

## **ENABLERS OF THE TECHNOLOGY TRANSFER TO RURAL ENTERPRISES IN DEVELOPING ECONOMIES**

DEYCY JANETH SANCHEZ PRECIADO, UNIVERSITY OF CAUCA, COLOMBIA AND PhD CANDIDATE IN INNOVATION SCIENCES, HALMSTAD UNIVERSITY, SWEDEN, deycy.sanchez@hh.se

### **ABSTRACT**

The paper builds on prior literature pertaining enablers for the technology transfer by Sanchez Preciado, Claes & Theodorakopoulos, 2015 and Theodorakopoulos, Sanchez Preciado & Bennet, 2012. Specifically the paper evaluates the importance of technology transfer enablers. The papers assess these enablers in the context of two rural enterprises respectively involved in pisciculture (fish farming) and coffee production in the Cauca region of Colombia.

**KEY WORDS:** technology transfer enablers, developing economies, rural enterprise, low technology, rural context

### **Introduction: Rural Living in the Developing World**

The rural sector in developing economies is often characterized by high levels of ethnic, cultural diversity and a broad variety of products and low levels of specialization. Aside from a limited number of large-scale operations with international focus, the primary sector in these countries tends to consist of a large number of small and medium sized family or community run ventures (Khan, 2001). The success of these rural enterprises defines to a large extent the incomes of the rural population of these countries (Dahlman, 2015) and with that the general success and wellbeing of the majority of their inhabitants.

This paper answers the question: what technology transfer enablers can be identified in rural enterprises of developing economies?. With the intention to accomplish its purpose, this paper first presents the theoretical approach that was taken and describes the technology transfer concept adopted for the present study and the criteria considered for the selection of the enablers in the two aforementioned studies of the literature. Secondly, it presents the methodology based on the development of two projects from 2013 to 2016. Thirdly, it describes the enablers, explaining the role of the collaboration among organizations that surround the rural enterprises. Finally, it explains the implications and conclusions of the findings.

### **Enablers of Technology Transfer in rural context**

In a recent study Sanchez-Preciado, Claes and Theodorakopoulos (2015) identify seven enablers associated to the technology transfer applicable in rural environment of developing economies:

- Absorptive capacity: is the ability of a firm to recognize the value of new, external information, assimilate it, and to apply it to commercial ends (Cohen and Levinthal, 1990). It is largely determined learning by activities which often relate to resources outside the firm (Deeds, 2001; Wahab, Rose and Osman, 2012).
- Understanding of the technology source and market maturity: To obtain a required technology, technology recipients tend to have two options: obtaining domestically or obtaining from overseas. In choosing between the two, they have to keep in mind i) the extent to which it is possible to acquire the required technology and ii) the level of their own technology at a given moment in time. Prior experience on the part of the recipient with the technologies available in the regional or national market will prepare them better to collaborate with foreign technology exporters (Chen and Shun, 2000; Vickery, 1986). Adopting the right mixture of technology will allow them access to other more profitable market environment and competition (Lee et. al., 2012; Theodorakopoulos et al, 2014).
- Cultural and geographic distance between transferor and recipient: refers to the organizational cultural distance between the participants. Considering the fact that relationships between the actors in technology transfer at this level are oftentimes informal and personal, long distances (physical or cultural) inhibit the formation of trust and understanding necessary for the transfer (Kedia and Bhagat, 1988; Cannarella and Piccioni, 2011).
- Recipient's comprehension of the financial implications of the technology transfer: refers to the degree to which the technology recipients understand i) the relations between the costs and benefits of the transferred technology at present and in future, and ii) the related financial flows between the transferor and the recipient as well as between the recipient and its other stakeholders partners. A lack of insight into the financial implications of the transferred technologies hinders the adaptation of these technologies (Walker and Ellis, 2000; Schneider, Holzer and Hoffmann, 2008)
- Intermediaries connecting transferor and recipient: The concept of intermediary is derived from the approach discussed by Shiau et al. (2001) and Li-Ying (2012). Its relevance for technology transfer in our particular context stems from the fact that in many developing economies it is necessary to have an external party (business incubators or R&D centres capable of bridging the gaps between producers,

government institutions and universities) who develop collaboration strategies and implement new projects.

