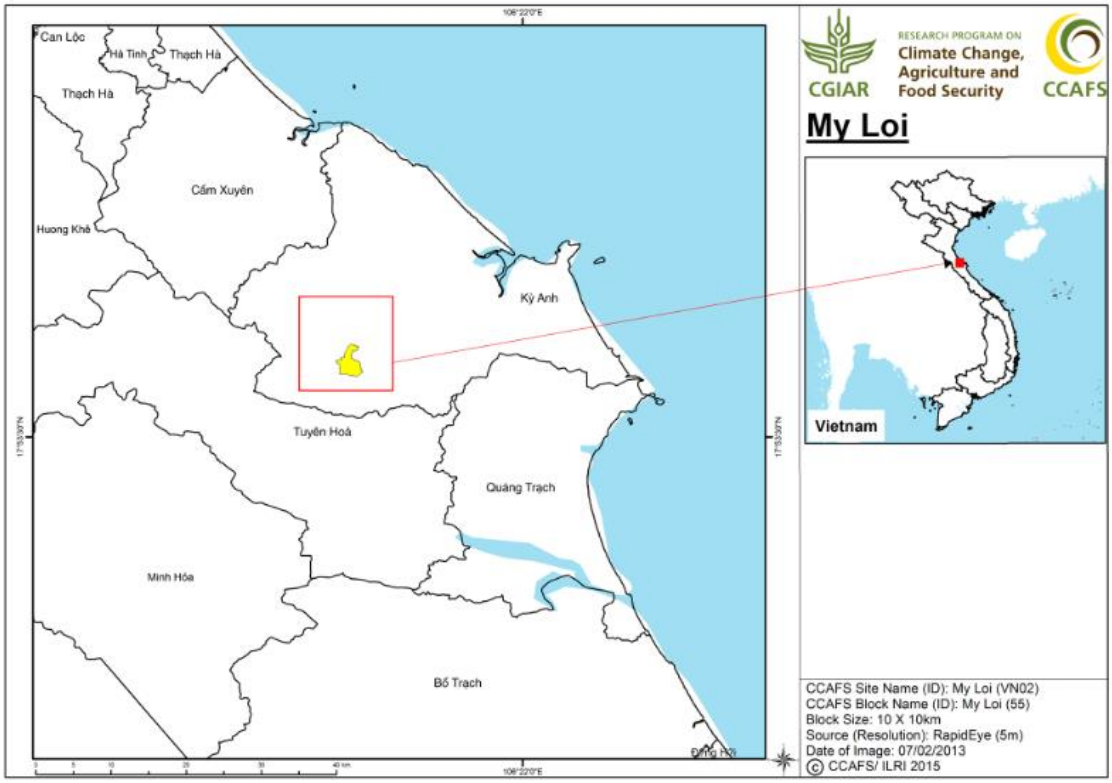

Figure 1. Location of My Loi village and Ha Tinh Province in the map of Vietnam

The village is primarily dependent on cassava, peanut, and acacia cultivation. It has a total land area of about 195 ha, in which 140 ha forestland (acacia and eucalyptus covering about 80 ha). About 40 ha of the forestland are used for cassava. The village has about 55 ha farmland used for annual crops such as peanut (30ha), paddy rice (8.5 to 9.5ha), maize, green bean, and sweet potato. About 90% of the households have a few animals for household consumption.

My Loi has faced a range of extreme weather events that may happen in one year – from cold spells to hot spells; droughts to floods; and from dry Foehn winds and tornado to tropical storm and typhoons. During floods, polluted water often sweeps over fields or end up in wells.

In 2014, it was chosen as a site for climate-smart village because of its exposure to multiple extreme weather events (temperature and water stress, storm and typhoon) and potential for climate-smart solutions. In 2015, the CSV implementation led by ICRAF started with key components including climate-smart agriculture, agro-climate information service, farmers' knowledge, and local policies. In 2016, CSA options were mainly introduced in My Loi village such as improved cook stove, organic fertilizer, and biochar, which leads to improve soil fertility (CCAFS 2016).

In 2017 inventory of CSA T & Ps in My Loi CSV, there were 17 different CSA practices introduced by CCAFS that were tested and evaluated (Bonilla-Findji & Bui 2018). These included improved cook stove, organic fertilizer, biochar, agroforestry) but also existing practices with technical improvement (i.e., intercropping, rotation, alley cropping). Moreover, it was found that orange-based agroforestry system, black pepper home garden, acacia-based agroforestry system, and vermiculture were prioritized in My Loi village to diversify household's income and improve soil fertility (Simelton et al. 2017).

Table 2.1. CSA Portfolio in My Loi CSV and the Households Involved, 2017

	CSA Practices	Number of households (N=213)
1	Alley cropping (non N-fixing trees)	7
2	Biochar	3
3	Biogas	8
4	Compost	2
5	Crop type change	2
6	Diet management	1
7	Drip irrigation	1
8	Improved cook stove	16
9	Improved sty/cage	1
10	Intercropping (nonlegume/non-legume)	26
11	Manure treatment	3
12	Mulching	2
13	Multistrata Agroforestry	2
14	Parklands	1
15	Rotation (mixed legume/non-legume)	2
16	Rotations (more complex)	25
17	Silvopasture	1

Constructed from data available in Bonilla-Findji O and Bui Tan Y. 2018. Southeast Asia Climate-Smart Villages AR4D sites: 2017 Inventory. Wageningen, The Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

3.0 FRAMEWORK

3.1 Theory

The discipline of Economics assumes that economic agents, when making decisions, are rational and maximizes self-interest. However, Simon (1972) has challenged the classical economic thinking, including the assumptions of rationality and maximization with his Theory of Bounded Rationality. His theory is based on the idea that decision-making is about 'satisficing' rather than about "optimizing. He argues that people are limited by their "cognition" and, thus, make decisions using information to produce a satisfactory result, rather than use of all available information needed to make fully rational decisions.

Following, the Theory of Bounded Rationality, then farmers facing the decision of whether to adopt or not a CSA T & Ps is affected by the information gained as well as the person's cognitive level and attitude about CSAs. Based on Roger's (1962) Diffusion of Innovation (DOI) Theory, the 5-stages by which a farmer adopts CSAT & P are: the farmer becomes aware of the CSA T & P, forms an attitude about CSA T & P, decided to adopt (or reject) the CSA T & P, initiate use of the CSA T & P to test it, and continue use of the CSA T & P. The farmer becomes aware of the CSA T & Ps (access to CSA T & P) both formally (through trainings or seminars, or technical support from agricultural technicians) and informally (through fellow farmers or from the mass media). The farmer's cognitive level is affected by personal and household's characteristics. The decision of the farmer to adopt depends on a range of background factors, including farmer's socio-economic and attitudinal/motivational factors, the farm and farming structure and management factors, the institutional factors, and the social factors.

3.2 Empirical Strategy

To assess the drivers of adoption and continuation of the practices, a two-fold empirical strategy was adopted. First, it considered the drivers of early adoption using a binary logit choice model. The dependent variable is 1 if at any one time, the farmer has adopted any one of the CCAFS-introduced CSA T & Ps. Second, the significant drivers underlying the continuation of the adoption of the CCAFS-introduced CSA T

& P was identified. The continued adoption behavior was treated as a function of farmer's factors, farm factors, and social factors.

3.3 Empirical model

The empirical analysis was performed in two steps. First, this study focused on investigating the factors affecting the decision of farmers to adopt CCAFS-introduced CSA T & Ps. The second stage of the analysis focused on the intensity of adoption or continuance of adoption. From the theories and literature, the factors influencing farmer's adoption behavior could include personal characteristics, family characteristics, farm/ing information, institutional, and social factors. The following are the empirical models used in the study.

Empirical Model 1

There are only two choices—to use or not use—in most farmers' technology adoption decisions. The farmers were asked whether they had used any CCAFS-introduced CSA T & P or not. The answer corresponds to the different situation and attributes of each farmer participating in the study. The dependent variable of the CSA adoption function is a discrete variable. As such, a binary discrete choice model was chosen andestimated using the binary logit choice model, which is popular in technology adoption research. Therefore, each farmer's decision regarding adoption of any CCAFS-introduced CSA T & P was represented by a dummy variable (D_i):1if a farmer has adopted any CCAFS-introduced CSA T & P, 0 if a farmer has not adopted.

$$D_i = \begin{cases} 1 \text{ if the farmer adopts any CCAFS-introduced CSA} \\ 0 \text{ if the farmer does not adopt any CCAFS-introduced CSA} \end{cases} \quad (1)$$

To quantify the factors influencing farmer decisions on whether to adopt any CCAFS-introduced CSA, the following binary model was constructed based on theories and practices:

$$\ln\left(\frac{p_i}{1-p_i}\right) = \alpha + \sum_{n=1}^{n} \beta_n x_{ni} \quad (2)$$

where dependent variable p_i stands for the probability of CSA adoption, α stands for the intercept parameter, β stands for the vector of regression coefficients, and x_{ni} stands for a vector of *ni* independent variables (see Table 3.1).

Empirical Model 2

The intensity of the adoption also referred to as the continuance of adoption, was measured in terms of the number of CSA T & Ps currently used. The dependent variable of the CSA continuance of adoption (DC_i) was a count variable, so the ordinary least squares (OLS) method was used. The corresponding OLS regression equation is specified as follows.

$$DC_i = \alpha + \sum_{n=1}^{n} \beta_n x_{ni}$$

where dependent variable DC_i stands for the farmer's number of CSA T & Ps currently adopted, α stands for the intercept parameter, β stands for the vector of regression coefficients, and x_{ni} stands for a vector of *ni* independent variables (see Table 3.1).

