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Innovation Trajectories in Honduras' Coffee Value Chain. Public and Private Influence on the Use of New Knowledge and Technology among Coffee Growers

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ABSTRACT

In this paper, results from a study on the use of improved coffee production technology schemes among smallholder coffee producers in three prominent coffee producing regions in Honduras are presented. The impact of various schemes (trajectories) in which different agents influence the producers' decision to use new technologies was analyzed. In particular, there are differences in the influence of a) private coffee buying organizations and b) government and public development agencies on the innovation behavior of coffee growers. Drawing from network data that depict the internal and outbound connectedness of producers in three village communities in main coffee producing zones in Honduras, tools of social network analysis were applied to find out how interactions with certain agents, separately and cumulatively, has influenced their use of improved methods in coffee production and marketing. The results suggest that there are significant differences in the way that various providers of knowledge and technology, especially private buyers and development agencies, influence the farmers' behavior towards innovation. The influence of buyers, according to the data, is focused on certification and quality aspects, whereas development agents focus on improved agronomic practices. Farmers who communicate with the extension branch of input providers tend to be more innovative. These results suggest that development programs should take more seriously into account the role of private actors in innovation among agricultural producers and, hence, design development programs in such a way to allow for collaboration with these agents.

Keywords: coffee production, innovation, upgrading, social networks, Honduras

1 Introduction

Enabling the participation of smallholder farmers in value addition has been the concern of many development efforts. Particularly, the coffee value chain is a frequently studied case and there is sufficient empirical evidence that inclusion of smallholders in the coffee value chain is possible but not an easy task (Talbot, 1997; Gresser, Tickell 2002; Blowfield, 2003; Taylor, 2005). In particular, for small producers to become involved in value chains, they not only need to become organizationally linked with the various agents in the chain, e.g. buyers, certifiers and input and service providers, they also need to improve the skills and technologies they use in production and marketing (Ponte, 2002). This requires a process of diffusion of information, learning, absorption and adaptation to local conditions which eventually leads to the "upgrading" of the methods farmers use in the production and marketing of their products (Foster, Rosenzweig, 1995).

Traditionally, development theorists considered upgrading of innovation processes an easy thing to achieve; training events and field trials as well as the extension of information and technologies to farmers would automatically diffuse innovations, reason for which public extension and development

agencies have been set up to provide these services. However, there is now much empirical evidence that communication with a single extension agent is not a sufficient condition for innovation processes to occur (Conley, Udry 2001). Agricultural producers as well as many other economic agents make their decisions in response to various communications that bring together sufficient evidence about the usefulness of an innovation, thus minimizing the risk of its failure. Therefore, in order to understand the farmers decision to upgrade, one must not only focus on the traditional factors of adoption studies such as the utility of the innovation, the costs of its application, and the endowment with resources that are required for its application, but also the set of relationships that farmers use to get informed and learn about the innovations at stake. In other words, the farmers' embeddedness in social networks and the sum of communications with actors in the value chain need to be taken in consideration in any attempt to explain and foster processes of upgrading (Bandiera, Rasul 2006).

However, the dynamics of social networks of exchange of knowledge, learning, and building of confidence for adopting innovations among resource-poor farmers in developing countries is still poorly understood in general and for the case of upgrading in value chains, in particular, and few studies on the effects of farmer connectedness on the adoption of innovations are available. In response, this paper seeks to expand on emerging conceptual and methodological work on smallholder innovation processes in developing countries and the role and impact of social networks and social capital on innovation processes. The results from a study on the exchange of information among coffee producers in Honduras as well as value-chain specific dynamics of technology and knowledge that influence the producers' behavior towards innovation are presented. For two important coffee producing regions all important providers of knowledge and technology on coffee production and primary processing were mapped, regardless if they operate through development projects, buy coffee or simply dispose and distribute information. Their interaction with farmers and how this has influenced the farmers' behavior towards upgrading and innovation was investigated.

The structure of this article is as follows. In section 2 insights from the study on the influence of networking on the adoption of innovations among small scale farmers in developing countries was discussed and some empirical evidence from the literature is presented. In Section 3, based on information from a survey among agents in Honduras' coffee value chain, schemes or paths of how various public and private agents currently influence the adoption of new knowledge and technology among coffee growers are described. These different schemes or paths are labeled as "innovation trajectories". In section 4 defines what innovation in coffee growing can consist on and present data about the degree of innovativeness coffee growers have achieved in three communities in three prominent coffee growing regions in Honduras. The properties of the networks of communication among the growers and other agents in these three communities and among all the agents on a national level are further described. At the end the findings are discussed and some policy recommendations from the results are provided, also pinpointing the limitations in the interpretation of the results and suggesting areas of further research work.

2 Social interaction and the role of change agents in fostering innovation and upgrading: Evidence from literature

We take the perspective of the value chain as our starting point. A value chain can be understood as a sequence of business relationships that allow the consequent addition of value as a commodity, such as coffee, passes from one segment in the chain to the next reaching from primary production, over various steps of transformation to the final consumer. However, though the value chain perspective provides an appropriate framework to understand the types of actors, interactions and support services required to let a product pass through the chain, it does not always explain how innovation and upgrading occurs.

