ORGANIC
RESEARCH CENTRE

Technological Change

AN AGENDA FOR CONTINOUS LEARNING

Abel Villa
THE ORGANIC RESEARCH CENTRE | TRENT LODGE, STROUD ROAD, CIRENCESTER GL7 6JN

An agenda for continuous learning

Introduction

In this paper, I analyse the Technological Change that occurs among smallholder farmers in SFP/PO. According to Lall (1992;1993) Technological Change is understood as the continuous process of absorbing and creating technical knowledge which enables firms to improve, master, or adapt a technology to new conditions. I discussed how farmers in SFP/PO define what constitutes a competent organic farmer based on the activities they undertake, and how they display competence at three distinctive levels which prove they are part of the community.

I analysed how smallholder farmers in SFP/PO learn the skills for producing organic crops. Specifically, I explained how learning took place *in situ*, based on social interactions which enabled the creation and absorption of experiential knowledge for organic farming practices. In addition, I argued that farmers' learning was guided by social ties. These ties enable the internalisation of experiential knowledge, and negotiation of new knowledge with competent farmers. I specifically focus on the continuous effort of learning that farmers in SFP/PO make, creating experiential knowledge contributing to the development of their production skills and enabling further innovations.

The analysis in this paper answers the research question *how does the technological change occur in farmers' production capabilities?* The analysis links to the aim of this research and contributes to the understanding of the development of production capabilities of participating farmers in the Global Value Chain. To address this research question, I developed the following argument: in SFP/PO, farmers, as practitioners in the community, have an agenda which enables them to continuously embrace an effort for learning. By embracing in the effort, farmers define their learning projects. The effort is driven by leadership by farmers, their

connectivity, and by brokering relationships among them. Consequently, farmers as a community of practitioners can support each other on their learning from basic production capabilities (Technological Capabilities) such as cultivation labours, to more complex tasks like developing their own seeds and technical solutions.

In analysing the agenda of SFP/PO for continuous learning and skills development, in the first section I examine the leadership exhibited by farmers that is present throughout the value chain. Specifically, I look at the role of farmers in carrying out this leadership to motivating novice farmers in the development of production skills, the support for obtaining the necessary certifications, and decision making for planning planting in future seasons. Secondly, I examine how connectivity among farmers, and the brokering of their knowledge enables the development of technical solutions, and further supports the agenda for continuous learning. Thirdly, I examine the learning project that SFP/PO has implemented for developing new products, and how a critical mass, consisting of competent farmers, area co-ordinators and geneticists, constantly assess inputs, such as seeds, to improve and create new materials (seeds) that comply with the requirements of customers and farmers. Finally, I present a summary of the paper and the answer to the research question

Production activities

Wenger (2000) argues that Communities of Practice depend on internal leadership and enabling the leaders to play their role in helping the community to develop (p.231). It is important to point out that for this analysis, *leadership*[1] in CoP is used to describe the role of competent farmers and area co-ordinators in motivating other farmers in their continuous learning. The leadership role of competent farmers is important for keeping continuous learning and collaboration throughout SFP/PO.

[1] I am aware of the existence of literature about leadership, and by no means is it the purpose of the analysis to further elaborate on this topic.

Monitoring the requirements and needs of the customer base and, at the same time, considering the needs of smallholder farmers, are aspects where motivation for continuous learning helps to push the learning agenda of the value chain forward. Wenger (2000) also argues that Communities of Practice must decide the type of activities it needs. In the case of SFP/PO, learning production skills is an activity that involves a constant engagement among smallholder farmers to provide support and supervision on cultivation for organic crop production and certification activities. My argument in this section, is that farmers play leadership roles for motivating other farmers throughout the value chain to continue learning production skills.

As Communities of Practice, leadership in SFP/PO enables continuous skills development for production capabilities in smallholder farmers which particularly did not have the necessary skills in organic agriculture and, in some cases, in agriculture in general. As these types of activities require continuous effort for learning, leadership maintains an understanding of the enterprise of SFP/PO. Leadership also enables the cooperation, mutual responsibility, sharing of experience among smallholder farmers across their geographical locations, and the experience of other farmers. Therefore, leadership in SFP/PO motivates and enables constant effort for learning as well as how to do the activity, and comply with demands of customers, global buyers, and international certifying agencies.

