Climate-induced vulnerabilities

Participatory assessment for My Loi village, Ky Son commune, Ky Anh district, Ha Tinh province

Working Paper No. 216

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

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Correct citation:

Simelton E et al. 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). Available online at: www.ccafs.cgiar.org

Titles in this Working Paper series aim to disseminate interim climate change, agriculture and food security research and practices, and stimulate feedback from the scientific community.

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is a strategic partnership of CGIAR and Future Earth, led by the International Center for Tropical Agriculture (CIAT). The Program is carried out with funding by CGIAR Fund Donors, the Danish International Development Agency (DANIDA), Australian Government (ACIAR), Irish Aid, Environment Canada, Ministry of Foreign Affairs for the Netherlands, Swiss Agency for Development and Cooperation (SDC), Instituto de Investigação Científica Tropical (IICT), UK Aid, Government of Russia, the European Union (EU), New Zealand Ministry of Foreign Affairs and Trade, with technical support from the International Fund for Agricultural Development (IFAD).

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Abstract

This vulnerability assessment was conducted for the project “Generating evidence base for upscaling local adaptation through Climate-Smart Agriculture” under the CGIAR Research Program Climate Change, Agriculture and Food Security (CCAFS). This report covers the My Loi climate-smart village (CSV) project site in Vietnam. A separate study is conducted for the sites in the Philippines.

The main purpose of this paper is to document evidences of exposure, impacts, and vulnerability. The results of this study will help in forming other CCAFS projects in the CSV, and these will be continuously updated throughout the project. Therefore, we also added a green section with recommendations for CSA interventions and items for further study of specific farming systems. The recommendations are summarized in the last chapter and attributed to the CCAFS CSA indicators: e.g. weather, water, energy, knowledge, pest and soil nutrient, as well as nutrition, gender and market smart.

Keywords

Climate-smart agriculture; CSA; Climate-smart village; CSV; Participatory Vulnerabilities Assessment; PVA; Ha Tinh province; My Loi CSV.

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Acknowledgements

The research was conducted for the project “Generating evidence base for upscaling local adaptation through Climate-Smart Agriculture” funded by CGIAR Consortium Research Programs Climate Change, Agriculture and Food Security (CCAFS) Flagship 1.3 on Scaling climate-smart practices. Part of the results were funded by CGIAR Research program Forests, Trees and Agriculture.

The authors are grateful for constructive comments from colleagues at World Agroforestry Centre (ICRAF); An The Ngo, Bang Nguyen Tran, and Tham Thi Dao from Vietnam National University of Agriculture; and Julian Gonsalves and Rene Vidallo from the International Institute of Rural Reconstruction (IIRR). The work depended on the support from Ky Son commune People’s Committee, Department of Agriculture and Rural Development and Farmers’ Union Ha Tinh.

Most importantly, the authors would like to thank the My Loi villagers for their eagerness to share their knowledge and experiences with the team for more than three years.

Contents

Methodology

This participatory vulnerability assessment report uses synthesised information from the following sources: focus group discussions (the first in 2012) as part of a larger study including nine villages in the district (Simelton 2013); climate land use adaptation planning meetings; and a set of focus group discussions conducted for baseline surveys of CCAFS climate-smart village in 2014 (Le et al. 2014, Le et al. 2015, Le and Simelton 2015) which are confirmed and updated with key informant interviews for this report in August 2015. This report also includes findings from household interviews with 34 male and 22 female villagers conducted in 2013.

A list of the participatory methods conducted for the studies in Vietnam and Philippines is found in Appendix 1. Focused group discussion was the method used using the following participatory appraisal tools: seasonal calendar, timeline, livelihood matrix, and problem tree (Simelton et al. 2013a). Additional and updated data and information were also gathered through key informant interviews with commune and village level officials.

Limitations of the study

The household interviews from 2013 have not been followed up for this report. Additional household surveys for baselines have been conducted in December 2015.

1. Introduction

My Loi profile

Topography	upland
Location	80 km southwest of province capital Ha Tinh town
Area	at least 195 ha, in which 140 ha forestland (the area is uncertain)
Population	768 individuals, 213 Households (3-4 members per HH)
Commune infrastructure	1 kindergarten, 1 elementary school, 1 secondary school, 1 health station, 1 market place
Community-based civil society organisations	Women's Union, Farmers' Union, Youth Union, and Fatherland Front
Farmer interest groups	home garden, livestock, intercropping and forestry groups
Infrastructure	one recently upgraded reservoir constructed in 1964, two telecommunication masts
My Loi village qualified as "cultural village" in 2015	

My Loi is an upland village located about 100 km southwest of province capital Ha Tinh town, 30 km west of district center Ky Anh, and immediately by the commune center Ky Son. The village centre is accessible by all roads throughout the year while parts of the village may be cut off temporarily during flooding. My Loi means 'beautiful landscape.'

Unique characteristics

The village depends primarily on cassava, peanut, and acacia cultivation. All agriculture production is rainfed except for 2 ha of rice. The village has a long history of extreme weather events. One of these is a tornado which hit the village in 2015 (see section 3.b).

Village history

1960s	In 1962, Cay Tram reservoir was built with stone foundation to irrigate paddy fields and control floods. My Loi village was founded in 1963.
1970s	During the war, My Loi became an important stronghold.
1980s	Deforestation began during the war in 1970s and it continued in the 1980s. Until 1986 the forest in the village was managed by a cooperative, but from then until 1995, it was gradually allocated to households. In 1989, a dyke was built.
1990s	In 1992, a national reforestation program 327 started. This became the 5

	million-hectare program in 1998. In 1995, the village population was 150 households, and the number of buffalos and cows were about 250. Ho Chi Minh trail and National Road 12 became connected. In 1995-96, households received the land use certificates (Red Book) for homesteads and agriculture land. In 1997, reforestation projects started to have noticeable impact. Ky Son Market place was established. In 1998, the village became connected to the national electricity grid.
2000s	Forest land allocation: about 35 households self-reclaimed forest land to plant acacia and pine. In 2002, hybrid rice was introduced and grass for feeding cattle. In 2004, the school was rebuilt In 2002-2005, the roads between the villages were constructed The village was split into two (My Loi and My Thuan) In 2007, the VEDAN factory opened in the commune which affected land use with more people converting to cassava cultivation, not only in My Loi village, but also those from Nghe An and Quang Binh provinces. The first telecommunication mast in the village was also established. Reforestation intensified. After the flood in 2008, there was a serious pest and disease outbreak on crops.
2010s	In 2012, the population was 220 households, and the number of cattle and buffalos were reduced to 150. In 2013, Cay Tram dam was upgraded with a cement barrier. In 2015, the village received “cultural village” status.

Water resources

Two rivers, Rao Tro and Rao Moc run through the commune. The rivers are used for irrigation and domestic use of some households. Mining activities upstream have changed the river flow and reduced the water quality. Until 1995, villagers catch large amounts of fish and shrimp in these rivers.

To supply water to Formosa industrial zone, two dams are placed in the Rao Tro river catchment. My Loi villagers believe that the dams will have negative impacts on agricultural production through more frequent floods near Cay Boong bridge.