Recent approaches to the adoption of innovations among farmers developed by scholars of the theory of (national) innovation systems offer a nuanced understanding of how smallholders experiment and further develop new knowledge and technologies in value chains based on processes of learning by doing and learning from others in the context of complex social relationships (Leeuwis, 2004). In particular, farmers require information on the possible effects and risks associated with the proposed innovation and options for cost reduction selling the resulting products. They also need to get practical experience how best to adopt and adapt the innovations in their specific environment and how to benefit from innovations, e.g. through selling the resulting product on the local market. Both processes involve in intensive communication with other farmers and people with knowledge on the innovation and associated effects and potentials (Hartwich, Scheidegger, 2009). Often it is the combined effect of farmer to farmer communication, the persuasion of various promoters, incentive mechanisms and social influence and learning processes that finally modulate farmer's adoption behavior.

Adoption and learning processes are particularly influenced by change agents and promoters of innovation and development, such as governmental and foreign development agencies, cooperatives, non-governmental and community-based organizations, credit providers, input sellers, product buyers and many more, that provide information about the adoption of innovations deploying a variety of persuasive mechanisms. Howells (2006) refers to these agents as innovation intermediaries and argues that they can bring two or more parties together by means of providing information about potential collaborators, brokering business transactions, mediation of relationships among organizations that already collaborate and providing access to advice, funding and technical support.

Besley and Case (1994) and Foster and Rosenzweig (1995) have provided evidence on how social learning and adoption among resource-poor farmers depend on information made unintentionally available to one individual as a result of the decisions made by other individuals. Conley and Udry (2001) extended this argument in a study of adoption of innovations in pineapple production in Ghana arguing that farmers learn by communicating (imperfectly) through social networks. Bandiera and Rasul (2006), in a study of sunflower adoption in northern Mozambique, model social learning as a non-linear process in which learning-by-doing effects dominate learning-from-others effects as network size increases. Their findings oppose the results from Udry and colleagues, suggesting that while adoption is often inhibited by limited knowledge of a given technology, this barrier can decrease with farmer's own experience and with his or her neighbors' experience.

These findings can also be related to recent advances in rural sociology that put farmers' behavior towards innovation in the context of their embeddedness in the local community (Flora, Flora, 1993). Flora et al. (1997) for example argue that rural communities rich in entrepreneurial social infrastructure (a particular type of social capital) are more likely to implement economic development projects than those lacking access to this social infrastructure. This work follows on Granovetter (1985) and Portes and Sensenbrenner (1993) who could show that economic behavior can be better explained through embedded relations both within and among firms and individuals.

Another strand of literature discusses the occurrence of innovations in the context of technological trajectories (Dosi, 1982). The argument is that within a technological trajectory, defined as a field of application of innovations where certain agents search for improvements only in a given field of technology (e.g. chemists provide chemical solutions), dynamics of technology-push and market (demand)-pull can occur. Technology push means that innovations are pushed through R&D, production and sales operations. In contrast, an innovation based upon market pull is developed by users or in consideration of user/consumer needs where the consumer requests the product and "pulls" it through the delivery channel. The (innovation trajectories) approach goes back to the idea of Dosi et al. (1994) who argued that and combines it with insights on technology trajectories in industry development (Kumaresan, Miyazaki, 2001) and the involvement of multiple agents in innovation development (World Bank, 2006). Information on the schemes- we use the term "innovation trajectories" in the following to depict the dynamics of exchange relationships - has been gathered from various experiences of the authors with extension and advisory services on three continents . Six main distinctive innovation trajectories were identified.

Finally there is a large body of literature that discusses the dynamics of innovation and upgrading in the context of value chains. Humphrey and Memedovic (2006), for example, discuss the knowledge flows within value chains, particularly from large buyers to small suppliers, providing a basis for upgrading and ask: To what extent do knowledge flows along value chains support upgrading, and what complementary flows are required to sustain upgrading? The response they find is that value chain linkages offer the prospect of private-sector knowledge transfers that should provide up-to-date and relevant information for producers, processors and exporters in developing countries. Humphrey and Schmidt (2000) argue that upgrading requires more than the passive acquisition and circulating of knowledge. Humphrey (2003) adds that firms learn from contact with new markets, and to the extent that insertion into value chains creates significant information flows between producers and buyers, this effect is magnified but it depends upon how this knowledge is used. Lack of timely and accurate market information, as well as lack of understanding of market trends and consumers, presents difficulties for firms in developing countries to participate in global value chains.

An UNCTAD (2002) report analyzes the upgrading opportunities in the coffee chain in developing countries. The material flows in the coffee value chain are relatively simple, consisting of growing and initial processing on the farm, processing up to the green bean stage, exporting, shipping, importing, roasting and retailing. This chain is comparatively simple because only a limited number of final products can be obtained (i.e. instant, ground and roasted coffee) for final consumption and there are only very few inputs needed along the chain for the final product.

Some upgrading strategies available to producers in developing countries aim at identifying and targeting niche markets (i.e. specialty, gourmet, organic, fair trade coffee) or acquiring new functions in the chain. Ponte and Gibbon (2005) point out that in coffee trade there are great discrepancies between the prices paid to coffee producers in developing countries and the retail price paid in importing countries. However, one of the paths to sustainable income growth lies in the capacity to upgrade (Kaplinsky, 2006; Pietrobelli, Rabellotti, 2007).