- Institutional network adapting the technology to the local needs: It is important to have an institutional network available that can support the collaborative arrangement among the parties involved in the technology transfer (Ison and Russell, 2000) that structures the knowledge interchange in terms of possible overlays. This infrastructure is expected to be generated endogenously (Etzkowitz and Leydesdorff, 2000) consisting of representatives of the state, industry and academia.
- Prior experience in technology transfer projects: is important, particularly in developing economies where oftentimes a complex relationship exists between agents of technology supply and demand. It is also important that the involved parties understand that the technology transfer should be sought not as a 'short-term fix' for enhancing production and growth possibilities, but rather as part of a long-term strategy to establish a culture of innovation and technological learning (Saad and Zawdie, 2005).

### **Rural Enterprise**

Peredo and Chrisman (2006) defined a community based enterprise (CBE) "as a community acting corporately as both entrepreneur and enterprise in pursuit of the common good". A main characteristic of a CBE is the use of the existence social structure to put in operation an enterprise. The contribution of this concept is that it takes in consideration the particularities of the creation of new ventures in depressed areas, like indigenous communities in developing countries.

The present paper is focused in rural enterprises that are conformed by a collective organization of different farms which develop the production activities and a support activities (e.g. technical assistance, transformation, administrative, marketing and logistic) in charge of a professional team. The owners of the rural enterprise are producers and the support team are employees.

### **Situated Learning Theory**

Lave and Wenger's (1990) described a theory of learning based on the practice as "legitimate peripheral participation" in "communities of practice". "Communities of practice are groups of people who share a concern, a set of problems, or a passion about a topic,

and who deepen their knowledge and expertise in this area by interacting on an ongoing basis” (Wenger et al., 2002:4).

### **Material and methods**

Using a qualitative interventionist approach (Bryman, 1988; Patton, 1990) based on two in-depth case studies, the paper assesses the previously identified enablers by Sanchez-Preciado et al. (2015) in the context of two rural enterprises respectively involved pisciculture (fish farming) and coffee production in the Cauca region of Colombia. These two enterprises have been in business for more than 15 years, have well-established internal (among producers) and external (among other institutions) networks and constitute exemplar cases of social and economic growth and organisational innovation.

The selection principles for identification of suitable cases were: i) rural firms involved in technology transfer process of low technologies, ii) they had to have experience running projects with external institutions to improve their performance, iii) they had to be in business for 10 years or more due to if they are very new, it is not possible to establish they will have enough evidence related to the seven enablers, and iv) they had to be considered successful in terms of sustainability and participation in different markets. The duration of the study was two and a half years.

### *Data Analysis*

First categories analysis of interest for the producers and other participants in the study were created (their explicit assumptions about each category of analysis (Miles and Huberman, 1994). The coding procedure was discussed with a committee consisting of four producers and one member of the research team. The table 1 shows the techniques were developed.

Triangulation of sources was used to complement and verify the information. In fact, most of the time the individual opinions were not comparable between actors and therefore the collective opinions of the producers were also observed in the workshops. In order to assess effects from the invention of the mechanisms a protocol was developed. After the intervention, interviews were conducted with participants from different levels in the sector as well as with regional technology brokers.

