Roles of Social Learning for the Adoption of Climate-Smart Agriculture Innovations

Case study from My Loi Climate-Smart Village, Vietnam

Working Paper No. 194

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

Helene Tran, Elisabeth Simelton, and Claire Quinn

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Abstract

With the rapid pace of climate change and its impact on food security and livelihoods, climate-smart agriculture is one strategy aiming to help farmers adopt more sustainable farming practices. This study looked at farmers' adoption of agricultural innovations and the role of social networks in the process. Through interviews and observations, we (1) identified determinants and barriers affecting farmers' adoption of agricultural innovations in My Loi Climate-Smart Village in northcentral Vietnam, and (2) explored how social learning and social networks contribute to farmers' knowledge generation during innovation adoption. Results show that determinants and constraints for the adoption of agricultural innovation exist at multiple levels. The study presents evidence of the value of social networks for the adoption of innovation, identifies what constitutes promising social networks, and gives examples of institutional structures that influenced the adoption process. Recommendations for social learning networks and scaling of climate-smart agriculture innovations are provided.

Keywords

Climate-smart agriculture, action learning, Climate-Smart Village

Key messages

- Social networks were important in the farmers' decision-making on innovation adoption, and also served as technical, moral and financial support centres.
- Social learning involved a mix of technical expertise and peer discussions, while public media, group and own experimenting were underutilised.
- Prospective (often autonomous) social networks were based on trust and commitment, a heterogeneous knowledge base among members and frequent meetings. Top-down support aiming to establish or remove gaps in existing social networks need to be responsive to its members' needs.
- Promoting women-only groups can support social learning among women.
- With climate-smart practices being context-specific, flexible multi-stage adoption processes are required with various degrees of tailor-made and top-down interventions.
- Facilitating 'learning by reflection' on actions seems critical for autodidact learners, such as farmers.
- Stakeholders must understand what limits adoption of innovation in the first place. Institutional innovation might be necessary before technological innovation can occur.

About the authors

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Contents

Acronyms

CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CSA	Climate-smart agriculture
CSV	Climate-Smart Village
FAO	Food and Agriculture Organization
ICRAF	World Agroforestry Centre
PSP	Participatory Scenario Planning
REDD+	Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries

Introduction

Farmers' adoption of new technologies

Research on adoption of agriculture innovations has often focused on how to deliver a 'finished package of technologies'. Less understood is how farmers formed their perceptions about the innovation before adopting it and how they continue to make adjustments in the adopted technologies.

Recognising the need for adaptation and mitigation through socio-economic and technological changes, the concept of climate-smart agriculture (CSA) emerged in 2009-2010, to reduce the double challenges to meet food security while addressing climate change (FAO 2013). This concept is promoted by several actors, such as the CGIAR Research Program on Climate Change, Agriculture and Food Security Research (CCAFS) Flagship Program on Climate-Smart Agriculture, as well as central governments, such as Ireland and India. Agricultural innovation is central to Vietnam's development policies to ensure food security and address climate change (Vietnam Government 2010).

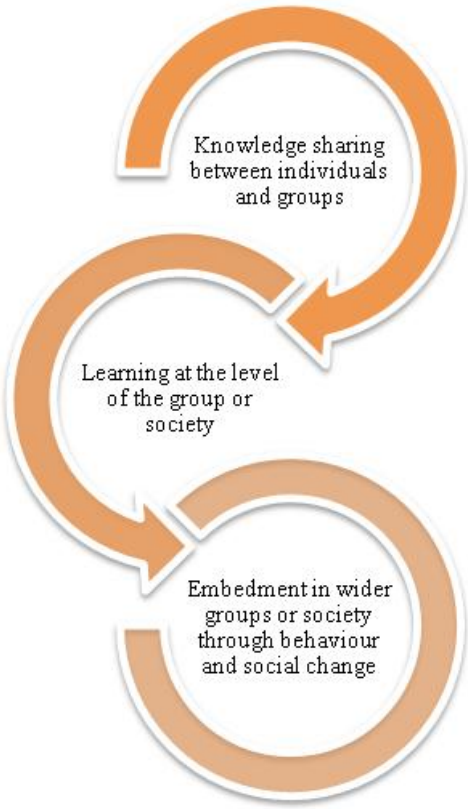


Figure 1. Social learning processes. Adapted from CCSL Initiative (2013)

The adoption of an agricultural innovation can be viewed as the decision to replace a technology or practice with an improved and more sustainable alternative, such as CSA. One approach to achieve such transformational change is through social learning (see Figure 1) (Pahl-Wostl and Hare 2004, CCSL Initiative 2013, Kristjanson et al 2014). In this context, social learning is understood as the process through which groups of people learn, by jointly defining problems, searching for and implementing solutions, and assessing the value of solutions for specific problems (Koelen and Das 2002). This process is expected to lead to a common understanding, resulting in learning and behaviour change beyond individuals to their households, communities and institutions (CCAFS 2013). Such emphasis on social learning draws attention to the role of social networks in farmers' learning and behaviour change, specifically on the potential of networks to influence the adoption process at the

micro level. A social network refers to “the pattern of friendship, advice, communication or support which exists among the members of a social system” (Valente 1996).

Empirical evidence remains limited on the extent to which social networks affect the adoption of innovation and how they interact with other determinants in the adoption of agricultural innovation.

Aims and objectives

Drawing from a case study in Vietnam, this research aimed to identify the factors affecting the adoption of agricultural innovation, focusing on the role of knowledge and learning in the adoption process of climate-smart agriculture practices. The specific objectives were:

(i) to identify determinants and barriers affecting farmers’ adoption of agricultural innovations; and
(ii) to determine how social learning and social networks contribute to farmers’ knowledge generation.