Table 3. 1. Definition of variables in the research models

	Description
Dependent variables	
Adopt CCAFS CSA at any one time since 2014	• 1 if farmer is an adopter of any CCAFs CSA at any one time since 2014; 0 non-adopter
Continue using/intensity of adoption of CCAFS CSA	• Number of CCAFS CSA technology and practices adopted and continued to use
Independent variables	
Farmer's level	
Sex	• 1 if farmer is a man; 0 if a women
Age	• Age in years of the farmer as of last birthday
Number of formal education in years	• Number of years in formal school
Farming experience in years	• Number of years as a farmer
Rice farmer	• 1 if the farmer is growing rice; 0 otherwise
Looking for better farming techniques	• 1 if the farmer indicated that he or she is always looking for better farming techniques
Has attended a CSA T & P training	• 1 if farmer had attended training on any CCAFS CSA T and P; 0 otherwise
Experience as source of information	• 1 if farmer's experience is a source of information by farmers; 0 otherwise
Tv as source of information	• 1 if TV is a source of information by farmers; 0 otherwise
Village information center as source of information	• 1 if village information center is a source of information by farmers; 0 otherwise

Fellow farmer as source of information	• 1 if fellow farmer is a source of information by farmers; 0 otherwise
Agricultural extension officer as source of information	• 1 if the agricultural extension officer is a source of information by farmers; 0 otherwise
Internet as source of information	• 1 if internet is a source of information by the by farmers; 0 otherwise
Perceived drought is more frequent now	• 1 if the farmer perceived that drought has increased its frequency since 2014; 0 otherwise
Perceived flooding is more frequent now	• 1 if the farmer perceived that flooding has increased its frequency since 2014; 0 otherwise
Farmer's family level	
Men in labor force	• Number of men family member in the labor force
Women in labor force	• Number of women family member in the labor force
Share of farming income to household income	• Percentage share of annual farming income to total annual household income
Farm/ing level	
Farmland size	• Farm land area in hectares
Farm land is owned	• 1 if the farmland is owned by family; 0 otherwise
Have both family and hired labor	• 1 if the farm labor is composed of family and hired labor; 0 otherwise
Ease in finding labor	• Score in a scale of 1 to 10 where 1 is most difficult and 10 is easy to find farm labor
Raise farm animals	• 1 if the farmer is raising farm animals; 0 otherwise
Number of crops	• Number of crops grown in the farmlands
Institutional	
Credit access	• 1 if the farmer was able to avail of credit for the past 10 (2011 – 2021) years; 0 otherwise
Social	
Membership in farmer organization	• 1 if the famer is a member of a community-based farmer organization ; 0 otherwise

4.0 METHODOLOGY

4.1 Study Participants

The study participants were 215 farming households in My Loi CSV in Ha Tinh province. As of August 2021, My Loi had 230 households. During the time of data collection, 15 households were on quarantine and were not included in the survey.

Women accounted for 73% among the study participants. Most of the men were not at home because the data collection period coincided with the off season in rice farming activities. During this period, the men usually temporarily leave the community to find temporary jobs elsewhere, leaving their wives to take care of the farm. The farmers in My Loi CSV practice two rice cropping system --- Summer-Autumn and Winter-Spring. Normally, the Winter-Spring crop season is from late December to May and the Summer-Autumn rice season is from June to September. During the survey period, the harvesting period for the Summer-Autumn season was over. The interview with local officers in Ha Tinh province corroborated this point. The average ratio of women to men employed in agriculture in Ha Tinh is about 65-35%, and in some places it canreach75-25%.

4.2 Data collection method and instrument

Mixed data collection methods were employed, which included key informant interviews with CSA experts from ICRAFT, local government agencies and farmers in My Loi, and direct interview with all farming households in My Loi CSV.

Key experts on CSA from ICRAF included the project manager and principal researcher with a broad overview of CSA project in My Loi CSV were consulted on the selection of key informants at the local level. Selection was based on involvement in agriculture, climate change, rural development, and CSA. The local key informants selected included a representative of a farmer union of Ha Tinh Province, a representative of the woman union of Ha Tinh Province, and the agricultural officer of Ky Son commune.

Focus group discussions (FGDs) were conducted with local communities led by project coordinator. All the meetings/interviews were conducted before the survey took placeto collect information to design and finalize the questionnaire format.

4.2.1 Pilot testing

The interview schedule used was pilot tested with five households in My Loi CSV to ensure that the questions and scenarios were highly understood by the study participants. The issues that were examined in the course of the pilot testing were: (i) whether there were any lack of clarity or misunderstandings of the questions; (ii) whether the options to question were appropriate; (iii) probability of a large number of unanswered questions; and (iv) whether the range of quantitative questions were appropriate. In general, the pilot test participants did not find difficulty in answering the interview schedule. Revisions were made to address the concerns raised during the pilot testing before the final implementation of the survey.

4.2.2 Survey Implementation

Face-to-face interviews were conducted by trained field enumerators with the farmers. These enumerators were students from Ha Tinh University with strong background on economics and experience in doing survey. A two-day online training was provided to the enumerators focusing on familiarization with the interview schedule, how to approach the farmers, and how to conduct the interviews to ensure reliable answers.

The survey was conducted from 16 to 24 September in My Loi CSV. Most of the interviews took place in the evening (16:00 to 20:00) to ensure the presence of key household members at the time of the survey. The survey team was accompanied by the leader of the My Loi village or commune agricultural staff where the survey was taking place to facilitate access to the households. However, the interviews were conducted without their presence for the purpose of eliminating possible bias due to the presence of a third party. Most interviews took 45 to 60 minutes to complete.

4.3 Statistical analysis

Descriptive statistics, binary logit regression, ordinary least squares method were employed for the analysis.

5.0 RESULTS

5.1 Characteristics of the Study Participants

5.1.1 Profile of the Study Participants

Out of the 215 farmers in My Loi CSV who participated in the study, 74% have adopted at any one time any T & P introduced by CCAFS since 2014. They were dominated by women (73%), with the men comprising only 22% (Table 5.1). The women-non-adopters were higher in proportion than the women- adopters (80% vs. 70%). Almost all were married (88%). On average, they were in their late40s but the non-adopters were younger (41 years old) than the adopters (50 years old). This result points to technology adoption as more attractive to older than younger farmers.

Table 5.1 Profile of the farmers in MyLoi CSV who participated in the study

	Adopter n=159		Non-adopter n=56		All N=215	
	No.	%	No.	%	No.	%
Sex						
male	48	30.19	11	19.64	59	27.44
female	111	69.81	45	80.36	156	72.56
Age						
mean	49.62		41.13		47.41	
24 below	2	1.26	0	0.00	2	0.93
25 to 35	27	16.98	26	46.43	53	24.65
36 to 45	31	19.50	14	25.00	45	20.93
46 to 55	39	24.53	5	8.93	44	20.47
56 to 60	27	16.98	4	7.14	31	14.42
Beyond 60	33	20.75	7	12.50	40	18.60
Civil status						
married	141	88.68	48	85.71	189	87.91
single	4	2.52	0	0.00	4	1.86
widow/er	12	7.55	8	14.29	20	9.30
separated	1	0.63	0	0.00	1	0.47
others	1	0.63	0	0.00	1	0.47
Educational attainment						
No. of years in school (mean)	8.04		9.41		8.40	
No schooling			1	1.79	1	0.47
primary school	15	9.43	4	7.14	19	8.84
Junior high school	117	73.58	29	51.79	146	67.91
Senior high school	14	8.81	14	25.00	28	13.02
High school	2	1.26	0	0.00	2	0.93
University/college/vocational	11	6.92	8	14.29	19	8.84

The study participants finished, on average, eight years of formal education in school, with the non-adopters staying a little longer in school (9.41 years vs. 8.04 years).

More than the majority (59%) reached or finished, at the minimum, junior high school education.

5.1.2 Farming Experience

Years in farming varied widely among the study participants (Table 5.2). The age when they started farming ranged between the young age of 10 years old and as late as 42 years old, or a mean age of 16 years old. Those who started young were apprentice of their parents who were also farmers.

Table 5.2 Farming experience of My Loi CSV farmers

	Adopter n=159		Non-adopter n=56		All N=215	
	No.	%	No.	%	No.	%
Age start farming activities (mean)	15.77		16.39		15.93	
Had stopped farming	49	30.82	22	39.29	71	33.02
Number of years stopped farming (mean)	5.87		4.01		5.29	
For another job	24	48.98	10	45.45	34	47.89
Pure rice farmer	4	2.52	3	5.36	7	3.26
In the past five years, attended any training on farming or farm demonstrations on climate smart agriculture	105	66.04	12	21.43	117	54.42

Three in every 10 farmers had stopped farming for about four years. Most of them who temporarily stopped farming found another work (48%). They eventually returned to farming, which reflects the importance of farming as a livelihood to them.

There were few who were pure rice farmers, most were into other cash crops. Half had attended any training on farming or farm demonstrations on climate smart agriculture. The proportion of adopter farmers who had training was three times higher than the non-adopter farmers (66% vs. 21%).

5.1.3 Membership in Community Organizations

Overall, 89% of the farmers were members of a community organization. By type of farmer-adopter, there were proportionately higher adopters (89%) than non-adopters (88%) who were members of community organization.

Among all farmers, 71% were members of a farming organization. Among them, they reported that through the organization they were able to avail of information, agricultural inputs, loans technical support, and camaraderie. Membership in a community organization can facilitate the fast exchange of information (e.g., climate, agricultural materials supply, technical training, market, financial assistance, etc) and also social support.

Table 5.3 Membership in organizations of My Loi farmers

	Adopter n=159		Non-adopter n=56		All N=215	
	No.	%	No.	%	No.	%
Member of a community-based organization	142	89.31	49	87.50	191	88.84
Member of farming organization	111	69.81	41	73.21	152	70.70
Number of years as member	12.39		8.48		11.34	
Organization provides Information support/learning and sharing	111	100.00	41	100.00	152	100.00
Provides agricultural inputs	107	96.40	37	90.24	144	94.74
Provide loans	81	72.97	24	58.54	105	69.08
Provide technical support	100	90.09	33	80.49	133	87.50
Provides camaraderie	101	90.99	39	95.12	140	92.11

5.1.4 Sources of Information

The farmers had a number of sources of information for different types of information needs. The TV was the common source of information for the daily forecast (68%) but it was the village information center (64%), farmer's experience (60%), and the TV (57%) that more than the majority relied on for seasonal forecast (Table 5.4). This means that the TV and the village information center remain as good vehicle to disseminate weather information.