Table 1. Techniques used in the study to analyze data

Source/Activity	Technique/ Tools	Comments
23 Interviews They were members of boarding committees and employees of the rural enterprises, producers and members of organizations to support the enterprises.	Open questions interviews with questions related with their internal relationships, their organizations and the connection between them and the external partners.	This was important to clarify incomplete information register in the documents. This gave sense to the projects and activities registered in previous processes.  The cultivators don't have the practice to talk and express all their ideas easily. In this case, structured interviews won't give useful information. Usually, interviews are relevant to identify the common language elements are clear for the producers and this guide the design of the workshops in order to have appropriate language and strategies to make more effective the collective interaction in workshops.
79 Visits to farms (1 visit to each farm) 44 trout farms and 35 coffee farms.	Field notes were developed using photos and interpretations about the type of knowledge exchange between the actors.	In the micro context of the cultivators, the differences and similarities showed gaps among the technology and knowledge transfer. In practical sense, the effect of the visits in the cultivators was extremely positive. They recognize the other members and become more open to share their knowledge.
Participant Observation	Field notes were written after certain periods of time (4 months)	It was used to gather direct evidence of the processes and activities involved in the technology and knowledge transfer between producers and organizations.
8 Workshops with around 17 producers each.	Memories with the synthesis of the information	The interaction to discuss and analyze the organization gave the opportunity to identify the individual and the collective knowledge about the key processes analyzed. The average duration of the workshops are 6 hours.
Documental analysis	Template with coded	Most of the reports and documents were not available in the firm's office. The source for these

## **Findings: Technology Transfer Enablers in Coffee and Fish Production in Cauca - Colombia**

This section of the paper assess the enablers in each case and after compare the technology transfer practices related to them.

### *Technology Transfer in CAFIAMBIENTE for Coffee Production*

Absorptive capacity is not homogeneous among the producers, there are some with low academic education and others with high academic education. The strategy in this network of producers is to provide technical assistance with different periods according to the needs. The registration of the process is mainly made it by the technicians. The technologies are developed in CENICAFÉ and the learning techniques are improved locally. In this aspect, this organization as a part of the network support member explains:

*“National Coffee Research Center (CENICAFÉ) is the most important research centre in its class in Colombia. It was created by Colombian Coffee Growers Federation (FNC) and has received the support of coffee producers, and has developed experimental projects in every area of the coffee business like genetic studies in order to develop new varieties, and the research of the industrialization of Colombian Coffee. Thus, a scientific innovation is only proved successful if it is adopted by growers so that penetration of the scientific and technological developments is ensured. To ensure this complementary objective, the FNC uses its Extension Service” (FNC website: [http://www.federaciondecafeteros.org/particulares/en/que\\_hacemos/investigacion\\_y\\_transferencia/](http://www.federaciondecafeteros.org/particulares/en/que_hacemos/investigacion_y_transferencia/) (accessed on July 20<sup>th</sup>, 2013)*

Understanding of the technology source and market maturity is a responsibility of the common activity of the support team for the producers. They analyse the available technologies and how difficult or easy could be its transfer. Usually the high level of specialization for the production force the development of technologies locally (for the entire country). In the transformation process (to have instant coffee, flavoured coffee, etc.), foreign technologies can be acquired. Always, the combination of technology and its impact in the market is relevant. In this aspect, an Executive Manager of Departmental Coffee Growers Committee of Cauca expressed.

*“Currently the international markets have preference for the specialty coffees. I am talking about the coffee with particularities that motivate the customers to pay more (organic, fair trade, bird friendly, social, etc.). In this case we design a program called Coffee with Roots. The purpose was to demonstrate the positive differences and features of the coffee bean in the sub-regions in Cauca Department. However, to obtain the certifications implies the development and application the appropriate technologies and a cultural change in*

*comparison with the traditional way to produce. These markets orient the adoption of new technologies and specific technical assistance to accomplish the normative that allow the successful certification”.*

Cultural and geographic distance between transferor and recipient is an aspect that give the producers effective technology transfer process and the guarantee to have a close interaction with experts to analyse and find solution to different problems during the process. In the words of Coordinator Technician Service of Departmental Coffee Growers Committee of Cauca:

*We have a system to monitor the coffee production provide help where necessary. For this we have established an assistance service. One technician is delegated to some farms and he/she monitors the progress and assesses any problems in the crops. They are professionals with experience in rural environment. We prefer to recruit technicians from amongst the relatives of the producers to avoid that the young people leave the rural areas for lack of good employment opportunities.*