Cay Tram dam borders to My Loi and My Thuan villages. It was built in 1960 and upgraded with cement in 2014. The reservoir is used for flood control and for irrigating 2 ha of rice in Chu Ke and Bai Nai fields - the only fields that produce two crops per year. The villagers’ answers on who actually manages the reservoir were unclear (i.e. women said “nobody”; men said “the village”; and leaders said “Binh Thuan agriculture and irrigation group supervised by commune People’s Committee’).

Da Quai reservoir is smaller and it is only made of soil. It is damaged and now operating inefficiently. There is approximately one kilometre of permanent irrigation channel connecting Cay Tram reservoir with Bai Nai and Chu Ke fields—the only fields which can support two crops per year. The remaining irrigation systems are not cemented, and the canals result in leakage, inefficient water use, and underperforming production of rice and cash crops. In non-irrigated fields which are predominant in the area, farmers can cultivate one crop per year only.

Infrastructure

The National Road 12, which runs through the village, was upgraded in 2013. This opened up opportunities for many vehicles to pass through this road more conveniently. Unfortunately, overweight trucks passing through this road have severely damaged it. Moreover, river Rao Tro became narrower due to the road reconstruction. There was also a 6km smaller "inter-commune" road network in the village, of which 4km of the roads have been asphalted since 2002. The remaining parts were completed in 2016 through New Countryside Program.

The nearest market to My Loi is Ky Son market located at the commune centre. It is managed by Ky Son Cooperative of Services, which belongs to commune People's Committee. The market was improved in 2013, but according to the authorities and villagers, waste management remains a challenge to be resolved.

There are Ky Son kindergarten school, Ky Son primary and several secondary schools for the education of children in the My Loi. During the CCAFS focus group discussion, male villagers expressed their concern over the water quality in the kindergarten. Schools are maintained using government funds and school fee collected from the students' parents. Aside from the schools, the commune center also has a health station that can provide villagers with basic health examinations and treatments such as first aid service during natural disasters.

The village is connected to the national electricity grid since 1998. Blackouts are frequent during rainstorms because of uprooted trees falling and affecting electricity towers, and during droughts due to water shortage in hydropower stations. My Loi has telecommunication mast connection through Viettel (2007) and VNPT (2010).

About 95% of the villagers own a mobile phone with only a few of them owning smartphones. About the same percentage for villagers shared they have a TV-set. Few use radios, except when they are working in the forest. Only teachers and some officials have laptops. Weather forecasts, early warnings and other information are broadcasted through village loudspeakers.

Land use and tenure arrangements

Officially, the village covers 195 ha, majority of which is forestland. Approximately 140 ha of forestland is used for the following: acacia and eucalyptus (both covering about 80 ha); and cajuput and pine forest plantations for paper pulp production. The plantations are mainly monoculture on the poorest soils with 5-7 year cycles.

About 40 ha of the forestland are used for cassava. In addition, the village has about 55 ha farmland used for annual crops such as peanut (30ha), paddy rice (8.5-9.5 ha), maize, green bean, and sweet potato. The farmland area in the village is declining due to road and house construction.

After corroborating the village area through satellite maps and field visits in 2015, it was found out that the forestland/upland area rather is about 800-900 ha and area of paddy fields are also larger than the previously estimated area. Nonetheless, the exact area size has not yet been confirmed, despite meetings with district officials.

- There are government guidelines for forestland allocation stipulating household responsibilities for utilization of forest products, afforestation, and forest protection. The commune natural regeneration forest in Hon De Mountain is of poor quality.
- In 1996, households received the land-use certificates (Red Book) for homesteads and agriculture land. Villagers now have 50-year land use rights for farmland and forestland.
- There are no landless households in the village. About 5% of the households lease farmland to others.

2. Livelihood profile

Social resources

The village has 213 households and a total population of about 768 in 2014. In the last two decades, the number of children per family has decreased from 4-5 to 1-2 children. Most of the current villagers were either born in the village or chose to move in due to marriage. On the other hand, some 15-20 people have left the village to seek other job opportunities. In 2013, the percentage of households considered poor was 22% and those which are considered near poor are 23%. This is much lower than the previous year's figure which indicated a poverty level of 27%.

Forestry

Half of the household income of residents in My Loi are usually generated from forestry activities. The remaining portion of their incomes is sourced from agriculture and other farm- and non-farm activities. Most families have forestland, with an average of 0.5-2 ha per households. There are 60-65% of households owning forest plantations of between 0.5-10 ha. Households' income is about VND 20-25 million/ha per 5-7 year-cycle while investment costs for seedlings, fertilizer, labour and transportation are between VND 10-20 million/ha (Le et al. 2015). Recently farmers began investing less on fertilisers and using mix cassava with newly planted acacia and cajuput to maximize incomes (so-called taungya agroforestry system). Despite this, the profit margins remain low. Moreover, the lack of irrigation and poor soils are two main restricting factors for productivity.

Agriculture

Peanut

My Loi has 30 ha peanut with an average yield of 2.5 t/ha. Most of these are sold via middlemen. Peanut is the main ingredient in the province's most famous product "Cu đơ,"—two crispy rice papers sandwiching a layer of peanut that holds together with ginger-flavoured sugar cane syrup. "Cu đơ" is one of 13 flagship agricultural products of Ha Tinh province.

Cassava

The plan for 2014 was to plant total 43 ha of cassava. The commune average cassava yield is 30 t/ha (1.2-1.7 tons/500m2). Since the VEDAN factory is in the commune, farmers residing beside it need not sell their produce to middlemen since they can sell them directly to the factory. VEDAN is a factory processing starch from cassava.

The price is set by VEDAN for the farmers' produce depends on the percentage of starch. The price varies throughout the years and it ranges from VND 1.400 – 1.800/kg. The average price for 1kg of cassava in 2014 was VND 1.500. Since 2016, the factory is temporary closed and doesn't have a plan to re-open yet.

Rice

My Loi has 8.5 ha rainfed paddy fields of which only 2.5 ha have irrigation for two crops per year. The common rice varieties are Xi23, NX30, IR35366, PC6, VNA2, Nhi Uu 838, N97, Khang Dan DB-KD 18, and HT1. The average rice yield for the commune in 2013 was 5 t/ha.

Vegetables and tubers

Vegetables are grown throughout the year in home gardens mostly for self-sufficiency. Commercial vegetables are usually grown in fertile and nearby fields such as Nha Rau, Cam

Dau and Bap Muong.Although there are some fertile fields, with good soil quality for vegetables and tubers, these fields are far from home. Sweet potato is intercropped with maize during the autumn season. The local variety of sweet potato sells at VND 10.000/kg which is 40% higher than standard varieties.

Agriculture outlook

Each district in Ha Tinh province has a number of official flagship products. For Ky Anh district these are rice, peanut, rubber, sweet potato, cassava, vegetables, tea, timber, pig, cattle, buffalo, and aquaculture (by the coast).

Rubber production in My Loi has been put on hold; Farmers say it is not productive and rubber trees are easily damaged during storms. When leaders from Ky Son commune ranked the top ten most important crops in 2013, and what changes they expected by 2030s (Figure 1), it was noted that half of the most important products were flagship products, and no new species were anticipated to enter the top-ten.