Table 5.4 Sources of Information of My Loi CSV farmers for weather forecast information

	Adopter n=159		Non-adopter n=56		All N=215	
	No.	%	No.	%	No.	%
Daily weather forecast						
TV	113	71.07	34	60.71	147	68.37
Experience	75	47.17	17	30.36	92	42.79

Village information center	64	40.25	24	42.86	88	40.93
Internet/mobile phone/computer	38	23.90	27	48.21	65	30.23
Fellow farmer	42	26.42	10	17.86	52	24.19
Government technician	36	22.64	15	26.79	51	23.72
Radio	10	6.29	5	8.93	15	6.98
Books, written materials	9	5.66	3	5.36	12	5.58
Others	2	1.26	0	0.00	2	0.93
Seasonal forecast						
Village information center	105	66.04	33	58.93	138	64.19
Experience	101	63.52	29	51.79	130	60.47
TV	92	57.86	31	55.36	123	57.21
Fellow farmer	76	47.80	19	33.93	95	44.19
Government technician	74	46.54	19	33.93	93	43.26
Internet/mobile phone/computer	23	14.47	23	41.07	46	21.40
Radio	18	11.32	7	12.50	25	11.63
Books, written materials	6	3.77	3	5.36	9	4.19
Others	2	1.26	0	0.00	2	0.93

Meanwhile, the government agricultural technician and the village, information center were relied upon on by the majority of the farmers for information on production inputs (Table 5.5): variety (78% and 56%, respectively), fertilizer (58% and 54%, respectively), and pesticide (64% and 54%, respectively). The results indicate the confidence the farmers have on the government agricultural technician in the area and the importance of the skills and knowledge they possess, and their willingness to share these with the farmers.

Table 5.5 Sources of Information of My Loi CSV farmers for technical advisories

	Adopter n=159		Non-adopter n=56		All N=215	
	No.	%	No.	%	No.	%
Agro advisories on: varieties						
Government technician	132	83.02	36	64.29	168	78.14
Village information center	84	52.83	37	66.07	121	56.28
Fellow farmer	79	49.69	22	39.29	101	46.98
Experience	70	44.03	25	44.64	95	44.19
TV	27	48.21	50	31.45	77	35.81
Internet/mobile phone/computer	16	10.06	17	30.36	33	15. 35
Books, written materials	10	6.29	3	5.36	13	6.05
Radio	3	1.89	4	7.14	7	3.26
Others	1	0.63			1	0.47
Fertilizer						
Government technician	100	62.89	25	44.64	125	58.14
Village information center	87	54.72	30	53.57	117	54.42
Fellow farmer	90	56.60	25	44.64	115	53.49
Experience	79	49.69	21	37.50	100	46.51
TV	48	30.19	25	44.64	73	33.95
Internet/mobile phone/computer	17	10.69	11	19.64	28	13.02
Books, written materials	17	10.69	10	17.86	27	12.56

Radio	6	3.77	2	3.57	8	3.72
Others	2	1.26	0	0.00	2	0.93
Pesticide						
Government technician	112	70.44	25	44.64	137	63.72
Village information center	86	54.09	31	55.36	117	54.42
Experience	74	46.54	16	28.57	90	41.86
Fellow farmer	66	41.51	21	37.50	87	40.47
TV	41	25.79	25	44.64	66	30.70
Internet/mobile phone/computer	23	14.47	13	23.21	36	16.74
Books, written materials	17	10.69	10	17.86	27	12.56
Radio	1	0.63	1	1.79	2	0.93
Others	1	0.63	0	0.00	1	0.47

Moreover, the majority of the farmers relied still on the government agricultural technician and their own experience for soil management (52% and 51%, respectively) and livestock management (61% and 56%, respectively). There was no common source of information on water management with one-third of the farmer relying on the government agricultural technician (34%), and the Village information center (34%).

Table 5.6 Sources of Information of My Loi CSV farmers for farming management

	Adopter n=159		Non-adopter n=56		All N=215	
	No.	%	No.	%	No.	%
Soil Management						
Government technician	91	57.23	21	37.50	112	52.09
Experience	99	62.26	11	19.64	110	51.16
Village information center	70	44.03	23	41.07	93	43.26
Fellow farmer	61	38.36	17	30.36	78	36.28
TV	31	19.50	15	26.79	46	21.40
Internet/mobile phone/computer	14	8.81	11	19.64	25	11.63
Radio	4	2.52	1	1.79	5	2.33
Books, written materials	7	4.40	3	5.36	10	4.65
Others	1	0.63	0	0.00	1	0.47
Livestock management						
Government technician	106	66.67	26	46.43	132	61.40
Experience	108	67.92	12	21.43	120	55.81
Village information center	74	46.54	27	48.21	101	46.98
Fellow farmer	72	45.28	15	26.79	87	40.47
TV	44	27.67	14	25.00	58	26.98
Internet/mobile phone/computer	15	9.43	11	19.64	26	12.09
Books, written materials	15	9.43	2	3.57	17	7.91
Radio	5	3.14	1	1.79	6	2.79
Others	1	0.63			1	0.47
Water/irrigation management						
Government technician	60	37.74	14	25.00	74	34.42
Village information center	59	37.11	13	23.21	72	33.49
Experience	55	34.59	1	1.79	56	26.05
Fellow farmer	46	28.93	3	5.36	49	22.79
Internet/mobile phone/computer	7	4.40	6	10.71	13	6.05
TV	9	5.66	0	0.00	9	4.19

Radio	4	2.52	0	0.00	4	1.86
Books, written materials	4	2.52	0	0.00	4	1.86

The fellow farmer was the main source of information for the price of farm produce (65%) (Table 5.7). Farmer's experience was also relied upon on by one-third of the farmers (35%).

Table 5.7 Sources of Information of My Loi CSV farmers for market price of farm produce

	Adopter n=159		Non-adopter n=56		All N=215	
	No.	%	No.	%	No.	%
Fellow farmer	114	71.70	26	46.43	140	65.12
Experience	62	38.99	13	23.21	75	34.88
TV	39	24.53	13	23.21	52	24.19
Village information center	30	18.87	17	30.36	47	21.86
Government technician	33	20.75	12	21.43	45	20.93
Internet/mobile phone/computer	16	10.06	8	14.29	24	11.16
Radio	4	2.52	1	1.79	5	2.33
Books, written materials	5	3.14	2	3.57	7	3.26
Others	1	0.63	0	0.00	1	0.47

When the sources of information were ranked for every type of information in terms of the number of farmers seeking information, the first common sources of information were government agriculture technician/extension officer, the village information centre, own experience, fellow farmer, and the TV (Table 5.8). Radio, the internet, and written materials were the least common sources of information.

Table 5.8. Rank of farmers sources of information by type of information needed*

source of information	Type of information: Daily forecast	Seasonal forecast	Agro advisories on: varieties	Fertilizer	Pesticide	Soil Management	Livestock management	Water/irrigation management	Price of the farm produce	TOTAL SCORE	RANK**
Agriculture technician/extension officer	6	5	1	1	1	1	1	1	5	22	1
Village information center	3	1	2	3	2	3	3	2	4	23	2
Experience	2	2	4	4	3	2	2	3	2	24	3
Fellow farmer	5	4	3	2	4	4	4	4	1	31	4
TV	1	3	5	5	5	5	5	6	3	38	5
Internet/mobile phone/computer	4	6	6	6	6	6	6	5	6	51	6
Radio	7	7	8	8	8	7	8	7	7	67	7
Books, written materials	8	8	7	7	7	8	7	8	8	68	8
Others	9	9	9	9	9	9	9	9	9	81	9

*rank was determined by the number of farmers who identified a particular source of information for a particular type of information.
** Overall rank was determined by summing up the rank scores of each source of information.

Government technician was the most common source of information for agro advisories on varieties, fertilizer, pesticide, soil management, livestock management, and water/irrigation management. However, it ranked low as a source of information for daily forecast, seasonal forecast and price of farm products. Village information was the most common source of information for seasonal forecast. Farmer's experience did not come out as most common source for any information but was mostly rank second or third. Fellow farmer was the most common source of information for the prices of farm products, while TV was the most common source of information for daily forecast.

The results indicate that farmers preferred closer and personal sources of information like the government technician, fellow farmers, and the village information center. Also this implies the importance of hiring skilled technicians who assists the farmers for their information and technical needs. This also indicate that the use of ICT tool such as mobile smart phones still has a long way to go as a source of farming related information or in influencing the behaviour of famers.

5.1.5 Experience with Manifestations of Climate Change

Almost all farmers reported to have experienced flashfloods/flooding (97%), drought (96%), tropical storm (95%), hot spell (88%), and cold spell and rain (87%) (Table 5.9). By type of farmer, the proportion of the adopter farmers who reported to have experienced these manifestations of climate changes was higher compared to the non-adopter farmers. In terms of rank on the extent of damage to farming brought by these events, drought (2.22) was on top of the list of the farmers, followed by tropical storm (2.32), and flashflood/flooding (2.84). By type of farmer, the ranking of the adopter farmers was the same for all farmers, but for the non-adopter farmer, the most damaging event for them was tropical storm (1.92) and drought (2.35).

Table 5.9. Experience with manifestations of climate change in the past 10 years by My Loi farmers

	Adopter n=159		Non-adopter n=56		ALL N=215	
	No.	%	No.	%	No.	%
Experienced in the past 10 years						
Flashfloods/Flooding	158	99.37	51	91.07	209	97.21
Drought	155	97.48	51	91.07	206	95.81
Tropical storm	153	96.23	51	91.07	204	94.88
Hot spell	142	89.31	47	83.93	189	87.91
Cold spell and rain	140	88.05	47	83.93	187	86.98
Rank in terms of extent of damage to farming						
Drought	2.27		2.35		2.29	
Tropical storm	2.45		1.92		2.32	
Flashfloods/Flooding	2.88		2.71		2.84	
Hot spell	3.13		3.45		3.21	
Cold spell and rain	3.94		4.15		3.99	

Since 2014, rainfall was perceived have been more or heavy (56%), heat period was longer (86%), drought was more frequent (77%), and the flashfloods or flooding were more frequent (61%) (Table 5.10). There was less consensus if there is delay (37%) or advance (49%) in the coming of the rainy season. Overall, climate change was perceived by the participants to have negative impacts on their farming (97%), with the proportion higher for the adopter farmers than the non-adopter farmers (97% vs. 95%).