In conclusion, various agents in the community itself, in the value chain as well as in the field of government support and development cooperation influence the farmers' decision making process with regard to innovation. Within the value chain context, two main types of agents have been instrumental to help farmers upgrade and follow innovation strategies: On one side, research, extension and development agents as well as NGOs have catered knowledge and technologies to farmers in a way that can be considered as "knowledge and technology push". On the other side, local and international buyers of raw and processed coffee have provided information to farmers on best options to improve production, productivity and quality in a form that can be considered as a process in which "product pull" is paired with "knowledge and technology push". Likewise, commercial providers of inputs may also be contributing to technology and knowledge push through the technology embodied in the product they sell and through spreading knowledge associated with the use of the technology. In fact, some input providers have gone far in recent years even organizing training events on how to properly use fertilizers or pesticides and providing individual consultations on optimal fertilizer and pesticide use, e.g. based on soil samples.

3 Innovation trajectories in Honduras' coffee sector

First, it is important to define what is meant by innovation in coffee production. In general innovations are referred to as anything new successfully applied into economic and or social processes. In coffee production this would refer to the way the manage their coffee plantations including the management of nurseries, pruning and weeding procedures, the use of fertilizers and pesticides, the planting of new varieties and the harvesting methods. The value of an innovation must be measured with regard to its potential to generate benefits, e.g. to increase yields, stabilize incomes or and contribute to sustainable development, just to mention some. The value of the innovation is also a major factor determining the process of adopting an innovation (Hartwich, Scheidegger, 2010).

In the following section, various schemes on how such innovations are transferred to coffee growers are revised. Coffee producers may or may not have access to a mix of these schemes. Additionally, it is not only the schemes which determine the producers' sources of information; there are also other producers and peers in the community who pass on information to producers and determine their trust and interest in innovation opportunities. Clearly, it is not assumed that the innovation process is one in which technology is transferred from one actor, e.g. a buyer, to a grower; rather, the involvement in the scheme enables farmers to innovate; if they actually do, depends on various other factors including their embeddedness in social networks and interactions with many other players (Hartwich, Scheidegger, 2010). Information on these schemes, inroads or paths to innovation - the term "innovation trajectories" is used in the following sections to depict the dynamics of exchange relationships - have been gathered from an exploratory survey among main agents in Honduras' coffee value chain. Six different innovation trajectories that allow coffee growers to anticipate innovations in production were found.

3.1 Local buyer led innovation trajectory

After harvesting producers usually dry coffee on the farm and then send it to a local processor (called the "*beneficio*") where it gets pealed, dried, cleaned, homogenized, husked (decascated) and calibrated. However, farmers deliver the coffee directly to the "*beneficio*" only when they accumulate sufficient quantity and dispose of adequate means of transport. Otherwise middlemen (sometimes called "coyotes") with special means of transport would come to get the coffee from the farmers delivering it to the *beneficio*. This system of procurement is overlaid by financing relationships: Usually growers don't dispose of enough cash to apply the necessary fertilizers and pesticides and pay harvest laborers. Therefore the *beneficios*, either directly or through their agents, the intermediaries, provide growers with credit to buy inputs and work their plantations. The credit is paid back when the farmers deliver the coffee. This scheme also allows the *beneficios* to bind the producer and make them deliver the coffee exclusively. Conditions of the credits, usually given out in an ad-hoc manner without detailed accounting systems, are often ambiguous reaching, at times, 3% interest per month.

Information on improvements in coffee cultivation, though often in the hands of *beneficios* and intermediaries (many of which are large coffee producers at the same time), is only passed to growers in

the case of special relationships of friendship and mutual dependency. For the majority of the farmers, however, this scheme does not provide any information on options for innovation. And often the farmers are caught in relationships that are unfavorable to them because of the low, sometimes unfair, prices paid to them and ambiguous interests on credits. This credit and procurement scheme via the *beneficios* has been the dominant scheme for many decades. However, recently through the appearance of improved telecommunication, niche markets and the demand for quality, alternative schemes have developed that sideline the activities of the *beneficios*.

3.2 International buyers / exporters – led innovation trajectory

There are larger buyers of coffee who maintain large processing and calibrating plants in San Pedro Sula and whose main business is exporting coffee to the buyers in North America, Europe and Asia. Often they sell through intermediary coffee traders and brokers. The larger among those exporters include HONDUCAFE, SOGIMEX, CIGRAH, BECAMO, BONCAFE, Molinos de Honduras and CADEXSA, but there are also a handful of smaller exporters and even some of the *beneficios* have recently gained export licenses. SOGIMEX and CIGRAH are part of larger coffee trading groups, ECOM Coffee Group in the case of SOGIMEX and Mercon Coffee Group in the case of CIGRAH. The exporters receive most of the coffee from the *beneficios* that operate in the coffee production regions but many have also set up direct relations with coffee producers or groups of producers. The reason for the latter is that in direct relationship with the growers and under specific contracts the exporters can control the quality of the coffee and sell it according to the region. Coffee bought from *beneficios* often comes in mixed quality and no tracing back to the origin is possible. In fact, both SOGIMEX and CIGRAH, but also other exporters, though to a lesser extent, have recently engaged in sourcing certified coffee directly from the producers. Under these schemes the exporters exceed that the growers produce and the control of certifiers such as Rainforest Alliance, UTZ Certified or MAYACERT. Often it is actually the exporters who identify producers that are willing to produce under certification standards and facilitate the link to the certifiers.