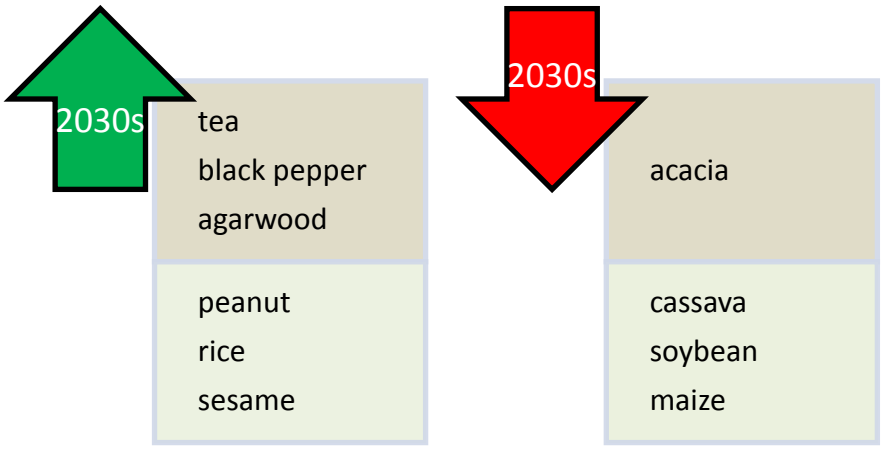

Figure 1. The top ten perennial and annual crops in 2013, distributed by their projected trends (upward arrow for increasing importance, downward for less importance) by 2030s, as ranked by Ky Son commune leaders.

Livestock

About 90% of the households have a few animals for household consumption. In 2014, one household had over 30 cattle and seven households had between 15-30 pigs. The number of cattle, pigs, and poultry are expected to increase due to increasing local demand. It is likely that a few households can afford expanding their livestock production as credit schemes available via Agribank, Vietnam Bank for Social Policies and the Cooperative Bank are small now.

In late 2015, the district announced plans to establish Hoang Gia Lai beef farms totalling approximately 120,000 animals. This is likely to affect smallholder farmers' land use on activities in upland communes, creating demand for feed, and affecting prices of beef.

Marketing

Farmers tend to sell fresh products close after harvest, either at local markets or via intermediaries. Middlemen arrangements are common for peanuts and timber. Some use mobile phones to get price information and to contact middlemen.

Non-farm activities

About 80 villagers have temporary or permanent jobs outside the farm in fields such as education, service, and construction. As My Loi is centrally located in the commune, the village has 20 kindergarten or school teachers and about ten Peoples' Committee-staff. Over thirty households run restaurants located mostly along National Road 12. There were 4-5 households with family members working fulltime as carpenters. In addition, some 15-20 households have at least one family member working abroad.

Gender situation

Women generally have less opportunities to attend training courses that last for more than a few days or those that are held far from home, as they are expected to take care of the household. Similar to many other villages, women in My Loi usually have longer working hours than men (Figure 2). They have less participation in training and meetings. Consequently, fewer women are aware of climate variability and change in general, and how these impact agriculture and livelihoods.

In group discussions, we separate women and men, as women are more outspoken in such groups. Both women and men generally agree that they have equal voice in choosing crop varieties, buying inputs, or selling to middleman. Quite often, women play the role of managing the family's money.

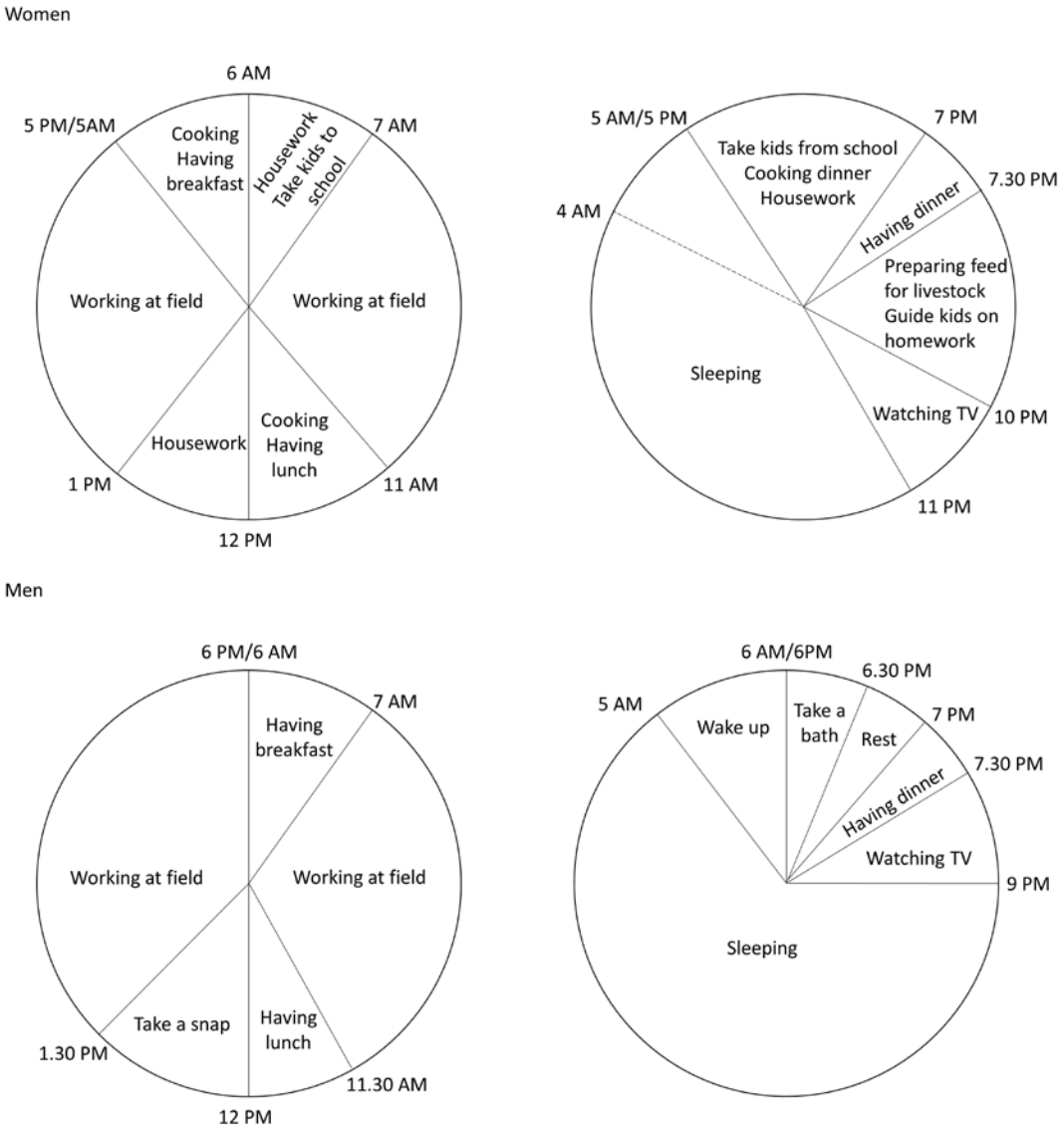

Figure 2. Gender clocks for women (upper two) and men (lower two) in My Loi village. Source: Fieldwork 2015

Cropping pattern

Cropping patterns depend primarily on water access, landscape location, and soil quality. Table 1 shows the climate calendar (at the top) and eleven adopted farming systems identified for further climate-smart interventions. The hatched line in the white boxes denotes potential for adding another crop or improved fallow systems.