The accounts of farmers shed light on the role of leadership to engage with other farmers and guide the collective effort, enabling continuous learning for the development and improvement of production capabilities. In this regard, central to farmers' continuous learning in production skill development, is the alignment to the understanding of SFP/PO enterprise, a view point that surfaces among experienced and novice farmers. For example, an experienced farmer, the Director of international farming says:

> *"A considerable part of our job is to keep the relationships among smallholder farmers […] our motivation in particular is that smallholder farmers become good organic farmers and keep them up to date with the organic production programme [SFPDIF01]"*

The Director of International Farming highlights the importance of keeping the community together and maintaining the motivation for continuous efforts for learning. This account shows his leadership, which is focused on promoting the learning of farmers in organic farming practices throughout the value chain. Specifically, his role as motivator in the community to constantly engage with farmers is clear. His role consists of visits to all smallholder famers across Baja Peninsula, to pass on the needs from customer and farmers, and constantly update the knowledge needed to improve the skills to stay competitive in the market. As a result, his leading role, motivation, and the keeping of relationships enables experienced farmers to be in interaction with supporting novice farmers in quality assurance, identification of risks, and organic farming practices.

However, leadership is also seen through commitment and engagement from other farmers. The Area co-ordinators also play a role in the continuous learning effort and enhance motivation among participating farmers in different geographical locations. For example, the area co-ordinator of Southern Baja Peninsula put it this way:

> *"I tell them [farmers] all the time in our meetings, look, imagine that you are in a supermarket where there are 20 different brands of cherry tomatoes. That parent may prefer SFP/PO brand, because of the taste, because they know we work with small-scale farmers, they consider our social purpose. And among those 20 brands, yours was chosen" [SFPS01COOR1]*

The leadership of the area co-ordinator explains the importance of reminding the mutual engagement and responsibility among smallholder farmers in southern Baja peninsula to maintain quality. His role as motivator draws on elements of a shared activities, such as meetings and exercises to place farmers in scenarios, to help them understand how competition happens, and what differentiates their produce, and what consumers prefer. This continuous effort ensures the compliance with international standards, the quality of

produce. Notwithstanding the importance of the role played by leading farmers, such as the Director of international farming and area co-ordinators, leadership is also taken by other farmers in remote areas. For example, one competent farmer narrated how he supports continued learning among novice farmers:

> *"I support farmers when they have issues with growing or handling a particular crop. I tell them see, let's do it this way, what do you think? And they say yes, farmers cooperate and we all see each other as allies" [SFPS03CM03].*

The leadership shown by the farmers, supports the leading role of area co-ordinators and is aligned with effort of promoting continuous learning of organic farming practices. This narrative illustrates the cooperation among farmers in their taking care of the day to day activities, by showing concern for the success of the practices of other farmers. Specifically, it helps maintain the value perceived in the markets as organic produce, elements of the enterprise that farmers are constantly reminded of.

Novice farmers also reflected on their leadership and elucidate on their motivation for continuous learning. One of the novice farmers said: *"We established a relationship with SFP in San Francisco, and they made a technician available as if he were a doctor [MD]"* [SFPS04PR]. The quote is indicative of motivation to engage and create relationships among novice and competent farmers. Their leadership allows continuous learning for the improvement of their organic cultivation practices (soil preparation, soil fertilisation and maintenance). The fact that they pursued a relationship with SFP, shows the motivation of novice famers on their understanding of the practices with the guidance of a competent farmer. It also illustrates the continuous learning needs.

By taking leadership, farmers in remote locations can make efforts to reinforce farmers' learning, to keep up to date with their skills to comply with the feature of an organic product and take care of their practices. Having manuals and the need to read them are aspects which are still out of the context of rurality. In simple terms, smallholder farmers are not used to

following instructions from a book. This simple book becomes a 'big deal' because written instructions are what they call 'dead letters' or because of comprehending complicated standards. Additionally, farmers explained that their understanding of complying with organic standards and leadership by procuring other farmers. With the interactions with other farmers, their motivation to look for help makes them have a clearer idea of how the practice must be carried out to take care of their farming operation.

One farmer said: *"Jumping from conventional to organic is a process. For example, your soil must have a certain amount of time of no use. In this case, it was 3 years of no use. From that onwards, the learning started"* [SFPS06IR01]. This quote shows the realisation that conversion to organic farming requires constant effort. It requires the production of a crop with different qualities from those of a conventional crop. And as such, farmers show their leadership by following the principles with conviction and enhancing customers' recognition of loyalty.

For example, one action that emerged as part of the leadership, is creating visual material for the documenting of the practices, i.e. creating visual material. The visual materials consist of illustrations, like pictures and power point presentations. For example, Picture 1 is one example of illustrations of the five different qualities customers want from cherry tomatoes. This information is passed on to all smallholder farmers. However, there are other types of practices which have more demanding requirements, or require major attention to detail, such as organic and food safety certifications. For this type of practices, there are power point presentations provided in the form of talks. The talks are given twice during the production season. To ensure farmers continue to pay attention to certifications, farmers are briefed at the beginning and end of the season. With this, farmers become aware of what the certification is about and all that is involved, especially given that requirements may be updated from time to time.