Certifiers are working with teams of assessors and auditors. Between 6 till 18 month can pass from the first training till the certificate is given to the growers. During this time they provide guidance on how to comply with the standards in capacity strengthening workshops. Often they also work through farmers' organizations; the organizations send a technician who then trains the growers back home. Rainforest Alliance, for example, receives support in their training efforts from the United Nations Program for Development (UNDP). The certifiers also help the producers finding markets (buyers) for their coffee. Because growers often need technical support to apply the standards (further to learning about the protocols from the certifiers) CIGRAH and CADEXSA, for example, maintain R&D departments with a number of field technicians which help farmers to optimize production under certification rules. It is these advisory services that have been a source of substantial improvements in the management of coffee plantations in Honduras over the last years. The certification under Rainforest Alliance and UTZ Certified does not only follow criteria of good agricultural practices such as reduced use of pesticides (the use of certain toxic ones is forbidden), but also promotes productivity, economic sustainability and social standards. The exporter's knowledge on optimized coffee production comes with the hiring of R&D staff who often has worked in research and development organizations such as IHCAFE and CATIE. ECOM Coffee group has also supported a group of coffee specialists which dropped out of a regional coffee development program, PROMECAFE, allying with the French CIRAD maintaining a coffee research hub in Nicaragua. CIGRAH, with the support of the German GTZ, and in partnership with IHCAFE set up a national contest for quality coffee, the "Cup of Excellence" which brought to the mind of many producers the potential that lies in selling quality coffee. Companies like CIGRAH also help producers' organizations become more efficient in the administration of their operations. SOGIMEX has launched a certification campaign throughout the country and about 4,000 producers are now UTZ-certified. Overall the number of producers that produce under UTZ Certified, Rainforest Alliance and other certifiers may not reach 10% but the number is growing.

3.3 Input suppliers-led innovation trajectory

A range of companies in Honduras specialize importing fertilizer, agrochemicals, biological products, farm implements and machinery and selling them to shops and businesses for further distribution to producers. There are two to three large companies how engage in this business such as SEAGRO and Atlántida Agrícola and a number of smaller ones. These companies are not specialized in inputs in coffee production but work with all agricultural subsectors; however coffee constitutes one of the important subsectors. It is common among these companies that they organize training events and demonstrations in which farmers of a certain region are invited to attend. These events are usually organized together with agents that maintain close relationships with growers, e.g. farmers organizations, the parastatal coffee development board IHCAFE or certain projects of development agencies. The large input supplier companies also

maintain a research and development (R&D) department with a limited number of agents that test products, sometimes on farmers' fields, develop recommendations from best-practices and applications, and diffuse the information to farmers. At times, the international companies that produce the inputs second sales technicians to help the importers marketing their products. For that purpose, SYNGENTA (agrochemical company from Switzerland) or COSMOCEL (agrochemical company from Mexico) maintain each one sales technician in Honduras with the duty to support the importers to distribute their products, train small shop owners, conduct demonstration days with farmers, etc.. The input importers, with their R&D departments, constitute hubs where a lot of relevant information on best practices in coffee production is accumulated. This level of technicians is also able to absorb knowledge from research conducted outside the country, for example from CENICAFE in Colombia or ANACAFE in Guatemala. The work of adapting the application of inputs under local conditions makes them clearly part of the innovation system. Not only do they work with chemical inputs, from Colombia for example, they import biological pest control remedies.

3.4 Government and development cooperation-led innovation trajectory

The Instituto Hondureño del Café (IHCAFE) is the key organization in Honduras with the public mandate to strengthen the coffee sector. The core operation of this privately organized but government-controlled organization is to improve productivity and quality, as well as to promote Honduran coffee at an international level. Finally, IHCAFE has helped farmers diversify production. Not only does IHCAFE engage in R&D, including, among others, the development of new coffee varieties, it also conducts extension and training, analysis of soils, plants and water, quality analysis, enterprise development and market intelligence. Recently it also manages the coffee levy which among others is used to finance IHCAFE's operations, the national coffee fund, Fondo Cafetero Nacional (FCN), a fund that finances road infrastructure improvement in coffee zones. The levy is taken at the level of export; basically the exporters pay 13.5 USD per every sack of coffee exporters. 4.5 USD is used for IHCAFE and FCN, the rest is paid back to the growers via IHCAFE at the end of the year thus allowing growers to use the payback as collateral with banks that have financed their coffee operations.