Table 1. Climate calendar and typical farming systems in My Loi village

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Location
Temp						Max 40-42°C			30-33°C			Min 5-7°C	
Rain			Drought					Heavy rain					
Wind		Lao winds (dry Foehn winds)					Tropical storms				NW cool humid		
1	Rice (1A)					Limited water							Paddy field (rainfed)
2	Rice (2A)					Rice (2B)							Paddy field Irrigated fields
3	Veg	Peanut mono (3A)		Mung bean mono (3B)			Maize mono (3C)				Vegetable (mustard green) (3D)		- Near home - Fertile soil
4	Veg	Peanut mono (4A)		Mung bean mono (4B)			Maize x Sweet potato (4C)				Vegetable (4D)		
5		Peanut mono (5A)		White radish (5B)									- Near home - Medium soil
6		Peanut x Cassava		Cassava mono									Terrace, near home
7		Peanut x Cassava x Maize		Cassava mono									Terrace, near home
8		Cassava mono											Upland
9	Acacia mono												Upland
10	Acacia x Cassava										Acacia mono		
11							Black pepper planting						Garden

Source: Focus group discussions May 2015

Paddy fields

- Rainfed paddy rice (June-January)

Only 2 fields Chu Ke and Bai Nai, which are near Cay Tram Dam, are provided with enough water via 1km cemented irrigation channel. The rest of 6-7 ha are fallowed in the autumn due to lack of water.

- Rainfed paddy rice (February – mid-June) + irrigated paddy rice (mid-June – November).

The main constrain in rice production is cold spell which kill seedlings. To resolve this problem, some have raised seedbeds to reduce frost damage

Paddy fields - Potential CSA research topics

- Water supply - yield difference between first and second crop is 1-2 t/ha – What water harvesting technologies could reduce the gap?
- For rainfed fields: Is it worthwhile to improve water supply? Rain water harvesting with plastic or making pond with bulls?
- What are the non-rice options for low-productive paddy fields? E.g. grass
- Alternative wetting and drying? Broadcasting? Alternative crops?

Lowlands fields (near homes)

- Peanut monoculture (March – mid-May) + mung bean (green bean) monoculture (mid-May – August) + Maize (September – November) + vegetables, mustard green (December – February)
- Peanut monoculture (March – mid-May) + mung bean monoculture (mid-May – August) + Maize intercropped with sweet potato (September – November) + vegetables (December – February)

Both rotations are located on comparatively fertile soil, based on rapid sequence of planting to avoid soil evaporation. Short-duration crops are flexible and easily adjustable.

Disease Pseudomonas solanacearum on peanut (fungus)

- Peanut monoculture (March – mid-May) + white radish (mid-May – August)

Lowland fields - Potential CSA research topics
- Possibilities for land intensification to fill gaps. Why are there no winter crops? Only because soils are less fertile or water shortage? Lack of labour? Inputs?

Terraced fields

- Cassava intercropped with peanut
- Cassava intercropped with peanut and maize. Only few households intercrop maize during this season, so higher price and higher risks.

Terraced fields - Potential CSA research topics
- Could other crops be intercropped such as arachis pintoi, fodder crops/ bushes?
- Pest inventories to identify and document pests and diseases

Uplands

- *Cassava monoculture* – planted in February and March and harvested from October-November. Some households, with enough money will keep it until after Tet holiday in January or February. Pests *Coptotermes ceylonicus*, *Macrotermes annandalei*, and *Odontotermes* cause damage on cassava stem.
- *Acacia plantation* – acacias are planted in March or August-September (according to focus group discussions in 2012). Some plantations are very dense, reaching up to 1 by 1 meter to reduce the number of fallen trees due to storms, according to farmers.
- Intercropping acacia and cassava (taungya) – if timing of planting coincides, acacia seedlings and cassava are intercropped during the first year. In the succeeding years, acacia trees are planted as monoculture.

Uplands - Potential CSA research topics
- Is such tree density efficient – can thinning increase incomes?
- Does the density increase fire risk (in particular under warmer climate)?
- Are there alternative drought and fire tolerant species?

Home gardens

- Fruit trees such as banana, jackfruit, mango, orange, and pomelo are planted in February and harvested between September and November (except for bananas which are harvested in January).
- Black pepper is planted in the autumn and is surrounded by windbreak trees. The highest productivity a tree can produce is about 20-28kg (2014). The seeds are dried at home and may be sold for about VND 150,000-200,000/kg dry weight.

Home gardens - Potential CSA research topics

- Role of home gardens for diversification and income generation, nutritional intake
- Role of home gardens for experimentation with CSA technologies, e.g. biogas, vermiculture and compost for soil improvement
- School vegetable gardens as pupils and community training and educational resources.

Three main issues

The three main and interacting challenges to agriculture livelihoods in My Loi, according to focus group discussions are weather, pest and disease, and prices (Figure 3).

Weather

Increasingly unpredictable extreme weather events, especially flooding and cold spells, cause damage to crops, animals, infrastructure, and houses.

> My Loi is in a geographic position where a range of extreme weather events may happen in one year—from cold spells to hot spells; droughts to floods; and from dry Foehn winds and tornado to tropical storms and typhoons. During floods, polluted water often sweeps over fields or end up in wells. Fortunately, tablets are available for cleaning the affected wells. After floods we observe secondary particles formed on dry soil surfaces.

Pest and disease

Peanut and cassava have problems after flooding and long hot spells, and are difficult to control. In the autumn of 2015, farmers said that pests had not been a major problem.

Peanut: fungus

Cassava: Pests Coptotermes ceylonicus. Macrotermes annandalei, Odontotermes cause damage on cassava stem.

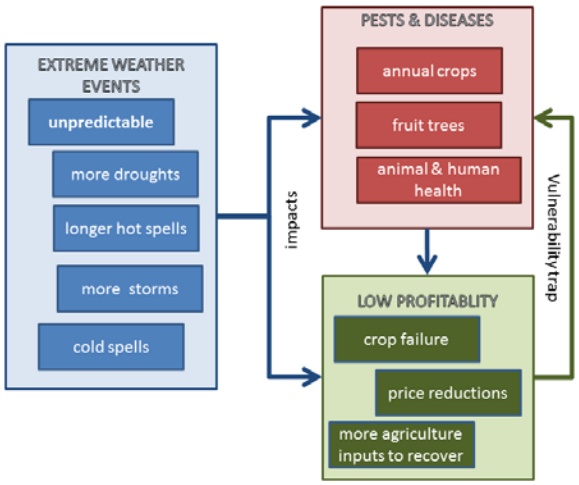

Figure 3. Problem tree identified in My Loi. ***(Source: field work 2012 and 2014)***

Prices

Input prices for fertilizer and pesticides are high, and pays for outputs are low, especially if middlemen are involved. After natural disasters, soil erosion cause crop failures and obstructs production – leading to income losses. Farmers can buy fertilisers and pesticides through Farmers' Union staff, who may offer credit until after the harvest, if necessary.