A qualitative research approach was applied for this case study to get an in-depth understanding of complex realities (Dunn 2010), in this case, farmers’ decision-making in the context of the adoption of innovation. Moreover, it allowed for exploring how different actors perceive the world and how it impacts their actions (Brickington and Sullivan 2003). A more quantitative approach was for collecting demographic data for the semi-structured interviews, to generate detailed and precise information about a large group while allowing systematic comparison (Singleton and Straits 2005).

Methodology

CCAFS Climate-Smart Villages (CSVs) are co-learning sites where researchers and communities evaluate and maximise synergies between different types of CSA interventions (Simelton 2015). The Southeast Asia region has three CSVs in Vietnam, two in Lao PDR, one in Cambodia and one in the Philippines, with different CSA interventions. The fieldwork for this study mainly took place in the My Loi CSV, northcentral Vietnam during May-July 2016.

Site description

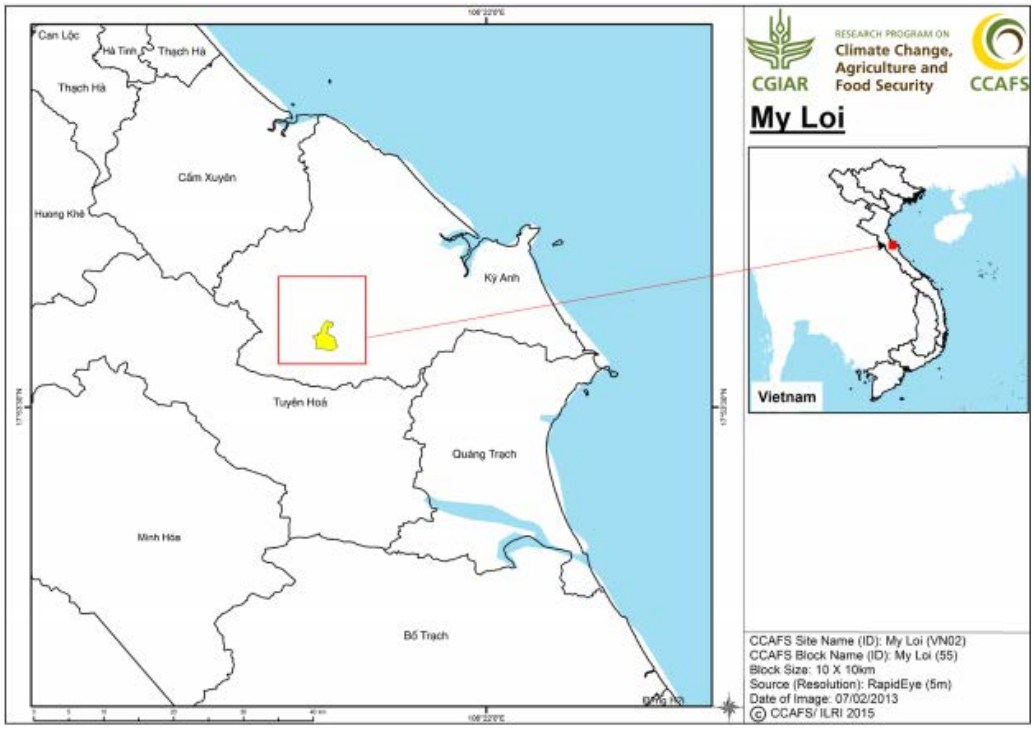


Figure 2. Map of Vietnam showing the location of My Loi village (Le et al. 2015b)

My Loi village, situated in Ky Anh district of Ha Tinh province (see map in Figure 2), represents upland agro-ecosystems in northcentral Vietnam. The population is about 770 and the total area 995 ha. The main income sources for smallholder farmers are acacia and predominantly rainfed agriculture (cassava, peanut and beans) along with a few livestock. Livelihoods are challenged by frequent natural disasters. In just the span of 2015 and 2016, My Loi experienced two severe cold spells, several hot spells and extended droughts, two major flood events, one tornado and three tropical storms (Le et al 2015a, Simelton et al 2015a). Vietnam has identified a number of Intended Nationally Determined Contributions from agriculture and forestry; in addition, Ha Tinh province implements REDD+ projects which provides a good potential for mitigation interventions.

Conceptual framework

To structure the research, the researchers adapted an analytical framework on farmers' adoption of agricultural innovations from Meijer et al (2015). They argue that farmers' knowledge and perceptions about an agricultural innovation forms the basis attitude towards the technology. Some intrinsic processes for attaining knowledge are direct observation, inference from previous experiences, or acceptance of information from external sources. Knowledge, attitudes and perceptions about an agricultural innovation are contextual and change over time, as the exposure to an innovation become social norm through early and late adopters. Furthermore, knowledge, attitudes and perceptions are influenced by extrinsic characteristics of the farmer, the external environment and the innovation. For example, personal characteristics include factors such as gender, age, assets, education, independence, networks and familiarity with the technology. Geographical settings include biophysical conditions (including natural disaster risks), proximity to markets, language, norms and values, land tenure rights, national policies, the structure of government and bureaucracies. Before adopting a technology, farmers weigh its benefits to livelihoods and ecosystem functions, e.g. soil improvement, against its costs for inputs, equipment and management, and return on investment.