Recipient's comprehension of the financial implications of the technology transfer is something difficult to establish from the producer point of view, usually the financial aspects are decided for experts of the support teams and the risk is share with the producers. Finally, a detailed schedule of the investment is generated and the way to funded it by the Coffee Association is established. A coffee Producer of the Departmental Coffee Growers Committee of Cauca, describes:

*“My farm does not have organic certification, but we like the idea of selling our coffee with better profits. However, in that case cannot use any pesticide or chemical product in the entire farm for a period of 5 years. This is complicated because we also produce fruits, vegetables and keep animals such us chickens and pigs. The change is big and we have to introduce new technologies and follow the rules to obtain the certification. This is a long term process; we can do it if the Departmental Coffee Growers Committee guarantees us good incomes.”*

Intermediaries connecting transferor and recipient is a common practice which usually does not need of external intervention. The arrangement for the transference of several technologies are achieve through the creation of new teams to make financially and logistically possible the process. Certifications require following the implementation of new technologies and it is necessary to do it in a network environment. One Rain Alliance Certified producer, member of Colombian Coffee Growers Federation explains:

*The organic certification of our coffee required the conformation of one network with other producers in order to be funded and support in the process for technicians of Departmental Coffee Growers Committee of Cauca. Otherwise, we cannot afford the cost and effort. I did the process at the same time with other 16 farms.*

Institutional network adapting the technology to the local needs is one of the main functions of the National Coffee Federation, with CENICAFÉ and the system for the technical, financial and marketing assistance, the entire support is provided internally and the external support is not significant. The FNC website comments the following on the matter:

*“The Colombian Coffee Growers Federation has programs of research and knowledge transfer are directed towards generating relevant technologies that can be easily implemented by Colombian coffee growers. More than half a million Colombian coffee producers have access to our Purchase Guarantee policy, which is implemented by the FNC to also act as a commercial agent. Our organization has also led the development of Promotion and Advertising programs so that consumers recognize and demand Colombian Coffee. Additionally, our policy of generating Added Value for our producers has demonstrated a leadership that few organizations in the rural world of developing countries have been able to do”.*

[http://www.federaciondecafeteros.org/particulares/en/que\\_hacemos/investigacion\\_y\\_transferencia/](http://www.federaciondecafeteros.org/particulares/en/que_hacemos/investigacion_y_transferencia/) (accessed on July 20<sup>th</sup>, 2013)

Prior experience in technology transfer projects shows an organized way to go step by step, achieving goals that become in the beginning of new challenges. The sophistication of the technology is improve whit the experience and complex technological packages can be transfer at the same time for the more advance producers. A coffee Technical Assistant at the Colombian Coffee Growers Federation comments on their approach:

*“The Committee has a division for the execution of different kind of projects and activities for the producers. The Federation has complete assistance to the supply chain from the new knowledge in Cenicafé until the application in the regional units to assessment. We test the new technologies in an experimental farm in Cauca before their application in the local farms. The producers know that they are very important to give feedback about new technologies and share their own experiences”.*

#### Technology Transfer in APROPESCA for Trout (Fish) Production

Absorptive capacity has different levels in this rural enterprise, the most experienced producers become the best team to explore the potential strategies for the technology transfer process adoption. Actually, these experts trained, at the beginning, the current

technicians and after the regional education organizations complemented their scientific knowledge. One fish Technician (Employee) of APROPESCA expresses:

*“We received different kinds of training courses from institutions as the National Service of Learning (SENA), the PIRC, the University of Cauca, as well as from experienced producers, etc. In our visits to the production units, we find very often that the producers have a deep understanding about the trout production and that they are capable to suggest and implement solutions for their problems. Our assessment activity depends on our learning capacity and the producer’s knowledge about the best practices for the trout production”.*

Understanding of the technology source and market maturity was partially developed in this organization. Still there are difficulties to assess technology sources and establish the best for each situation. Former General Manager of APROPESCA during 6 years explains:

*“APROPESCA has recently received invitations to supply several European companies. For the company, this implies serving a new market for which they have to develop and apply new practices, technologies, and different ways to do the production, transformation and commercialization. We are not ready yet to reach this market. We need clear conditions about the new market before to invest in new technologies and practices.*