With the VEDAN factory in the commune, there is little competition. The factory sets prices after harvest even though farmers would prefer a set minimum price. Cassava has been cultivated in My Loi since time immemorial and the area for commercial cassava has significantly expanded especially with the establishment of the VEDAN factory in 2007. However, deforestation activities to transform forestland for cassava plantation also began since the factory started operating in the area. More recently, farmers have started to experiment on intercropping peanut with cassava to get two harvests, for this practice is a more efficient way to plant both crops without them having a negative effect on the yields of either crop.

3. Climate change perceptions and coping mechanism

My Loi farmers perception of climate change

The general awareness of climate change has increased since the team first visited. In 2012, approximately two-thirds of the women and one-third of the men said they had never heard about climate change. In 2015, farmers and leaders alike, spontaneously attributed all sorts of unusual weather events to climate change. Their perceptions of changes in weather patterns are often shaped by recent weather events and by unusual impacts (see further section IV.C).

When the villagers were asked to reconstruct past events, most of the events accounted for are those which occurred in the last five years.

Climate patterns

My Loi climate is characterized by a unimodal rainy season from August to November with the rise in temperature peaking in June-July (Figure 4a). The main typhoon season occurs from June to November. The monthly average winter temperature anomalies or the deviation from the long-term monthly mean from 1982-2011 are shown in Figure 2b. This suggests an increasing variation in winter temperatures since 2005-2006.

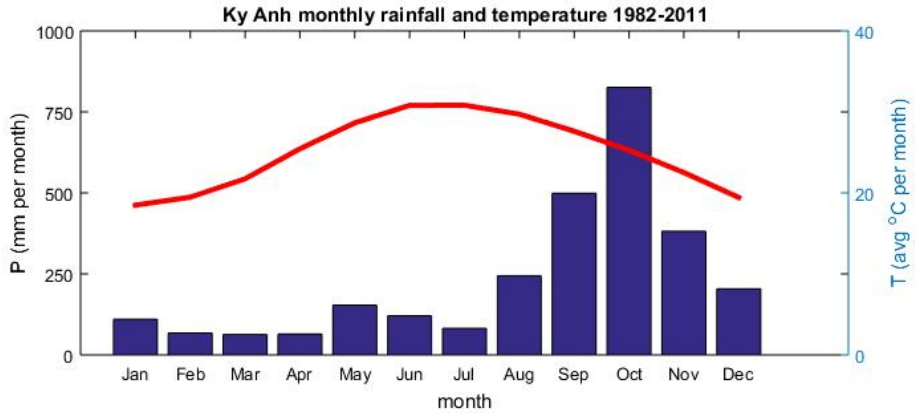

Figure 4a. Climate for Ky Anh 1982-2011, distribution of monthly total rainfall (bars, left axis) and monthly average temperature (red line, right axis) for Ky Anh 1982-2011. Data source: IMHEN. Analysis: the authors

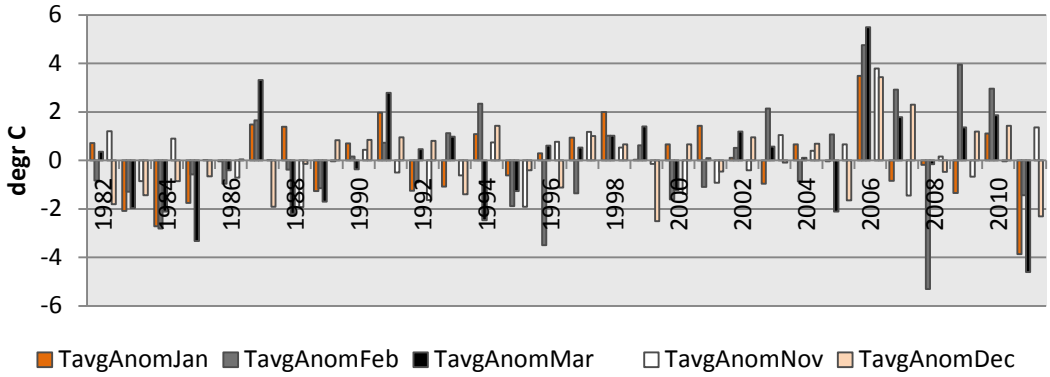

Figure 4b. Monthly average temperature anomalies during winter for Ky Anh (1982-2011). Data source: IMHEN. Analysis: the authors

Impacts – extreme event and climate variability

When asked to recall events from the long-term past, farmers tend to remember years with unusual impacts rather than the weather events that coincide with memorable events (Simelton et al. 2013b). All memories recalled by villagers from the year 2000s, are those which occurred in the recent years. These memories are used for cross-checking whether

meteorological observations indicate potentially extreme events. During this activity, farmers were not able to recall particular impacts of these events, nor did they recall adaptation initiatives they have taken during these moments.

After comparing different drought indices, research has confirmed the influence of El Niño on meteorological droughts, and the effects of La Niña during rainy season in southern parts of Vietnam (Vu-Thanh et al. 2014). For our Ky Anh dataset, the standardised monthly average temperature correlates significantly with El Niño index (n=360 months, $p<0.006$, $r=0.147$). However, monthly total rainfall did not correlate with the El Niño index when all months are included (n=360 months, $p=0.335$, $r=-0.051$).

Village hazard history

In 2012, the focus group farmers said that the major hazards which occurred in My Loi were the 1964 storm and flood, 1987 cold spell, 1992 storm and flood, 1998 hail storm, 2008 long-lasting flooding; and the 2010 long-lasting drought. All these events caused major losses on crop failures and/or animals. The household surveys results are shown below.

1964 **Storm and flood** –During this disaster, the village was flooded; many trees have fallen; half of the houses had broken roofs; four houses were totally destroyed. The event also affected the neighbouring village of My Thuan.

1987 **Cold spell** – According to the focus group, many cattle and fish have died. Meteorological data for Ky Anh shows that while January-March were warmer than normal, the average temperature for December 1987 was 2°C below the average; February-April of 1988 were also colder with temperatures that are 0.5, 2.2 and 2.7°C below normal.
El Niño spring and autumn - might explain the high observed temperatures

1992 **Storm and flood** – Meteorological data shows rainfall higher than normal on June, July and September. Temperatures were higher than normal on March, May and September while it was generally colder than normal during the months of June, July, September, October, and November.
El Niño occurrence during spring could explain warm spring temperatures.

1998 **Hail stones** - Crop yields were badly affected due to this phenomenon. Daily meteorological records show no abnormal rainfall amounts, except for a day in November with 215 mm.
El Niño-During the El Niño in spring, monthly mean temperatures are 1-2°C above normal.
La Niña- during La Niña occurrence in autumn there was a great variability in rainfall anomalies between months.

2000 **Drought**-According to 2% of the interviewed households, they suffered losses to this phenomenon.
La Niña-Because of the occurrence of La Niña during spring and autumn, temperatures on February, March and November were 1-2°C below normal.

2001 **La Niña-** Because of the occurrence of La Niña during spring, the temperature on February was 1°C below normal while January temperature was 1.5°C above normal.

2002 **Cold Spells**-According to 2% of interviewed households, they suffered losses from cold spells.
El Niño- This event occurred during autumn.