In both instances, this passing experiential knowledge is designed as carefully as possible so that farmers can incorporate it, link it with their own context and understanding thus

building their knowledge-base. Competent farmers such as the Area co-ordinators, together a long with the staff from the Coordinating Firm, design the materials in the form of power point presentations and printed materials. However, it is important to highlight that this is led by the sales department, and Director of International Farming (DIF) in San Francisco Produce in the U.S, due to close interaction they have with the customer base. Therefore, the constant interaction with the customer base allows them to capture vital information of customer needs. In addition, along with the leadership and support of DIF, those needs are translated into visual material so farmers can understand what it is expected.

One farmer in central Baja Peninsula said: "*Quality is based on classifications related to size, consistency, colours, residue levels, nutritional balance* [SFPS04IT]. This quote exemplifies the understanding of farmers of what quality is. It sheds light on how the farmers relates his understanding with the features that produce must comply with. Taking the example of one of the most demanded products, organic cherry tomatoes, one farmer said: *"Say, they [San Francisco Produce] want numbers 4 and 5, or there might be a customer that wants number 6, which is the brightest red and sweetest"* [see picture 1][SFPS05CM01] The narrative tells us how the illustration helps as guiding and visual support as to how the crop should look when harvesting according to the requirements of customers. This action is viewed as important because as customers adjust their quality requirements depending on the preferences of final consumers[2], farmers need to be updated.

For instance, picture 1 illustrates the level of ripeness required according to the needs of customers in the USA and around the world. In addition, by giving instruction *in situ* to farmers in need, farmers become knowledgeable about the characteristics of crops. Moreover, during the winter time, which marks the beginning of the season, customers demand as much produce as possible, due to seasonal festivities. Therefore, the market for

[2] It is important to point out there is a difference between customers and consumers. On the one hand, customers are the direct buyers of SFP/PO. They are mainly medium and large retail stores (supermarkets). On the other hand, consumer are people who buy the produce at retail stores.

cherry tomatoes accepts produce with qualities ranging from 1 to 6. However, as the season goes on, the standard gets stricter, ranging only from 3 to 5. Produce that does not comply with this standard will not be accepted. Therefore, the leadership taken by the sales department, DIF along with the understanding of farmers, elucidates the continuous effort of learning from novice and competent farmers. The leadership performs periodic visits to make sure there is an internalisation of level of ripeness in relation with colours to meet the requirements of customers.

Picture 1: Quality measures of organic cherry tomatoes

Source: Data collection, 2015

A recurrent subject among farmers was their need to achieve standards for certifications such as organic, food safety, and Fairtrade. The importance of certifications as documents, lays on the acknowledgements from national and international certifying agencies. Leadership is

relevant for the farmers to be able to have these acknowledgements. As part of the role of the DIF said:

> *"We are currently working with four farm zones [across Baja Peninsula] with […] Fairtrade certification with plans to add a fifth zone toward the end of June […] by the end of 2015, we plan to have all our farm zones in Baja California certified, representing over 3,000 acres of farm land"(Abcarian 2015)*

For achieving certifications in SFP/PO, leadership of DIF allows to focus it in a collective way, with efforts to allow smallholder farmers to be part of value added activities. Leadership also enables to set up the general objective of having all farmers certified across geographical locations with specific times. This is particularly important as SFP/PO has divided the southern Baja peninsula into five zones. These geographical locations enable to address certifications and consequently, having the general objective of achieving more certifications for farmers, reflects a leadership that increases the chances for more farmers to develop skills in organic farming practices and access markets.

In taking further the leadership for achieving certifications, the area co-ordinator of northern Baja said: *"here we make sure every farmer keeps their land free of chemicals. […] We have to make sure they follow organic standards"*[SFPN01COOR]. Here, leadership drives the efforts in the northern geographical location and illustrates the continuous learning effort and support for farmers. When looking at remote areas, particularly, another novice farmer also provided an account in line with the area co-ordinator:

> *"He [the area co-ordinator] helped me a lot and with field chief, who although has not technical training, has a lot of experience and sometimes knows more than I, that I have a degree. I know the theory, but not practice". [SFPS05CM02]*

The quote also indicates the farmers in her leadership role draw from the shared repertoire and contributes to the learning effort of both farmers, novice and competent work together. As a result, SFP/PO farmers are continuously making the effort to support novice farmers in

passing on experiential knowledge. This effort enables the continuous development of skills in novice farmers given their importance when obtaining organic certification.

Another aspect of leadership in SFP/PO is the use of group certification. It consists of including the organic operation of novice farmers in one combined certification, where the area co-ordinator takes full responsibility for satisfying the requirements of the certification. Group certification is part of the elements of shared repertoire and provides novice farmers the space and time to learn the requirements of organic farming certification. In the longer-term, farmers will also be able to gain their own individual certification. In this regard, the area co-ordinator said: *"we want every farmer to have their own certifications, because they are assets for them. In the moment they wish to expand their horizons they can do it"* [SFPS01COOR01].

