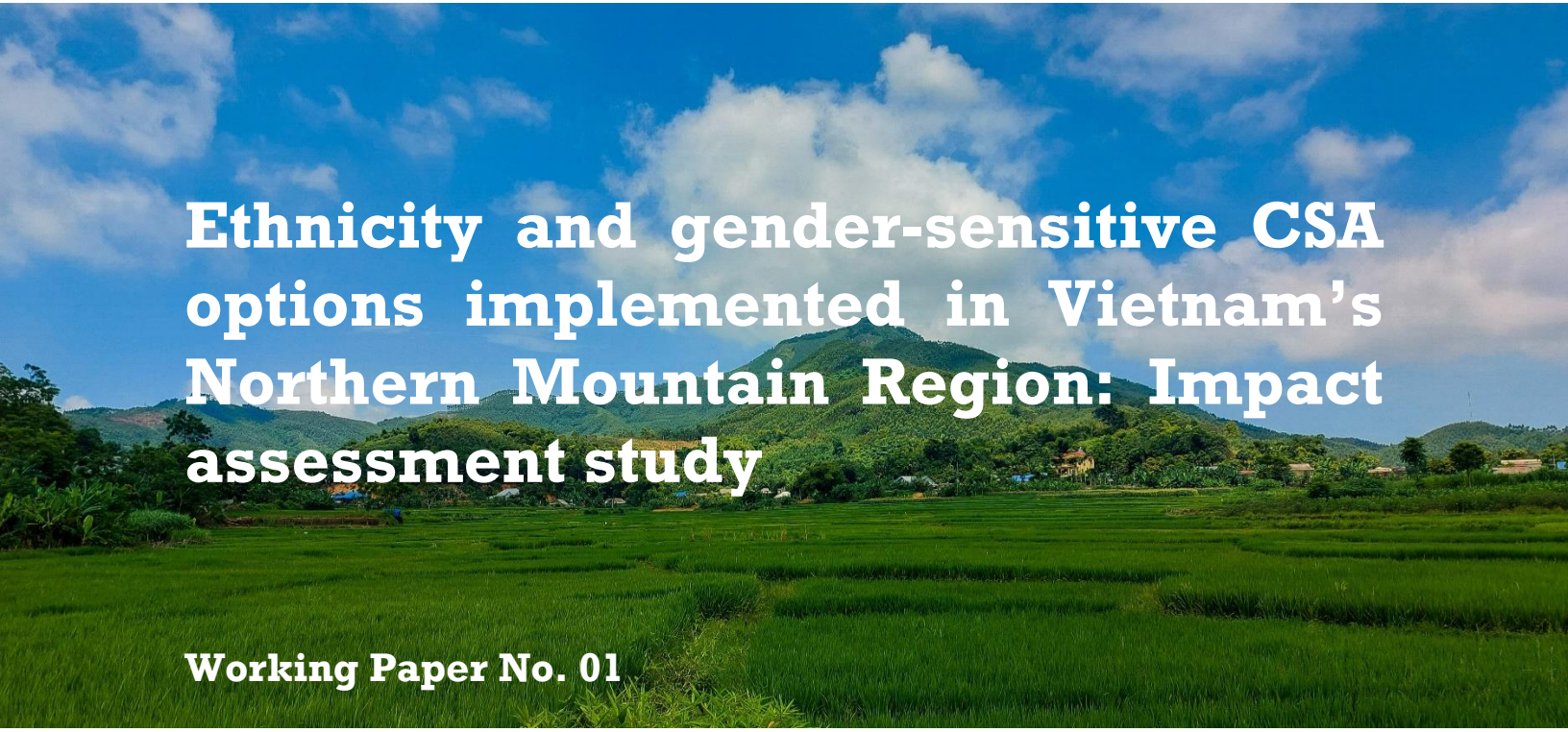

Ethnicity and gender-sensitive CSA options implemented in Vietnam's Northern Mountain Region: Impact assessment study

Working Paper No. 01

Climate-Resilient AgriFood Systems (CRAFS) Research Group
Vietnam National University of Agriculture (VNUA)

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CRAFS Research Area

Climate-smart agriculture

Contributes to SDGs

SDG 13 - Climate action

Country

Vietnam

Abstract

Climate change has long been a major challenge to rural livelihoods in Vietnam, particularly in NMR. Enhance adaptive capacity and resilience to climate change is considered vital to rural households' and communities' sustainable development. Despite significant achievements of CCAFS FP2.1 project through synergies and engagement of Yen Bai governments (village, commune, district, and province), local farmers, local private sector, and researchers (CIAT[1], NOMAFSI[2], VNUA[3]) in developing a climate-resilient community in the Ma CSV, the project yet seem to be far left on a concern of social issues, i.e. rural migration, social disruption, conflicts, discrimination, gender inequalities, and ethnic disadvantages. This study, funded by the CCAFS P1596 project, aims to unveil and explicate previously unknown social inequalities (gender and ethnicity) in the horizontal application of the climate-smart agriculture technologies and practices (CSA T&Ps) within the CSV model in Ma village. In addition, the presence of social factors (age/gender/ethnicity/education/experience) in the adoption of CSA T&Ps was also tested by the binomial logistic regression. The study flexibly utilized mixed methodology (qualitative and quantitative approach) to best highlight and triangulate change outcomes and impacts of the CCAFS FP2.1 project work on the horizontal scaling of CSA options. According to the empirical findings, no existence of social inequalities by gender has been found but exhibited significant other social issues in terms of ethnic disadvantages referring to opportunities to participate in training (AP and CCF), having access to science and technology services (S&T), and agricultural production management (FR). Further, farmers' willingness to adopt CSA T&Ps (CSA options) from the CSV project was influenced by several factors including gender (Gen), training of agricultural practices (TrAP), training of agricultural production management (TrAM), access to extension service (AcES), access to climate change service (AcCS), perception of extreme weather (PeEW), and perception of depleting water source (PeEW).

Keywords: Climate-smart village, outcomes, climate change, adaptive capacities, resilience

[1] International Center for Tropical Agriculture

[2] Northern Mountainous Agriculture and Forestry Science Institute

[3] Vietnam National University of Agriculture

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About CRAFS working papers

Titles in this series aim to disseminate interim climate-resilient agrifood systems research and knowledge products and stimulate feedback from the scientific community.

About CRAFS

CRAFS (Climate-Resilient AgriFood Systems) is a research group founded and operated by a group of young and competent lecturers and researchers from Vietnam National University of Agriculture (VNUA). CRAFS conducts research activities across various fields of expertise to address issues of research and development interdisciplinarily under the climate change umbrella. For more information, please visit http://crafs.vnua.edu.vn/en/homepage/.

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Acronyms

CC	Climate change
CIAT	International Center for Tropical Agriculture
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CGIAR	Consultative Group for International Agricultural Research
CSA	Climate-Smart Agriculture
CSV	Climate-Smart Village
DARD	Department of Agriculture and Rural Development
NTM	Nông Thôn Mới
VNUA	Vietnam National University of Agriculture

I. INTRODUCTION

The United Nations Entity for Gender Equality and the Empowerment of Women (UN Women), in collaboration with the Institute of Labour Science and Social Affairs under the Ministry of Labour, Invalids and Social Affairs (ILSSA-MOLISA), and the Department of Ethnic Minority Affairs - Committee for Ethnic Minority Affairs (CEMA) has launched the report on "Figures on Ethnic Minority Women and Men in Viet Nam 2015-2019". This Irish Aid funded study highlighted outstanding achievements in terms of gender equality in ethnic minority and mountainous areas such as decreasing rate of child marriage in ethnic minority groups; the increasing access to the internet (Wi-Fi, cable, or 3G) of ethnic minority households; the improved average income per capita of ethnic minority female-led households; the remarkable proportion of children attending school at the right age; and the higher level of health insurance coverage between men and women of ethnic minority people (UN Woman Vietnam, 2022). Along with other studies, the report also indicated that gender equality issues intersected with ethnicity are often difficult to tackle and require a comprehensive approach to promoting socio-economic and sustainable development in ethnic minority areas (Veenstra 2011, Crowder-Meyer 2021, Rosette et al. 2018, Belkhir and Barnett 2001, Ryder and Boone 2019, Pearson et al. 2017). The nature of ethnic and gender differences in accessibility to opportunities and resources are significant factors in determining future development outcomes including poverty, inequality, vulnerability, adaptability, flexibility, and resilience especially under various social attributes and climate change impacts (Pearson et al. 2017, Azong and Kelso 2021, McCright 2010, Huyer et al. 2021).

In general, the members of rural and remote communities within mountain regions are substantially more vulnerable to negative impacts of climate change (Johnson 2011, Sen et al. 2020, Cox and Hamlen 2014, Hahn, Riederer, and Foster 2009). Further, gender disparities among these communities lead to the difference in climate change experience and their adaptability due to the roles of men and women in the agricultural sectors which are defined by gender norms, socio-cultural background, and religion. The ethnic diversity and community disadvantage with gender issues impeded the access and control of key resources and inputs (such as land, labor, credit, information, and technology) that define the differences in vulnerabilities and adaptive capacities to cope with climate risks. Reducing this gap by integrating gender and ethnic sensitivities into rural employment promotion and capacity building to effectively enhance productivity and sustainable agricultural production is one of the key priorities of any action research program in Vietnam's Northern Mountain region (NMR). Perhaps more than any contemporary environmental concerns, climate change

nowadays presents the growing social challenges for diverse ethnic groups and gender across cultures in agricultural systems of disadvantaged communities, which require sustainable, climate-smart, and community-centered interventions (Azong and Kelso 2021, Pearson et al. 2017, Huyer et al. 2021). For that reason, the Research Program on Climate Change, Agriculture, and Food Security in Southeast Asia (CCAFS-SEA) of the Consultative Group on International Agricultural Research (CGIAR), in 2014, selected Ma, one of many poor villages in the NMR, to implement the model "CSV - climate-smart village" (CCAFS Flagship 1.1). The project aims to provide climate-smart-agriculture technologies and practices (CSA T&Ps) for enhanced adaptive capacity and resilient livelihoods in Ma CSV. Ma ethnic farmers and other stakeholders are exposed to several climate-smart agriculture options (CSA Community Learning) to enhance their adaptive capacity and resilience to climate change.

In the 2015-2018 duration, Bui et al. (2015; 2016; 2017; 2018d) designed the overall step-wise CSV implementation process and achievements in Ma CSV. From the successful Ma CSV story, the VNUA (Vietnam National University of Agriculture) research team has raised more funding to extend the work to two more agro-ecologies in Yen Bai province. The CSV work in Yen Bai has been documented in various forms of publications, including evaluating impacts of certain CSA T&Ps (Bui et al., 2021a; 2021b; Trieu et al., 2021), farmers' perceptions of climate change in agricultural production (Vu et al., 2020; Nui et al., 2021), participatory CSA priority setting (Vu et al., 2021a), assessment of livelihood improvement CSV farmers via CSA implementation (Vu et al., 2021b), impact assessment of CSA conservation measures (Bui et al., 2020a; 2020b), documentation of CSV implementation achievements (Vernooy et al., 2015; 2018; Hoang and Vernooy, 2017), evaluation of climate risk impacts in the implementation of the NTM program (Bui et al., 2020c), to policy recommendations for CSA T&Ps and CSV adoption into the national NTM program in the 2021-2030 strategy (Bui et al., 2020d; 2020e). Furthermore, the project team submitted a policy brief for policy recommendations of adopting the CSV approach into the 2021-2030 NTM implementation nationwide (Bui et al., 2021c). To look further for the CVS's impact assessment, this CCAFS funded study aims to examine how gender, ethnicity, and other socioeconomic characteristics (age, experience, and education) can influence the processing of climate-related experience, knowledge, perception, and issue engagement in adaptive capacity to climate change impacts through CSV approach. Throughout the study, we identify key issues of ethnic community disadvantages and gender gaps. The empirical evidence highlights potential applications for developing more effective, inclusive, and informed climate change advocacy.