IHCAFE is the one public organization that promotes innovation among coffee growers. IHCAFE offices are found in 15 out of the 18 geographical departments in Honduras. There are 6 regional centers, 35 extension offices, and 6 R&D and training centers. Given the amount of coffee producers in the country – it is estimated that there are that about 80,000 coffee growers (IHCAFE 2009) – one finds that the number of field workers is not enough to pass information to the majority of the producers. Coffee growers are registered with IHCAFE and get invited to training activities that IHCAFE organizes in partnership with input providers, certifiers and development agencies. However, it is true that IHCAFE is overburdened (and maybe always has been) to organize a full-fledged extension service for the benefit of all coffee growers in the country. This fact may explain the low level of improved management in coffee fields and the appearance of private companies, sometimes related to the input and buyer scene, that complement their services. Often it is IHCAFE which links up growers with private and public providers of advisory services.

There are also a number of international development agencies such as UNDP, the Canadian International Development Agency (CIDA), GTZ, the Foundation for Rural Entrepreneurship Development (FUNDER), HEIFER International, the Farmer Training and Development Unit of FINTRAC, an agency related to the Millennium Development Goals Program of the USA, and the Central American Training and Education Institute (CATIE) and many others operating in the coffee sector. Each of these programs has their own sources of knowledge and information and enriches the basis of knowledge and technology from which innovations for the Honduran coffee sector can be drawn. They also have their own goals and agenda: HEIFER International, for example, has been active in southern Honduras, helping coffee farmers find alternative income sources. In general, these agencies work on the basis of programs that are affiliated to IHCAFE, and recently more prominently, to private buyers. The lack of advisory service capacity on the local level has also lead to the appearance of private local advisory service consultants such as for example ICADE which focuses on conserving biodiversity and ensuring sustainable livelihoods by transforming land-use practices, business practices and consumer behavior.

3.5 Farmers led innovation trajectory

While the cooperative movement in Honduras, due to factors of mismanagement and government influence, has lost much of its attractiveness to farmers, coffee growers continue to be associated in producer's organizations under different legal forms. These associations have recently experienced revitalization due to the boom of certification and direct relations to buyers. There are two major unions which regroup coffee growers' associations in Honduras, AHPROCAFE and ANACAFEH. AHPROCAFE for example, has concentrated on enabling growers to access funding of FCN to improve road infrastructure.

However, producers organizations' as well as the union's role in providing important information to growers about how to improve and optimize coffee production on their farms has been rather marginal. It is through the certification vein that recently new information on how to do things better is channeled into the system. Some organizations, such as the small growers association COMIPIL in Paraíso have been able, with the help of development agencies, IHCAFE and buyers to improve their operations. However, it is estimated that 85% of the total number of producers belong to associations such as AHPROCAFE and ANACAFEH, the benefits they receive from them is marginal and, when it comes to inducing innovation, in-existent.

3.6 Financing institutions-led trajectory

There are a number of public and private banks and financing institutions, such as BANADESA and BANHCAFE, who provide farmers with credits. Rather excessive in terms of the requirements of documentation and collateral, it is only a small part of coffee growers who can access these sources of financing. In cases that growers achieve to get a loan with these institutions, usually at much better conditions as with the *beneficio*, they do not, however, get any information on best practices in farm management. Even if the financing institutions evaluate the capacity of payment on the basis of coffee operations, work which is usually done by officials who know the sector well, the banks restrict completely from giving advice on how to improve operations. At the end, most farmers rely on informal credits provided by the *beneficios*. But the growing of coffee, and more so any improvement and intensification in coffee growing requires funding. This is also particularly true under conditions of certification. As sources of funding outside the *beneficio* scheme are scarce, many growers remain with few sources of information on improving their production.

Out of the six innovation trajectories discussed above, four of them are dominated by the private sector: Innovation through local buyers, international buyers/exporters, input suppliers and financing institutions. However, it is important to stress that it is not private sector agents alone which bring about the innovation in the trajectory. For example, IHCAFE is engaged in most of the private and publicly dominated innovation trajectories. As described, it is the combination of various private, public, non-governmental and local agents which make the innovations occur.

4 Innovation and communication in three coffee growing communities

After showing how, in general, new knowledge and technology in coffee production can reach growers via different innovation trajectories, the study went on to derive empirical evidence on how various agents engaged in these trajectories influence innovation behavior among growers in three coffee-producing communities in Honduras. In particular, answers to the question of how access to certain innovation trajectories and the dynamics of local information exchange between producers and external agents (those which lead innovation trajectories such as coffee buyers, farm input providers and governmental and international development agencies) influence the use of improved coffee production methods among small coffee producers in Honduras were sought. Data collection for this study was carried out from December 2009 to February 2010.

4.1 Three typical coffee producing communities: El Pacon, Las Crucitas and San Marcos de Colon

In the following section, the situation in the three communities studied is briefly described. The first community, el Pacon, lies in the department of El Paraíso in the southern region of Honduras. Although this department has the largest number of producers in Honduras (approximately 15,000 or 17% of the total), the yields obtained are lower than the national average. The majority of the producers are small-scale, having a cultivated area of a hectare or less. The community is located 30 kilometers from the closest town. It is characterized by a clear divide between large producers and small producers: Three large producers account for more hectares of coffee plantations than all the rest of the 25 small-producers. The small producers, with the help of development assistance, have formed a farmers' organization, the Cooperativa de Innovation (COMIPIL). As part of the cooperative, a women group engages in efforts to process and market coffee. The quality of the coffee produced in El Pacon is considerable; in a latest nationwide quality contest in the frame of the "cup of excellence" initiative, a coffee from El Pacon ranked third. This has attracted local buyers and exporters to seek buying coffee from the community. Meanwhile a number of development projects with the participation of IHCAFE, ICADE, FUNDER and CATIE have been providing technical assistance with regard to agronomic and production matters, organizational development, business administration and marketing. Producers in El Pacon produced on average land sizes of and the average yield is 9 sacks per *manzana* (about 7,000m²). Three out of the 25 producers in El Pacon sold all of their production directly to exporters and 5 of them sold a fraction of their production, roughly 40% on average, through producer unions or *cooperativas*.