Table 5.10 Perception of manifestations of climate change in the past 10 years by My Loi farmers

	Adopter n=159		Non-adopter n=56		ALL N=215	
	No.	%	No.	%	No.	%
Perception of rainfall since 2014 to now						
Less rainfall	34	21.38	9	16.07	43	20.00
More/heavy rainfall	85	53.46	35	62.50	120	55.81
Worst distribution rainfall	36	22.64	10	17.86	46	21.40
No change	4	2.52	2	3.57	6	2.79
Perception of the heat period since 2014 to now						
Shorter heat period	17	10.69	2	3.57	19	8.84
Longer heat period	133	83.65	51	91.07	184	85.58
No change	9	5.66	3	5.36	12	5.58
Perception of the drought since 2014 to now						
Less frequent	16	10.06	6	10.71	22	10.23
More frequent drought	123	77.36	43	76.79	166	77.21
No change	20	12.58	7	12.50	27	12.56
Perception of the flood since 2014 to now						
Less frequent	34	21.38	6	10.71	40	18.60
More frequent floods	96	60.38	36	64.29	132	61.40
No change	29	18.24	14	25.00	43	20.00
Perception of the start of rainy season since 2014 to now						
Delay in the start of the rainy season	66	41.51	13	23.21	79	36.74
Rainy season comes earlier	73	45.91	32	57.14	105	48.84
No change	20	12.58	11	19.64	31	14.42
Climate change is perceived to have adverse impact on farming	155	97.48	53	94.64	208	96.74

5.1.6 Attitudes towards New Technology

Most of the farmers were looking for a better ways of farming (88%) (Table 5.11). This was truer among adopters farmers (93%) than the non-adopter famers (75%). The farmers indicated varied response when presented with a new farming technology: adopt immediately (41%), adopt when good results appear (44%), or adopt when all others have adopted (15%). Half of the adopter famers would adopt new technology right away, while only 14% of the non-adopter farmers would do so. Moreover, 59% of the non-adopter farmer would wait for good results to appear or wait for others to have adopted before adopting the new technology. These results show that although the farmers in My Loi were open to new farming technologies, theadopter farmers were more open to technology adoption that the non-adopter farmers.

Table 5.11 Attitudes towards new technology by My Loi farmers

	Adopter n=159		Non-adopter n=56		All N=215	
	No.	%	No.	No.	%	No.
Looking for better ways of farming	148	93.08	42	75.00	190	88.37
Response when become aware of new technology						
adopt immediately	80	50.31	8	14.29	88	40.93
adopt when good results appear	62	38.99	33	58.93	95	44.19
adopt when all others have adopted	17	10.69	15	26.79	32	14.88
Looking for better ways of farming to increase						
increase productivity	144	90.57	37	66.07	181	84.19
increase income	148	93.08	40	71.43	188	87.44
reduce losses	132	83.02	37	66.07	169	78.60
reduce gas emissions	111	69.81	31	55.36	142	66.05
Rank of goals in terms of priority of the farmers						
increase income	1.95		1.70		1.90	
increase productivity	1.97		1.73		1.92	
reduce losses	2.60		2.76		2.63	
reduce gas emissions	3.23		3.65		3.32	

In general, the farmers were looking for new ways of farming to increase productivity (84%) and income (87%), and to reduce losses (79%) and gas emissions (66%), among others. These were truer among the adopter farmers than the non-adopter farmers who had higher proportion seeking new technology that increase productivity (91 % vs. 66%) and income (93% v. 71%), and reduce losses (83% vs. 66%) and reduce gas emissions (70% vs. 55%), among others. The results indicate that primary to the farmers is to improve economic welfare than to protect the environment.

5.2 Characteristics of the Household

5.2.1 Basic Household Information

The households of the study participants had, on average, four members, with the household of the non-adopter farmers bigger compared to the household of the adopters (4.23 vs. 3.80) (Table 5.12). Conversely, 62% of the households had at least four members, with a higher proportion among households of non-adopter farmers than among the households of adopter farmers (77% vs. 57%).

Households with male member or female member in the labor force were 86% and 84%, respectively of the total number of households in My Loi. Households of adopter farmers had lower proportion but had more male (84% vs. 91%; 1.52 vs 1.43)

and female (81% vs. 93%; 1.5 vs. 1.15) in the labor force than non-adopter farmers. On the other hand, 62% of the households had dependents. The non-adopter farmers had higher proportion (82% vs. 55%) and number (2.3 vs. 1.9) of dependents compared to adopter farmers. As shown, the household size and composition of the adopter and non-adopter famers are different.

Table 5.12 Household information of My Loi farmers

	Adopter n=159	Non-adopter n=56	All N=215
Household size			
Mean	3.80	4.23	3.91
At least 4 members (%)	57.23	76.79	62.33
Households with 15-60 years old males			
No.	134	51	185
%	84.29	91.07	86.04
Mean	1.52	1.43	1.50
Households with 15-60 years old females			
No.	128	52	180
%	80.50	92.86	83.72
Mean	1.51	1.15	1.41
Households with children age 14 and below			
No.	87	46	133
%	54.72	82.14	61.86
Mean	1.90	2.3	2.04

5.2.2 Economic Status

Household Income

On average, the mean annual household income of the farmers was VND 88.30 million. The mean total household income of non-adopter farmers was (VND 131.00 million) higher than the adopter farmers (VND 73.50 million) (Table 5.13). It was clear that non-farming was the highest source of household income, which was sharing at least 66% of total household income. It seemed animal husbandry is a losing venture. However, farmers usually raise small farm animals for food and not for sale. Farming was sharing 15% of the total household income. The combined income from farming and animal husbandry, however, shared 34% of their total household income

Table 5.13 Annual household income by the farmers in My Loi

	Adopter n=159	Non-adopter n=56	All N=215
Total household Income (VND) (mean)	73,469,303	130,599,863	88,349,821
Total Annual Farming income	9,776,072	13,300,000	10,700,000
Total Annual income from animal husbandry	(1,699,725)	(978,929)	(1,511,983)
Total Annual Non-farming income	65,400,000	118,000,000	79,200,000
Share of farming to total income	16.33	12.62	15.36
Share of farming and animal husbandry to total annual income	40.44	14.51	33.69
Share of non-farm income to total household income	59.56	85.49	66.31

Most of the households had other members earning income (91%). On average, a household had two members who are earning income (Table 5.14). There were other income sources as hired labor (61%), work in the private sector (20%), small-scale business (13%), and a small number had government job (7%), receiving remittances (6%), and others (11%).

Table 5.14 . Other non-farm income sources by the farming households in My Loi

	Adopter n=159		Non-adopter n=56		All N=215	
	No.	%	No.	%	No.	%
No. of household members with income sources (mean)	2.23		2.11		2.23	
Hired labor	102	64.15	30	53.57	132	61.40
Private sector job	19	11.95	23	41.07	42	19.53
Small scale businesses	11	6.92	16	28.57	27	12.56
Government job	10	6.29	5	8.93	15	6.98
Remittances	11	6.92	2	3.57	13	6.05
Other sources	20	12.58	3	5.36	23	10.70

5.2.3 Material Lifestyle Indicators

Almost all households had electricity (99%) (Table 5.15). Eight in every 10 households had flat screen TB and smartphone. However, the proportion was low of households with internet connection (15%), laptop (15%), and had radio (8%). The data shows why radio was the least source of information among farmers.

Table 5.15. Material lifestyle indicators of households of MyLoi farmers

	Adoptor n=159		Non-adoptor n=56		ALL N=215	
	No.	%	No.	%	No.	%
House has electricty	157	98.74	56	100.00	213	99.07
Owns flatscreen tv	132	83.02	46	82.14	178	82.79
Owns smartphone	129	81.13	50	89.29	179	83.26
Has internet connection	24	15.09	9	16.07	33	15.35
Owns radio	18	11.32	1	1.79	19	8.84
Computer/laptop	24	15.09	9	16.07	33	15.35

5.3 Farm Characteristics

5.3.1. Land Type and Area

Farmers had different types of lands, including agricultural land, forestry land, aquaculture area, and their home garden. Their agricultural lands were planted to annual crops (e.g. rice/paddy, food crops, industrial crop, and vegetables) and perennial crops (Table 5.16). Almost all farmers owned their farmland (1.4 ha, 99%), but there were also among them using land of others but not paying rent (0.36 ha, 10%). No farmer was using a farmland for rent.

The farm lands were small. On average, their farm land size was 1.45 ha, with the adopter farmers had 1.43 ha and the non-adopter farmers had 1.52 ha. Moreover, the small total land area were made of five different lots near or far from each other and with the adopter farmers having one more lot that the non-adopter famers.

On average, the area for agricultural land was small even when most farmers owned agricultural land (89%, 0.22 ha), with 98% of adopter farmers had 0.23 ha while the 62% of non-adopter farmers had 0.67 ha. Commonly, agricultural lands were planted to rice/paddy lands (80%, 0.09 ha) and food crops (84%, 0.13 ha). There were few farmers who planted their land with industrial crops or vegetables.

Forestry land, on average, was the biggest in size among the types of land. Two-thirds of farmers reported having forestry land (1.72 ha), with 71% of the adopter farmers (1.60 ha) and 64% of the non-adopter farmer (2.07 ha). Four in every 10 farmers had home gardens (0.12 ha), with 42% of adopter farmers (0.37 ha) and 36% of non-

adopter farmers (0.1 ha). Few farmers planted perennial crops or had aquaculture ponds.

The results indicate that the farm lands were composed of different lots of various uses. The three important farmlands were the rice paddy land, food crops land, and the forestry land. In terms of land size, forest land was the biggest or about eight times larger than the agricultural land. Among the agricultural land, rice paddy was smaller than the area for other food crops, but belonged to most number of farmers. Among the types of farmers, a higher proportion of the adopter farmers than non-adopter farmers had agricultural land (98% vs. 63%) and forestry land (71% vs. 64%).

Table 5.16 Farmlands of My Loi farmers by type and size (in hectares)

		Adopter n=159	Non-adopter n=56	All N=215
Total area of farm	Mean	1.4285.41	1.5222.48	1.4529.48
Owned	no.	158	54	212
	%	99.37	96.43	98.60
Using but not paying rent	no.	17	4	21
	%	10.69	7.14	9.77
Area of owned land (in ha)	Mean	1.3938.99	1,5119.07	1.4239.58
Area of land (in ha) being used but not paying rent	Mean	0.4060.00	0.1742.50	0.3618.57
Farm lots	no.	4.99	3.48	4.61
Agricultural land	no.	156	35	191
	%	98.11	62.50	88.84
	Mean	0.2368.65	0.1668.29	0.2240.31
Annual crop land	no.	154	37	191
	%	98.09	69.64	88.84
	Mean	0.2035.97	0.1333.78	0.1899.95
Rice paddy land	no.	144	29	173
	%	90.56	51.79	80.47
	Mean	0.0912.92	0.0803.79	0.0894.62
Food crop land	no.	139	21	160
	%	87.42	37.56	74.42
	Mean	0.1263.02	0.1353.33	0.1274.88
Industrial crop land	no.	3	1	4
	%	1.89	1.79	1.86
	Mean	0.0276.67	0.1000.00	0.0457.5
Vegetables	no.	13	3	16
	%	8.17	5.36	7.44
	Mean	0.0453.08	0.0366.67	0.0436.86
Perennial crop land	no.	10	4	14
	%	6.29	7.14	6.51
	Mean	0.5577.00	0.1040.00	0.4280.71
Forestry land	no.	113	36	149
	%	71.07	64.29	69.30
	Mean	1,6092.48	2,0706.39	1,7207.25
Home garden	no.	67	20	87
	%	42.14	35.71	40.85
	Mean	0.1371.94	0.0979.00	0.1281.61
Aquaculture	no.	2	0	2
	%	1.26	0.00	0.94
	Mean	750	0.00	750

5.3.2 Location of the Farm Lands

The different types of farm lands were located in irrigated lowland, non-irrigated lowland, terraced upland, or elsewhere (Table 5.17). More than the majority of the rice paddy lands (63%) and food crop lands (70%) were in non-irrigated. Meanwhile, 76% of forestry land was in terraced upland area, with higher proportion among the non-adopter farmers, 83% and non-adopter farmer, 74%.