II. OBJECTIVES

In this study, we examine the impacts of CSA prioritization of the Ma CSV project on the change outcomes (social, economic, and environmental) and the adaptive capacities of rural mountainous farmers from the intersections of gender and ethnicity. Based on the integrated methodology (quantitative and qualitative approaches), the empirical work will specifically explore comparisons within gender groups (female and male-headed household) and between ethnic groups (Kinh majority and Cao Lan minority) to evaluate the different rates of changes on the radical adoption strategies of CSA T&Ps and scaling of the CSV approach. The results should be highlighted as a way of understanding social inequalities by gender and ethnicity to improve CSA interventions towards addressing smallholder farmers' resilience to climate change (CC) and sustainable rural development. The specific objectives of the study should be the following:

i. To unveil and explicate previously unknown social inequalities (gender and ethnicity) in the horizontal application of the CSA T&Ps within the CSV model in Ma village. This will be obtained through focus group discussions (FGDs) and in-depth interviews of pre-identified representative farmers;

ii. To compare the overall performance of the Ma farmers, focusing on gender and ethnic differences in (a) farming practices; (b) gained knowledge and perceptions of climate impacts from the CSV project; (c) opportunities to access important rural services and resources; (d) sustainable systems changes in which the CC impacts remains; and (e) synergies between men and women, Cao Lan ethnic minority and Kinh majority in joint climate actions;

iii. To identify the gender and ethnic inclusion gaps and differences in adoption of CSA T&Ps and how women and men, Cao Lan ethnic minority and Kinh majority benefit from the scalability of the CSV approach, not only within Ma village but also other villages and communities;

iv. To enhance the capacity of local government and services in adopting and advocating the CSV approach in Yen Bai's agricultural development plans and strategies, ensuring that ethnic disadvantages and women's empowerment are dealt with in coordinated climate and agricultural policy;

III. METHODOLOGY

3.1 Site selection

Located between the intersection of the Northwest midlands and mountain forests of Yen Bai province, Yen Binh symbolizes a typical district in terms of economy, politics, and culture of Yen Bai. This is also an economic exchange hub of Yen Bai province with Lao Cai and Hanoi and is the gateway to the NMR. The regions are home to many ethnic groups, which has resulted in the diversity of culture, traditions, and farming systems. Ethnic communities often reside in remote and isolated areas with special difficulties. From here, the existence of long-established customs, religious beliefs, and practices in life also makes women the most miserable social group. Like other ethnic communities in NMR, there are fewer opportunities for ethnic minority women in Vinh Kien to be educated, to rest, to entertain, or participate in social activities. In some matriarchal societies, women not only shoulder all the housework and take care of the children, but are also the main provider in the family.

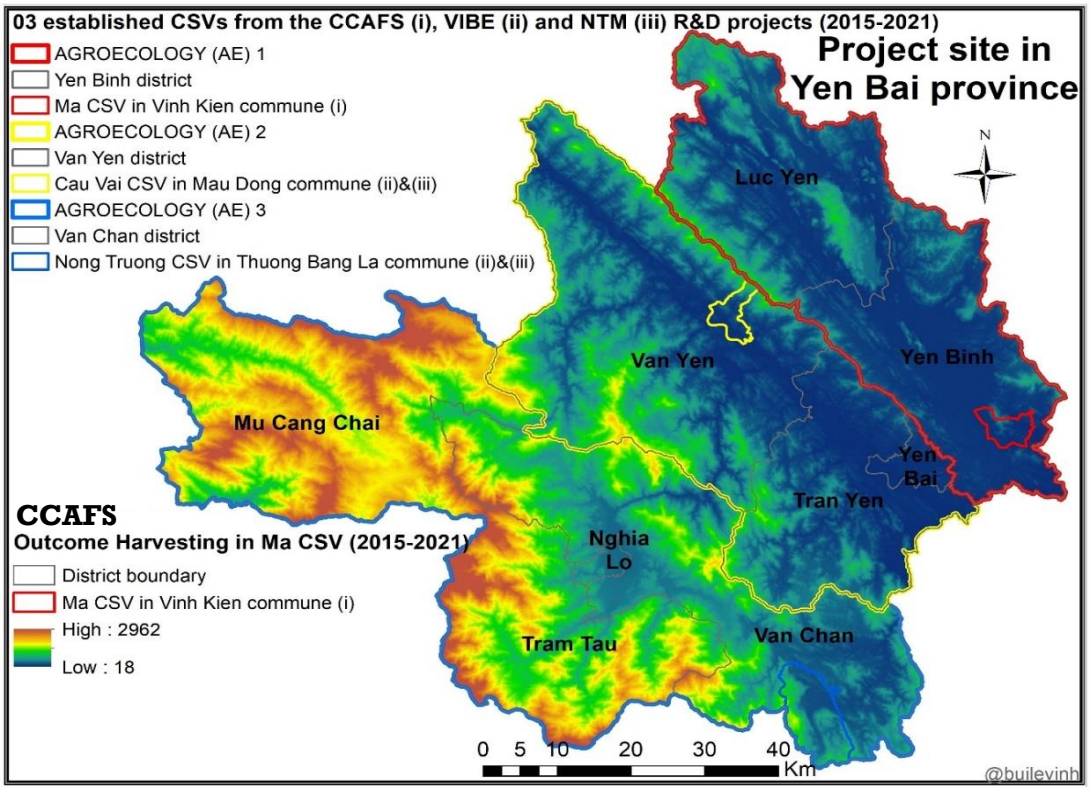

Figure 1. The research site in Vinh Kien commune,
Yen Binh district, Yen Bai province

The study was conducted in Vinh Kien commune, Yen Binh district of Yen Bai, a province in the Northern mountainous regions (NMR) of Vietnam (Figure 1). To expand study results on the impacts of CSA T&Ps beyond the CSV site level (impact diffusion), we also carried out the household investigation in the other three villages adjacent to Ma, which are the villages of Dong Cum, Ba Chang, and Da Coc. This selection enabled the research team to investigate how the CSV's intervention impacts to reach more farmers over wider areas through their gained perception knowledge, and spillover effect (Aramburu et al. 2019, Guo and Marchand 2018, Bloch 2013) in climate change resilience and adaptation. Hence, the perspective of gender and ethnic intersection, the mutually constitutive relations among rural societies, will further be explored, conceptualized, and incorporated into identical sets of questions at individual, interpersonal, and social structural levels (Huyer et al. 2021, Belkhir and Barnett 2001, Ryder and Boone 2019).

3.2 Research design

In this study, we incorporate gender and ethnicity differences in local farmers' priorities and preferences for the adoption of CSA T&Ps, which also define their differences in vulnerabilities and adaptive capacities of female and male-headed households, Cao Lan ethnic minority and Kinh majority to cope with CC impacts. Mainly guided by the intersectionality theory (Ryder and Boone 2019, Atewologun 2018, Rosette et al. 2018) and theory of change (Serrat 2017, Reinholz and Andrews 2020), we defined gender and ethnic inclusive scaling outcomes of CSV as the positive/negative changes in social, economic, and environmental sustainability accrued to the individual farmer at the communal level. Intersectionality theory is a way of understanding (the mindset and language) social inequalities by race, gender, class, and sexuality (Atewologun 2018, Fehrenbacher and Patel 2020). By examining interconnections and interdependencies between social categories and systems, Intersectionality theory is a critical framework for conceptualizing a person, group of people, or social problem as affected by several discriminations and disadvantages (Atewologun 2018, Ryder and Boone 2019, Rosette et al. 2018). Under the hypotheses of the uncertainty (Akama, Pink, and Sumartojo 2020), complex social structure (Li 2011), dynamism generated by climate change impacts (Riedy 2016), the analysis looks both at addressing gender norms and ethnic disadvantages that constraint smallholder farmer's opportunities to efficiently allocate rural resources, access to rural services, gain knowledge, and attain other benefits from CSV horizontal scaling (Huyer et al. 2021). From August to September 2021, the research team engaged every CSV farmer and non-CSV farmers in Ma and surrounding

villages in MS team calls for direct interviews and focus group discussions (FGDs). In addition, the survey also included field and home visits to observe and identify technology and practices adopted at household level to multiple integrated CSA interventions. The observation was supplementary to the interviews, which is described as "unobtrusive observation" (Robson 2002). The main aim of the study was to focus on capacity of local farmers both individually and as part of the local communities to act on priorities and CSA options as well as on issues (from gender and ethnic perspectives) they define important (Huyer et al. 2021).

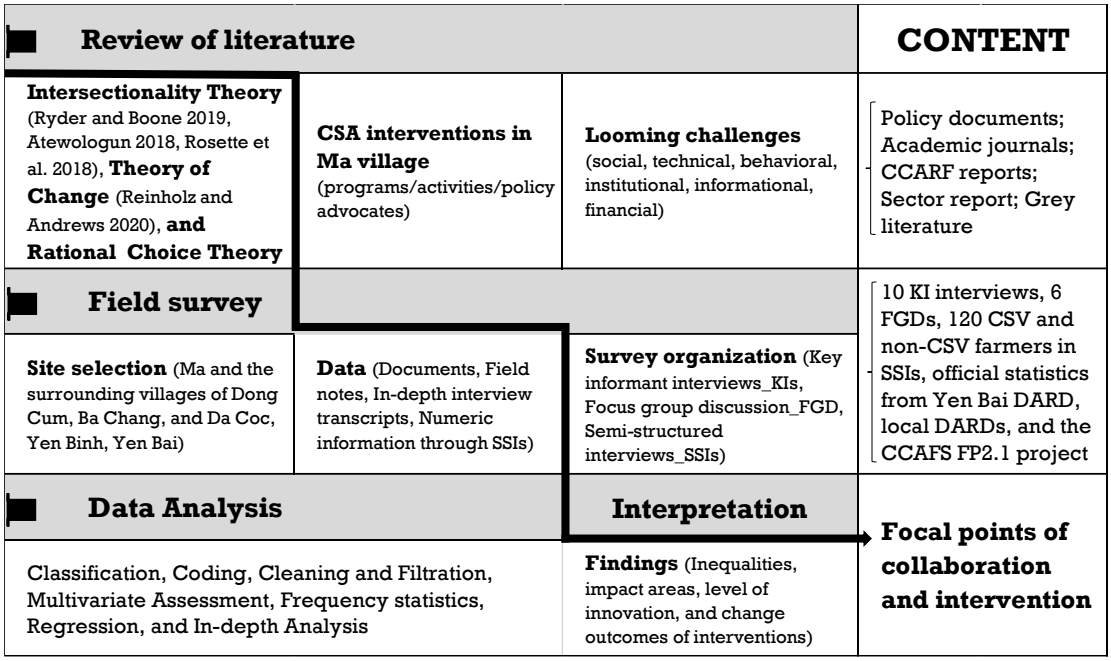

Figure 2. Research design

3.3 Data and sampling

We organized the sampling process into 2 stages where the unit of analysis is systematically grouped. The sampling technique must focus solely on the selection of respondents that were consulted by the Yen Binh local authorities, extension centers, and officers from the Yen Bai Department of Agriculture and Rural Development (Yen Bai DARD). In addition, the Farmer Association (FA), cooperative directors, and village heads were also involved in the finalizing stage of the respondent list. The first stage involved a purposive sampling of 120 household farmers in the CSV areas, consisting of Ma CSV and some villages surrounding it. In this area, CCAFS FP2.1 project carried out the identification and assessment of climate risks to select and prioritize CSA T&Ps for testing at the CSV level during 2015-2018. The second stage was

to identify groups of farmers which are the female-headed household (female) and the male-headed (male), with an expectation of 60 farmers per stratum. From this, the following classification of Caolan ethnic minority (other) and Kinh majority was supplementary to the analytical stage of intersectionality. The purpose is to ascertain each axis of inequality interacted significantly with at least one other. Among these groups, farmers are those who have adopted CSA T&Ps and the non-adopter possesses similar farming systems without CSA interventions.

The study uses all sorts of data available (primary/secondary data sources) to gain an in-depth understanding of the two-way interaction terms between the social inequality variables (regarding gender and ethnic gaps). The data collected are in various forms including project reports, project data sets, and publications, documents and statistics from Yen Bai province, key informant interviews (KIs), expert interviews, focus group discussion (FGD), and the household survey. We utilized the preliminary survey (including both KIs and FGD) to justify the structure and contents of the questionnaire as well as the respondents' understanding of concepts and terminologies in each question. Thus, we analyzed responses and incorporate modifications in the finalized questionnaire (main household survey). In addition, document analysis[4] refers to the various procedures involved in analyzing and interpreting data gathered from reports and official statistics from Yen Bai DARD, local DARDs, and the CCAFS FP2.1 project. To obtain the same amount of information and insight from in-depth interviews, the key informants[5] were selected based on their perspectives on the problems and issues regarding gender and ethnic intersection in CSV participation facing smallholder farmers. The KIs are to validate and elaborate the interpretation of the data collected in SSIs stage (Tremblay 2009). The KIs with the official staff of Yen Bai DARD and field trips are supplementary to the FDGs and SSIs.

Due to exclusion of missing cases, the empirical analysis was merely based on 116 farmer households. Table 1 describes the specific demographic information of surveyed farmers. On average, the female-headed household is characterized by 51.2 years old, 6.7 years-education level, more than 30 years of agricultural production experience, 2.4 family labors, 3.8 sao[6] farm size, and 32.6 million VND annual gross income. The t-statistics confirmed no differences in these variables between female-headed households and the male-headed. In addition, the t-statistics only showed the significant difference in annual gross income

[4] Document analysis requires that data be examinedand interpreted in order to elicit meaning, gain understanding, and develop empirical knowledge (Corbin & Strauss, 2008; Rapley, 2007).

[5] Key informant is an expert source of information (Tremblay 2009). The key informant technique is an ethnographic research method.

[6] 1 sao = 360m^2

between Cao Lan minority farmers and the Kinh majority farmers, which are 30.7 million VND and 42 million VND, respectively. The frequency distribution in statistics showed a large number of Cao Lan minority farmers coming from Ma village (38.8% of the total sample), while the number of Kinh majority farmers only account for 11.2% of the total surveyed sample. Ethnic minority farmers dominate the agricultural production in NMR but always struggle to earn their living through household economic activities despite similar socio-economic characteristics with the Kinh farmer household. As previously mentioned, Ma's surrounding villages are Dong Cum, Ba Chang, and Da Coc of Vinh Kien commune.