Table 1. Factors influencing the adoption of agricultural innovations. Adapted from Meijer et al (2015)

Extrinsic factors	Intrinsic factors
Farmer characteristics • personality • livelihood assets External environment • geographical settings • structural settings • political conditions • institutional setting Innovation characteristics, i.e. socioeconomic and environmental • costs (externalities) • benefits	Farmer's knowledge • factual (awareness of the innovation) • about climate and weather • skills to use the innovation Farmer's perceptions • importance of learning • risk • to experimenting and trialling Farmer's attitudes • needs and goals with the innovation

Data

The data collection was done in two phases. The first phase was exploratory and primarily for orientation, to discern potential issues and emerging themes during three different types of knowledge/social learning events. First, participant and non-participant observations were conducted during in a week-long roving workshop on CSA technologies and practices in northern Vietnam. The workshop was organised for village leaders and farmers from the six CSVs in Cambodia, Laos and Vietnam (in total 19 participants). The aim was to observe

farmers' learning, particularly what caught their attention and how they interacted with other participants[1]. Second, non-participant observation took place during a Participatory Scenario Planning meeting in the My Loi village, where farmers generated and interpreted climate forecasts to make agriculture plans with the help of a facilitator. The purpose of this activity was to observe how farmers created, used and shared knowledge. Third, attending a technical training on sorghum in My Loi village with 19 participants, delivered by a local seed company allowed the researchers to observe farmers' decision-making process in choosing to experiment with a new crop and how they communicated with both experts and peers.

The second phase of data collection was done in My Loi village, to achieve a more in-depth understanding about intrinsic and extrinsic processes related to the adoption of agricultural innovations. Data was gathered through 35 semi-structured interviews covering themes such as farmer learning and factors influencing adoption. To study the role of social networks, researchers selected non-members as well as members of four existing CSA interest groups. Additionally, key informant interviews were done to produce a timeline for key events that had led to the adoption of innovations in the village, and to confirm and clarify certain information.

Data analysis

Emerging themes from the respondents' answers were analysed based on manifest (direct citations) and latent content (underlying meanings) (Babbie 2007). Using the qualitative data analysis software NVivo, the researchers extracted themes, identified relationships and differences to generalise and organise the information based on the conceptual framework presented by Meijer et al (2015).

Caveats

While adoption of innovations was studied over a five year-period, the CSA interests groups were only actively working for less than a year. Still, one hypothesis could be that CSA-farmers would be more apt to join and adopt CSA as an innovation. The case study should be understood as a particular case due to the added presence of scientists and facilitators. The use of participatory research includes the risk of subjectivity from the researcher's point of view (Crang 2003). Furthermore, with limited number of respondents and settings, this research may lack the potential to be generalised (Singleton and Straits 2005). However, the intended

1 Blogs on the event (CCAFS 2016) https://ccafs.cgiar.org/blog/viet-khmer-lao-farmer-leaders-commit-climate-smart-agriculture#.WBmOz9exi7M; (ICRAF 2016) https://ccafs.cgiar.org/news/farmers-envoys-climate-smart-agriculture-villages-southeast-asia#.V5rgGo9OJKZ; and coverage in Ha Tinh TV https://youtu.be/eHzmN-dwhZw

purpose of this study was not to offer generalisation but rather to contribute to the overall debate on the adoption of innovation.

Findings

The setting

The major changes over the past five years involved both management and production, while less in terms of land area (Table 2). On average one to two changes were made per household. Slightly more farmers changed the crops or livestock (37%) than the management (28%). There was no significant difference in the adoption of agricultural innovation between non-members and members of a CSA group, which may depend on the fact that the CSA-groups had only recently been established.

Table 2. Types of changes on farms in the past 5 years, by CSA and non-CSA group members in My Loi village (n=35).

Changes on farm	CSA-group			
	Inter-cropping (n=13)	Livestock (n=11)	Non-CSA (n=11)	Total (n=35)
No change	1	0	0	1
Management				
New way of feeding livestock	0	2	1	3
New way of growing crops	5	2	3	10
New way of managing crops or livestock	4	3	3	10
Production				
Change to a different crop	6	0	2	8
New feed for livestock	0	2	1	3
New variety or breed	5	3	5	13
Assets				
Increase in farm size	0	1	2	3
Decrease in farm size	0	0	0	0
Total changes	*20*	*13*	*17*	*50*

Source: authors' questionnaire, fieldwork 2016

Factors affecting the adoption of agricultural innovations

Key determinants and barriers for farmer's adoption of agricultural innovations are shown in Figure 3.

Institutional factors, for the most part, enabled adoption of innovation (71%). Similar to many parts of Vietnam, new varieties were often introduced and supplied by extension, sometimes with shared investment costs for entirely new practices. However, there were also examples

of institutional barriers to adoption (46%). For instance, the participatory scenario planning meetings highlighted that designated land use plans and fixed farming calendars could be felt as restricting innovation and the adoption of new practices. To change to a non-designated crop, farmers needed approval from authorities, based on an application with a set of requisites, including being a model farmer and being in a good economic situation.

Access to training (37%), financial help (34%) and networks affected farmers' ability to adopt innovations (both barriers and enabling). Besides the CCAFS projects, annual training opportunities for farmers and village leaders were provided by the district Department of Agriculture and Rural Development. However, some farmers felt their opportunities to gain knowledge were limited by the ways participants were selected for training.

Personality traits were seen as important determinants of innovation adoption (71%), and less so as a factor that hindered adoption. For example, over one third of farmers believed that their decisions were controlled by weather, and could not be influenced by them. Such personality traits can be understood as a reflection of farmers' perceptions of their external environments. A majority of respondents associated intrinsic variables, such as attitudes and in particular, personal goals (80%), with adoption behaviour, while fewer viewed the perception of the innovation's compatibility (or lack thereof) (29%) to hinder adoption.