Table 5.17. Location of the farms of My Loi Farmers

	Adopter n=159		Non-adopter n=56		All N=215	
	No.	%	No.	%	No.	%
Agricultural land						
Rice paddy land	144	90.57	29	51.79	173	80.47
Irrigated lowland	51	35.42	4	13.79	55	31.79
Non-irrigated lowland	91	63.19	18	62.07	109	63.01
terraced upland	20	13.89	8	27.59	28	16.18
Other location	5	3.14	0	0.00	5	2.89
Food crop land	139	87.42	21	37.56	160	74.42
Irrigated lowland	8	5.76	1	4.762	9	5.63
Non-irrigated lowland	99	71.22	13	61.905	112	70.00
terraced upland	31	22.30	8	38.095	39	24.38
Other location	5	3.60	0	0.000	5	3.13
Vegetables	13	8.18	3	5.36	16	7.44
Irrigated lowland	4	30.77	0	0	4	25.00
Non-irrigated lowland	3	23.08	1	33.33	4	25.00
terraced upland	6	46.15	2	66.67	8	50.00
Other location	13	100.00	3	100.00	16	100.00
Perennial crop land	10	6.29	4	7.14	14	6.51
Irrigated lowland	0	0.00	1	25.00	1	7.14
Non-irrigated lowland	3	30.00	2	50.00	5	35.71
terraced upland	7	70.00	1	25.00	8	57.00
Forestry land	113	71.07	36	64.29	149	69.30
Non-irrigated lowland	7	6.19	1	2.78	8	5.37
terraced upland	84	74.34	30	83.33	114	76.51
Other location	1	0.88	2	5.56	3	2.01
No answer	21	18.58	3	8.33	24	16.11
Home garden	67	42.14	20	35.71	87	40.47
irrigated lowland	4	5.97	3	15	7	8.05
non-irrigated lowland	28	41.79	6	30	34	39.08
terraced upland	32	47.76	11	55	43	49.43
Other location /none	3	4.48	0	0	3	3.45

Multiple answer ; did not include industrial crop lands of 2 farmers

5.3.3 Topography of the Farm Lands

The topography of the farm land differed by type of land (Table 5.18). The majority of the rice paddy lands were in flat areas (58%) but there were those in the hill (8%), valley (15%), areas with gentle slope (20%), and other areas. Similarly, 75% of the food crop land, 63% of the vegetable plots, and 53% of the home gardens were in a flat area. In contrast, the forestry land were in gentle (49%) and steep (25%) slope areas.

Table 5.18. Topography of the farm lands owned by MyLoi farmers

	Adopter n=159		Non-adopter n=56		ALL N=215	
	No.	%	No.	%	No.	%
Agricultural land						
Annual crop land						
Rice paddy land	144	90.57	29	51.79	173	80.47
a flat area	88	61.11	14	48.28	101	58.38
hill	6	4.17	7	24.14	13	7.51
in a valley	23	15.97	3	10.34	26	15.03
gentle slope	29	20.14	5	17.24	34	19.65
steep slope	1	0.69	0	0.00	1	0.58
Food crop land	139	87.42	21	37.56	160	74.42
a flat area	104	74.82	16	76.19	120	75.00
hill	17	12.23	3	14.29	20	12.50
valley	6	4.32	1	4.76	7	4.38
gentle slope	16	11.51	4	19.05	20	12.50
steep slope	1	0.72	0	0.00	1	0.63
Vegetables	13	8.18	3	5.36	16	7.44
a flat area	8	61.54	2	66.67	10	62.5
hill	2	15.38	0	0.00	2	12.5
in a valley	0	0.00	1	33.33	1	6.25
gentle slope	3	23.08	0	0.00	3	18.75
Perennial crop land	10	6.29	4	7.14	14	6.51
a flat area	1	10.00	3	75.00	4	28.57
hill	3	30.00	0	0.00	3	21.43
in a valley	0	0.00	1	25.00	1	7.14
gentle slope	2	20.00	0	0.00	2	14.29
steep slope	4	40.00	0	0	4	28.57
Forestry land	113	71.07	36	64.29	149	69.30
a flat area	3	2.655	3	8.33	6	4.03
hill	12	10.62	5	13.89	17	11.41
in a valley	3	2.65	4	11.11	7	4.70
gentle slope	57	50.44	16	44.44	73	48.99
steep slope	29	25.66	8	22.22	37	24.83
Home garden	67	42.14	20	35.71	87	40.47
a flat area	38	56.72	8	40.00	46	52.87
hill	6	8.96	3	15.00	9	10.34
in a valley	4	5.97	5	25.00	9	10.34
gentle slope	13	19.40	4	20.00	17	19.54
steep slope	6	8.96	0	0.00	4	4.60

Multiple answer; did not include industrial crop lands and aquaculture land of 2 farmers each.

5.3.4 Distance to home, nearest Agricultural Extension office, product market, and trader

When home is not in the farmland, then farmers gave the estimated distance in kilometers. The annual crop lands (rice paddy, food crop, and vegetables land) were all within the two kilometer distance to home, nearest agricultural extension office, product market, and trader (Table 5.19). By type of farmer, however, the rice paddy lands and food crop lands of the non-adopter farmers were farther compared to those of the adopter farmers to their homes (1.71 km vs. 1.03 km), nearest agricultural extension

office (2.30 km vs. 1.68 km), product market (2.21 km vs. 1.80 km), and trader (2.53 vs. 1.57 km).

Table 5.19. Distance of farmlands of My Loi farmers to home, and nearest government office and product market, in kilometers

	Adopter n=159	Non-adopter n=56	ALL N=215
Agricultural land			
Annual crop land			
Rice paddy land	**n=144**	**n=29**	**N=173**
to home	n=140; 1.03 km	n=28; 1.71 km	n=168; 1.14 km
to nearest Agricultural Extension Office	n= 144; 1.68 km	n=28; 2.30 km	n=172; 1.78 km
to nearest market of goods	n= 142; 1.80 km	n=28; 2.21 km	n=170; 1.87 km
to nearest trader	n=113; 1.57 km	n=16; 2.53 km	n=129; 1.69 km
Food crop land	**n=139**	**n=21**	**N=160**
to home	n=85; 1.16 km	n=14 ; 1.16 km	n=99; 1.16 km
to nearest Agricultural Extension Office	n=138; 1.69 km	n=21; 2.54 km	n=159; 1.80 km
to nearest market of goods	n=136; 1.75 km	n=21; 2.52 km	n=157; 1.85 km
to nearest trader	n=110; 1.60 km	n=10; 1.90 km	n=120; 1.63 km
Vegetables	**n=13**	**n=3**	**N=16**
to home	n=5; 0.52 km	n=1; 0.4 km	n=6; 0.5 km
to nearest Agricultural Extension Office	n=13; 1.46 km	n=3; 1.50 km	n=16; 1.47 km
to nearest market of goods	n=9 ; 1.48 km	n=2; 1.65 km	n=11; 1.51 km
to nearest trader	n=8; 1.23 km	n=1; 3 km	n=9; 1.43 km
Perennial crop land	**n=10**	**n=4**	**n=14**
to home	n=6; 4.50 km	n=4; 0.63 km	n=10; 2.95 km
to nearest Agricultural Extension Office	n=10; 3.20 km	n=4; 1.41 km	n=14; 2.69 km
to nearest market of goods	n=9; 2.92 km	n=4; 1.6 km	n=13; 2.51 km
to nearest trader	n=6; 3.72 km	n=1; 3 km	n=7; 3.61 km
Forestry land	**n=113**	**n=36**	**N=149**
to home	n=102; 4.74 km	n=35; 5.79 km	n=137; 5.00 km
to nearest Agricultural Extension Office	n=113; 4.96 km	n=36; 6.72 km	n=149; 5.38 km
to nearest market of goods	n=101; 5.35 km	n=36; 6.53 km	n=137; 5.66 km
to nearest trader	n=73; 5.64 km	n=16; 5.63 km	n=89; 5.63 km
Home garden	**n=67**	**n=20**	**N=87**
to home	n=5; 0.16 km	n=2; 5.20 km	n=7; 1.60 km
to nearest Agricultural Extension Office	n=67; 1.11 km	n=20; 2.16	n=87; 1.35 km
to nearest market of goods	n=52; 1.28 km	n=12; 1.90	n=64; 1.39 km
to nearest trader	n=37; 1.05 km	n=5; 2.4 km	n=42; 1.21 km

Compared to the agricultural farmlands, the forestry lands were farther from home (5.00 km), nearest agricultural extension office (5.38 km), product market (5.66 km), and trader (2.4 km vs. 1.05 km). The forestry land of the non-adopters were farther from home (5.79 km vs. 4.74 km), nearest agricultural extension office (6.72 km vs. 4.96 km), and product market (6.53 km vs. 5.35 km).

5.3.5 Challenges

More than half of the farmers cited the challenges they face: drought (89%) and flooding (88%), low production (79%), high production losses (77%), low output price (77%), inadequate financial capital (72%), hot spells (71%), and moving produce to the market (59%). Four were manifestations of climate change, three were economic factors, and two were production concerns. In terms of rank based on the gravity of the challenge, drought, and flooding were top two. By type of farmers, it shows that these top two challenges were higher among the non-adopter farmers.