Table 1. Descriptive statistics

Categories		Female		Male		Minority		Kinh	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age		51.2_a	12.71	55.0_a	11.32	51.7_a	11.87	54.6_a	12.75
Education level		6.7_a	2.71	6.8_a	2.46	6.6_a	2.29	6.9_a	3.05
Farming experience		30.4_a	13.97	33.9_a	13.08	30.5_a	13.84	34.3_a	13.18
Labor		2.4_a	1.10	2.6_a	1.10	2.6_a	1.16	2.3_a	0.97
Farm size		3.8_a	4.15	3.1_a	1.72	3.4_a	3.34	3.6_a	3.43
Gross income		32.6_a	21.83	38.2_a	26.74	30.7_a	21.30	42.0_b	26.85
Categories		N	Freq	N	Freq	N	Freq	N	Freq
Location*	Other	31	0.267	27	0.233	27	0.233	31	0.267
	Ma village	36	0.310	22	0.190	45	0.388	13	0.112

Note: Values in the same row and subtable not sharing the same subscript are significantly different at $p < .05$ in the two-sided test of equality for column means. Cells with no subscript are not included in the test. Tests assume equal variances. SD denotes standard deviation. N denotes the number of households. Freq denotes frequency. * Chi-square statistics for Gender and Ethnicity: 0.883 and 11.864 (P-value: 0.347 and 0.001, respectively)

3.4 Questionnaire

The semi-structured questionnaire covers a wide range of household demographic characteristics, agricultural activities, access to rural resources and services, adopted CSA T&Ps, CC-related knowledge and perception, perceived benefits from the CSV project, and adaptive strategies to CC. We designed the questionnaire based on the existing literature of intersectionality theory, theory of change, rational choice theory, and the related CCARF documents of farmers taking action on CC. The preliminary survey that includes 2 FGDs and 5 KIs interviews (Ma village) was not only to ensure how the farmer would be able to answer the questions but also to identify the potential problem of missing information. The set of both closed and open-ended questions was designed in the questionnaire by the dichotomous and

non-dichotomous choice approaches using revealed preference[7] techniques (Varian 2008, Adams and Crawford 2015).

3.5 Data analysis and choice modeling of CSA adoption

The data analysis was carried out in two steps by using the Statistic Package for Social Science (SPSS 22.0). First, data were analyzed using statistics of frequency distribution, Chi-square, and Z-test statistics based on categorical variables. The simple descriptive analysis served to identify basic demographic characteristics of farmer households under four different groups of ethnic and gender-inclusive in CSA T&Ps adoption. The variables refer to farmer's CC-related adaptation decisions (adoption of CSA T&Ps) under the horizontal scaling (out scaling) of CSV project including individual knowledge and perception, access to rural services, resource allocation, suffering from negative CC impact, benefits from CSV, and adaptive capacities. To model farmers' choices of CSA T&Ps adoption, the empirical logistic model was employed in the second step of the analysis. The employed binomial logistic regression based on random utility theory (McFadden 1973, Greene 2000) is a non-linear regression model that has a dichotomous dependent variable. Logistic regression coefficients can be used to estimate odds ratios for each of the independent variables in the model. The independent variables can be either dichotomous, non-dichotomous, or continuous. The basic participation decision is a dichotomous choice, so the logistic was widely applied (Lee and Stewart 1983, Soule, Tegene, and Wiebe 2000, Sheikh, Rehman, and Yates 2003). An individual farmer is assumed to maximize the expected utility gain from the adoption of CSA options. The theoretical model is formulated as follows:

$$y_i^* = \beta_0 + \sum_{j=1}^{k} \beta_{ij} x_{ij} + u_i$$

Where the x_{ij} represents a set of explanatory variables, β_{ij} are estimated coefficients, and u_i is an error term assumed to follow the logistic distribution. The y_i^* known as an unobserved latent variable indicates farmers' net utility gain from the adoption. The observed dummy variable y_i is specified as farmers' decision to adopt.

$$Willingness\ to\ adopt = \begin{cases} 1\ if\ y_i^* > 0 \\ 0\ if\ y_i^* \leq 0 \end{cases}$$

Empirically, the probability density function of willingness to adopt is characterized as:

[7] Revealed preference is a way to infer the preferences of individuals given the observed choices.

$$\log\left\{\frac{p_i}{1-p_i}\right\} = \beta_0 + \sum_{j=1}^{k} \beta_{ij} x_{ij}$$

In this study, farmers' willingness to adopt will be measured by a dichotomous variable that takes a value of one for "agreed" and zero for "disagreed". The explanatory variables represent 5 groups of factors that influence farmers' decisions, which are selected from related existing literature (intersectionality theory, theory of change, rational choice theory, and documentations from CCAFS FP2.1 project) and pretested in a preliminary survey. Accordingly, these are demographic characteristics of coffee farmers (DEM), training participation (TRP), perception of CC impact (PCC), access to rural resources and services (ARS), and perceived CC impacts (CCI). The final logistic model was specified as bellows:

$$\log\left\{\frac{p_i}{1-p_i}\right\} = \beta_0 + \sum_{d=1}^{5} \beta_{id} DEM + \sum_{t=1}^{3} \beta_{it} TRP + \sum_{p=1}^{3} \beta_{ip} PCC + \sum_{a=1}^{4} \beta_{ia} ARS + \sum_{c=1}^{7} \beta_{ic} CCI$$

As most regression has to deal with the problem of multicollinearity and heteroskedasticity, the multivariate assessment was also included. With the presence of multicollinearity, the standard error will increase. The multicollinearity test was utilized using the variance inflation factor (VIF) and the Eigenvalue (Wurst, Neter, and Godfrey 1989). However, no multicollinearity problems among variables in the sample were detected by the VIF test. The variance inflation factor (VIF) ranges from 1.255 to 4.965 and the tolerance ranges from 0.201 to 0,797 (Table B1 Appendix). Also, Breusch-Pagan and Koenker test statistics confirmed no presence of heteroskedasticity that BP test statistic equals 0.682 and Koenker test statistic 0.277 (Table B2 Appendix). The existence of heteroscedasticity is a major concern in regression analysis and the analysis of variance, as it invalidates statistical tests of significance (White 1980).

3.6 Research limitations

The site selection of the study might be an issue because there exist unobservable variables (preference, motive, social embeddedness...), which would lead to biased results. Further, if the selection of the farmer groups is an issue, which is sometimes called heterogeneity bias, "failure of common support" or "spillover effects" to the comparison group, this would have slightly been a concern in evaluating the impacts of the CSV horizontal scaling. In addition, the empirical results pertained from the small research sample, so the study was not extrapolated to the entire rural system of Yen Bai. Finally, online surveys through the MS team may suffer from two serious methodological limitations: the population to which they are distributed cannot be described, and respondents with biases may select themselves into the

sample (Andrade 2020). However, the sample of 120 household farmers in the CSV areas was selected via a process of ‘‘theoretical sampling’’ (Glaser and Strauss 1967) based on their adoption decision and their potential to offer distinct and important perspectives on CSA options and recent CSV-related issues.

IV. FINDINGS

4.1 Agricultural activities and adopted practices

Ma village, Vinh Kien commune (Yen Binh district, Yen Bai province) has about 200 households, with 750 people, of which 50% of the population is the Cao Lan ethnic group. The main income of the people here is mainly from animal husbandry and forestry production. In recent years, Ma village is often affected by natural disasters, especially prolonged drought, unusually heavy rain, and sudden cold spells. Figure 3 indicated five household production activities in Ma and surrounding villages including staple crops, fruit and vegetable, industrial crop, poultry, and livestock. There are a significantly higher number of farmers who are cultivating staple crops (such as rice, maize, cassava...) with poultry and livestock production. Z-test statistics (Table A1 Appendix) showed no differences in agricultural activities between the female and male groups of farmers but significant differences between Cao Lan minority and Kinh majority farmers. Cao Lan farmers tend to focus more agricultural activities on staple crops (97.2%) and industrial crops (72.2%) rather than fruit and vegetable by the Kinh majority farmers (56.8%).

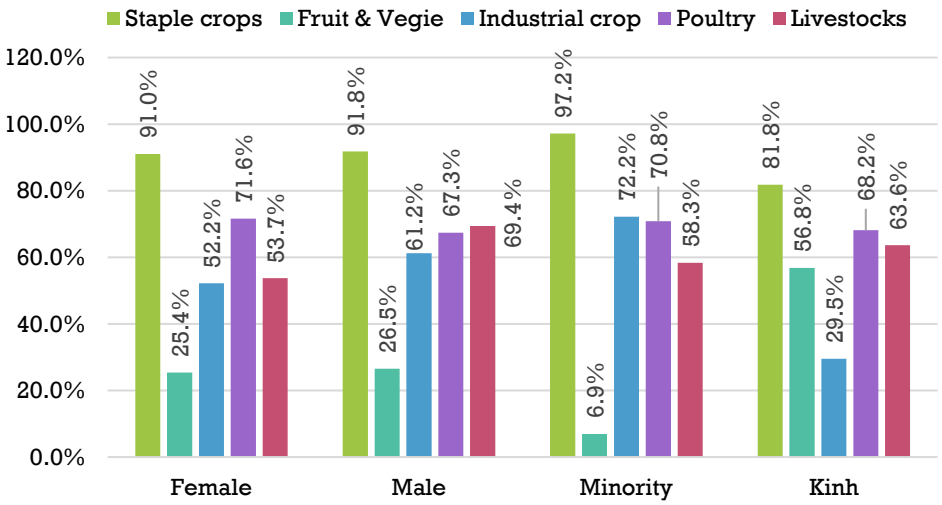

Figure 3. Household's agricultural activities

Note: Chi-square statistics (df 1) for each variable in gender and ethnicity categories equal to 0.02, 0.02, 0.93, 0.25, 2.9 and 8.23*, 35.43*, 20.19*, 0.09, 0.32, respectively. * The Chi-square statistic is significant at the 0.05.

In 2014, the Program on Research on Agricultural Climate Change and Food Security in Southeast Asia (CCAFS-SEA) of the Consultative Organization for International Agricultural Research (CGIAR), selected Ma village to implement the model "Climate-smart village (CSV)". Participating in the model has significantly helped diversify agricultural production in Ma against severe impacts of climate change, food insecurity, adaptive incapability, and climate-related risk aversion of small household farmers. Until now, there are a majority of farmers who have continued to maintain CSA T&Ps in their agricultural production. The most favorable CSA practices are the integrated home garden and rice straw processing (see Figure 4). The description of these CSA T&Ps can be found in Bui et al (2015, 2016, 2017) that include: CLI (Cassava-legume intercropping); CCGT (Cassava-contoured grass strips); VC (Vermicomposting); AWD (Alternate wetting-drying); RSP (Rice straw processing); IHG (Integrated home garden). Z-test statistics (Table A2 Appendix) only indicated the significant difference of adopted IHG between Cao Lan minority and Kinh majority farmers as Kinh farmers favored this model more than the Cao Lan (56.8% vs 37.5%). IHG model is the most appropriate and income-generated practice related to soil and climatic conditions in Vinh Kien.

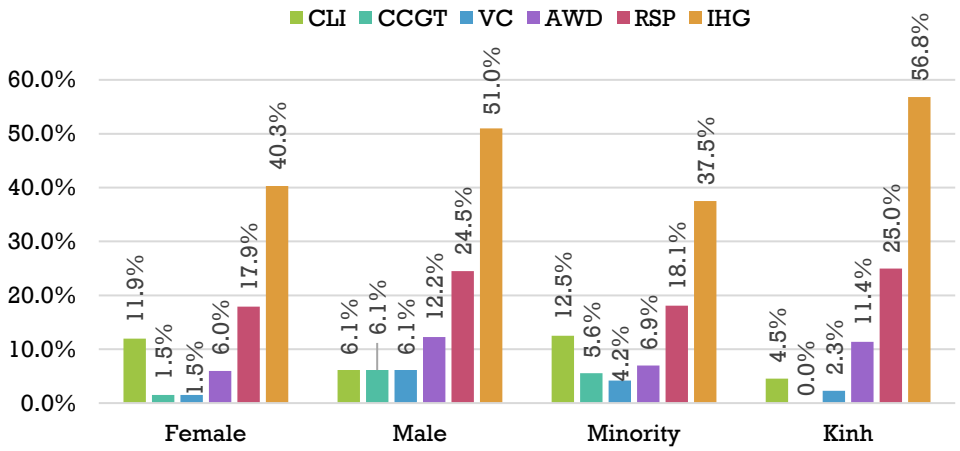

Figure 4. Adopted agricultural practices

Note: Chi-square statistics (df 1) for each variable in gender and ethnicity categories equal to 1.116, 1.822, 1.822, 1.415, 0.747, 1.315 and 2.013, 2.532, 0.294, 0.677, 0.803, 4.121*, respectively. * The Chi-square statistic is significant at the 0.05. CLI (Cassava-legume intercropping); CCGT (Cassava-contoured grass strips); VC (Vermicomposting); AWD (Alternate wetting-drying); RSP (Rice straw processing); IHG (Integrated home garden)

4.2 Gained knowledge and perception

In Vinh Kien, the main source of household agricultural knowledge is accumulated self-experience, knowledge exchange between farmers in the local communities, and gained knowledge in training (Figure 5). The only significant difference in farmer's source of knowledge was found between the groups of Cao Lan minority and Kinh majority farmers as only 22.7% of surveyed Kinh farmers reported that their agricultural knowledge is partly from CSA training (see Table A3 Appendix). The same statistic was significantly higher in the group of Cao Lan farmers (45.8%). Cumulated knowledge from self-experience and knowledge circulated in the exchange between farmers is the sub-set of local knowledge that enables them to farm in specific local conditions. It is based on their practical experience and often linked to a practical skill (Šūmane et al. 2018).