However, producers still depend on financing from local buyers and much of the coffee is still sold to middlemen at low prices.

The second community studied, Las Crucitas, is located in the department of Santa Bárbara, in western Honduras. This area is the second largest in terms of coffee producers, accounting for about 15% of the total. The next greater town, Santa Bárbara, is 8 kilometers away from the community. In Las Crucitas the producers sold almost exclusively to intermediaries. On average, they grew coffee on 4 *manzanas*, but in contrast to El Pacon, the productivity was higher, the average yield being 17 coffee sacks per *manzana*. 7 out of the 28 producers were women, in contrast to El Pacon where seven out of the 25 producers were women. In the case of Las Crucitas, Las Crucitas profits from an increased presence of IHCAFE, which runs a regional office only a few kilometers away in Santa Barbara, one of the largest towns in this coffee-producing area. IHCAFE's extension agents visit members of this community on a regular basis and have developed a relationship of trust with them. Another development agent that has exchanged information with producers in Las Crucitas is SIDA. One notable difference between Las Crucitas and El Pacon is that SEAGRO, an input provider, has a close relationship with the producers and they exchange information with them. SEAGRO's activities of selling farm input goes beyond that and they also provide training to producers. Several producers acknowledged that they have participated in training sessions organized by SEAGRO.

The third community, San Marcos de Colon, located in the department of El Paraíso, is characterized by the strong presence of development agents, notably IHCAFE and ASONOG-FOR with farmers' organizations, in form of the cooperative COCASAM and the producers Union AHPROCAFE, also playing major roles. Coffee quality in the region is good and there are a number of buyers and exporters present in the region facilitating procurement and financing. On average, coffee was produced in small-scale farms of 6 *manzanas*. The average yield in this community was lower than in the other two, 7 sacks per *manzana*. All of the producers in San Marcos de Colon sold directly to the local *cooperativa*.

4.2 Degree of innovativeness among coffee growers in the three communities

We collected data on the level of innovativeness of farmers in the three communities. Coffee growers were asked to describe the nature of the innovations they had implemented over a lapse of five years. The innovations included changes in the agricultural practices, as well as acquisition of certifications, and marketing and management aspects. On a scale from 1 to 5, the enumerators rated how much growers had innovated, 1 being no improvements and 5 being many improvements. Out of eight dimensions an overall innovation score was built and normalized to present a discrete value between 0 and 1. Average innovation scores for each dimension in the three villages are depicted in Table 1:

Table 1.
Innovation scores among coffee producers in three communities

Community	El Pacon	Las Crucitas	San Marcos	
Innovation dimension	Average among 25 producers	Average among 29 producers	Average among 25 producers	Average of dimension
Innovation in agricultural practices (nursery, seedlings, fertilization)	0.621	0.696	0.632	0.650
Innovation in shade within the plantation	0.607	0.568	0.576	0.584
Introduction of improved pest management practices	0.671	0.568	0.552	0.597
Introduction of new coffee varieties	0.571	0.608	0.552	0.577
Improvements in post-harvest management	0.657	0.656	0.648	0.654
Innovations in the dry processing of coffee	0.579	0.632	0.688	0.633
Introduction of quality standards	0.593	0.568	0.704	0.622
New certifications – organic, origin, fair trade	0.493	0.552	0.720	0.588
Overall	0.599	0.606	0.634	0.613

Table 1 shows that coffee growers are innovating mostly in agronomic aspects, such as improving fertilization, shade and pest management. However, most farmers consider that they have not implemented many changes in both production and improved quality aspects. The introduction of quality standards and certification have been more prominent features in San Marcos and less so in El Pacon and Las Crucitas. Over the past decade, San Marcos has become a region known for the cultivation of organic coffee, so it is perhaps not surprising that the producers interviewed have acquired certifications or now comply with different standards. Overall, farmers in San Marcos were slightly more innovative considering the whole range of innovation aspects investigated.

4.3 Agents influencing innovation in coffee production: Financing institutions, buyers, development agents, farmers organizations and input providers

Coffee growers were asked which agents have been helpful to inform them about measures for improved coffee production. The type of agents and the innovation trajectories they lead have been discussed in section 3. An overview on how many interactions with these agents farmers had in each of the communities is presented. The results are depicted in Table 2.