Table 5.20 Challenges in farming faced by My Loi Farmers

	Adopter n=159		Non-adopter n=56		ALL N=215	
	No.	%	No.	%	No.	%
Drought	149	93.71	42	75.00	191	88.84
Flooding	146	91.82	43	76.79	189	87.91
Cold spells	132	83.02	38	67.86	170	79.07
Low production	129	81.13	40	71.43	169	78.60
High production losses	123	77.36	42	75.00	165	76.74
Low output price	126	79.25	40	71.43	166	77.21
Inadequate financial capital	121	76.10	34	60.71	155	72.09
Hot spells	122	76.73	30	53.57	152	70.70
Moving produce to the market	98	61.64	29	51.79	127	59.07
Average rank						
Drought	3.26		2.07		2.99	
Flooding	4.08		2.67		3.76	
Low production	3.67		4.35		3.83	
High production losses	3.86		4.36		3.99	
Low output price	4.10		4.8		4.27	
Inadequate financial capital	4.64		5.65		4.86	
Hot spells	5.24		4.17		5.03	
Cold spells	5.47		4.45		5.24	
Moving produce to the market	6.76		8.00		7.04	

5.3.6. Animal Husbandry

Farmers mainly raised small farm animals (chicken, duck, goat, pig) for food and not for the market. They also had cows and buffaloes as work animals. A higher proportion of adopter farmers (88%) than non-adopter farmers (64%) reported raising farm animals, or 82% of all farmers (Table 5.21). Half of the farming households had chickens (58%), while one-third had pigs (36%) and cow (34%). A few farmers had buffaloes, ducks, and goats. The adopter farmers had higher number of heads of farm animals (38 heads) than the non-adopter farmers (31 heads).

Table 5.21. Farm animals raised by My Loi farmers

	Adopter n=159		Non-adopter n=56		All N=215	
	No.	%	No.	%	No.	%
Farmers raising any farm animal	140	88.05	36	64.29	176	81.86
chicken	93	58.49	31	55.36	124	57.67
pigs	66	41.51	11	19.64	77	35.81
cows	63	39.62	11	19.64	74	34.42
buffaloes	27	16.98	4	7.14	31	14.42
duck	9	5.66	5	8.93	14	6.51
goats	5	3.14	0	0.00	5	2.33
Number of heads						
chicken	47.09		43.32		46.15	
pigs	14.91		14.91		14.91	
cows	4.87		11.09		5.80	
buffaloes	1.89		6		2.42	
duck	26.78		22.00		25.07	
goats	8.40		0		8.40	
All	37.89		31.48		36.22	

5.3.7 Agricultural Production

Almost all farmers indicated to grow crops (99%). Diversified these include rice, cash crops, fruits, and forest trees. Rice was a common crop grown by 80% of the farmers, with 91% of the adopter farmers and 52% of the non-adopter farmers. Acacia, a forest tree, was grown by 67% of the farmers, with almost the same proportion between the types of farmers.

Peanut was a crop for 60% of the farmers, but more among the adopter farmers (72%) than the non-adopter farmers (23%). Similarly, a higher proportion of adopter farmers than non-adopter farmers was growing maize (52% vs. 18%), soybean (37% vs. 14%), cassava (22% vs. 11%), fruits (16% vs. 1%), and sweet potato (13% vs. 2%). It was the opposite or vegetables (16% vs. 20%).

Table 5.22. Crops grown by My Loi farmers

	Adopter n=159		Non-adopter n=56		All N=215	
	No.	%	No.	%	No.	%
With crop production	159	100.00	53	94.64	212	98.60
Growing crops (mean)	3.77		2.30		3.41	
rice	144	90.57	29	51.79	173	80.47
acacia	108	67.92	36	64.29	144	66.98
peanut	114	71.70	13	23.21	127	59.07
maize	83	52.20	10	17.86	93	43.26
soybean	59	37.11	8	14.29	67	31.16
cassava	35	22.01	6	10.71	41	19.07
vegetables	26	16.35	11	19.64	37	17.21
fruits	25	15.72	7	12.50	32	14.88
sweet potato	21	13.21	1	1.79	22	10.23
pepper	6	3.77	1	1.79	7	3.26
tea	4	2.52	1	1.79	5	2.33

By size of land, the average area planted to acacia (1.73 ha), fruits (0.21 ha), and tea (0.105 ha) were the top three largest areas. The area planted to acacia by non-adopter farmers was bigger than the adopter farmers (2.07 ha vs. 1.62 ha). In contrast, for fruits and tea, the area planted by the adopter farmers (0.26 ha and 0.12 ha, respectively) was way higher than the non-adopter farmers (0.09 ha and 0.05 ha).

Table 5.23 Area in hectares planted to crops by My Loi farmers

	Adopter n=159	Non-adopter n=56	ALL N=215
acacia	1.623	2.065	1.734
fruits	0.261	0.094	0.213
tea	0.119	0.050	0.105
peanut	0.100	0.137	0.104
maize	0.094	0.157	0.100
cassava	0.078	0.167	0.091
rice	0.091	0.079	0.089
soybean	0.074	0.038	0.070
sweet potato	0.069	0.050	0.068
pepper	0.059	0.040	0.056
vegetables	0.027	0.019	0.023

Non-adopter farmers planted maize (0.16 ha vs. 0.09 ha), peanut (0.14 ha vs. 0.10 ha), and cassava (0.17 ha and 0.08 ha) to a bigger area compared to the adopter farmers. Rice was most common crop but planted to 0.09 ha only. The rest of the corps – soybean, sweet potato, pepper, vegetable --- were planted between 0.02 ha and 0.07 ha.

5.3.8 Farm Labor

The farms had family labor (34%), hired labor (6%), and a combination (58%) (Table 5.23). The proportion of adopter farmers having combined family and hired labor in the farm was higher than the non-adopter farmers (61% vs. 48%). Both types of farmers indicated that it was easy to find labor for the farm.

Table 5.24.Types of labor in the farm of My Loi farmers

	Adopter n=159		Non-adopter n=56		ALL N=215	
	No.	%	No.	%	No.	%
Family labor	53	33.33	21	37.50	74	34.42
Hiredlabor	7	4.40	6	10.71	13	6.05
Family and hired labor	98	61.64	27	48.21	125	58.4
No data	1	0.63	2	3.57	3	1.40
Score in terms of difficulty of findinglabor for the farm (0-10 easiest)	n=158 8.89		n=54 8.89		n=212 8.89	

The farms had regular laborers, who were mostly composed of both men and women (79%) (Table 5.24). There were a small number of farms that had male workers only (10%) or women only (11%). The proportion of farmers with both men and women workers was higher among the non-adopter farmers than the adopter farmers (86% vs. 77%). Conversely, there were a higher proportion among adopter farmers than non-adopter farmers who had men only (11% vs. 7%) or women only (12% Vs. 7%) workers.

Table 5. 25. Regular and Seasonal Farm Labor of My Loi farmers

	Adopter n=159		Non-adopter n=56		ALL N=215	
	No.	%	No.	%	No.	%
Regular Labor						
With both men and women	122	76.73	48	85.71	170	79.07
With Men only	18	11.32	4	7.14	22	10.23
With Women only	19	11.95	4	7.14	23	10.70
Number of men and women (mean)	2.31		2.04		2.24	
Number of Men(mean)	1.31		1.27		1.30	
Number of Women(mean)	1.31		1.12		1.26	
Seasonal Labor (mean)	n=94	59.12	n=31	55.36	N=125	58.14
With seasonal workers*	89	94.68	26	83.87	115	92.00
Men only	9	10.11	1	3.85	10	8.70
Women only	1	1.12	1	3.85	2	1.74
With both men and women	79	88.76	24	92.31	103	89.57

Only 58% of the farmers indicated that they have seasonal workers. Most of these seasonal workers were men and women (90%), and a few men (9%) and women (2%). There was slight difference in the proportion of adopter and non-adopter farmers who had both men and women seasonal workers.

5.3.9 Financial Assistance

Half of the farmers indicated having received financial assistance for the past 10 years (50%), but most received a loan (49%), while three others received a grant (Table 5.26). The proportion of adopter farmers who received a loan was higher than the non-adopter farmers (53% vs. 38%).

Loans were mostly from formal sources. The bank was the main source of loan (85%) of those who availed of loan. All non-adopter farmers availed of loan from the bank, while 81% of the adopter farmers who availed of loans did. Loans from the farmers' association and NGOs were availed of by adopter farmers but not of the non-adopter farmers. The mean number of sources of loan was 1.40 for adopter farmer and 1.09 for the non-adopter farmers.

Loans were used for a number of uses such as buy farm inputs, farm animals, or for others uses. Other uses included to buy a land lot, to build a house, to purchase equipment, for health purposes to buy motorbike, and go to work abroad.

Table 5.26 Financial assistance availed of for the past 10 years (2011-2021) by My Loi farmers

	Adopter n=159		Non-adopter n=56		ALL N=215	
	No.	%	No.	%	No.	%
Received any livelihood financial assistance for the	87	54.72	21	37.50	108	50.23
Had loans	84	52.83	21	37.50	105	48.84
Sources of loan						
Bank	68	80.95	21	100.00	89	84.76
Farmer's association /Women's Union	18	21.43	0	0.00	18	17.14
NGO (CCAFS, ICRAF)	13	15.48	0	0.00	13	12.38
Relative	7	8.33	2	9.52	9	8.57
Friends	1	1.19	0	0.00	1	0.95
Small lending agencies	1	1.19	0	0.00	1	0.95
Number of sources of						
One	56	66.67	19	90.48	75	71.43
Two	22	26.19	2	9.52	24	22.86
Three	6	7.14	0	0.00	6	5.71
Mean	1.40		1.09		1.34	
Use of Loan						
To buy inputs for farming (e.g. fertilizer, seeds, etc)	16	19.05	9	42.86	25	23.81
To buy farm animals	32	38.10	10	47.62	42	40.00
Others	48	57.14	15	71.43	63	60.00

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5.4 Adoption of Climate Smart Agriculture Technologies and Practices

5.4.1 The Seventeen CCAFS CSA T & Ps Introduced in My Loi

Seventeen climate smart agriculture technologies and practices and technologies were introduced in My Loi that were designed to 1) increase productivity and incomes, 2) enhance resilience of livelihoods and ecosystems and 3) reduce and remove greenhouse gas emissions from the atmosphere. These were Alley cropping (non N-fixing trees), biochar, biogas, compost, crop type change, diet management, drip irrigation, improved cook stove, improved sty/cage, intercropping (non legume/non-legume), manure treatment (EM bad, Vermiculture), mulching, multistrata agroforestry, parklands, rotation (mixed legume/non-legume), rotations (more complex), and silvo pasture.

5.4.2 Measuring Adoption of CSA T & Ps

Adoption was measured in two ways. The first measure is "ever adopted", which means that the farmer has adopted any CSA T & P at any one time since CCAFS introduced CSA T & Ps in MyLoi CSV as an adaptive strategy to climate change starting 2014. The second measure is the continuance of adoption or the intensity of adoption, which is the number of CSA T and Ps that a farmer was currently adopting, or after five years since the My Loi CSV was established.