Some of the farmers interviewed stated they acknowledge that they must have the skills to carry out all cultural labours and thus apply for their own certification, while others still felt the need for time to gain more confidence and pass the certification. One competent farmer said:

> *"during the two years, I was certified as a group while I was learning, but as I learned I felt confident enough and this year I got my own organic certification and I am working on the food safety and Fairtrade as well to get them in the coming years" [SFPS06IR01].*

In contrast, other novice farmers, still feel the need to be certified in the group certification. *"I know we already have the knowledge to pass the certification on our own, but I feel we need a bit more time to practice"* [SFPS05PJC].

Although SFP/PO provided a leadership to support farmers in their obtaining their organic certification, additional activities were still more active leadership is needed with those farmers that do not have it yet. In this regard, specific actions are taken, for example, the coordinating firm is directly responsible for the certification of those farmers. One of the cooperatives started operations in 2001; the coordinating firm along with other experienced

farmer, supported the operation of that co-operative of smallholder farmers. It is important to highlight that the co-ordinating firm took full responsibility of this co-operative's organic certification. Now that the farmers of this co-operative developed the skills, they have taken full responsibility of their operation, and in July 2015 passed the organic inspection and therefore were granted the organic certification.

Another aspect of farmers' leadership is that it enables them to make decisions about planting for the future season. During the interviews, farmers stated that their participation involves decisions making for planning the production season. Making decisions to reflect the development of skills and provide the leverage power for negotiations between the area co-ordinator and the farmers. A common theme among famers in general, is the support received during the planning of the following season. Competent and novice farmers interact with one another, and especially with the area co-ordinator and the Director of International Farming. As the area co-ordinator states:

> *"It's not a written plan, ok? It is a plan that naturally goes along the way. The question about the money has been long done this way. Throughout the years we have made adjustments. All farmers have records […] depending on their production capacity, their volumes we can forecast their availability for the season, how much money they would need". [SFPS01COOR02]*

Leadership is shown from novice and competent farmers when planning the next production. There is no written plan, and it develops organically through the interaction between farmers and Area co-ordinators. Based around forecasts of demand and the individual farmers capacity for production.

The role of farmers is to discuss and negotiate the strengths and weaknesses of each smallholder farmer. The display of leadership enables them to negotiate based on their experience and the skills they have developed on certain crops e.g. some farmers are good at producing herbs, others cherry tomatoes. As the area co-ordinator said:

> *"I can give you the garlic example. We told and advised farmers in Firm A to keep sizes big, that they should have harvested big garlic due to the preferences of chefs and their high prices. What happened was that only one farmer did it and has been the only one that supplies this type of garlic". [SFPS01COOR03]*

The quote sheds light on elements of leadership displayed by competent and novice farmers. On the one hand, the strengths of farmers are highlighted with the features of crops i.e. garlic, that were appreciated. On the other, it displays their weaknesses also by advising the farmer on how to keep up with the quality required. Although only one farmer complied with the standard, the leadership and role of both farmers during the negotiation resulted in technical and financial allocation. Thus, in this cooperative, only one farmer was able to carry out the production activities for garlic. Additionally, this farmer enhanced motivation and learning among the rest farmers in the co-operative and the region. One farmer of this co-operative further explained:

> *"yes, indeed, the same legislation, be that of United States, or even one important customer of SFP say that if by this date you do not have this crop certified or have not met this requirement, this farmer will have to decide whether to comply or not with this requirement to continue selling that crop or changes crop pattern". [SFPS05PJC]*

Openness is a characteristic and feature of farmers to try new things, for example, to comply with regulations that don't apply in their home countries. This openness facilitates the learning with competent farmers. Furthermore, smallholder farmers are willing to making the necessary efforts to comply with any legislation in both, national and international, specifically in Mexico and US. As indicated with garlic, only one farmer wanted to follow such suggestion. It was his decision to do so and to take advantage of the continuous demand for that type of garlic. Hence, only that farmer decided on his own to make the extra effort to make it at the customer's request.

SFP/PO provides the systems that enables both learning from hierarchy but also from fellow farmers. Leadership in SFP/PO enables smallholder farmers to continuously learn from other

farmers within the dynamics of the social elements of the learning in SFP/PO. Leadership enables a continuous development of skills for organic production in smallholder farmers who particularly did not have the necessary experience in organic farming and, in some cases, in agriculture in general. Throughout the value chain, leadership maintains the understanding of the enterprise of SFP/PO, enhancing the cooperation and mutual responsibility among smallholder farmers across their geographical locations, and the passing on of experience of other farmers, i.e. supporting farmers in obtaining their organic certification and in decision making.