2004 **El Niño**-This occurred during autumn.

2005 Seven percent of the interviewed households incurred losses due to droughts.

2006 Two percent of the interviewed households incurred losses due to storm or drought.
La Niña- This occurred spring and **El Niño**- This occurred autumn.

2007 According to the survey results, 45% of the interviewed households incurred losses due to storms while 23% of them incurred losses due to floods.
La Niña-This event occurred during autumn causing November temperatures to drop by 1.5°C below normal and temperature in December to rise by 2°C above normal.

2008 **Flood -** Long-lasting flood caused fields to be submerged in waters. Moreover, according to the household survey results, 40% of the interviewed households suffered losses due to cold spells and 12% of them incurred losses due to floods. Meteorological records show that most months were actually drier than normal. If the flooding occurred sometime between early October-early November, there were only seven rain free days recorded, and there would have been presumably saturated soils within 16 days. Moreover, there were two days with over 100 mm and one day with over 200 mm.
La Niña- This phenomenon occurred during spring resulting to spring which is colder than normal with February having temperatures 5°C below normal.

2009 **Cold spells and droughts**- According to the survey, 5% of the interviewed households suffered losses from floods and about the same percentage suffered from these two events.

Based on the observed temperatures during the previous winter, December 2008 and January 2009 temperatures were below normal. The observations show conflicting evidence of La Niña and El Niño:
La Niña-Because of the occurrence of this phenomenon during spring, March and April each had over 100 mm rainfall above normal. Temperature on February was 4°C warmer while May temperature was 1.2°C cooler than normal. There was also less rain during February and march.
El Niño-due to the occurrence of El Niño in autumn, there was a great rainfall variability between these months: August and September (160-400 mm wetter than normal); October and November (600 and 260 mm drier than normal); and December (1.2°C warmer than normal and 100 mm drier than normal).

2010 **Drought** – this event led to crop failures. In 2010 a record number of households suffered losses in one year (43%). Moreover, according to the survey, 37% of the interviewed households suffered losses from droughts and cold spells for the third year in row.

Meteorological data for Ky Anh shows that temperatures were above average

every month except for the month of August. The months February, March, May, September, November and December had less rainfall than normal, and overall, the total rainfall for June-August were slightly above normal. However, between February 20 and July 16 (147 days) there were 120 dry days (rainy day counted as >1 mm in one day), the total rainfall recorded was 365 mm in which 195 mm fell in one day.
El Niño spring – 1-2°C warmer than normal, especially February.
La Niña autumn – big variability between months for rainfall and temperature

2011 Cold spells-Household survey stated only 2% incurred losses to cold spells. However, it is possible this referred to the winter 2010-11, considering the survey results for 2010 and meteorological observations.
La Nina- Its occurrence during spring caused temperature to drop by 4-5°C below normal.

2012 During the focus group, farmers in My Loi mentioned no particular observations for 2012. However, in coastal Ky Hai area, commune farmers said that the Lao-winds began later (mid-March) and left earlier (mid-June). Moreover, farmers in My Loi's neighbor village, My Thuan, observed that rain season began earlier than normal (June instead of July) and ended earlier than normal (August instead of September). Hence, they were not able to prepare seedlings. In Ky Hai, other villagers mentioned this as a severe drought with freshwater shortage, and farmers in the neighbouring village, Son Binh 2, as well as those in coastal villages mentioned that there was a week-long hot spell in June in which the temperature rose up to 42°C.

The survey highlighted that 23% of the interviewed households stated that the losses were mostly caused by the droughts and less than 5% of these losses were attributed to storm and flood impacts.
La Niña-This phenomenon occurred during spring.

2014 **El Niño**-My Loi residents experienced this during autumn.

2015 **Tornado followed by two months spring drought.** These two phenomena occurred during March 30- mid-June. Acacia trees were damaged and farmers estimated a 50% peanut yield loss due to the drought. Cassava yields were reduced but their sugar content might have increased as consequence of the drought (Le and Simelton 2015).
El Nino-This occurred during the spring autumn seasons.

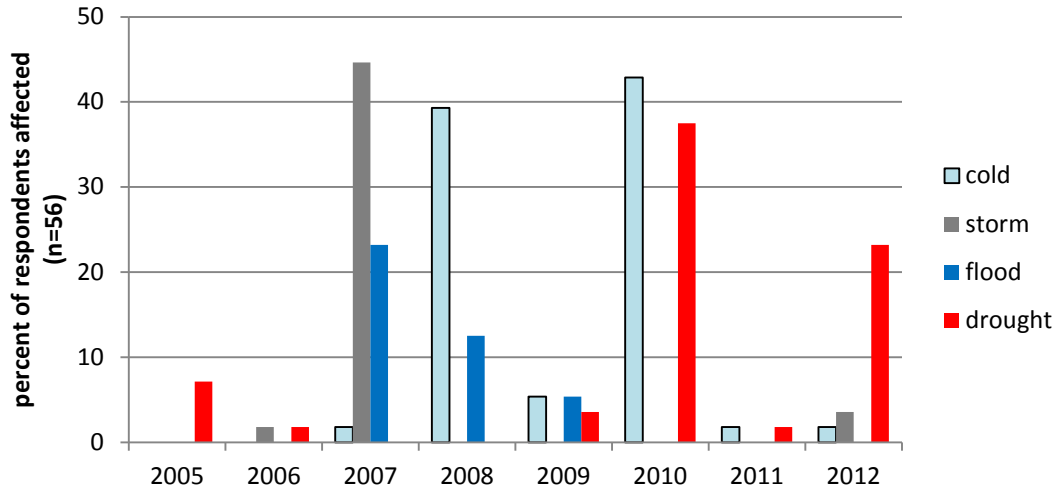

Figure 5. Share of interviewed households in My Loi suffering losses from extreme weather events between 2005 and 2012 (n=56 of [total population]). Source: household survey 2013.

Figure 5 shows that the largest share of households impacted by extreme weather events are in recent years. The typical location of hazards are illustrated in Figure 6. The worst disasters affecting villagers in My Loi are the storms that occurred in 2007 which affected 45% of the interviewed households. The following disasters also negatively affected the villagers: cold spells in 2008 and 2010 which affected about 40% of households in both years; drought which happened on 2010 and 2012 which affected at least 25% of households, and flooding on 2007 and 2008, affecting over 20% and 10% of households. All, except for the cold spells, fewer households were affected during the second occurrence of each disaster. This could indicate any of the following: the events were less intensive; households have adapted better; some had not yet recovered from the previous impact.

Socioeconomic vulnerability

This part of the assessment is a synthesis based on available material which includes household survey in 2013, key informant interviews, and focus group discussions between 2012 and 2015.

Impacts of extreme events by socioeconomic grouping

The survey in 2013 had 56 households as respondents. This accounted for approximately 25% of the total number of households, in which 8 poor, 19 near-poor (here, both groups are counted as poor), and 29 non-poor. Of the extreme events, a larger share of non-poor households were affected by cold spell (48 vs 55% for poor and non-poor, respectively) and storm (44 vs 52%), while the situation was the opposite for droughts (52 vs 41%), and about the same share for flood (30 vs 31% for poor and non-poor, respectively).