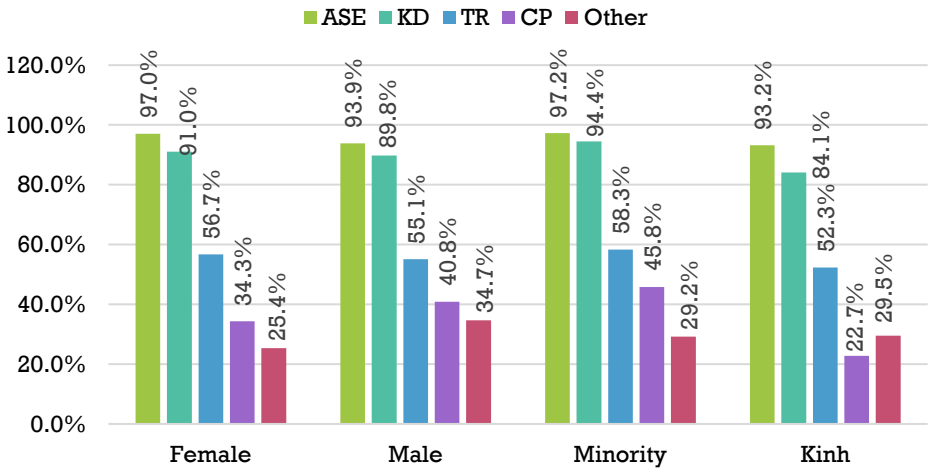

Figure 5. Source of farming knowledge

Note: Chi-square statistics (df 1) for each variable in gender and ethnicity categories equal to 0.675, 0.051, 0.03, 0.511, 1.187 and 1.081, 3.411*, 0.407, 6.250*, 0.002 respectively. * The Chi-square statistic is significant at the 0.05. ASE (Accumulated self experiences), KD (Knowledge diffusion), TR (Knowledge from extension training activities), CP (Common knowledge from project participation), and other source of knowledge.

In fact, smallholder farmers always produce far below their potential yields, often due to poor farming practices and poor access to extension training. CSV program facilitates training in good agricultural practices to help farmers effectively cultivate their crops, and increase their harvests. However, Table 2 showed that Kinh farmers seem to benefit significantly more than Cao Lan farmers as more of them could be able to participate in AP and CCF training (see Z-test in Table A6 Appendix). In the aspect of gender inequalities in training participation, the significantly higher number of female farmers reported that they hardly ever take part in training to improve their agricultural knowledge and skills (also see Z-test in Table A6 Appendix). Like another developing world, it is ironic in Viet Nam that women generally continue to form a large majority of the working poor, earn less income, and are more often affected by under- and un-employment and precarious working conditions than men. Women in Viet Nam are principally found in lower-paid occupational sectors or vulnerable employment. Foremost, Vietnamese women often have less access to productive resources, education, skills development, and labor market opportunities than men (Khuat et al. 2016, Goodkind 1995).

Table 2. Participation in training

Categories		Female		Male		Chi-square	Minority		Kinh		Chi-square
		N	Freq	N	Freq		N	Freq	N	Freq	
Training content	AP	34	0.507	17	0.347	2.96	37	0.514	14	0.318	4.246*
	CCF	19	0.284	18	0.367	0.914	30	0.417	7	0.159	8.341*

	APM	18	0.269	10	0.204	0.644	15	0.208	13	0.295	1.132
	MMA	1	0.015	0	0.000	0.738	1	0.014	0	0.000	0.616
	AOT	2	0.030	0	0.000	1.488	1	0.014	1	0.023	0.126
Training sequence	frequently	23	0.343	23	0.469	8.1	30	0.417	16	0.364	4.223
	sometimes	4	0.060	4	0.082		5	0.069	3	0.068	
	occationally	3	0.045	0	0.000		3	0.042	0	0.000	
	hardly ever	12	0.179	2	0.041		6	0.083	8	0.182	

Note: Results are based on nonempty rows and columns in each innermost subtable. *. The Chi-square statistic is significant at the .05 level. AP. Agricultural practices. CCF. Climate change forecasting. APM. Agricultural production planning and management. MMA. Marketing and market access. AOT. Application of ioT in farm management.

Rural contexts and rural social structures are crucial to farmers' knowledge (Thomas, Riley, and Spees 2020). Access to information pertaining to CSA T&Ps is essential to improve farmers' knowledge in maintaining and increasing farm productivity. Figure 6 exhibits positive knowledge improvement through the horizontal scaling of CSA options. The least knowledge improvement regarding risk management while most farmers in four groups have improved their knowledge in terms of animal & plant breeding and varieties (more than 90% of farmers in each group). Z-test statistics confirm the only significant difference between the group of Cao Lan and Kinh farmers in terms of fertilizer use and management (Table A4 Appendix).

Farmer interaction plays a significant role in facilitating learning processes as farmers actively build knowledge upon the exchanges and responses of others (Thomas, Riley, and

Spees 2020). Figure 7 indicated 6 different types of knowledge that farmers in Vinh Kien share with each other in daily life, which include new technology, managerial skills, climate information, policy, market information, and agricultural-related risks. The majority of farmers in most groups exchanges knowledge of technological practices and climate information (more than 95%). Z-test statistics displayed no significant difference in each type of knowledge exchange among four groups of farmers (Table A5 Appendix).

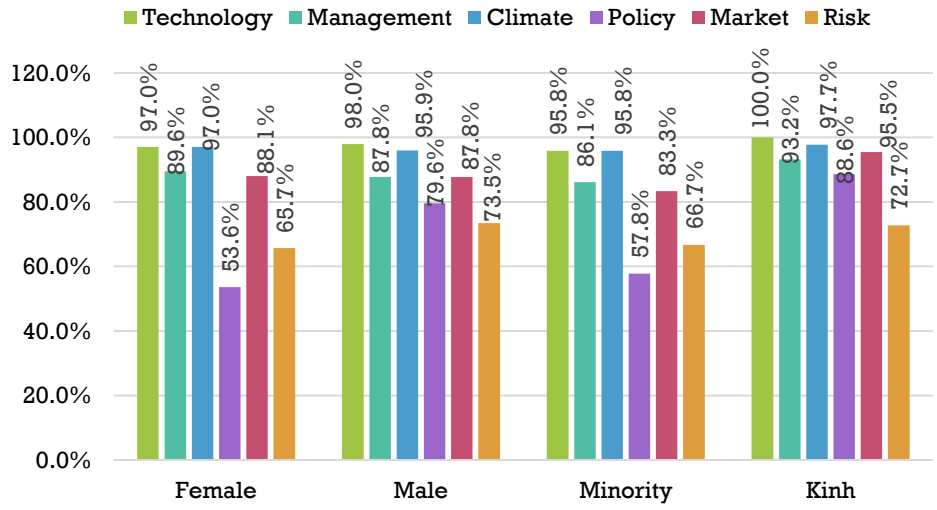

Figure 7. Knowledge exchange

Note: Chi-square statistics (df 1) for each variable in gender and ethnicity categories equal to 0.1, 0.092, 0.102, 0.304, 0.002, 0.804, and 1.882, 1.372, 0.294, 2.172, 3.781, 0.469 respectively. * The Chi-square statistic is significant at the 0.05.

4.3 Access to rural services

Access to quality services and local infrastructure are vital parts of supporting sustainable and resilient rural farmers (Halseth, Markey, and & Ryser 2018). Rural services encompass service delivery, promoting inclusivity, market orientation, and empowerment of small-scale farmers as informed actors in agri-food systems. It draws on the plurality of support institutions and service providers, from the public, private, and farmers organizations, to cater to the wide range of services required by smallholder farmers to increase productivity, manage agricultural activities, act collectively, and link to profitable markets. Farmers organizations and cooperatives play a central role in this respect, both as service providers and as mediators with other actors on behalf of their members and communities, to enable collective economic action and effective engagement in transformative processes. Access to such services is also a major issue in the discourse of gender empowerment, especially in remote rural areas. Several rural services in Ma village are found in the survey that includes extension, finance, science and technology, climate change, and market access services. The

extension service in Vinh Kien is a crucial factor for farmers to access new scientific and technical advances in agriculture, through a team of extension engineers. They closely cooperate with research institutes, universities, and other professional agencies to conduct training sessions, scientific seminars, test new products and varieties, demonstrate new agricultural models, etc. Figure 8 showed that more than 60% of female and male farmers have access to extension, finance, science and technology, and climate service. Among the groups of Cao Lan and Kinh farmers, it is surprising that only 50% of Kinh farmers reported having access to science and technology services. The z-test statistics also confirmed the significant difference between farmers in these groups in terms of having access to S&T and market services. Undoubtedly, farmers in most rural mountainous areas in MNR do not have good market access. However, it is interesting fact that Cao Lan ethnic minority in Vinh Kien is recently having a better link to the market than Kinh people (see Table A7 in the Appendix).

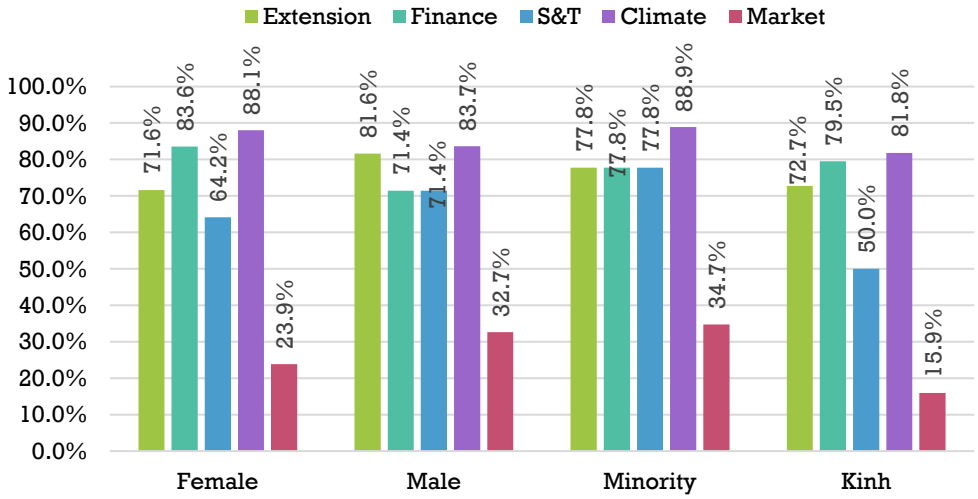

Figure 8. Access to rural services

Note: Chi-square statistics (df 1) for each variable in gender and ethnicity categories equal to 1.543, 2.473, 0.675, 0.458, 1.090, and 0.380, 0.050, 9.567*, 1.148, 4.839*, respectively. * The Chi-square statistic is significant at the 0.05.

Through FGDs, CSV-participant farmers (Cao Lan group) have stated that they can benefit from CSV's agricultural insurance that covers the risk of crop failures and livestock losses due to abnormal weather changes. The CSV program also financially encourages farmers to use fuel-saving machine tools, manage agricultural by-products, apply measures to save water for crop irrigation (take advantage of groundwater, rainwater), and establish community teams to effectively consult and protect water sources.

4.4 System changes from CSV approach

Analysis of positive economic changes consists of variables related to the household's agricultural production efficiency, which include: the IYP (Increased yield and productivity of household agri-products), IQAP (Improved quality of household agri-products), DCI (Decreased cost of input use), BRM (Better risk management in production planning and sale), DCL (Diminishing cost of household labor), and BMC (Better market access). Descriptive statistics in Figure 9 unveiled the most positive economic changes in terms of IQAP (more than 85% reported in four groups) and DCL (especially in the group of Kinh farmers). The least change is related to other types of economic improvement, i.e. price premium, partnership, and other transaction cost attributes…The z-test statistics showed no statistically significant difference in terms of economic changes among groups of farmers (Table A8 Appendix).