Table 2 provides an indication of which innovation trajectories are most dominant in the community. Whereas relationships to local buyers still dominate the situation in El Pacon, in Las Crucitas it is the relationships with Development Agents and Input Providers that are most frequent. In San Marcos, it is the relationships with the development agencies IHCAFE and ASONOG-FLO as well as with the cooperative union AHPROCAFE and the local cooperative COCOSAM which are most influential in passing information on innovations in coffee production. We may conclude that in El Pacon it is the buyer trajectory (a), in Las Crucitas the input provider trajectory (d) and in San Marcos the mix of a development cooperation trajectory (c) and farmers' self initiative trajectory (b) that determine opportunities of absorption of innovations for coffee growers. Drawing from the results on the average level of innovation in the communities from the former section - San Marcos seems to have the most innovative growers - we may ask ourselves if it is the latter mix which is most efficient in inducing innovations among farmers.

Table 2.
Number of interactions producers-agents

Type	El Pacon	Las Crucitas	San Marcos
Banks (BANCAFE, BANADESA, HSBC)	1	5	0
Buyers (BELAGO, Beneficio Gaitan, Beneficio Sosa, Beneficio Toledo, CIGRAH, SOGIMEX, CEDECO)	17	0	2
Development Agents (ACDI, CATIE, EDA, Fondo Cafetero, FUNDER, Heifer, ICADE, IHCAFE, SAG, FINTRAC, ASONOG-FLO)	37	35	47
Farmers' Organizaitons (AHPROCAFE, COMIPIL, COCASAM))	3	6	42
Input Provider (Agrocomercial Gaitan, Agrocomercial Maribel, SEAGRO)	3	17	0
Total	61	63	91

4.4 Networks of information exchange

We collected data on the interaction between knowledge and technology providers and farmers (farmer-to-farmer, and agent-to-farmer networks) which allowed us to construct knowledge and technology exchange networks in the three communities. Growers were asked which growers and agents have been helpful to inform them about measures for improved coffee production. Interviewees reported on their relationship to a) coffee producers in their own community and b) agents in the coffee sector that passed relevant information to them for improvement in coffee cultivation. In all the three communities the total population of small coffee producers was interviewed, 25 in the community of El Pacon, 28 in Las Crucitas and 25 in San Marcos. The resulting networks can be classified as full networks of the relationships between coffee producers in each community combined with the cumulated egonetworks of the producers with regard to their relationships with external agents.

The resulting dataset was analyzed with regard to general network properties and visualized using UCINET software for social network analysis (Borgatti et al., 2002). We also plotted the networks using the spring-embedding algorithm suggested in Net Draw (Borgatti et al., 2002). The size of the nodes reflects degree centrality, viz the number of incoming ties of the actors; the colors indicate the type of actors (red for

coffee growers and blue for agents that provide innovations). The names of the producers have been kept anonymous.

Figure 1 depicts the network of information exchange relationships with regard to innovations in coffee production among producers and agents in El Pacon. IHCAFE and CATIE seem to play a major role in the exchange of information with the producers. Another relevant development agent is FUNDER. With the exception of CIGRAH, local buyers and exporters appear to have no relevant role in exchange of information on coffee technology. This is surprising, as many producers maintain credit relationships with the local buyers. Farmers' organizations did not exchange much information with producers. As for the input providers, they were not significant actors in the exchange of information with the coffee growers, they are found in the periphery of the network. Most strikingly producers in the community seem to source information rather from other producers than from agents. The role of EP02 and to a lesser degree EP17, EP25 and EP11 is evident in the exchange of information. It is known that those individuals are leaders in the community and carry out leading functions in the local cooperative, COMIPIL. They received special training through development agencies and assumed catalyzing functions in transferring information to the community members.