Furthermore, leadership is seen throughout the value chain. Farmers across geographical locations also support the leading role of area co-ordinators and align their leadership to promoting continuous learning of organic farming practices. Leadership draws on elements of shared repertoire that ensure the compliance of international standards, i.e. documenting of the practice with visual material. It helps to keep the community together, where the role of farmers as motivator enables constant engagement among farmers.

Technical Solutions

In SFP/PO *Technical solutions* are the result of farmers' experiential knowledge circulating throughout the value chain. Wenger (2000) argues that CoP is about enabling a rich fabric of connectivity among people. In this regard, in SFP/PO has developed a robust and wide fabric of connectivity in which farmers interact, enabling the flow of experiential knowledge and other resources such technical and financial. Furthermore, Wenger (2000) argues that in CoP, brokering relationships between people who need to talk to each other, or between people who need help and people who can offer help, builds connectivity in the community.

In SFP/PO there are farmers who are motivated by the idea of improving their brand, making their produce better to secure a long-lasting loyalty of their customers in the USA market. I argue that as farmers learn the organic farming practices and carry on with them, they master

the practices, and can improve their own production activities and farming operation. These improvements are acknowledged by competent farmers and they broker these improvements throughout the community. This enriches connectivity among SFP/PO by brokering experiential knowledge exchange which improves their organic farming practices. The interactions occur mostly among farmers who are within medium participation, and with competent farmers in full participation in the community. However, it does not necessary exclude those novice farmers that are in the periphery.

From the farmers' point of view, they understand the connectivity among themselves. The area co-ordinator of southern Baja Peninsula, as a competent farmer said: *"We all work as a machine. A machine has gears and every farmer is a gear. If we all are well tuned, then everything will go normally"* [SFPS01COOR01]. This view and analogy of farmers as a machine sheds light on the robustness and wide connectivity throughout farmers across the peninsula of Baja Mexico.

As a leading farmer, the area co-ordinator takes the responsibility of making sure the network of farmer stays connected by identifying the issues related with cultivation or certifications, so that the operation of SFP/PO runs according to the season's plan. However, given that the area co-ordinator is a farmer himself, he manages the improvements farmers implemented in different farming operations. The area co-ordinator commented about brokering farmers' ideas: *"I am conveyor between farmers. If I see some farmers are doing something that can benefit others, I spread the word"* [SFPS01COOR01].

For example, among these views, which surfaced mainly in respect to improving the growth of cherry tomatoes (including germination), pest control, and crop management, the improvements come from ideas of smallholder farmer which are taken and carried out throughout the community. On the one hand, farmers considered every recommendation given by competent farmers, as one farmer said: "*For example, when the area co-ordinator taught us that we should put three plants per meter, that you have to prune the first tomatoes for the plant*

(of tomatoes) grow. That was the idea we (farmers) had" [SFPS06IR02]. On the other, farmers found new ways of carrying out practices that became improvements and in some cases solutions to problems. Farmers constantly stated that if one knows how to solve an issue that others have, then they tell them what worked for them, as this farmer said:

> *"Then, one day, a farmer said that he let plants grow without pruning them. I followed up on that. That previous technique we had, we changed it and we had incredible results". [SFPS05PM01].*

Another competent farmer, when asked about acknowledging the improvements of farmers said: *"most of these improvements come from farmers themselves. We just need to give them the technical aspects*[3]*"* [SFPS06IR03]. For example, the development of improvements on practices is based on the technical aspects they first learned when they began their organic operation. Specifically, as farmers continued with their practices, they build on that knowledge and as result as, they experiment. By acknowledging farmers' contributions by competent farmers, SFP/PO incentivises motivation in farmers for learning. In other words, the fact that competent farmers acknowledge the ideas of smallholder farmers acts as a motivation for farmers to continue sharing their learning. The quote illustrates the mutuality among smallholder farmers. In the narrative, the farmer stated how a competent farmer such as the area co-ordinator passed on his experience on how to carry out the practice of transplanting and pruning. Nonetheless, despite the value of the knowledge and experience of competent farmers, novice farmers also carry out their own experiments in their effort to improve their own practices. In this regard another farmer said:

> *"We were told to transplant three plants per meter. We tried something different; instead, we transplanted six plants per meter in zig-zag in double line. With that we realised we saved seeds, wood sticks. In 1/8 of the same space we planted more plants, and therefore we also saved water". [SFPS03PM]*

[3] Technical aspects are all recommendations the area co-ordinator and other experienced farmers make in order to ensure proper production.

These accounts from smallholder farmers reveal the teaching of organic practices mainly from the area co-ordinator. However, as their mastering of their practices went further, they decided to try different approaches to improve their practices. These improvements are acknowledged by competent farmers. As a result, learning is carried out by trial and error, and this knowledge is brokered by competent farmers and circulated to farmers who participate in the periphery in different locations. Therefore, new techniques are shared, contributing to the repertoire of SFP/PO and improving the operation.