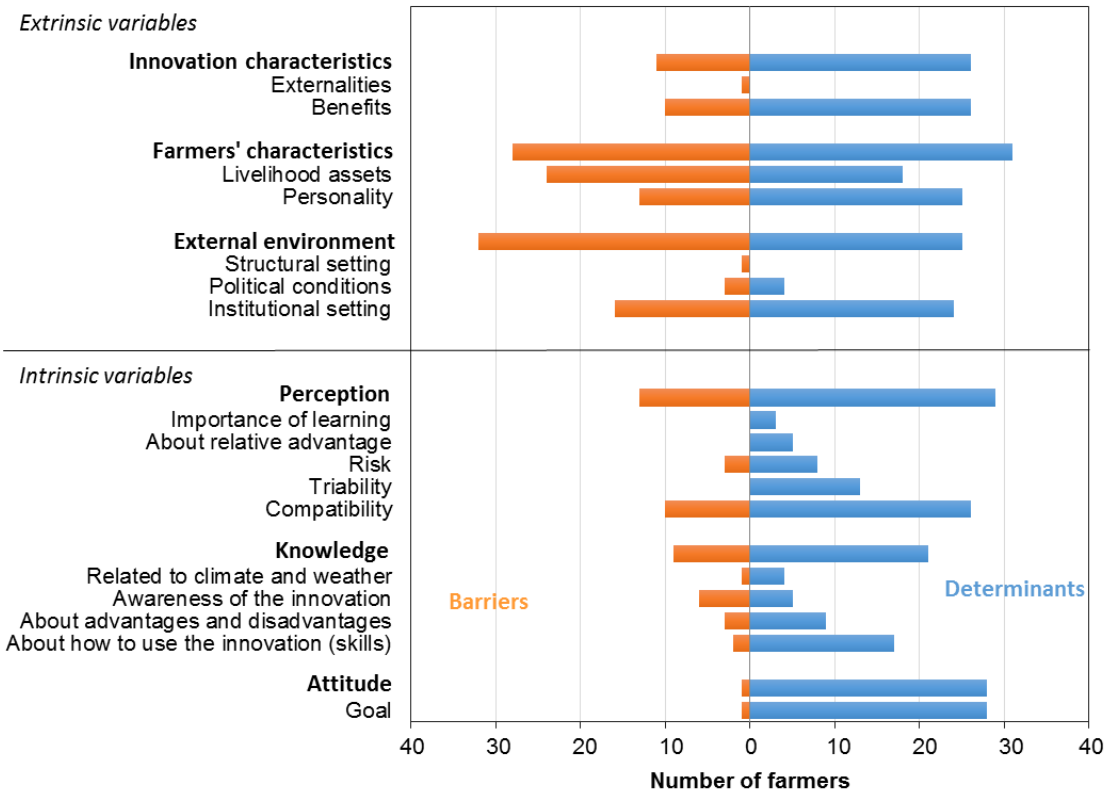


Figure 3. Perceived barriers (left) and determinants (right) of adoption of agricultural innovations among farmers in My Loi village, related to extrinsic and intrinsic factors (n=35). Source: authors' questionnaire 2016

Social learning and social networks

In addition to the interviews, this section draws on observations from three examples of social learning events: a roving workshop (Box 1), a participatory scenario planning (Box 2) and a technical training (Box 3).

Box 1. Roving CSA workshop

The roving workshop during five days in May 2016 for 19 farmers from six CSV farmers and leaders in Southeast Asia was organised by CCAFS. It was the first time the farmers visited each other. The trip involved several stops to see demonstration models between Ma CSV in Yen Bai and My Loi CSV in Ha Tinh, as well as two indoor meetings. The event gave researchers the opportunity to study farmers from My Loi while visiting other places, as well as while receiving visitors in their own village. The project team in My Loi encouraged women members from the CSA interest groups to join the workshop. The groups from Lao and Cambodia had one translator per group, while all Vietnamese participants spoke amongst themselves.

Social learning is influenced by the way farmers communicate with both peers and experts during learning events. For example, during the roving workshop the CSA farmers' ability to communicate with other participants was restricted by language barriers. Hence, participants mostly communicated within their groups as the interpreter could not cater to all their needs. The participants from Laos and Cambodia were observed to take more notes than the Vietnamese participants for whom many circumstances may be familiar, or who would be able to contact and follow up with each other later on, if needed.

Box 2. Participatory Scenario Planning (PSP)

Participatory Scenario Planning is a process for transferring weather forecasts and developing agroclimate advisories based on scientific and local knowledge.

The meeting is initially facilitated by a project staff member, extension worker or representative from Farmer's Union and involves the farmers in the CSA interest groups. The main objectives of the seasonal forecast and the scenarios are to develop different response strategies, based on farmers' knowledge, with inputs from 'experts' as needed. The final agro-advisory is then shared with other farmers (individuals and groups) through loudspeakers and bulletins.

Three meetings are held per season: before, during and after, to update and follow-up on information and actions, and for documentation purposes.

Differences in levels of active participation were observed in terms of farmers' perception of their need to learn and the relevance of the information. These are reflective of intrinsic factors, such as farmers' characteristics and goals. Hands-on concrete field-tested models drew most interest from farmers.