Out of the 215 farmers in My Loi village, 159 were identified to have adopted at least one of the CSA T & Ps since 2014 to 2020 (Table 5.26). The number of CSA T & P adopted changes through the years. The common CSA T & P adopted were ally cropping (75%) and compost (52%), with crop type change (49%) coming in close. At least one-third of the adopter farmers were into improved sty/cage, and diet management. At least one-fourth of the adopter farmers were into manure treatment, intercropping, and mulching. The least common CSA T and Ps adopted were multi-strata agro forestry, parklands, rotation, biogas, and biochar.

Currently, on average, the 159 adopter farmers had adopted four CSA T & P, with the ranged between 1 and 12. The proportion of those who have heard and attended trainings, and of those who have heard only of the training for almost all of the CSA T & Ps was higher among the adopter farmers than among the non-adopter farmers.

Table 5.27. Awareness and Attendance to Training and Adoption of CSA T & Ps by My Loi Farmers, n=159

	Heard and Attended trainingsand Have Ever Adopted		Heard of trainings and Have Ever Adopted		All	
	No.	%	No.	%		
Alley cropping (non N-fixing trees)	79	49.69	41	25.79	120	75.47
Compost	56	35.22	26	16.35	82	51.57
Crop Type Change	54	33.96	24	15.09	78	49.06
Diet Management	49	30.82	11	6.92	60	37.74
Improved Sty/Cage	42	26.42	12	7.55	54	33.96
Manure Treatment	38	23.9	8	5.03	46	28.93
Intercropping (non-legume)	39	24.53	6	3.77	45	28.30
Mulching	29	18.24	8	5.03	37	23.27
Improved Cook Stove	25	15.72	4	2.52	29	18.24
Rotation (mixed legume/non-legume)	19	11.95	6	3.77	25	15.72
Drip Irrigation	11	6.92	3	1.89	14	8.81
Silvopasture	12	7.55	1	0.63	13	8.18
Multistrata Agroforestry	9	5.66	0	0.00	9	5.66
Parklands	3	1.89	1	0.63	4	2.52
Rotation (more complex)	2	1.26	0	0.00	2	1.26
Biogas	1	0.63	1	0.63	2	1.26
Biochar	1	0.63	0	0.00	1	0.63

5.4.3 Factors Influencing the Adoption of CSA Technologies and Practices

The factors that significantly influence the farmer's decision to adopt one of the 17 CCAFS CSA T & Ps were identified using binary logit regression for the first measure ("ever adopt") and ordinary least squares regression for the second measure. (continued/intensity of adoption). The summary statistics for the two independent variables and 26 independent variables are found in Table 5.27. The independent variables were personal characteristics of the farmer, and family level variables, farm variables, and institutional and social variables.

Table 5.28 Summary Statistics of Regression Variables

	Mean	SD	Min	Max
Dependent variables				
Adopt CCAFS CSA at any one time since 2014	.7395349	.4399127	0	1
Continue using/intensity of adoption of CCAFS CSA	3.186047	2.940658	0	12
Independent variables				
Farmer's level				
Sex	.2744186	.4472622	0	1
Age	47.4093	14.09049	19	79
Number of formal education in years	8.395349	3.194179	1	20
Farming experience in years	29.73488	14.9172	0	63
Rice farmer	.8046512	.3973943	0	1
Looking for better way to d farming	.8837209	.3213074	0	1
Has attended a CSA T & P training	.5023256	.5011614	0	1
Experience as source of information	.8976744	.3037833	0	1

Tv as source of information	.8651163	.3423965	0	1
Village information center as source of information	.8883721	.315643	0	1
Fellow farmer as source of information	.9162791	.2776152	0	1
Agricultural extension officer as source of information	.9116279	.2844977	0	1
Net as source of information	.4232558	.4952283	0	1
Perceived drought is more frequent now	.772093	.4204612	0	1
Perceived flooding is more frequent now	.6139535	.4879776	0	1
Farmer's family level				
Men family member in the labor force	1.288372	1.018797	0	10
Women family member in the labor force	1.176744	.806758	0	5
Share of farming income to household income	24.29302	27.35732	-15	100
Farm/ing level				
Farmland size	1.32093	1.870649	0	12
Own farmland	.9023256	.2975667	0	1
Have both family and hired labor	.5767442	.4952283	0	1
Ease in finding farm labor	8.893023	1.374908	2	10
Raising farm animals	.8186047	.3862447	0	1
Number of crops	3.35814	1.750064	0	10
Institutional				
Credit access	.4883721	.5010313	0	1
Social				
Membership in community-based farming organization	.7069767	.4562112	0	1

5.4.4 Factors Influencing Adoption Anytime of Any CCAFSCSA T& Ps

The significant factors influencing the decision of the farmers to adopt any CCAF's CSA T & Ps anytime ("ever adopt) since the introduction of CSV in 2014 were identified through logit regression. The whole model is significant (Prob >chi2 = 0.0000) with correct prediction at 89.77%.

The significant factors positively influencing the decision of the farmers to adopt any CCAF's CSA T & Ps were having attended any training on CSA T & Ps (1% level of significance), having a fellow farmer as source of information (5% level of significance), growing rice (10% level of significance), own farmer's experience as a source of information (10% level of significance), and number of crops grown (10% level of significance) (Table 5.28).

Table 5.29 Logit regression results: Ever Adopt CCAFS CSA T and Ps.

	Odds Ratio	P>|z|
Farmer's level		
Sex	1.496848	0.502
Age	1.039017	0.506
Number of formal education in years	.9991139	0.992
Farming experience in years	.9664835	0.537
Rice farmer	3.46574	**0.074***
Looking for better ways of farming	2.738941	0.204
Has attended a CSA T & P training	40.70339	**0.000*****

Experience as source of information	4.097629	**0.093***
TV as a source of information	2.059588	0.316
Village information center as source of information	.5708328	0.563
Fellow farmer as source of information	7.131598	**0.045****
Agricultural extension officer as source of information	1.366904	0.723
Internet as a source of information	.4662679	0.189
Perceived drought is more frequent now	.6648633	0.596
Perceived flooding is more frequent now	1.604274	0.464
Farmer's family level		
Men family member in the labor force	.455081	**0.014****
Women family member in the labor force	1.721271	0.276
Share of farming income to household income	.9986208	0.908
Farm/ing level		
Farmland size	.9210572	0.586
Own farmland	2.768717	0.259
Have both family and hired labor	1.428072	0.564
Ease in finding farm labor	.8761266	0.573
Raising farm animals	2.186263	0.207
Number of crops	1.394436	**0.080***
Institutional		
Credit access	2.081886	0.183
Social		
Membership in community-based farming organization	.3595519	**0.088***

Number of obs = 215 Pseudo R2 = 0.5084
LR chi2(32) = 125.39 Log likelihood = -60.617358
Prob > chi2 = 0.0000 Correctly classified 89.77
*** significant at 1% ; ** signicifant at 5% , *Significant at 10%

On the other hand, the two factors that significantly and negatively influence adoption were having men in the family in the labor force (5% level of significance) and membership in farming organization (10% level of significance).

Attendance to training on any CSA T & P is highly significant (1%) and positive variable with strong association with adoption behavior. Given the odds ratio (40.70339), then it means that the farmer's attendance to the training increases the likelihood to adopt any CSA T and P by 3970% compared to those who did not attend or increases the odds of adoption by a factor of 40.70. This highlights the significance of having training when introducing new farming technologies and practices. This also reflects the quality of the trainings that were provided to the farmers.

Similarly, having a fellow farmer as source of information is also significant (5%) and strongly associated with adoption behavior. Given the odds ratio (7.131598), then the likelihood of adopting any CSA T &P is 613% higher than those who do not source information from fellow farmers. This means that having well-informed farmers that can promote new ways of farming would be an important strategy in scaling out CSA T and Ps. This also proves that the CCAFS's roving workshops where farmers

meet other farmers to share practices was a good strategy and all other farmer gatherings that provided farmers venue to share practices and experiences.

Moreover, the significant variable "own farmer's experience as a source of information" (odds ratio= 4.097629) was strongly associated with adoption behavior. This variable can also be a proxy of the confidence of the farmer as a farmer. Those who learn from their experiences increases the likelihood to adopt any CSA T & P by 309%. Being a rice farmer (odds ratio = 3.46574) also increases the likelihood of adopting any CSA T and Ps by 246%. As shown in the previous sections, farmers in My Loi have diversified their crops grown from rice to cash crops, fruit trees, and forest trees, with 80% growing rice. With rice as a basic food item, then the rice farmers could be more open to improve their practices. In addition, given the odds ratio (1.394436) of the variable number of crops grown, it means that an additional crop grown increases the likelihood of adopting any CSA T and P by 39%.

On the other hand, having men family member in the labor force (odds ratio=0.455081) and membership in community-based farming organization (odds ratio=.3595519) reduces the likelihood of adoption of any CSA T & P. This can be understood in the context of My Loi where the men usually leave the village temporarily (such as during in between farming seasons) or permanently to find other work. The mobility of men reduces their full attention to farming. The farm labor force is dominated by women. In this study, 73% were women farmers. Despite this, the men are usually the members of the farmer's organization, which again can explain the negative influence.

5.4.5 Factors Influencing Intensity and Continuance of Adoption of CCAFS CSA T & Ps

A different set of factors influence the continuance or intensity of adoption of CCAF's CSA T & Ps. This is measured by the number of CSA T & Ps that the farmers were currently adopting. It should be noted that this measure of adoption reflects behavior overtime (i.e., within the period 2014 to 2021 [time of data collection]). The significant factors influencing the decision of the farmers to continuously adopt CCAF's CSA T & Ps were identified through ordinary least squares method. The model has an adjusted R^2 of 41%, which means that 41% of the variation in the dependent variable is due to the collective behavior of the independent variables.

The factors that significantly and positively influencing the intensity and continued adoption behavior were attendance to a CSA T & Ps training (1%), agriculture extension officer as source of information (5%), TV as a source of information (5%), positive attitude of open to or looking for better ways of farming (10%), owns farmland (10%), and number of crops grown (10%). The variables that significant but negatively influencing the decision to continuously adopt were having male family member in the labor force (10%) and ease in finding farm labor (10%)

Attending a CSA training will likely increase the number of CSA T and Ps adopted by three, which is similar to the results in the 'ever adopt' regression, that indicated a strong association between attendance to training and adoption behavior.