On the other hand, with brokering farmers' contributions, the community is constantly built and strengthens constructive feedback to make possible for farmers to communicate and pass on their knowledge throughout the value chains and locations. Furthermore, famers have taken the initiative to start experimenting with seeds. It was common to hear farmers say that they let crops flourish to make the first trials, make experiments with the first generation, and they grow fine. Therefore, trial and error exercises draw on their experiential knowledge which is anchored in their connectivity with the land and with other farmers.

Farmers' knowledge regarding biological control, along with their observations, played a key role in developing a new technique, a technical solution to tackle issues with pests. As one farmer explained:

> *"Bugs are very smart. There was one kind that every time were going to use the neem it would hear us coming and let itself fall of the tomatoes. It would look as if it were dead, that's what they made us believe as we were spraying around. As we noticed this, we decided to use a sticky plastic, yellow preferable. We put those on the ground. Then we turned on a vacuum so that we made them believe we were spraying something. With that they fell off the tomatoes and got stuck on the sticky yellow cardboards".*

Yet another farmer said:

> *"There was a problem with bug we struggled with for many years. It destroyed our crops. I looked around the crops, took samples of the bug. I took my electronic loop. With that I saw which type of bug it was. The key thing here*

> *was I used the cheapest and simplest inputs. It was all about trying, being patient and the use of my tools. It took me around ten days to figure out [a solution]".*

These two examples make it clear farmers drew on their understanding of the practice of biological control to resolve problems. As their experience increases, they have drawn on that experience and applied it to guide their actions towards finding solutions to problems for themselves. In addition to figuring out a solution to a problem, they also happened to save money, opening the possibility of reducing the amount of debt when finishing their season.

Connectivity in the community of SFP/PO enables smallholder farmers to develop technical solutions. Brokering farmers' experiences and perspectives are crucial for the development of innovative technical solutions. Brokering among smallholder farmers improves their organic farming practices, which are ultimately disseminated throughout the Community. In addition, this connectivity enables the passing of experiential knowledge exchange not only from competent farmers to novice farmers, but also for those that have intermediate level of participation in the community and those that are novice farmers.

Genetic Improvement programme

Wenger (2000) argues that Communities of Practice deepen their mutual commitment when they take responsibility for pushing their practice further and define their own learning projects. In the context of agricultural value chains, it has been discussed that upgrading means that suppliers can use knowledge for moving to higher value activities. These activities, such as modern farming techniques and access to finance may further improve their capabilities to meet strict quality, sanitary, and phytosanitary (SPS) standards required by global markets (Fernandez-stark et al. 2011; Navas-Alemán, Pietrobelli, and Kamiya 2012).

In the case of SFP/PO, innovation is important given that it is the result of the continuous learning effort among smallholder farmers. In other words, innovation is the result of the development of their Technological Capabilities. It enables them to contribute to the further

improvement of practices, farming operations, and development of new products. It also shows the how the SFP/PO value chain has evolved throughout thirty-three years of operations. The nature of innovation of smallholder farmers in SFP/PO is incremental. When it comes to product innovation, farmers play a significant role for improving the characteristics of their produce, as opposed to technical solutions, where the interactions are more focused on improving their practices.

Main stream literature on upgrading in Global Value Chains emphasise the role of actors such the GB or Multinational Companies. The emphasis is based on the evidence that these two actors are essential for participating firms to take advantage in their participation and upgrade in their production skills. However, my argument is that *product innovation* in SFP/PO, farmers take responsibility of their learning agenda by defining a structured programme, called the Crop Genetic Improvement Programme (CGIP) which originated in 2002. SFP/PO establishes an ongoing project anchored in critical mass of three actors a) full participating farmers, b) area co-ordinators and c) geneticists. These three actors assess the properties and characteristics of the crops, particularly cherry tomatoes. The objective of CGIP is to develop genetic cherry tomatoes varieties through genetic selection, (genetic material) that enhances the reputation of SFP/PO brand, for example in terms of e.g. colour, taste, and sizes.

The development of varieties considers the farmers' experience of the crop and field, as well as how easy it is to manage the growth of the variety. It is important to notice that innovation activities are more flexible, in the sense that they allow farmers to experiment based on trial and error, observing results with colours, textures, sizes and flavours, as it is observed with technical solutions. In carrying out these activities, farmers take responsibility of their learning agenda. As the Area co-ordinator, a competent farmer put it:

> *"it is like new year model car, you know there is always one new coming and we do the same here. For the wellbeing of smallholder farmers and stay*

> *competitive in the market, we constantly need to look for new products and we all need to work together for this type of development". [SFPS01COOR3]*

As critical mass, competent farmers in full participation, draw on a solid shared repertoire, and are driven by a deep sense of mutuality. The quote illustrates on the level of awareness on competition as well as the context in which smallholder farmers carry on with their farming operation. The quote also sheds light on the fact that full participation means taking the responsibility to contribute with ideas for product development. As being the critical mass of the community, mutuality is evident when keeping an equilibrium between meeting the expectations of customer base as well as the needs of farmers.