The diverse sources of knowledge highlight that farmers are seeking information. Interestingly, nearly all interviewed farmers said they learned from other farmers (97%) and experts (94%), while only half of them perceived that they learned from personal experience (51%). Figure 4 highlights that farmers relied on experts primarily for knowledge on processes and skills (77%) while only one quarter turned to family members, in particular elders and educated family members. Nearly half of the women preferred to learn from other women because they understood each other, while men had no preference. In term of age, most preferred to learn from others with the same age or older than themselves, who would be perceived to have more knowledge and experience.

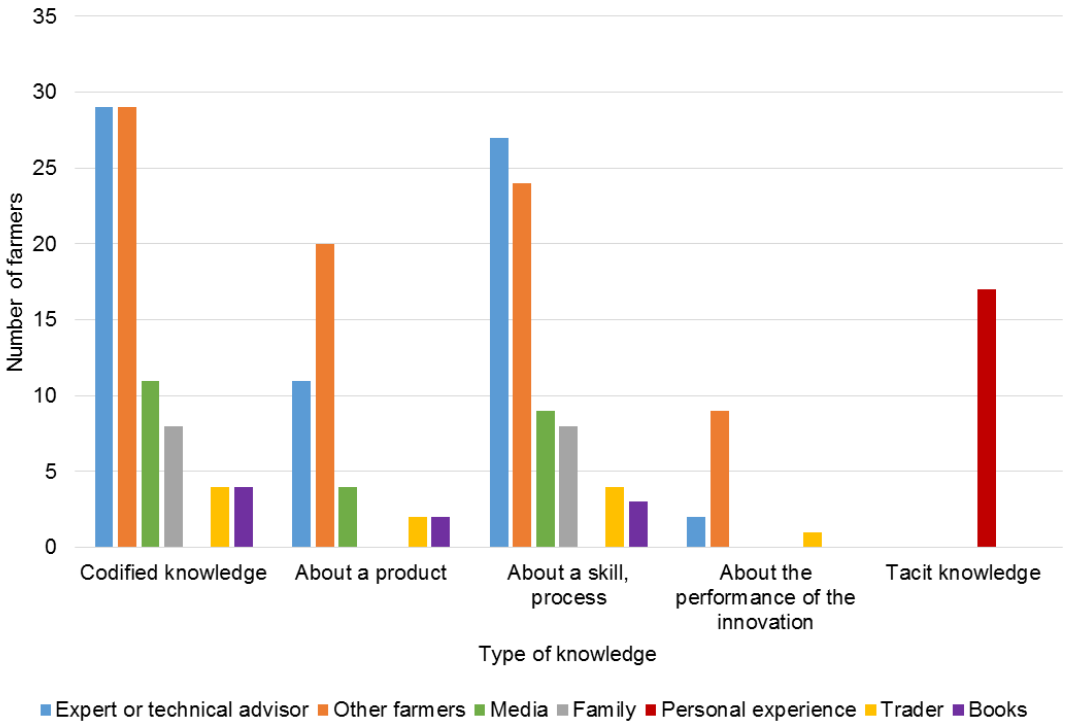


Figure 4. Farmers' types of knowledge and sources of learning (n=35). Source: authors' questionnaire 2016

These findings are consistent with observations from the sorghum training (Box 3) where participants relied on their peers for discussing and generating knowledge on the advantages and disadvantages of the crops, and on experts who gave information on the technical aspects of the crop and how to grow it. Structured learning, such as classes, often gives the impression of a learning situation, while autodidact learning modes can appear intangible. This highlights the importance of including 'learning by reflection on own activities' as a key facilitation activity in participatory scenario planning meetings (Box 2).

Box 3. Sorghum training

Sorghum seeds were provided to farmers in My Loi early in spring 2016, for testing as a drought tolerant crop in preparation for upcoming dry (El Niño) conditions. This appeared as a feasible strategy because some farmers had previous experience with the crop, and the village leader also had some seeds from a previous trip to the Philippines. Training was organised in June through the project with trainers hired from a local seed company. At the end of the training, only four participants out of 19 decided to take the seeds to experiment. The project staff did not inquire about the specific post-harvest processing requirements when hiring the trainers and that the seed company failed to clearly present the disadvantages of the particular variety, which were only disclosed at the end of the training through a discussion between the farmers and experts.

The adoption process

Before deciding on changing technologies or practices, farmers used combinations of individual (83%) and collective (100%) learning strategies.

Among individual learning sources, more than half of the farmers independently searched for information in media and books. One respondent emphasised how he tried to make sure that his wife does not watch movies during the television show “Friends of farmers”. While only half of the farmers said they learn from personal experience, more than half experimented by themselves to assess an innovation. However, on-farm experimentation was mostly done on individual basis, while learning-by-doing with other farmers was only mentioned twice.

In terms of collective learning, all respondents said they learned through their social networks (Figure 5). Learning through discussions was mainly done via peers (60%), while technical advisory was mainly provided through experts (83%) and other farmers (66%). Notably, only few farmers learned by observing other farmers (26%), experts or technical advisors (6%). When organising roving workshops, it would be worth keeping in mind to divert from the common show-and-tell-and-take-questions pedagogy.