The positive role of the agriculture extension officer in the intensity of adoption is brought to fore with the results showing a significant influence on the adoption behavior of the famers. This is a confirmation of the earlier data that shows that the agricultural extension officer was identified as common source of information for matters related to the production inputs such crop variety, fertilizer, and pesticide, also soil management and livestock management. This suggests the importance of having highly-skilled agricultural extension officer who is willing to share information and skills to the farmers.

Similarly, sourcing farming information from TV will also increase the number of CSA adopted by one more. As previously showed, the TV is the main source of information for the daily weather forecast and one of the major sources of seasonal forecast. This is important findings on the role of TV in the promotion of better farming technologies and practices.

Table 5.30 OLS regression results: Continuance of Adoption of CCAFS CSA T & Ps

	Coefficient	P>|z|
Constant	-2.361351	0.262
Farmer's level		
Sex	.2121892	0.573
Age	.0210593	0.506
Number of formal education in years	.0223356	0.719
Farming experience in years	-.019495	0.516
Rice farmer	.2029881	0.693
Looking for better ways of farming	1.135354	**0.051***
Has attended a CSA T & P training	2.587759	**0.000*****
Experience as source of information	.2793121	0.648
TV as a source of information	1.014287	**0.050****
Village information center as source of information	-.6350433	0.274
Fellow farmer as source of information	.716224	0.259
Agricultural extension officer as source of information	1.455952	**0.029****

Internet as a source of information	-.2443909	0.530
Perceived drought is more frequent now	.0902402	0.831
Perceived flooding is more frequent now	-.1890054	0.604
Farmer's family level		
Men family member in the labor force	-.3204198	**0.092***
Women family member in the labor force	.2454057	0.291
Share of farming income to household income	.0027749	0.698
Farm/ing level		
Farmland size	-.0859117	0.377
Own farmland	1.007964	**0.073***
Have both family and hired labor	.2377755	0.530
Ease in finding farm labor	-.2413748	**0.052***
Raising farm animals	.4811667	0.298
Number of crops	.2089711	**0.093***
Institutional		
Credit access	-.3632189	0.284
Social		
Membership in community-based farming organization	.5238211	0.162

Number of obs = 215	df= 214
F(26, 188) = 6.73	*** significant at 1% ;
Prob > F = 0.0000	** signicifant at 5% ,
R-squared = 0.4819	*Significant at 10%
Adj R-squared = 0.4103	
Root MSE = 2.2583	

Farmers with positive attitude towards better ways of farming will likely increase CSA adoption by one more. The same is true for farmers who are owners of their land. As owners they can do what they want on their, with no restrictions unlike when the land is rented, or with trepidation when the land is allowed to be used but not rented. One more crop grown increases the adoption of CSA T & P by 0.21.

On the other hand, ease in finding farm labor negatively influence adoption of CSA. This could be attributed to the mobility of labor force in My Loi in particular and rural area of Vietnam in general. Similarly, having more men family members in the labor force have negative influence on CSA T & P adoption. This can be attributed to the mobility of the men in the village, going out to temporarily find work.

6.0 CONCLUSIONS

The study focused on the adoption of CCAFS-introduced Climate Smart Agriculture Technology and Practices (CSA T & Ps) among farmers in My Loi village, Ha Tinh province, Viet Nam. Specifically, the study identified the factors influencing farmer's decision to adopt CSA T & Ps. Primary data from 215 farmers were collected through face-to-face interviews in September 2021.

Seventeen CSA T & Ps were introduced by CCAFS in My Loi as a climate smart village starting 2014. These were alley cropping (non N-fixing trees), biochar, biogas, compost, crop type change, diet management, drip irrigation, improved cook stove, improved sty/cage, intercropping (non legume/non-legume), manure treatment (EM bad, vermiculture), mulching, multistrata agroforestry, parklands, rotation (mixed legume/non-legume), rotations (more complex), and silvo pasture. These CSA T & Ps were supposed to 1) increase productivity and incomes; 2) enhance resilience of livelihoods and ecosystems; and, 3) reduce and remove greenhouse gas emissions from the atmosphere.

Out of the 215 farmers in My Loi village, 159 were identified to have adopted at least one CSA T & Ps since 2014. Ally cropping (75%) and compost (52%) were most common CSA T & P adopted, while multi-strata agro forestry, parklands, rotation, biogas, and biochar were the least adopted. The number of CSA T & P adopted changes through the years. Currently, the 159 adopter farmers had four CSA T & Ps, on average.

The adoption behavior of farmers was treated as a function of factors including farmers, household, farm or farming, institutional, and social factors. For the 'ever adopt' farmer's decision, binary logit regression was used. For the intensity of adoption or continuance of adoption, ordinary least squares method was used. The set of factors influencing the ever adopt behavior of farmers was different from the set of factors influencing the intensity of adoption behavior of the farmers.

The factors that significantly and positively influence the ever adopt behavior of farmers were attendance to any training on CSA T & Ps, having a fellow farmer as source of information, growing rice, own farmer's experience as a source of information, and number of crops grown. On the other hand, the two factors that significantly and negatively influence adoption were having men in the family in the labor force and membership in farming organization.

Meanwhile, the significant factors influencing the decision of the farmers to continuously adopt CCAF's CSA T & Ps were attendance to CSA T & Ps training, the agriculture extension officer as source of information, TV as a source of information, positive attitude of looking for better ways of farming, owns farmland, and number of crops grown. Significant but negatively influencing the decision to continuously adopt are having male family member in the labor force and ease in finding farm labor.

In both measures of adoption, attendance to training CSA T and Ps was significantly and positively associated with adoption behavior. This highlights the importance of having training when introducing new farming technologies and practices.

Sources of information influence adoption decisions. Specifically, sourcing information from fellow farmers and own experience were strong drivers of adoption of CSA T & P at any time. Having well-informed farmers ("champion farmers") that can promote new ways of farming and roving workshops where farmers meet other farmers to share practices would be important strategies in scaling-out CSA T and Ps. However, it is sourcing information from the agriculture extension officer and from TV that strongly influence the intensity of adoption. This suggests the importance of having highly-skilled agricultural extension officer who is willing to share information and skills to the farmers, and of the TV as a vehicle in sharing information that will help the farmer in making farming decisions.

Attitude of the farmer counts. The favorable attitude of the farmer towards new ways of farming is a good driver of intensity of adoption behavior.

Farming characteristics such as growing rice (a staple food) and ownership of land (which could mean freedom to make decisions) are positive drivers of adoption. In both measures of adoption, number of crops grown, is a significant and a strong driver. The more crops grown, the more spread the time attention of the farmer, and higher risk faced.

Having more men family members in the labor force negatively influences adoption behavior. In the context of My Loi, this is understandable because of mean leaving temporarily or permanently the village for work elsewhere. This provides evidence that farming in My Loi is women dominated.

REFERENCES

Aggarwal, P. K., A. Jarvis, B. M. Campbell, R. B. Zougmoré, A. Khatri-Chhetri, S. J. Vermeulen, A. Loboguerrero, L. S. Sebastian, J.Kinyangi, O. Bonilla-Findji, M. Radeny, J. Recha, D. Martinez-Baron, J. Ramirez-Villegas, S. Huyer, P. Thornton, E. Wollenberg, J.Hansen, P. Alvarez-Toro, A. Aguilar-Ariza, D. Arango-Londoño, V. Patiño-Bravo, O. Rivera, M. Ouedraogo and B. Tan Yen. 2018.The climate-smart village approach: framework of an integrative strategy for scaling up adaptation options in agriculture. Ecology andSociety 23(1):14. https://doi.org/10.5751/ES-09844-23011

Arndt, C., Tarp, F., Thurlow, J. 2015. The Economic Costs of Climate Change: A Multi-Sector Impact Assessment for Vietnam. Sustainability. **2015**, *7*(4), 4131-4145; https://doi.org/10.3390/su7044131

Bonilla-Findji O and Bui Tan Y. 2018. Southeast Asia Climate-Smart Villages AR4D sites: 2017 Inventory. Wageningen, The Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

Campbell, B.M., Vermeulen, S.J., Aggarwald, P.K., Corner-Dolloff, C., Girvetz, E. Loboguerrero, A. M. Ramirez-Villegas, J., Rosenstock, T., Sebastian, L. , Thornton, P., Wollenberg, E. 2016. Reducing risks to food security from climate change. Global Food Security 11: p34-43. http://dx.doi.org/10.1016/j.gfs.2016.06.002

CCAFS. 2016. Climate-Smart Villages. An AR4D approach to scale up climate-smart agriculture. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Available online at: www.ccafs.cgiar.org

Ferrer AJG, Bernardo EBV. 2020. Outcomes of CCAFS Work in Vietnam. Hanoi, Vietnam: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Available online at: www.ccafs.cgiar.org

Le V. H., Duong M.T., Simelton E., Ferrer A., Yen B. T. and Sebastian L.S. 2015. Situation Analysis and Needs Assessment Report for My Loi village and Ha Tinh province, Viet Nam (VN02) CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark. Available online at: www.ccafs.cgiar.org

Le V.H., Duong M.T., Do T.H., Le K.H., Phan H.L., Simelton E. 2014. Village Baseline Study –Site Analysis Report for My Loi, Ky Anh district, Ha Tinh province –VietNam (VN02). CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark. Available online at: www.ccafs.cgiar.org

Maitah, K., Smutka, L., Sahatqija, J., Maitah, M., Phuong Anh, N. 2020. Rice as a Determinant of Vietnamese Economic Sustainability. Sustainability,12: 5123. doi:10.3390/su12125123

Rogers, E. 2003. Diffusion of Innovations, 5th ed.; Free Press: New York, NY, USA,

Simon, H.A. 1972. Theories of bounded rationality. In Decision and Organization: A Volume in Honor of Jacob Marschark; North-Holland Publishing Company: Amsterdam, The Netherlands, 1972; Volume 1, pp. 161–176. 10.

Simelton E., Hai, L.V., Tuan, D.M., Hoa, L.D. (2017). Climate-induced vulnerabilities: Participatory assessment for My Loi village, Ky Son commune, Ky Anh district, Ha Tinh province. CCAFS Working paper No.216. Wageningen, The Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

Yu, B.; Zhu, T.; Breisinger, C.; Hai, N.M. 2010.Impacts of Climate Change on Agriculture and Policy Options for Adaptation: The Case of Vietnam; Discussion Paper 01015; IFPRI: Washington, DC, USA, 2010.