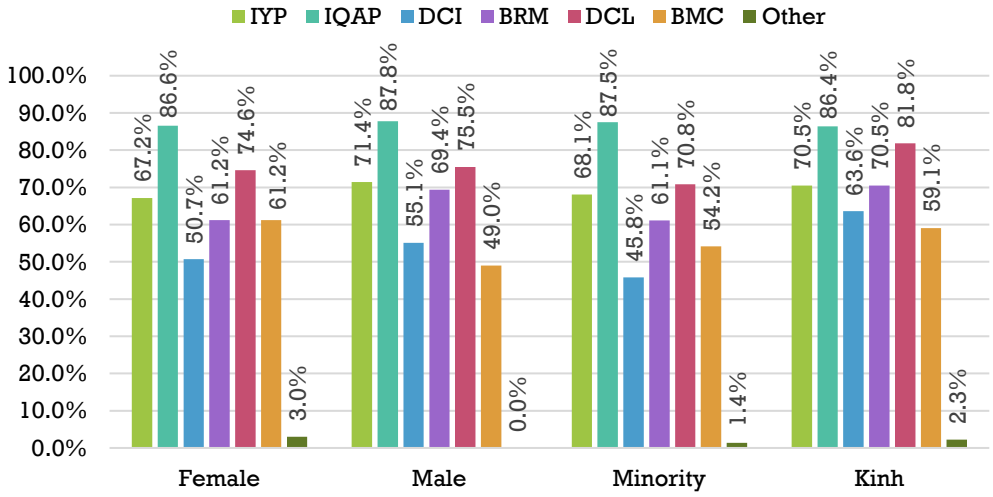

Figure 9. Positive economic changes

Note: Chi-square statistics (df 1) for each variable in gender and ethnicity categories equal to 0.24, 0.035, 0.215, 0.831, 0.012, 1.714, 1.488 and 0.073, 0.031, 3.472, 1.043, 1.758, 0.269, 0.126 respectively. * The Chi-square statistic is significant at the .05.

All of the farmers interviewed reported that their income has increased over the last five 5 years. Reasons for the income increase include reducing production inputs cost (vermiculture provides worm for animals, straw and dung composting provides organic fertilizer), enhancing productivity, reducing labor cost; rearranging labor division; diversifying farming activities, and CSA based livelihoods (chicken raising, integrated home-garden, eucalyptus planting, fishing, …). While some farmers have changed their livelihood from focusing on rice to more crop diversification and market orientation, 70% of Ma villagers participate in the wood business. In addition to animal husbandry and crop production, fishing is an important livelihood. Ma people fish and engage in aquaculture in a large area of water (500ha) surface from Thac Ba lake located very near to the village center (only 10 -15 minutes on foot). In 2014

there were only 60 fish cages owned by 30 households with an average yield of 0.5 tons/cage/year, bringing an income of about 30 million VND per cage per year. Currently, there are more than 200 cages owned by Ma villagers.

Analysis of social aspects related to the change outcomes of CSV's interventions focusing on the following variables including SDL (standard of living of the household family), FS (family solidarity), KDCA (increasing knowledge diffusion and collective action among household members), IHC (improved health conditions), CAMI (improved communication and access to market information), CATE (improved capability to access to technology and extension services), CAFI (improved capability to access to finance and insurance markets), ACCC (improved adaptive capabilities to climate changes), GI (decreased gender inequity in household's agricultural activities and decision-making process). Figure 10 exhibit the most positive social change in terms of SLD and FS (more than 90% reported in four farmer groups). Z-test statistics showed no difference of social positive changes between farmer groups (Table A10 Appendix).

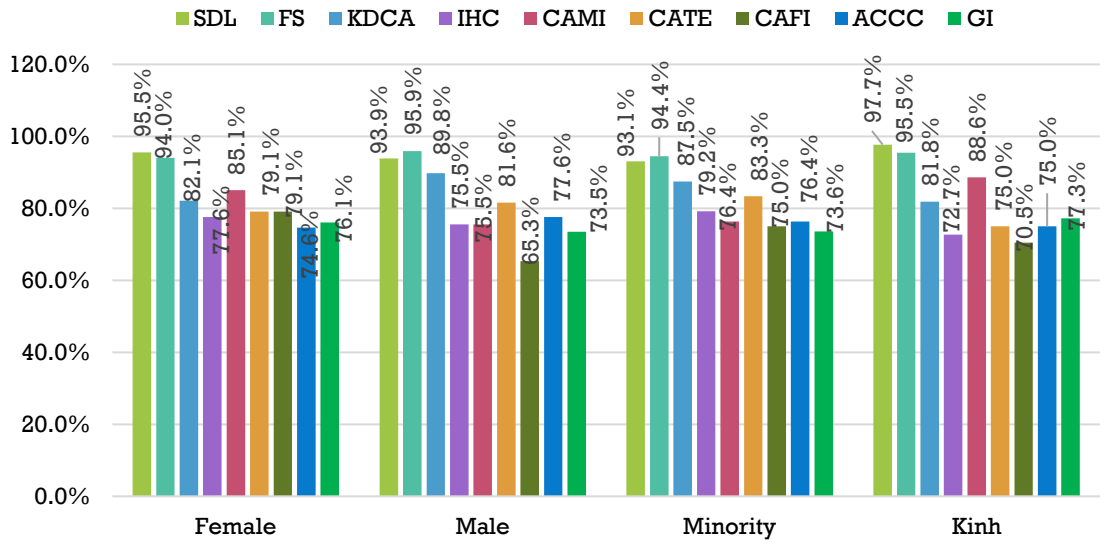

Figure 10. Positive social changes

Note: Chi-square statistics (df 1) for each variable in gender and ethnicity categories equal to 0.24, 0.035, 0.215, 0.831, 0.012, 1.714, 1.488 and 0.073, 0.031, 3.472, 1.043, 1.758, 0.269, 0.126 respectively. * The Chi-square statistic is significant at the .05.

As the main aim of this study is to focus on gender empowerment in CSA options implemented at the communal level, female farmers identified a range of personal development outcomes including confidence, awareness, and a range of skills about key CSA T&Ps. For many years, there has been a hidden gender norm that affects the division of labor between men and women in most agriculture activities in the village. In conservative villages, men tend to be afraid of change since there is a danger of losing their authority and masculine power. In more

conservative villages, male farmers may prefer utilizing the existing resources rather than learning new different technologies and/or planting new crops/ Some new technologies may be aimed at supporting women but their husband and mother-in-law may feel jealous and therefore they may not approve of young wives' participation in the project. In Ma village, women have a lot of work and they said that additional labor input was not acceptable.

In Ma village, marriage rules and practices have been simplified through intermarriage between Kinh ethnic majority and Cao Lan ethnic minority. If the wife is Kinh and the husband is Cao Lan, men reduced their power. Men make most of the important decisions within the family. Women may be consulted, but men make the final decision, and women are enjoined to follow the guidance and direction of men. Women's roles are often limited to domestic tasks and childcare. Women guard household money, but the final decision of how to use this money is made by men. In agricultural production, both men and women are involved in crops and animal husbandry, but they divide the tasks based on a rule that men automatically take on the heavier work and women the lighter tasks. Often, men tend to do hard jobs, mostly at the planting and harvest time like land preparation and transportation whereas women do a lighter job such as plant management during the season. Women often do more jobs and have more voice in making a decision relating to short-term investments like planting and harvest of annual crops, selling food products, purchasing household commodities. On the other hand, the men have more role in deciding on long-term investment such as cultivating perennial plants, developing an integrated farming system, and selling and purchasing goods/products of big value. In eucalyptus-growing activities, men take on most of the work, especially the heavier tasks. Women are also involved but only with the lighter work. Women's tasks tend to include clearing grass, fertilizing, and drying while men focus more on planting, pruning, digging drainage around the roots; watering cutting activities. Men and women have an equal share in harvesting and selling the product. Overall, men make the decisions on almost all of the work, for example, selection of seeds, borrowing money to invest in production; or buying/selling high-value equipment. To explain this division, local people do not conceive the issue of "who does what" in the family. For them, it is simply that each person should do one thing and whoever does something better from their experience should continue working on it. There is a perception from the community that women are physically weaker and more suited for housework rather than for job opportunities outside the village, while men being stronger, are capable of heavier work or working faraway. Thus, gender stereotypes make both men and women incapable of recognizing the inequality in the then division of labor in agriculture-related activities.

In the context of climate change, gender norms also block women from the opportunities and resources to adapt to their roles effectively. While both sexes are affected by climate change impact it is women, given they are in charge of crop and animal management, are likely to be more affected. Historical climate events in Ma showed that women often bear the burden of post-flood recovery, with responsibilities for cleaning and clearing houses of debris. They are also heavily involved in community work such as environmental sanitation and ditch dredging. There was also a common concern about the impact of temperature extremes on human health. Children were frequently sick in the hot weather after playing in dirty water, and during cold snaps, they often came down with colds, coughs, and fevers. Women were unable to work in the field or collect forest products in these situations, leading to lost productivity. In addition, temperature extremes were also linked to animal disease and mortality, increases in pest outbreaks (such as chicken mites), and damage to stored food. Prolonged cold spells also increase the need for firewood. This adds to the burden on women and female children, who may spend up to two hours a day collecting firewood. During drought seasons (October-May) women from households that have no access to a water pipe have to carry water from the spring to their houses, which can take several hours each day. Women are also responsible for the irrigation of fields and vegetables. This task increases the work burden of ethnic minority women, leaving less time for other productive, family, and cultural activities. The CSA project has created a positive shift in women's resilience, which in turn changes power relations between men and women in Ma. The first change began when more and more women participated in the project activities (CSA training, group discussions, workshops, Photovoice).

To identify the positive environmental changes, analysis was focused on the following variables: EP (decreasing environmental pollution from burning straw, overuse of pesticide and fertilizer, etc., CCI (eliminating the appearance of extreme weather events such as flood, drought, hail…etc..), SQ (improved soil quality), BD (sustain the appearance of bio-diversity in the agriculture), ID (eliminated impacts of insect and diseases), and WM (better water use management). Figure 11 indicates the most significant environmental changes are the WM, SQ, and the EP from the opinions of farmers in four groups. During the interviews, it was repeatedly identified that farm production is facing problems such as increased climate hazards, soil erosion, and water pollution. The cultivated lands of Ma village in the past were of better quality but now the degradation and erosion of cultivated lands are a major concern. In the upland part, serious soil erosion often occurs due to unusual high-intensity rainfall. The high soil erosion level, in turn, creates the need for the use of greater inorganic fertilizer inputs and causes considerable sediment in the lake, river, and canal systems, and reduction

of water quality for domestic and production use. Soil quality not only affects rice but also fruit trees.

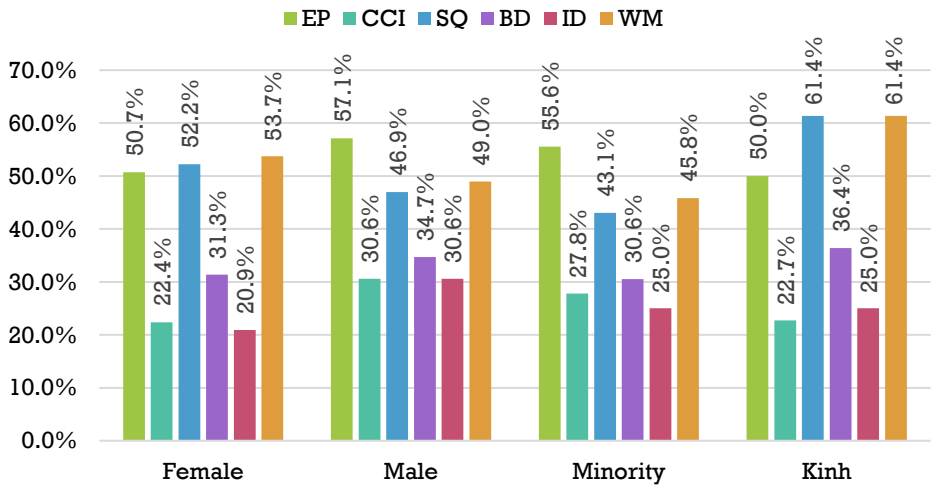

Figure 11. Positive environmental changes

Note: Chi-square statistics (df 1) for each variable in gender and ethnicity categories equal to 0.465, 0.998, 0.318, 0.144, 1.425, 0.256 and 0.339, 0.363, 3.662, 0.418, 0.00, 2.638 respectively. * The Chi-square statistic is significant at the .05.

Villagers expressed great concern about the water pollution in all rivers, lakes, and streams system. Farmers reported that currently, the river water cannot be used for domestic use and animals to drink because 'water quality is so bad'. Old people said that before 2000, the water in Thac Ba lake and also in the local river systems were "high and clean" and could be used for both animals and villagers. Natural aquaculture resources were plenty and diverse. Recently water pollution has become a significant environmental problem in Agri production and human consumption. In addition, farmers in Ma village use water from a small stream originating from Cao Bien Mountain to irrigate their crops. Unfortunately, the water volume of this stream is very low and also polluted. The level of water pollution has reached a serious level as partly reflected by the popularity and frequency of cancer disease in the village. The degradation of the water in Ma village is attributed to different reasons: i) too much and improper use of fertilizers and pesticides for crops; (ii) improper management of waste from animal production, human living activities, and from cassava processing facilities; iii) massive exploitation of sand and gravel in the region. In addition, there have been a lot more diseases among crops/plants, cattle, and aquaculture than before. Fungi are a major disease to cassava, which makes cassava leaves turn yellow/reddish. Reduced levels and flows of water in lakes and rivers affect fish farming. Extension officers and villagers also reported about recent African swine fever in the region. In 2020 and 2021 Lumpy Skin Disease among cattle is widely occurred, impacting many cows in Vinh Kien commune.