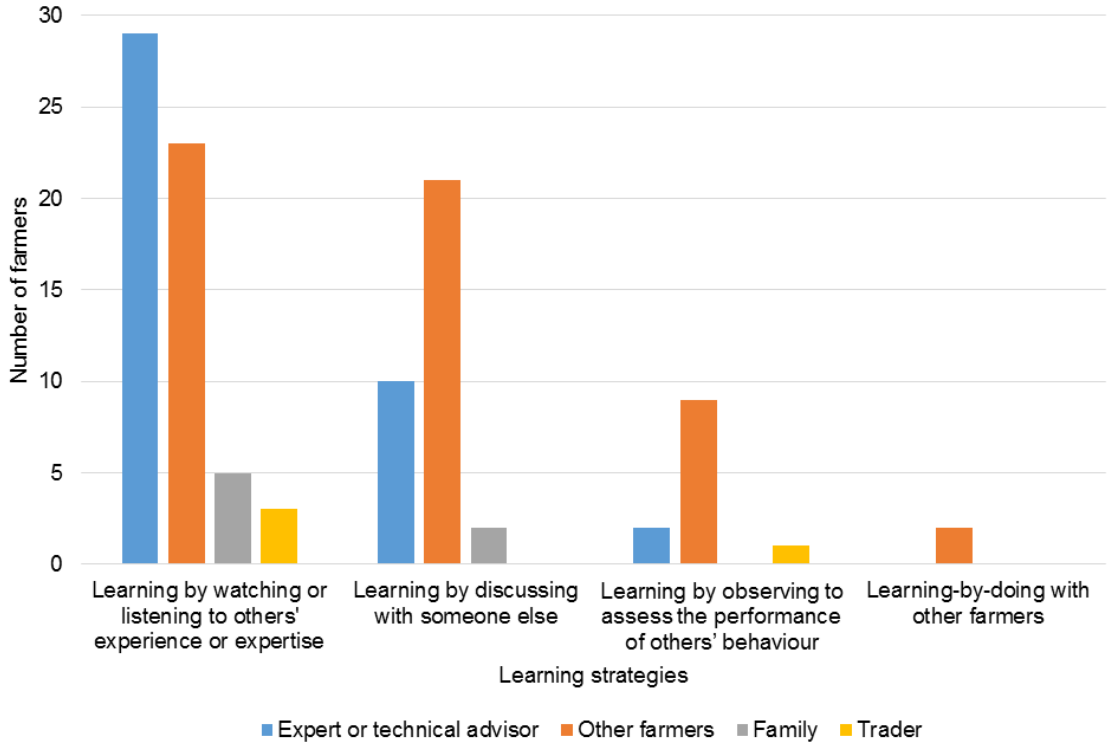


Figure 5. Learning strategies involving social networks (n=35). Source: authors' questionnaire 2016

The roles of social networks

Farmers' social networks played various roles besides providing knowledge inputs. They also provide farming inputs (29%), facilitate access to innovations (20%) and provide financial support (20%), however, the efficiency of social networks depended on certain contexts (Figure 6). The willingness to learn from others (personality and attitude towards other agents) was an important determinant of adoption for nearly one-third of the farmers, while about one-tenth were unwilling to share their knowledge, thus undermining their potential for collective learning.

Having a social network was often necessary for effective knowledge sharing and support (57%). For example, one-third of the farmers said social networks provided opportunities to interact and exchange knowledge (29%), and a quarter perceived that their social networks had contributed to raising their capacities to succeed or confidence when trying new technologies or practices. See the Appendix for more concrete examples. This social learning within networks manifests the original intention of the participatory planning scenarios and CSA interest groups.

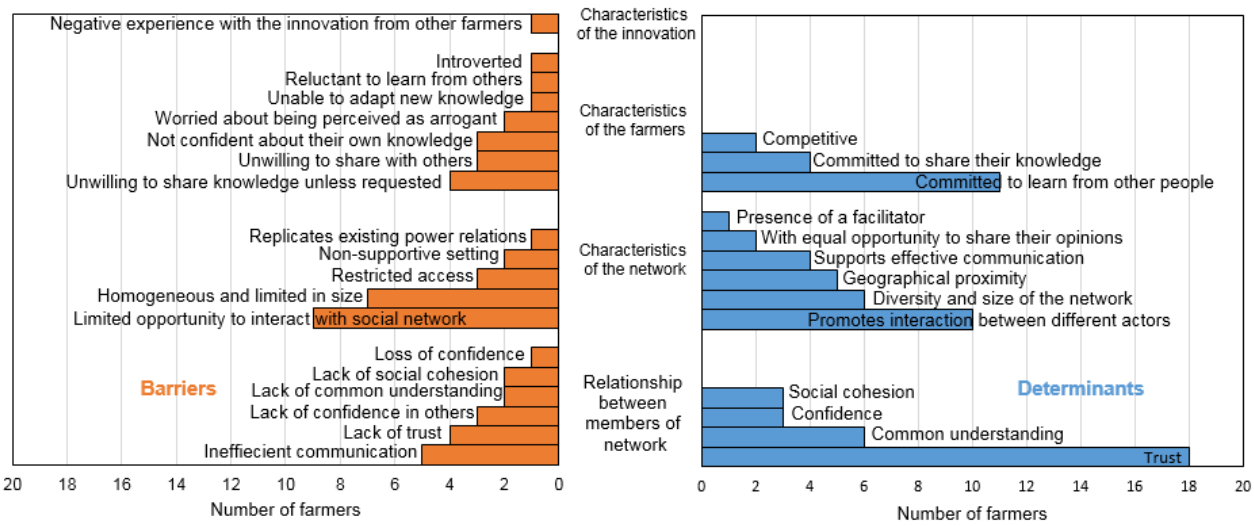


Figure 6. Barriers (left) and determinants (right) for social networks in farmers' adoption of agricultural innovation (n=35). Source: authors' questionnaire 2016

How well a network could support its members was influenced by its size and diversity, where having more members and members with diverse backgrounds was seen as more positive. Positive relationships between members of social networks were characterised by mutual trust (51%) and common understanding (17%), and by farmers' traits, in particular their commitment to learn and share knowledge (43%).