A particular economic vulnerability is evident as households that borrow money for agricultural investments run a high risk of losing the investment twice. Cold spells primarily affect cattle and rice seedlings. Hence, as cattle have a higher value and more non-poor households are likely to have more cattle, this group is more affected. During the time of the interviews about 90% of interviewed households had borrowed money.

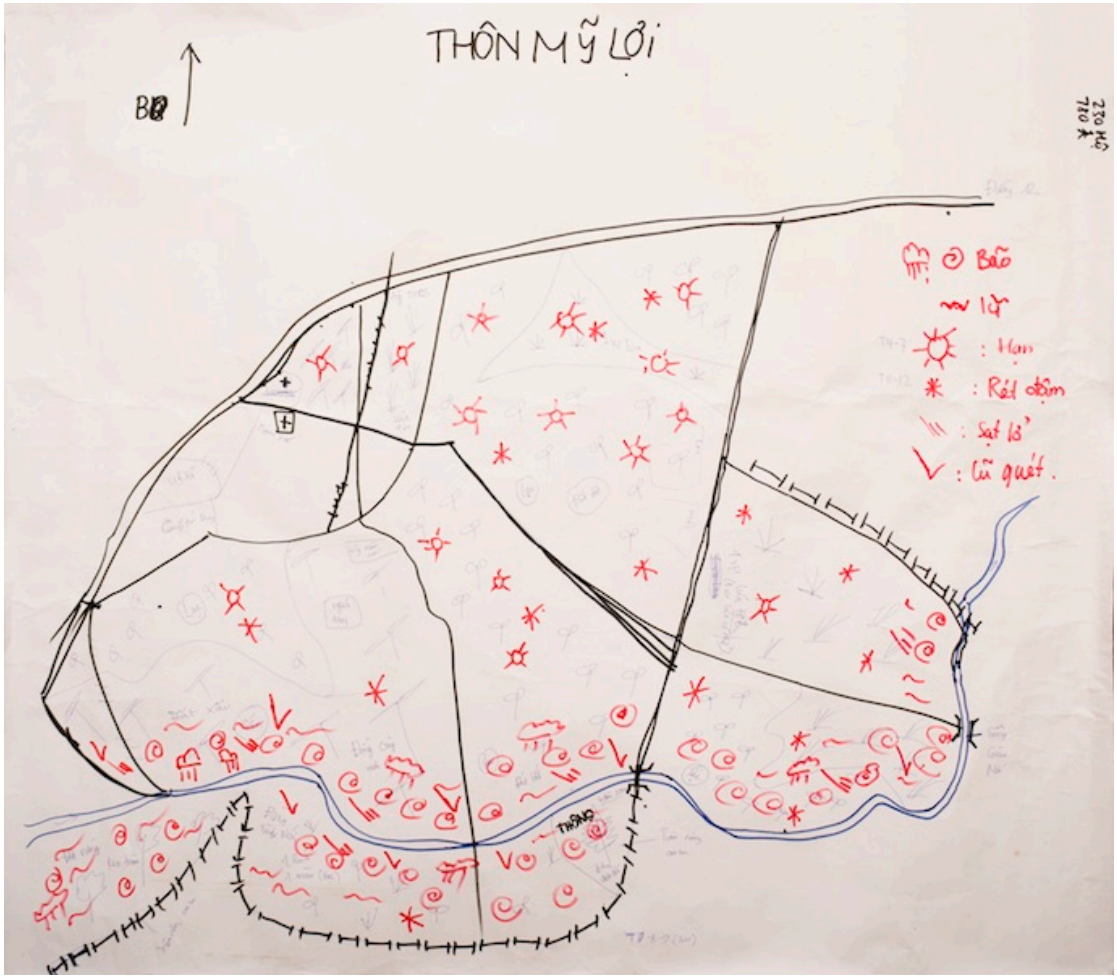

Figure 6. Hazard map for My Loi village. The legend shows storm, flooding, drought, cold spell, landslide, flash flood.

Impacts

When households were asked to compare the financial impacts of the two recent worst disasters, 10 households stated they incurred a larger loss from cold spell in the most recent year. While for drought, 11 households of the total 56 and 9 households for floods. With regards to storm impacts, three (all poor) households had higher losses during the former year of disaster occurrence while the remaining 26 had higher losses during the second year. Households without agroforestry generally took a longer time to recover economically after droughts, floods, and storms than households practicing agroforestry (Simelton et al. 2015).

Social vulnerability

After the tornado event in 2015, “female-headed” households, with men working away from home, had a harder time clearing up after the damage (Le and Simelton 2015).

Coping mechanisms

A number of coping and adaptation mechanisms before, during, and after different extreme events have been identified. The suitability of crops and trees to the various extreme events were ranked by a group of farmers (Figure 4). This ranking varied slightly compared to the ranking made by commune leaders. For instance, leaders ranked maize as more suitable than how farmer ranked it.

Droughts, hot spell

Before droughts and hot spells, farmers embank the paddy fields to retain water. They clean ditches and drainage systems for more effective water distribution. Crops can be planted early. For instance, beans can be planted immediately after peanuts have been harvested and while soils are still moist. Warnings about forest fire risks during the hot season.

During droughts and hot spells, water for daily consumption and irrigation is saved. Fields are monitored and home gardens were irrigated regularly. Coping mechanisms during droughts and hot spells include planting drought-tolerant rice varieties such as Xuan Mai or Black Chiem. The weakest plants are thinned out to give space for other plants. Longer-term adaptive measures include regenerating forests to protect watershed functions and provide shade.

Cold spell

Before a cold spell, farmers add fertilizer (e.g. phosphate, ash), cover rice with plastic sheets, prepare firewood for heating, and reserve animal feed. Updated weather information for commune/village were announced via loudspeakers.

During cold spells, earth is placed around trees for insulation (this insulation method probably works if the soil is dry), and animals are kept warm. In paddy fields, water is discharged and ash and phosphate are added. Embankments surrounding forests are strengthened. Afterwards, water is added to fields and fertilizer (nitrogen) added.

Table 4. Suitability of trees and crops to common extreme weather events in My Loi. Source: Focus group discussion in 2012 (Simelton, 2013)

Tree/Crop	Drought	Hot spell	Cold spell	Flooding (rain)	Hail stones	Heavy rain	Heavy storm
Acacia	2	2	4	3	3	3	5
Banana	4	3	4	5	3	3	5
Black pepper	4	4	4	5	4	3	5
Cassava	4	4	4	5	3	4	5
Eucalyptus	3	3	3	3	3	3	4
Jackfruit	3	3	4	3	3	3	4
Lime	2	5	4	5	3	4	4
Longan	3	3	4	3	3	5	4
Maize	5	3	5	5	4	5	5
Orange	2	3	4	5	3	4	4
Peanut	4	4	5	5	2	4	3
Pomelo	2	3	4	5	3	5	4
Paddy rice	4	5	4	5	4	4	5
Soybean	5	5	5	5	4	4	5
Sweet potato	4	4	4	5	3	4	4
Tea	3	3	4	3	3	3	3
			multiple benefits	yield increase	not affected	yield reduce	dies

Flooding, storm, flash floods

Before flood and storm occurs, the irrigation systems are cleaned to ease water discharge. Villagers are informed about risks via loud speakers and rice may be harvested early. Aside from these, trees and/or branches are thinned out to avoid breaking. Belongings are also moved to higher elevated areas or placed inside the house and houses are reinforced. Residents also stock food.