For example, competent farmers draw on a solid shared repertoire by actively participating with their experiential knowledge in the form of comments and views because they are constantly interacting with the crop. As one farmer stated: *"the geneticists do the breeding based on the mendelian method taking into account the desirable characteristics reported by famers, e.g. they can grow it in all regions"* On the one hand, the solidity of the shared repertoire is based on the experiential knowledge that serves as repository of reliable information that helps make the correct adjustments to varieties under development, along with the knowledge of geneticists. One example of how these shared repertoires is used is discussed by the area co-ordinator of Northern Baja Peninsula:

> *"Look, we work the geneticists in the breeding's. You take the plants with the characteristics you want. You take one that is the mother and another one that is father. You breed them and then you have the F1. With that F1 and what they say is that you have 50% chances that the plants will be like the mother and other like the father. You select the characteristics you look for from that 100%. Then, if you are interested in the characteristics of the mother, you take those that are more like the mother that is the F1. With the F2 you select them, but you have less chances, that is 25-75 % chances and so on and so forth you leave those plants that have the characteristics you want. This takes a long time, 3-4 years". [SFPN01COOR]*

The Area co-ordinator for the northern Baja region stated farmers provide their insight as to how the crops that are in trial behave given that crops vary throughout time. Farmers know their land, their soil, and in general, their conditions. They know exactly the temperatures and humidity they need. Solid shared repertoire draws on experiential knowledge to CGIP, one farmer said: "*we know that it is not the same conditions in the north than in the south (of Baja Peninsula). The latitude is an advantage in our zone (southern Baja). Having this orientation is an advantage, the sun rays we get influence the crops for sure, how they behave, the quality. These are the things that help us"* [SFPS04IT01]. Another farmer had similar views regarding CGIP: *"the genetic improvement programme is thought to face challenges, to know things we did not know before. Here what we use is our knowledge about the moon"* [SFPS04PMB]. In both quotes it is evident that competent farmers and their experience are relevant elements which strengthens the shared repertoire of SFP/PO given that knowledge on climatic conditions, local environment, and the experience of farmers contribute to the development of varieties.

For example, the shared repertoire is drawn to help identify the issues with a variety of cherry tomatoes under development. It serves to constantly assess the development of produce and make decisions to correct them. Farmers across Baja Peninsula reported about its imperfections on colour, developing white spots on the fruit's skin and deficiencies water absorption due to cracks in the fruit as well. For example, an experience narrated by a competent farmer regarded the generic seeds for yellow-pear cherry tomatoes. It happened to be infected with fusarium, affecting the whole interaction with organisms in the soil. As part of the improvement programme, geneticists could develop a resilient variety in line with what farmers were reporting as desirable for them. One farmer put it this way:

> *"I can tell the about the yellow-pear and red-pear tomatoes. We used generic seeds. However, it had an issue with Fusarium [a fungal disease] in the soil and affected several farmers. Today we have yellow-pear tomatoes that were developed by our programme, and is resilient; farmers are happy with" [SFPS01COOR1]*

The Area co-ordinator of southern Baja said, *"it is not worth developing a variety that farmers don't like"*, it is about convincing farmers. If farmers can manage the crop after 3-4 years of trial, then we start a pre-commercial stage. However, if farmers are not fully convinced, they need to work on improving the crop. One farmer that was not convinced with the variety of cherry tomatoes said:

> *"For example, last year, we told (geneticists) them it [variety] was not working well. They came and took samples, because we were not reaching the goal of having the tomatoes with certain characteristics. What happened was that after some days tomatoes would develop some lines and would take the shape as if they were habanero peppers, affecting the farmers' yields. We told them that, so that we had to work on getting rid of such characteristics. Perhaps after so much breeding, it got like that". [SFPS05PM01]*

In fact, the critical mass of farmers reports on how the crops behave year-round between both regions, north and south, while varieties are under development. While the southern coordination grows in the months of October to April, the northern coordination starts in May and ends in September. The Area co-ordinator of southern Baja Peninsula, along with geneticists, visit farmers to look for feedback. Once the programme has the variety with the desire characteristics, the second stage in the following season starts. The Area co-ordinator of northern Baja Peninsula said:

> *"We start growing the variety commercially. However, we need to protect the efforts of farmers and geneticists. If we didn't protect it, then every customer could grow our tomatoes. What we do is what seed companies do, which is to make it hybrid. That is to make every seed mother. To do this, the seed with the desirable this breed it with another type of seed. And the seed that comes out of that is the one we grow. By doing this we guarantee that the sharing of genetic material is secure within farmers and ensure our customer or competitor won't be able to use our material that has taken us so much time to develop". [SFPN01COOR]*

Famers keep record of how crops behave, they analyse the period in which it is grown, the yield, and if it is working well for them. The different times in growing between the two regions enables the exchange of seeds and enhances the cleaning of the genetic material.