Factors limiting the ability to utilise social networks included inability to meet with other members often enough (25%). Such time constraints were particularly critical for single heads of households. Furthermore, limited size and lack of diversity in terms of knowledge and experience within the network, inefficient communication (14%), and lack of trust (11%) had negative influences on the network's efficiency.

In summary, access to different sources of knowledge was important for enabling learning to contribute to the adoption of innovations. In particular, while experts were important for 'learning' the skill or knowledge, in lieu of facilitated reflective learning, supportive social networks amongst peers were important avenues for discussing and 'understanding the knowledge', and hence achieving behaviour change.

Like I have the knowledge, now I want to learn more, I practice to see whether it works, I experiment first. If it increases productivity this year, I'll apply it to next year.

Interview #73

Discussion

Facilitating farmers' social learning networks for the adoption of CSA has many similarities to learning about other agriculture innovations. Confirming other research, this study shows that My Loi farmers learned in a myriad of individual and collective ways, that successful adoption is usually foregone by testing, discussions with family, peers and experts, and that personal attributes such as willingness to learn often is reflected both through conducting on-farm experiments, as well as making contributions to group learning. These collective and personal traits are well suited for innovating and adopting *context-specific* CSA practices. Additionally, the researchers highlighted a layer of complex, subjective factors determining farmers' needs and adoption of innovations.

Table 3. Different types of learning groups and activities.

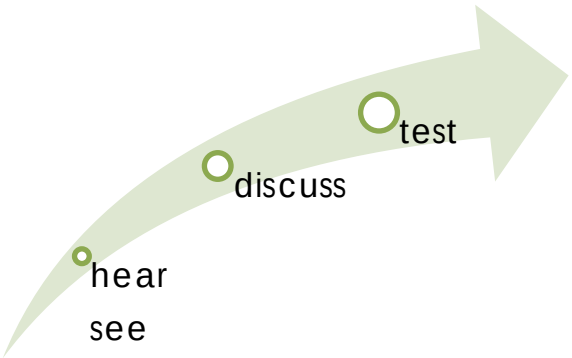
LEARNING GROUP / NETWORK CONTEXTS	Type of groups and scaling of such groups		
	Planned	Mixes	Autonomous
* *Setting* * *Reasons for joining* * *Trust among members* * *Cost for scaling* * *Expansion*	External support (funding) to meet project objective Formalised groups Different objectives for joining, could be artefact interest groups Trust may be questionable High-cost "Controlled"	(a) starts as planned, expected to trickle down automatically (b) builds on existing groups, expected to expand with external support	Builds on farmers own interest Sporadic/loosely organised groups Mutual trust likely in self-organised groups Low-cost "Uncontrolled"
TYPICAL LEARNING ACTIVITIES BY SCALE			
Households to village	Technical training Participatory scenario planning On-farm research Community innovation fund	Cross-visits Farmer learning networks Participatory scenario planning	Discussion Experimenting Farmer interest groups/learning networks
Village to commune	Farmer learning networks	Demonstration farms Farmer field schools Cross-visits	Markets
Commune to district, province	Targeted campaigns on specific topic	Media broadcasts	Market contacts

Learning activities and main learning process

The CCAFS CSV project in My Loi offers a variety of group learning opportunities (Table 3), such as roving workshops, CSA interest groups, community innovation funds, participatory scenario planning, access to technical experts, technical and theoretical training, field visits and external visitors. Through the project, farmers have also been featured on local and national television on several occasions, hence becoming voices to other farmers.

Despite the academic stress on the synergy among the three pillars of CSA, farmers' foremost motivation for adoption was for livelihood improvements – sometimes understood as being achieved by adapting. Some scholars propose that the expected outcomes of social learning may be exaggerated. For example, Koelen and Das (2002) questioned why individuals should change in favour of collective interests. As seen in this study, although farmers had personal motivation for joining and contributing to learning in groups, results suggest different reasons why some farmers are reluctant to share information.

If CSA is hence expected to spread through social learning and if farmers are expected to become agents of 'scale', then trainers and facilitators will need to point out how practices are climate-smart. They will need to also demonstrate what synergies to expect from what specific objectives of food security, adaptation and mitigation at which scales: (i) at farm level to motivate individual farmers; (ii) at socially aggregated scales to motivate groups of farmers; and (iii) at some spatially aggregated scale that is relevant for government authorities to report impacts of investments, e.g. on mitigation targets.



Key factors encouraging social learning networks

1. Encouraging learning and building specialty skills amongst members

Social learning networks clearly build on trust and commitment amongst its members. However, trust and commitment is highly associated with self-organised groups. Hence, farmer groups and learning events that are established with external support (top-down) will need to be flexible enough to foster and support social cohesion amongst its members.

Contributing to this is building up a diversity of knowledge and skills that meet the needs (or fill the knowledge gaps) of the members, and that is physically accessible to all members.

In the case of the farmer interest groups and community innovation fund in My Loi village, which are partly artefacts of project interventions, project facilitators need to pay more attention to building and maintaining trust, and developing a complementary special skills bank within the group. Furthermore, trust enables the networks to function as technical, moral and financial support centres. This means arranging for opportunities to meet frequently, for example two or more interest groups joining one evening to discuss weather forecasts and planning.