Cultural and geographic distance between transferor and recipient is a critical aspect that made the rural enterprise to trained two technicians, both from the same geographic area and with strong family background in trout production. This proximity helps the interaction during the technology transfer activities and make sustainable the process. In the past, some of this technical assistance was conducted by governmental offices, but they were not a record of the processes and the priorities in the rural production were not oriented to the pisciculture. A fish producer 1 of APROPESCA underscores:

*“Technical assistance is very important. We receive visits to receive information and verify the condition of our animals. The technicians are from our region and they learn from more experienced producers and courses given at institutions. They validate our knowledge and explain everything in practical way.”*

Recipient’s comprehension of the financial implications of the technology transfer is something that still remains unsolved when certain variables are not very well known from the producer side. How to define with reliable information the effect of the technology transfer in the financial situation is not well defined yet. A fish producer of APROPESCA comments:

*“We want to export our trout because this is an opportunity to obtain more money for our families. Our tanks for production will be more productive if we introduce a system designed*

*by the University of Cauca. If the investment justifies this we will obtain more money, we will do it. Just now, however, this is not a solution for all the producers. We have to analyse the terms of the various financing alternatives in detail”.*

Intermediaries connecting transferor and recipient in the fish production were delegated to a different support external organization such as Production and Innovation Regional Centre (PIRC), this type of strategy has been effective and affordable. A fish producer of APROPESCA explains:

*“When the university comes and offers technologies for our problems, we prefer to involve other organizations like PIRC or SENA because they help us to understand exactly how to implement the new technology and they spend more time with us building solutions for the problems”.*

Institutional network adapting the technology to the local needs is something very common in the pisciculture activity in Cauca. APROPESCA interacts with national, regional and municipal organizations and they have learned how to work in a collaborative way. The region created organizations like PIRC when it was needed in the rural sector and the specialization in several aspects of the fish production help them to don't compete for the role. A producer of APROPESCA comments:

*“There are several institutions such as Agriculture Secretary of the Municipality and Region, Universities, PIRC, SENA, Suppliers, Customers, etc. that dedicate their members to work with us. We don't like to work without them, we need their cooperation in the solution of our problems. We don't want to choose only one, we prefer to work with all of them when we need it”.*

Prior experience in technology transfer projects is a very common practice. It allows to find financial resources for the technology transfer activities. Each project has become in a starting point for the next. This way to conduct the technology transfer actions is positive and brings the opportunity to establish specific goals for each project. A fish Producer of APROPESCA describes:

*“Currently, APROPESCA started to design and send proposals to develop directly. This is an evolution of our organization, we are recognized in the region because we produce with good quality and we have good reputation. After the development of projects we had positive and negative experiences and we learned very much about the implications to use the resources that the institutions provide through projects”.*

## Conclusions

Technology transfer in this particular context stems from the fact that in many developing countries it is necessary to have external party (like business incubators or research and development centres able to bridge the gap between producers and government institutions and universities) who develops strategies to facilitate the collaboration among organizations and implements new projects and activities.

The progressive development of projects creates an environment for learning and it allows the participants to solve problems and establish practices for innovation in different dimensions (e.g. organizational, technological, marketing, business model.) For this reason the sophistication of the knowledge infrastructure often provides an indication of the maturity of the participating institutions.

While other studies primarily focus on the input-output elements of technology transfers (ie, resources, commitments on the one hand and the resulting products or patents on the other) this study predominantly seeks to understand the transfer processes and the enablers that make them more effective. In this paper enablers were extracted and validated. This study argues that the analyses of technology transfer processes in the light of these seven enablers will not only enhance the understanding of those processes and the role that the actors play in this, it will also increase the likelihood that the transfers are being done successfully.

However, till date this study only analysed the seven identified technology transfer enablers in two research projects in Colombia. Further research should broaden the scope and origin of case studies to strengthen the preliminary conclusions that the study has drawn in this paper.

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