4.5 Choice of CSA adoption

The binomial logistic regression was used to assess farmers' willingness to adopt CSA T&Ps (CSA options) from the CSV project piloted in Ma village. The common measures of goodness of fit in the choice model are the *pseudo-R^2* that equals 0.435 (Cox & Snell R square) and 0.59 (Nagelkerke R- Square). This suggests that the model explains approximately 43.5% and 59% of the variation in the outcome. The *pseudo-R^2* ranges from zero to one, and the logistic model with a *pseudo-R^2* value between 0.2 and 0.4 refers to having a good model fit. In addition, the Hosmer and Lemeshow test of the goodness of fit suggests that the model was a good fit to the data as P-value equals 0.237 (> 0.05). A test of the full model versus a model with intercept only was statistically significant at $p < 0.01$ according to the Chi-square statistics that equals 66.259 (P-value = 0.000). The odds ratio Exp (B), the exponentiation of the coefficients, indicates the likelihood that a farmer's adoption decision occurs. The sign of B predicts whether the estimated variable influences adoption decisions positively or negatively.

The estimation results showed that farmers' willingness to adopt CSA T&Ps (CSA options) from the CSV project was influenced by several factors. Those include gender (Gen), training of agricultural practices (TrAP), training of agricultural production management (TrAM), access to extension service (AcES), access to climate change service (AcCS), PeEW (perception of extreme weather), and depleting water source (PeEW) (Table 3). A positive estimated coefficient indicates an increase in the likelihood that a farmer will be willing to adopt CSA T&Ps. The discussions of marginal effect Exp (B) are in terms of the statistical significance and sign of the estimated coefficient. The marginal effect greater than one refers to the probability of farmers' adoption of CSA T&Ps relative to the probability of farmer' non-adoption increases as the variable increases. Variables that have significant and positive impacts on farmers' adoption of CSA T&Ps include gender (Gen), training of agricultural practices (TrAP), training of agricultural production management (TrAM), access to extension service (AcES), and farmer's perception of extreme weather (PeEW). The positive estimated coefficient of these variables indicates an increase in the likelihood that farmers who are male, participated in the training of agricultural practices and production management, had access to local extension services, and experienced extreme weather events, are willing to adopt CSA T&Ps within the CSV framework. The marginal effects of positive estimated coefficients refer to an increase by the respective factors of 4.3738, 9.1176, 9.3069, 4.1417, and 8.7386 the probability of farmers' adoption of CSA T&Ps if the variables Gen, TrAP, TrAM, AcES, and PeEW increase, *ceteris paribus*. On the contrary, variables that have significant and negative impacts on farmers' compliance were the AcCS and DWS. The negative estimated coefficients of EXPE and IRRI indicate an increase in the likelihood by the respective factors of 0.0284 and 0.1003

that farmers who had access to rural climate services and suffered depleting water sources might refuse to adopt CSA options, *ceteris paribus*.

Table 3. Logistic model estimation and determinants of farmers' decision

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Constant	-3.2190	2.9078	1.2255	1	0.2683	0.0400
Age	0.0544	0.0476	1.3063	1	0.2531	1.0559
Gen	1.4756	0.6945	4.5151	1	0.0336**	4.3738
Ethnicity	0.9510	0.7432	1.6371	1	0.2007	2.5883
Education	0.2198	0.1351	2.6485	1	0.1036	1.2458
Experience	-0.0207	0.0431	0.2314	1	0.6305	0.9795
TrAP	2.2102	0.7761	8.1107	1	0.0044**	9.1176
TrCC	1.1496	0.8028	2.0507	1	0.1521	3.1570
TrAM	2.2308	0.8066	7.6484	1	0.0057**	9.3069
AcES	1.4211	0.7907	3.2305	1	0.0723*	4.1417
AcTS	-0.3117	0.7330	0.1808	1	0.6707	0.7322
AcCS	-3.5626	1.2767	7.7872	1	0.0053**	0.0284
PeEW	2.1677	1.3038	2.7642	1	0.0964*	8.7386
PeCI	0.2656	0.8911	0.0888	1	0.7657	1.3042
PeA	0.0380	0.8691	0.0019	1	0.9651	1.0388
PeCA	-0.9603	0.7883	1.4842	1	0.2231	0.3828
DSN	-2.4634	1.6395	2.2577	1	0.1330	0.0851
BI	-0.3727	1.0929	0.1163	1	0.7331	0.6888
DWS	-2.2994	1.3698	2.8179	1	0.0932*	0.1003
IID	3.1165	2.2143	1.9809	1	0.1593	22.5666
CF	1.0038	1.9580	0.2628	1	0.6082	2.7286
AEP	-0.0775	1.4808	0.0027	1	0.9583	0.9254
DR	0.9910	0.9598	1.0660	1	0.3019	2.6939
N: 116; -2 Log likelihood: 88.673; Cox & Snell R Square: 0.435; Nagelkerke R- Square: 0.59; Chi-square (Hosmer and Lemeshow test): 10.413 (Sig 0.237); Chi-square (Omnibus test): 66.259; Sig: 0.000.						

Note: B. Estimated coefficient. S.E. Standard error. Wald. Wald test. Df. Degree of freedom. Sig * and ** denote significant at P < 0.1 and 0.05. Exp (B) indicates marginal effect.

4.6 Adaptive strategies and joint climate actions

All farmers have become more aware of the CC phenomena. For decades, poverty is exacerbated by the combination of climate hazards and their limited capacity to recover or potentially adapt. Possible interventions by households and communities to reduce disaster risks, such as acacia or eucalyptus planting, are limited due to the lack of access to resources in the community and limited support. Compared with the climate conditions 20 years ago villagers noted many changes regarding the rainy season and dry season: the rainy season

lasted from June/July to January next year with somewhat evenly distributed rains. Nowadays, the rainy season starts in late March/April and ends in September with very unevenly distributed rains. During the rainy season, there are months with lots of rain and also months with no rain at all. Figure 12 displays the overall picture of farmers' perception of extreme precipitation in Vinh Kien. Z-test statistics only indicated the difference of farmers' perception toward cold/hot spells weather events between Kinh and Cao Lan farmers (Table A11 Appendix).

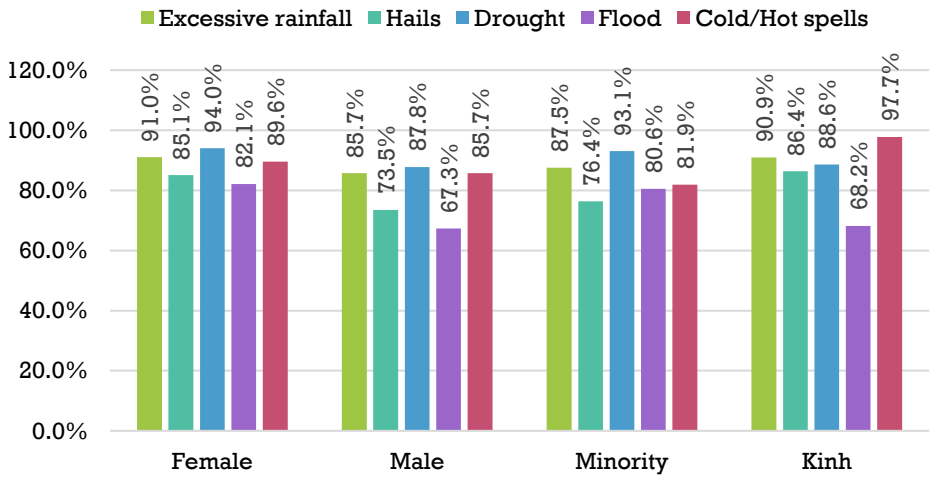

Figure 12. Occurrence of extreme weather

Note: Chi-square statistics (df 1) for each variable in gender and ethnicity categories equal to 0.808, 2.398, 1.415, 3.359, 0.393 and 0.319, 1.709, 0.677, 2.284, 6.410* respectively. * The Chi-square statistic is significant at the 0.05.

In general, farmers have gradually raised their awareness and perception of climate change impacts. Figure 13 shows the most typical negative aspects of CC that include: DSN (Decreasing soil nutrients), BI (Biodiversity imbalance in the agricultural fields), DWS (Depleting). water source), IID (Invasive insects and diseases), CF (Crop failure due to extreme weather events), AEP (Agri-environmental pollution ie acidification, water pollution…), DR (Diminishing returns from agricultural productions). Most farmers in four groups express the same experiences of these CC negative impacts (see z-statistics in Table A12 Appendix). Further, farmers also indicated that both crops and animals are vulnerable to extreme climate events such as cold spells, floods, hoarfrost, unusual hot spells, and drought spells. Nowadays, floods occur more often and more heavily causing serious landslide problems. Frost also occurs more frequently nowadays when compared to 20-30 years before. Hot spells and typhoons often occur in July to October in time for the maize season and the second cropping season for rice. 20 years ago, drought was rare. Most typically, severe drought problems are experienced during November to March of the next year, greatly

affecting crops, especially paddy rice. Villagers attributed drought not only to CC but also to the degradation of forests. The water level in river systems and the lake has dropped, causing problems in irrigation, animals use, and human consumption.

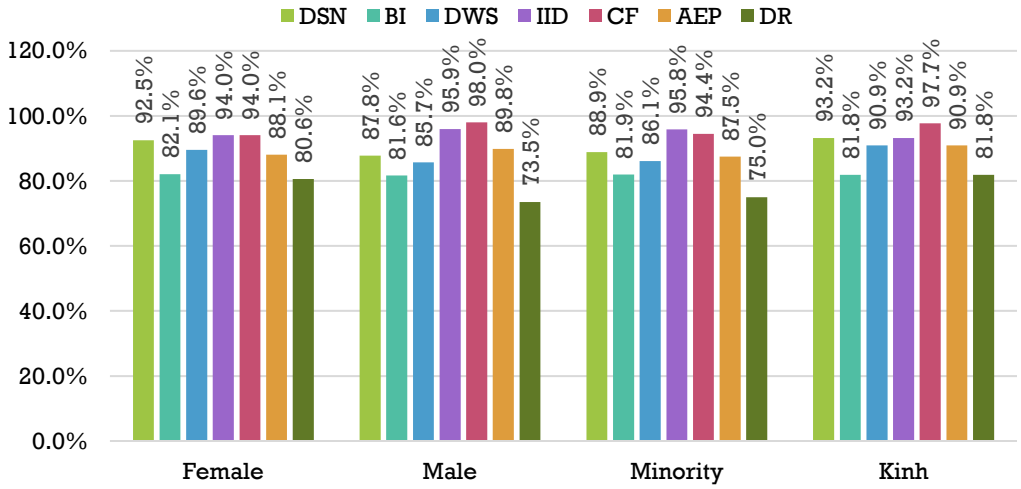

Figure 13. Negative impacts of climate change

Note: Chi-square statistics (df 1) for each variable in gender and ethnicity categories equal to 0.754, 0.004, 0.393, 0.206, 1.059, 0.086, 0.827 and 0.586, 0.00, 0.592, 0.391, 0.714, 0.319, 0.730 respectively. * The Chi-square statistic is significant at the 0.05.

Individual change creates community change. Farmers actively commit to the implementation of project activities and are eager to share their knowledge and experience learned from training and hands-on practice with other farmers inside and outside of Ma village. Collective actions are gradually formed by Ma villagers based on hands-on interrelated activities. Villagers mentioned that previously no significant attempts were made to help Mạ village mitigate and adapt to climate change impacts, particularly in agriculture but now village head and women union encourage all villagers to apply CSA T&Ps. Clearly, CSV has been promoted as the main instrument of community mobilization for CC adaptation and mitigation. Ma village has become an enabling environment for CSA and a platform for multi-stakeholder participation and collaborative work at the community level and beyond. Community resilience is well reflected by adopting resilient practices that are the SRV (Selection of resilient varieties), CCC (Changing crop calendar), EAW (Exploitation of alternate water source), ITC (Intercropping), DRP (Dripping irrigation), CPT (Composting), PLC (Polyculture), AGF (Agroforestry), ORF (Organic farming), BIC (Biological cushion) (Figure 14). Among these strategies, Kinh farmers prefer CPT and PLC significantly more than Cao Lan farmers (Table A13, Appendix).