Consequently, the CGIP speeds up the process of obtaining seeds with desirable characteristics, which is how they get the F1, F2 and F3 are produced between the regions. This is the stage in which the trial is carried out, where it is grown for non-commercial purpose.

SFP/PO's Crop Genetic Improvement Programme (CGIP) illustrates the mutual commitment among competent farmers given that farmers themselves take the lead and responsibility to further expand their learning. The interactions among farmers play a role for improving the characteristics of their produce, considering farmers' experiential knowledge on the crop and field as well as their appreciation of how easy it is for them to manage the growth of variety. The interactions take place between three actors a) smallholder farmers, b) area co-ordinators and c) geneticists, illustrate the critical mass and commitment for assessing the properties and characteristics of their products. For example, farmers experiential knowledge helped identify the issues with a variety of cherry tomatoes. Farmers constantly and actively participate with their experiential knowledge in the form of comments and views because they are constantly interacting with the crop. These type of innovation activities are more flexible because they allow farmers to experiment, based on trial and error, with colours, textures, sizes, and flavours.

Summary

This paper addressed the research question *how does the technological change occur in farmers' production capabilities?* The concept of *technological change* was used in this analysis for understanding the continuous learning of smallholder farmers in SFP/PO. Table 12 summarises the main argument of the paper was that SFP/PO has an agenda for enhancing continuous learning, the concepts of Leadership, Connectivity and Brokering as well as Learning projects were used from the Communities of Practice to support the analysis on technological change and shed light on the agenda. As value chain, SFP/PO has integrated smallholder farmers in agricultural activities for producing organic produce. Leadership

enables farmers to align to the understanding of the *enterprise* of SFP/PO. Farmers' leadership and their roles reflects the *mutual* responsibility for the operations of the entire value chain and contributing to the *repertoire* with knowledge, experience and tool. As a community, the smallholder farmers have been able to draw from these three elements that enable a continuous learning for developing skills for producing organic crops.

In addition, leadership has enabled farmers to certifications (organic, Fairtrade and food safety) as well as decision making. Yet, the continuous learning goes further to improve their practices with technical solutions, where connectivity among farmers and the brokering of their experiential knowledge has allowed farmers to complement the organic farming practices of every farmer and thus contribute to the operation of the value chain across the Baja Peninsula. Interactions in the community of SFP/PO smallholder farmers enable incremental innovation. This allows farmers' experiential knowledge and perspectives to be shared and considered for the development technical solutions as a type of innovation.

Table 1. SFP/PO Agenda for continuous learning

	Technological change	*Effects on organic farming practices*
Leadership	Motivating leadership roles throughout the SFP/PO	Continuation of development of production skills for novice farmers as well as providing the necessary knowledge on Organic, Fairtrade and Food Safety certifications.
Connectivity and Brokering	Technical solution	To improve the practices of farmers throughout the community and production activities in the Value Chain.
Learning project	Crop Improvement Genetic Programme	To develop new varieties of seeds for cherry tomatoes for desirable characteristics to enhance flavour, colour and sizes.

Source: Fieldwork Data 2015

Furthermore, the interactions among smallholder farmers improve their organic farming practices which are ultimately disseminated throughout the chain. In addition, these interactions enable the passing of experiential knowledge not only from competent farmers,

but also for those that have intermediate level of participation in the community, and those that are novice farmers. Finally, SFP/PO focuses the efforts of its competent farmers on carrying out projects for developing varieties. This project furthers their knowledge and enables incremental innovation in products, bringing them together.

Bibliography

Abcarian, Lora. 2015. "Jacobs Farm / Del Cabo Expanding Fair Trade Certification Zones." *The Produce News*, June 2015.

Fernandez-stark, Karina, Contributing Cggc, Researchers Ghada, Shelli Jo Heil, R T I Researcher, and Christopher Root. 2011. "The Fruit and Vegetables Global Value Chain ECONOMIC UPGRADING AND WORKFORCE DEVELOPMENT," no. November.

Lall, Sanjaya. 1992. "Technological Capabilities and Industrialization." *World Development* 20 (2): 165–86.

Navas-Alemán, Lizbeth, Carlo Pietrobelli, and Marco Kamiya. 2012. "Inter-Firm Linkages and Finance in Value Chains." Inter-American Development Bank.

"Understanding Technology Development." n.d.

Wenger, Etienne. 2000. "Communities of Practice and Social Learning Systems." *Organization* 7 (2): 225–46.