During storms and floods, electricity is cut-off, and the children and elderly were evacuated to a higher elevated area. Afterwards, fields are embanked and lime is ploughed into the soil to prepare for the next cultivation. Some villagers plant rice in their yards because flooded fields are prone to pests and diseases. Apart from these, damaged trees are cut down or stabilized by the residents. Wells are also cleaned and water in the wells is treated. Gardens and houses cleaned up, children and elderly return home.

In general, after a disaster, government officials from the province, district, and commune levels inspect the situation and provide support (e.g. Providing farmers with

new varieties, lending them fertilisers, adjusting farming calendars, and giving them technical training. Figure 7 summarises costly coping and adaptation strategies, as compared to no-regret options, which are also quite cheap and flexible.

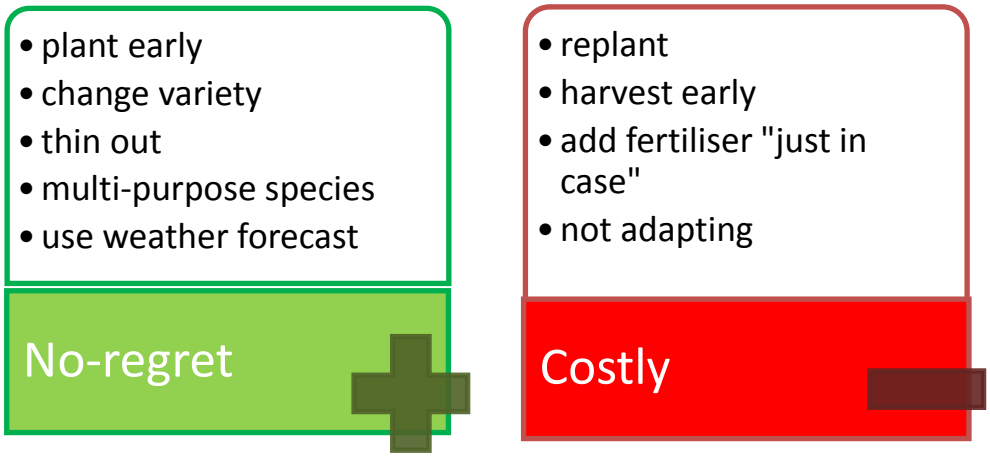

Figure 7. Costly and economical labour-related agriculture coping and adaptation strategies

4. Summary and recommendations

My Loi village is located in an environmentally and economically dynamic area.
On the ground, farmers are affected by direct and indirect weather phenomena that seem to cause uncertainty and narrow down the windows for decision making among farmers.

Small-holder farmers should learn to adapt to the rural transformations in agriculture such as the mechanization and industrialization taking place in the district. Smallholder agriculture will be an increasingly financially challenged endeavour. Solving this challenge entails s farmer collaboration to take one step further into the middlemen's arena, and better access to information. As for the climatic exposures, some already had seen as increasingly variable and unpredictable weather patterns. This means that farmers need to constantly adapt, and in doing so, they may need help in interpreting different signals from the markets, weather forecasts, and other scientific knowledge.

Table 5 summarises some recommendations for potential CSA interventions following CCAFS official CSA-indicators and those discussed and added for CCAFS Southeast Asia. Climate-smart agriculture options for smallholder farmers will need to consider land-intensive farming options for farmers to build on their competitive advantage. These may include diversification into niche agriculture to compete with large-scale farming, and higher-value products.

Table 5. Recommendations for potential interventions as a means to reduce vulnerability in My Loi village – with relevance to the commune and district

CSA indicators	Potential interventions
Weather smart	Seasonal weather forecasts Agro-climate information developed for different zones together with farmers and extension workers Improving farmers' understanding of the role of agroforestry and trees for recovery after extreme events
Water smart	Integrated farming systems with permanent mixed tree-crop stands (agroforestry) Simpler forms of drip irrigation systems for home gardens, water-saving techniques may be tested Need for drought-tolerant crops (e.g. sweet potato varieties) Cover crops and green mulch to reduce soil evaporation could be diversified beyond peanut, (e.g. *arachis pintoi*, fodder crops)
Carbon smart	Reforestation as sustainable forest management with mixed age and species stands Link to UN-REDD programs
Soil nutrient and pest smart	Better timing of fertilizer applications Soil improvement options (e.g. soil nutrient and carbon) Pesticide-free school vegetable garden to showcase the possibilities of using less agrochemicals Better monitoring of pests, what pests and what crops are affected?
Energy smart	There is still very little fossil fuel-run equipment Expansion of using existing biogas and biochar cooking stoves Minimum tillage could be an option in uplands to enhance soil moisture and soil carbon, and to reduce weeds
Knowledge smart	Farmer learning groups for sharing adaptation practices, farmer field/climate schools Farmer logbook to monitor interventions, weather, and outputs School vegetable garden that also serves as learning center
CCAFS-SEA added CSA indicators	
Nutrition smart	Awareness-raising campaigns to reduce malnutrition rates may be done via school vegetable gardens
Gender smart	Awareness-raising campaigns on gender which will actively identify ways to reduce and monitor women's work time so that they are able to join training programs and meetings
Market smart	Linking farmers to markets, engaging in farmers collaboration groups, encouraging farmers to become middlemen Land intense options (e.g. diversification into higher-value farm products, niche agriculture) Cost-benefit assessments of new farming systems Market-value chain assessment for new products like fruits

Annex

PRA tools

The following PRA tools were used to generate different information and data for this report. Depending on the sector and gender representation, sectoral and gender-disaggregated groupings were conducted in selected PRA tools.

1. **Community mapping** identifies the community's boundaries, road networks, river and springs, landmarks, infrastructures, and houses.
2. **Historical timeline** outlines the significant events in the community such as major disaster, socio-economic, political and cultural events and development; changes on landscapes; good and negative impacts of changes; and coping capacities and mechanisms to these changes. It also shows the trends, frequency, and intensity of events.
3. **Seasonal calendar** shows the annual seasonality of climate patterns, different livelihood activities in the community, water and food availability, pest and diseases on crops and livestock, health issues among children and adult, social and cultural activities, and income and expenses. The tool was also used to identify the changes in climate patterns overtime (10, 20 and 30 years ago).
4. **Matrix of livelihood activities** lists the various work performed, and identifies whether each activity is dominantly done by men or women. It also shows who will be most likely affected if a climate hazard impacts their livelihood.
5. **Daily Activity Clocks** determine the time and allocation of productive and reproductive activities done by men and women over a course of a day. It also determines whether there are changes and adjustment in time, allocation, and roles if there are climate hazards or extreme events.
6. **Problem tree** identifies the three major problems and challenges on livelihood, and their different factors and reasons. Information and data gathered were rooted mainly on developmental issues and problems which are worsened by climate hazards and changes in climate patterns.
7. **Identifying vulnerable groups** is based on the household survey. It identifies which families have suffered losses from different extreme weather events, and what their activities were.

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