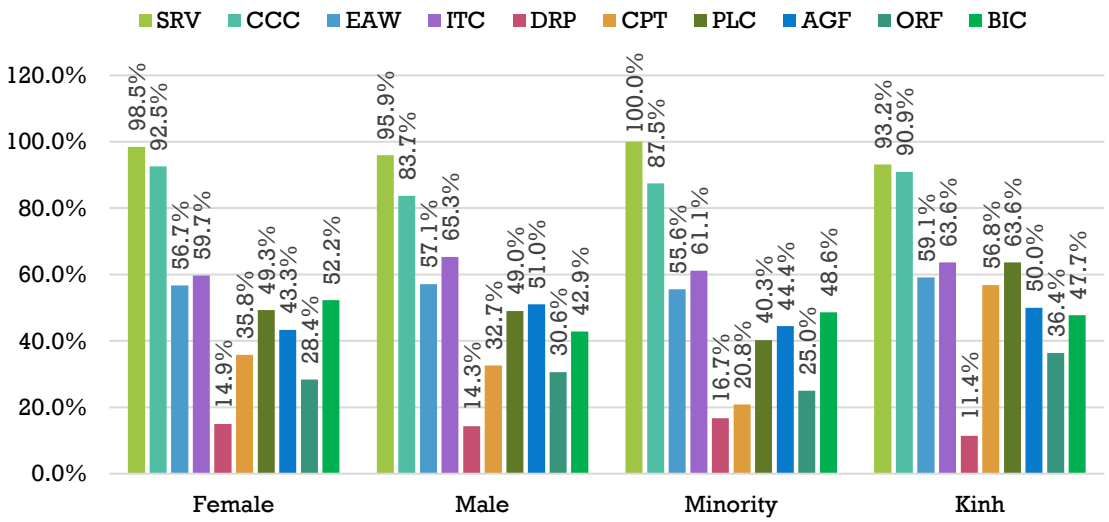

Figure 14. Household's adaptive capabilities

Note: Chi-square statistics (df 1) for each variable in gender and ethnicity categories equal to 0.753, 2.235, 0.002, 0.378, 0.009, 0.126, 0.001, 0.681, 0.069, 0.998 and 5.039*, 0.319, 0.139, 0.074, 0.614, 15.653*, 5.962*, 0.339, 1.702, 0.009 respectively. * The Chi-square statistic is significant at the 0.05.

Farmers and village cadres identified that there were positive relationships and strong accountability to each other. The roles of each village board member, especially women union chairwoman in the community work were valued. All farmers identified that the cohesion and solidarity brought something greater to the project, where overall effort contributed to the achievement of the project outcomes and village change.

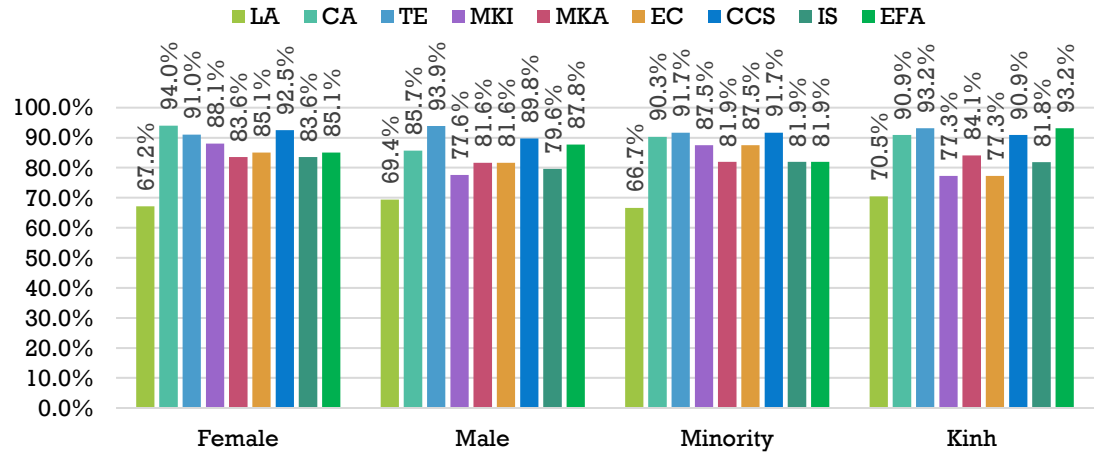

Figure 15. Recommended actions at local level

Note: Chi-square statistics (df 1) for each variable in gender and ethnicity categories equal to 0.064, 2.280, 0.317, 2.282, 0.075, 0.245, 0.270, 0.304, 0.171 and 0.180, 0.013, 0.088, 2.086, 0.088, 2.086, 0.020, 0.00, 2.900 respectively. * The Chi-square statistic is significant at the 0.05.

The four most significant factors for policy change from bottom-up upwards include i) perception change from "adaptation only" to "adaptation and mitigation at the community

level; ii) active participation of the farmers and village authority; iii) the strategic interventions at the grassroots level and iv) the support of authority. These achievements have been recognized and appreciated by government officials at local levels. Ma village model is an important contributor for Vinh Kien commune to be awarded Nong thon Kieu mau (Model Village). Moreover, the project has also contributed to socio-economic development planning (SEDP) at the community level. Interviews with local officers in Ma and Vinh Kien show that the project activities were discussed and integrated at different levels of authorities and different stages of local planning, thus promoting climate-smart governance at the grassroots level needed to target actions including LA (land policy), CA (capital investment), TE (technical support), MKI (market information), MKA (market access), EC (education and communication), CCS (climate change services), IS (institutional reform), EFA (enhancement of farmer's autonomy) (Figure 15).

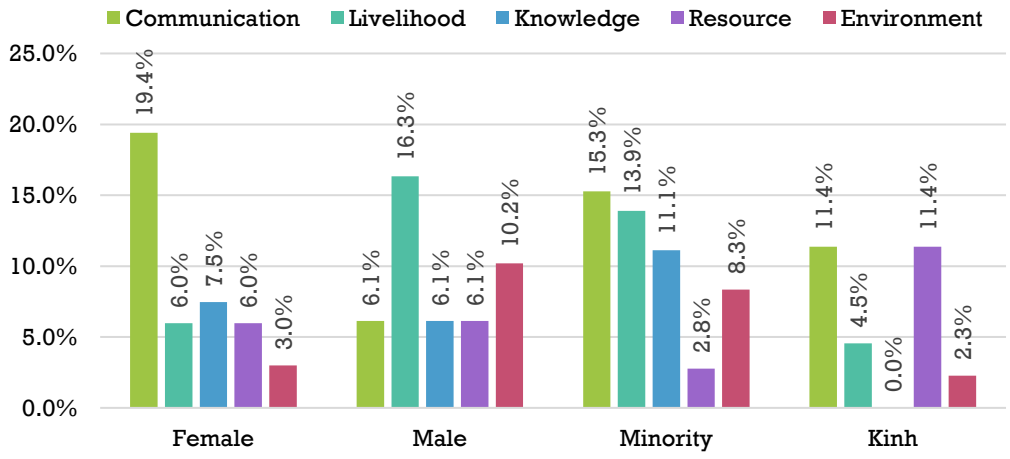

Figure 16. Concerns regarding CSA adoption and scaling

Note: Chi-square statistics (df 1) for each variable in gender and ethnicity categories equal to 9.12 and 14.786* respectively. * The Chi-square statistic is significant at the 0.05.

The first impact of the CSV project is the spreading of the notion 'Lang Nong Thuan Thien' (CSV notion), a term which is very much favored by the Vinh Kien people in general and the experts in particular, partly as it relates to the Vietnamese sacred and traditional Lang que (native village). Next, there has been an increased awareness and favorable attitude and strong support for CSA T&Ps from the interviews with officials and experts from relevant ministries and institutions (MARD, VAAS, NAEC, IPSARD, SANRM, Rikolto, VASS, World Bank) as well as from mass media (VTC). In terms of CSA options and scaling, the focal points the Project and authorities (local/national) should address include: the extensive propagation and promotion of the CSV's positive outcomes (Communication), the efficacy to improve the livelihoods of CSV farmers (Livelihood), the gained knowledge toward climate change

adaptive response (Knowledge), the ability to efficiently allocate rural resources (Resource), and the on-going environmental problems (Environment) (Figure 16). Extensive consultations with MARD and networking among CIAT, NOMAFSI, MARD, VNUA, IPSARD, Donors, NGOs, CSOs…should also be considered for scaling up/scaling out the CSV model.

V. CONCLUSION

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is a strategic ten-year partnership between the CGIAR and Future Earth to help the developing world overcome the threats posed by a changing climate, to achieve food security, improve agriculture and livelihoods. In 2014, the CCAFS South East Asia region began identifying and implementing Climate-Smart Villages (CSVs). Six CSVs were selected in three countries: Vietnam, Cambodia, and Lao PDR. The objectives of CCAFS CSV are to increase the adaptive capacity of small-holder farmers in light of climate change effects, improve livelihoods by increasing productivity and resilience, mitigate climate change by reducing greenhouse gases (GHGs), and enhance national food security and development goals. Through on-farm/ participatory testing of context-specific climate-smart technologies and practices derived from earlier research of CGIAR Centers and their programs, the project aims to shed light on the process of the practical application of introduced technologies, assess their suitability at farm level and from farm to landscape level. Ma village is a typical example of the CSV approach that proposed several technological, institutional, and policy interventions to help farmers adapt to current and future weather variability and to mitigate the climate change impacts.

The main aim of this impact assessment study regarding the CSA options implemented in Ma CSV project is to identify social inequalities (gender and ethnic intersection) from the change outcomes (social, economic, and environmental) and the adaptive capacities of Vinh Kien rural mountainous farmers. Utilized by the mixed methodology (quantitative/qualitative), the empirical work explored comparisons across gender and ethnic groups of farmers and the logistic regression questioned the essence of the social factor (gender and ethnicity) together with other CSV-related attributes that influence the adoption decision of CSA T&Ps in Vinh Kien. The empirical results slightly highlighted none existence of social inequalities by gender, but significant other social issues in terms of ethnic disadvantages referring to opportunities to participate in training (AP and CCF), having access to science and technology services (S&T), and agricultural production management (FR). In Vinh Kien, farmers' willingness to adopt CSA T&Ps (CSA options) from the CSV project was influenced

by several factors including gender (Gen), training of agricultural practices (TrAP), training of agricultural production management (TrAM), access to extension service (AcES), access to climate change service (AcCS), perception of extreme weather (PeEW), and perception of depleting water source (PeEW). None of significant statistic differences has been found among groups of farmers in term of CC impacts experiences, perception of climatic extremes, adaptive capacities, and system changes (economic/social/environmental). Merely relying on staple and industrial crops, it is surprising that Cao Lam minority farmers in Vinh Kien have a better link to profitable market than Kinh majority farmers. Market access has long been the crucial problem that contributed to stagnant productivity growth and mire millions of rural mountainous households in chronic poverty.

In brief, the major factors influencing the CSVs' achievements are the knowledge improvement, the capacity development, implementation support provided to the village women as well as for many other key stakeholders (e.g. village authority, commune authority, extension officers…) on cross-cutting issues of climate change, disaster response, hazard, and risk mapping, vulnerability assessment, human rights approach, gender equality, collective action, and policy advocacy to influence planning processes that led to change and action. This new comprehensive knowledge minimized the risk of resistance in terms of the CSA/CSV implementation and served as a driver for change.

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APPENDIX

A. Z-test statistics

Table A1. Z test for household's agricultural activities

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
Staple crop	91.0%$_a$	91.8%$_a$	97.2%$_a$	81.8%$_b$
Fruit & Vegie	25.4%$_a$	26.5%$_a$	6.9%$_a$	56.8%$_b$
Industrial crop	52.2%$_a$	61.2%$_a$	72.2%$_a$	29.5%$_b$
Poultry	71.6%$_a$	67.3%$_a$	70.8%$_a$	68.2%$_a$
Livestocks	53.7%$_a$	69.4%$_a$	58.3%$_a$	63.6%$_a$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances.[1]

Table A2. Z test for household's adopted agricultural practices

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
CLI	11.9%$_a$	6.1%$_a$	12.5%$_a$	4.5%$_a$
CCGT	1.5%$_a$	6.1%$_a$	5.6%$_a$	0.0%[1]
VC	1.5%$_a$	6.1%$_a$	4.2%$_a$	2.3%$_a$
AWD	6.0%$_a$	12.2%$_a$	6.9%$_a$	11.4%$_a$
RSP	17.9%$_a$	24.5%$_a$	18.1%$_a$	25.0%$_a$
IHG	40.3%$_a$	51.0%$_a$	37.5%$_a$	56.8%$_b$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one.

Table A3. Z test for household's source of farming knowledge

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
ASE	97.0%$_a$	93.9%$_a$	97.2%$_a$	93.2%$_a$
KD	91.0%$_a$	89.8%$_a$	94.4%$_a$	84.1%$_a$
TR	56.7%$_a$	55.1%$_a$	58.3%$_a$	52.3%$_a$
CP	34.3%$_a$	40.8%$_a$	45.8%$_a$	22.7%$_b$
Other	25.4%$_a$	34.7%$_a$	29.2%$_a$	29.5%$_a$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one.

Table A4. Z test for household's knowledge improvement

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
APBV	98.5%$_a$	91.8%$_a$	94.4%$_a$	97.7%$_a$

SM	88.1%$_a$	93.9%$_a$	87.5%$_a$	95.5%$_a$
FR	89.6%$_a$	91.8%$_a$	86.1%$_a$	97.7%$_b$
WM	74.6%$_a$	77.6%$_a$	73.6%$_a$	79.5%$_a$
PDM	88.1%$_a$	79.6%$_a$	81.9%$_a$	88.6%$_a$
RM	73.1%$_a$	59.2%$_a$	66.7%$_a$	68.2%$_a$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one.