2. Removing barriers for learning and adoption

A group of farmers is a heterogeneous group with different needs and skills. Nevertheless a fine line exists between learning in homogenous groups, which farmers preferred, and belonging to a homogenous group, which was seen as limiting when concerned with knowledge and experience.

Language barriers for learning were evident in the example of joint international workshops. Similar barriers appear, but are often overlooked, in the case of sociolects and ethnic minority languages. Given the intensive note-taking, alternative learning modes may compensate for the inability to make sense of what was said (illustrations, video-recording, translated handouts, etc.), however the need for translation restricted active participation. Mere observation of methods was also not a preferred way of learning by farmers. It would be interesting to follow up after the visits to try and capture what messages the non-native visitors took home.

Institutional barriers were particularly related to the adoption of innovations. Many farmers felt restricted by not having financial sources nor the institutional support for making some land use-related changes. This issue has been raised elsewhere in Vietnam (Simelton et al. 2015b), often highlighting home gardens as the only land that was unrestricted by policies in terms of experimentation.

Critical factors for adoption of innovations

Adopting a new practice involves farmers combining a variety of information sources and making various cost-benefit calculations. Farmers learn about the innovation, its performance and how to use it. Personal experience, talking with other farmers and experts, and gaining personal experience through experimentation were all important components of the adoption

process. Hence, the social learning must be seen a continuous process that involves elements of planned and unplanned educational opportunities.

When it came to sharing knowledge the researchers observed that some farmers, after going on field visits, were reluctant to initiate sharing in the village because they did not want to be perceived as ‘more than others’ or having received preferential treatment. Rather, they preferred to answer if others asked them. This shows the importance of setting some top-down criteria (such as gender balance and being comfortable to share their experiences in altruistic manners) so that the selected representatives for these events actually represent the village, i.e. ‘sanctioned’ by the peers. Those who usually go to trainings, often referred to as ‘better educated’ or ‘early adopters’, are not necessarily the best knowledge sharers. The establishment of farmer groups should hence be carefully planned to support cohesion amongst its members, and be flexible enough to support cohesion. In addition, it should build a diversity of knowledge and skills that meet the needs of the members, and that is physically accessible for all members.

Recommendations

Innovations are contextual, based on available resources. Hence, before introducing new innovations, it is important to understand why farmers have not adopted such innovation already. This study suggests a range of factors, such as product or market information, knowledge, social and language barriers, physical or financial access to inputs, institutional or policy support, that could be restricting farmers from adopting innovation.

Farmers' social learning is a continuous process that may involve elements of planned and unplanned educational opportunities. The planned ones need to be tailor-made for the specific needs of farmers. Facilitated discussions and interaction should be embedded in the training plan as a formal or informal process. Farmers' learning opportunities can be improved by carefully considering who gets to join training events, and by encouraging women trainers. Similarly, when mutual trust and common understanding are more important within certain groups, holding women-only learning events, or offering opportunities for gendered breakout group discussion, can promote social learning.

To enhance the learning about CSA innovations may require facilitating a follow up on adopted practices throughout the farming season, in order to document the performance in relation to weather-related impacts (adaptation). This type of group learning can be achieved through participatory scenario planning activities before, during and after the crop season. Deploying creative ways to monitor mitigation contributions can be done with local schools, e.g. converting carbon sequestration or greenhouse gas emissions reductions to tangible measures.

Efficient social networks are able to meet often enough – hence if the members are geographically spread, other means of communication needs to be supported, e.g. social media, back-to-back or co-organising meetings with other events. Such networks also have a core network with a "functional size". However, finding a workable size range may involve some trial-and-error rather than setting limits from the beginning. In addition, the networks should have diversity in terms of knowledge and experience amongst members. Facilitators of such groups and networks should pay attention to the details that form and maintain active networks, especially when they are not self-formed.

For the scaling of social learning and networks, the non-knowledge aspects of social cohesion, such as enabling trust, are as important to consider as delivering the technology or knowledge. For organisers of training, the study shows the importance of providing sufficient and transparent information about a practice or training and trusting that farmers can make

their own decisions whether they need the group or training. They must also make learning events flexible enough to allow for farmers' needs to influence the content.

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Appendix

Support provided by social networks for the adoption of agricultural innovations according to farmers (n=35)

Elements provided by social networks in the adoption of agricultural innovations	Examples provided by farmers	Number of farmers
Knowledge	*- The teacher taught me for only a few days, I learn mostly from my friends (#45)*	35
Support		*19*
Input support	*- If anyone has seeds from trainings, I will ask them to give me some seeds. When My Loi village received peanut seed, they shared with households to grow it. I exchanged seed with them; I will follow them if it increases productivity (#70)*	10
Farmer's Union		6
Livestock group		1
Other farmers (sharing/borrow equipment)		1
Association of Soldiers		1
Reduce isolation and perceived risk as farmers work together	*- All people, they are male and female. I do the same as they do so if they succeed, I succeed. If I lost my crops, they lost theirs too (#78)*	2
Access to innovation	*- Although training did not provide any (financial) support but I had the chance to visit large cages (#47)*	7
Financial support (lending within group, joint loan applications)	*- If someone wants to open up a pig farm or need capital. They can report to Farmer Union to take a loan (#63)* *- I borrowed money from my friends. If I need bigger capital, I take loans from bank (#64)*	7
Perception		*11*
Perceived capacity to succeed through increase in confidence	*- We learn together about agriculture. I saw they could do it, so I think I can do it (#57)*	9
Perceived benefits of the innovation	*- Everyone in the village is the same, I got seeds from those who have good seeds, I ask them. I saw their results so I changed seeds like theirs (#65)*	3

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