Table A5. Z test for household's knowledge exchange

	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
Technology	97.0%$_a$	98.0%$_a$	95.8%$_a$	100.0%[1]
Management	89.6%$_a$	87.8%$_a$	86.1%$_a$	93.2%$_a$
Climate	97.0%$_a$	95.9%$_a$	95.8%$_a$	97.7%$_a$
Policy	83.6%$_a$	79.6%$_a$	77.8%$_a$	88.6%$_a$
Market	88.1%$_a$	87.8%$_a$	83.3%$_a$	95.5%$_a$
Risk	65.7%$_a$	73.5%$_a$	66.7%$_a$	72.7%$_a$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one.

Table A6. Z test for household's training participation

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
AP	50.7%$_a$	34.7%$_a$	51.4%$_a$	31.8%$_b$
CCF	28.4%$_a$	36.7%$_a$	41.7%$_a$	15.9%$_b$
APM	26.9%$_a$	20.4%$_a$	20.8%$_a$	29.5%$_a$
MMA	1.5%$_a$	0.0%[1]	1.4%$_a$	0.0%[1]
AOT	3.0%$_a$	0.0%[1]	1.4%$_a$	2.3%$_a$
frequently	34.3%$_a$	46.9%$_a$	41.7%$_a$	36.4%$_a$
sometimes	6.0%$_a$	8.2%$_a$	6.9%$_a$	6.8%$_a$
occationally	4.5%$_a$	0.0%[1]	4.2%$_a$	0.0%[1]
hardly ever	17.9%$_a$	4.1%$_b$	8.3%$_a$	18.2%$_a$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one.

Table A7. Z test for household's access to services

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
Extension	71.6%$_a$	81.6%$_a$	77.8%$_a$	72.7%$_a$

Finance	83.6%$_a$	71.4%$_a$	77.8%$_a$	79.5%$_a$
S&T	64.2%$_a$	71.4%$_a$	77.8%$_a$	50.0%$_b$
Climate	88.1%$_a$	83.7%$_a$	88.9%$_a$	81.8%$_a$
Market	23.9%$_a$	32.7%$_a$	34.7%$_a$	15.9%$_b$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one. S&T indicates science and technology

Table A8. Z test for household's positive economic changes

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
IYP	67.2%$_a$	71.4%$_a$	68.1%$_a$	70.5%$_a$
IQAP	86.6%$_a$	87.8%$_a$	87.5%$_a$	86.4%$_a$
DCI	50.7%$_a$	55.1%$_a$	45.8%$_a$	63.6%$_a$
BRM	61.2%$_a$	69.4%$_a$	61.1%$_a$	70.5%$_a$
DCL	74.6%$_a$	75.5%$_a$	70.8%$_a$	81.8%$_a$
BMC	61.2%$_a$	49.0%$_a$	54.2%$_a$	59.1%$_a$
Other	3.0%$_a$	0.0%[1]	1.4%$_a$	2.3%$_a$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one.

Table A9. Z test for household's positive environmental changes

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
EP	50.7%$_a$	57.1%$_a$	55.6%$_a$	50.0%$_a$
CCI	22.4%$_a$	30.6%$_a$	27.8%$_a$	22.7%$_a$
SQ	52.2%$_a$	46.9%$_a$	43.1%$_a$	61.4%$_a$
BD	31.3%$_a$	34.7%$_a$	30.6%$_a$	36.4%$_a$
ID	20.9%$_a$	30.6%$_a$	25.0%$_a$	25.0%$_a$
WM	53.7%$_a$	49.0%$_a$	45.8%$_a$	61.4%$_a$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one.

Table A10. Z test for household's positive social changes

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
SDL	95.5%$_a$	93.9%$_a$	93.1%$_a$	97.7%$_a$

FS	94.0%$_a$	95.9%$_a$	94.4%$_a$	95.5%$_a$
KDCA	82.1%$_a$	89.8%$_a$	87.5%$_a$	81.8%$_a$
IHC	77.6%$_a$	75.5%$_a$	79.2%$_a$	72.7%$_a$
CAMI	85.1%$_a$	75.5%$_a$	76.4%$_a$	88.6%$_a$
CATE	79.1%$_a$	81.6%$_a$	83.3%$_a$	75.0%$_a$
CAFI	79.1%$_a$	65.3%$_a$	75.0%$_a$	70.5%$_a$
ACCC	74.6%$_a$	77.6%$_a$	76.4%$_a$	75.0%$_a$
GI	76.1%$_a$	73.5%$_a$	73.6%$_a$	77.3%$_a$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one.

Table A11. Z test for household's perception of extreme weather

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
Excessive rainfall	91.0%$_a$	85.7%$_a$	87.5%$_a$	90.9%$_a$
Hails	85.1%$_a$	73.5%$_a$	76.4%$_a$	86.4%$_a$
Drought	94.0%$_a$	87.8%$_a$	93.1%$_a$	88.6%$_a$
Flood	82.1%$_a$	67.3%$_a$	80.6%$_a$	68.2%$_a$
Cold/Hot spells	89.6%$_a$	85.7%$_a$	81.9%$_a$	97.7%$_b$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one.

Table A12. Z test for negative impacts of climate change at household level

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
DSN	92.5%$_a$	87.8%$_a$	88.9%$_a$	93.2%$_a$
BI	82.1%$_a$	81.6%$_a$	81.9%$_a$	81.8%$_a$
DWS	89.6%$_a$	85.7%$_a$	86.1%$_a$	90.9%$_a$
IID	94.0%$_a$	95.9%$_a$	95.8%$_a$	93.2%$_a$
CF	94.0%$_a$	98.0%$_a$	94.4%$_a$	97.7%$_a$
AEP	88.1%$_a$	89.8%$_a$	87.5%$_a$	90.9%$_a$
DR	80.6%$_a$	73.5%$_a$	75.0%$_a$	81.8%$_a$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one.

Table A13. Z test for household's adaptive capabilities

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
SRV	98.5%$_a$	95.9%$_a$	100.0%[1]	93.2%$_a$

CCC	92.5%$_a$	83.7%$_a$	87.5%$_a$	90.9%$_a$
EAW	56.7%$_a$	57.1%$_a$	55.6%$_a$	59.1%$_a$
ITC	59.7%$_a$	65.3%$_a$	61.1%$_a$	63.6%$_a$
DRP	14.9%$_a$	14.3%$_a$	16.7%$_a$	11.4%$_a$
CPT	35.8%$_a$	32.7%$_a$	20.8%$_a$	56.8%$_b$
PLC	49.3%$_a$	49.0%$_a$	40.3%$_a$	63.6%$_b$
AGF	43.3%$_a$	51.0%$_a$	44.4%$_a$	50.0%$_a$
ORF	28.4%$_a$	30.6%$_a$	25.0%$_a$	36.4%$_a$
BIC	52.2%$_a$	42.9%$_a$	48.6%$_a$	47.7%$_a$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one.

Table A14. Z test for household's recommended actions at local level

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
LA	67.2%$_a$	69.4%$_a$	66.7%$_a$	70.5%$_a$
CA	94.0%$_a$	85.7%$_a$	90.3%$_a$	90.9%$_a$
TE	91.0%$_a$	93.9%$_a$	91.7%$_a$	93.2%$_a$
MKI	88.1%$_a$	77.6%$_a$	87.5%$_a$	77.3%$_a$
MKA	83.6%$_a$	81.6%$_a$	81.9%$_a$	84.1%$_a$
EC	85.1%$_a$	81.6%$_a$	87.5%$_a$	77.3%$_a$
CCS	92.5%$_a$	89.8%$_a$	91.7%$_a$	90.9%$_a$
IS	83.6%$_a$	79.6%$_a$	81.9%$_a$	81.8%$_a$
EFA	85.1%$_a$	87.8%$_a$	81.9%$_a$	93.2%$_a$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one.

Table A15. Z test for household's concerns regarding CSV horizontal scaling

Categories	Female	Male	Minority	Kinh
	Column N	Column N	Column N	Column N
Communication	19.4%$_a$	6.1%$_b$	15.3%$_a$	11.4%$_a$
Livelihood	6.0%$_a$	16.3%$_a$	13.9%$_a$	4.5%$_a$
Knowledge	7.5%$_a$	6.1%$_a$	11.1%$_a$	0.0%[1]
Resource	6.0%$_a$	6.1%$_a$	2.8%$_a$	11.4%$_a$
Environment	3.0%$_a$	10.2%$_a$	8.3%$_a$	2.3%$_a$

Note: Values in the same row and subtable not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column proportions. Cells with no subscript are not included in the test. Tests assume equal variances. 1. This category is not used in comparisons because its column proportion is equal to zero or one.

B. Multivariate assessment of the logistic model

Table B1. Collinearity Diagnostics

Variables	UC	SC	T-test	Sig.	Collinearity Stat

	B	S.E.	Beta			Tol	VIF
(Constant)	.177	.379		.466	.642		
Age	.007	.007	.165	.970	.335	.215	4.650
Gender	.161	.087	.163	1.850	.067	.797	1.255
Ethnicity	.181	.096	.180	1.878	.064	.677	1.478
Education	.019	.018	.100	1.058	.293	.692	1.445
Experience	-.006	.006	-.169	-.961	.339	.201	4.965
TrAP	.277	.112	.282	2.463	.016	.473	2.113
TrCC	.145	.118	.138	1.231	.222	.490	2.042
TrAM	.255	.102	.224	2.505	.014	.773	1.294
AcES	.192	.107	.168	1.793	.076	.702	1.424
AcTS	.006	.103	.006	.060	.952	.635	1.575
AcCS	-.325	.132	-.230	-2.454	.016	.707	1.414
PeEW	.210	.133	.149	1.573	.119	.695	1.439
PeCI	.004	.120	.003	.031	.976	.694	1.441
PeA	-.002	.110	-.002	-.023	.982	.602	1.660
PeCA	-.111	.099	-.108	-1.124	.264	.675	1.482
DSN	-.246	.200	-.148	-1.229	.222	.429	2.330
BI	-.080	.153	-.064	-.524	.601	.422	2.371
DWS	-.201	.153	-.134	-1.313	.192	.592	1.690
IID	.219	.249	.099	.879	.382	.484	2.068
CF	.088	.253	.037	.349	.728	.557	1.794
AEP	.026	.156	.017	.168	.867	.606	1.651
DR	.145	.120	.124	1.205	.231	.587	1.703

Note: UC. Unstandardized Coefficients. SC. Standardized Coefficients. Tol. Tolerance

Table B2. Heteroscedasticity test

Variable	B	S.E.	T-test	Sig.	95% LB	95% UB
constant	0.005	1.088	0.005	0.996	-2.128	2.138
Age	0.035	0.02	1.793	0.076	-0.003	0.073
Gender	-0.573	0.25	-2.292	0.024	-1.063	-0.083
Ethnicity	-0.03	0.276	-0.108	0.914	-0.571	0.511
Education	0.043	0.051	0.841	0.403	-0.057	0.144
Experience	-0.041	0.018	-2.29	0.024	-0.077	-0.006
TrAP	0.075	0.323	0.233	0.816	-0.557	0.708
TrCC	-0.281	0.338	-0.833	0.407	-0.944	0.381
TrAM	-0.601	0.293	-2.049	0.043	-1.175	-0.026
AcES	0.275	0.307	0.894	0.373	-0.328	0.877
AcTS	0.129	0.295	0.438	0.662	-0.449	0.707
AcCS	-0.347	0.38	-0.913	0.364	-1.092	0.398
PeEW	-0.456	0.384	-1.19	0.237	-1.208	0.295
PeCI	0.197	0.344	0.573	0.568	-0.477	0.871
PeA	-0.221	0.315	-0.702	0.485	-0.838	0.396
PeCA	0.16	0.284	0.565	0.574	-0.396	0.717

DSN	0.076	0.574	0.133	0.895	-1.05	1.202
BI	-0.123	0.441	-0.28	0.78	-0.987	0.741
DWS	0.427	0.44	0.971	0.334	-0.435	1.289
IID	-0.55	0.716	-0.768	0.444	-1.953	0.853
CF	1.299	0.727	1.786	0.077	-0.126	2.724
AEP	-0.705	0.449	-1.571	0.12	-1.585	0.175
DR	0.235	0.345	0.681	0.497	-0.441	0.911
ANOVA table						
	SS	df	MS	F	Sig	
Model	36.81	22	1.673	1.187	0	
Residual	131.115	93	1.41	-999	-999	
Breusch-Pagan and Koenker test statistics						
	LM	Sig	Null hypothesis: heteroskedasticity not present (homoskedasticity). If sig-value less than 0.05, reject the null hypothesis.			
BP	18.405	0.682				
Koenker	25.428	0.277				

Note: Breusch-Pagan test is a large sample test and assumes the residuals to be normally distributed.