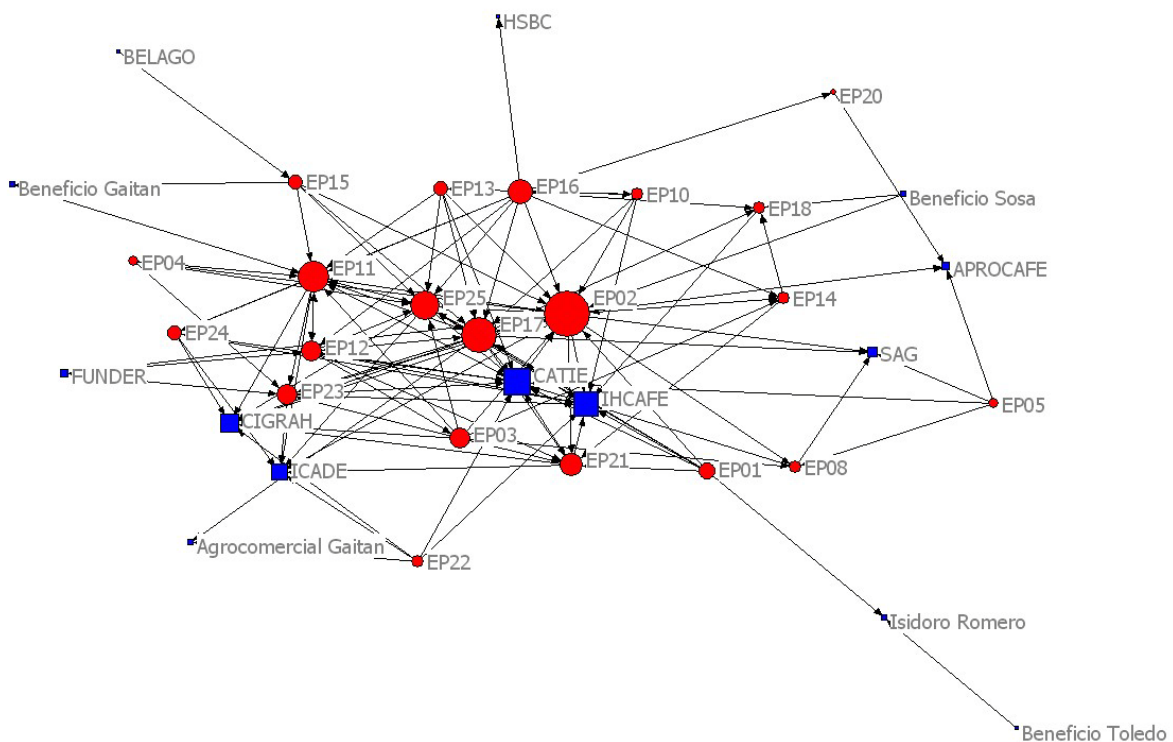


Figure 1.
 Producer-agent information exchange network for coffee innovations in El Pacon community

Figure 2 depicts the network of information exchange relationships with regard to innovations in coffee production among producers and agents in Las Crucitas. It confirms the predominant role that IHCAFE and SEAGRO play as agents providing information to growers. A less important role can be attributed to SIDA, BANADESA and AHPROCAFE. Buyers seem to be completely absent from information exchange on innovation in coffee production. Again, there are a number of well connected producers, such as ST1, ST7, ST14 and ST18.

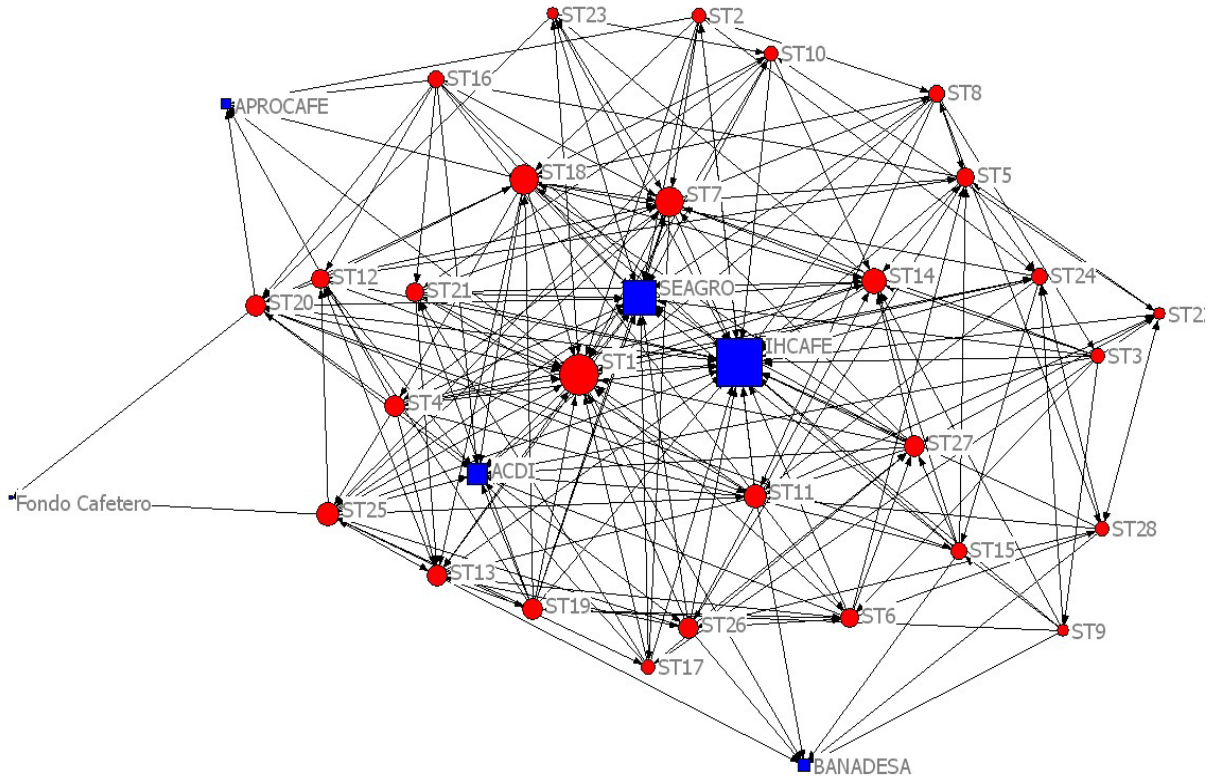


Figure 2.
Producer-agent information exchange network for coffee innovations in Las Crucitas community

Figure 3 depicts the network of information exchange relationships with regard to innovations in coffee production among producers and agents in San Marcos. The information exchange relationships are dominated by IHCAFE and the development agency ASONOG-FLO. AHPROCAFE and the local cooperative, COCASAM, also play important roles. Other types of agents seem to play marginal or no roles in the network. Again there are a number of producers, such as SM1, SM8 and SM20, with a high degree of connectedness, viz. they play important roles in providing other producers with information how to innovate.

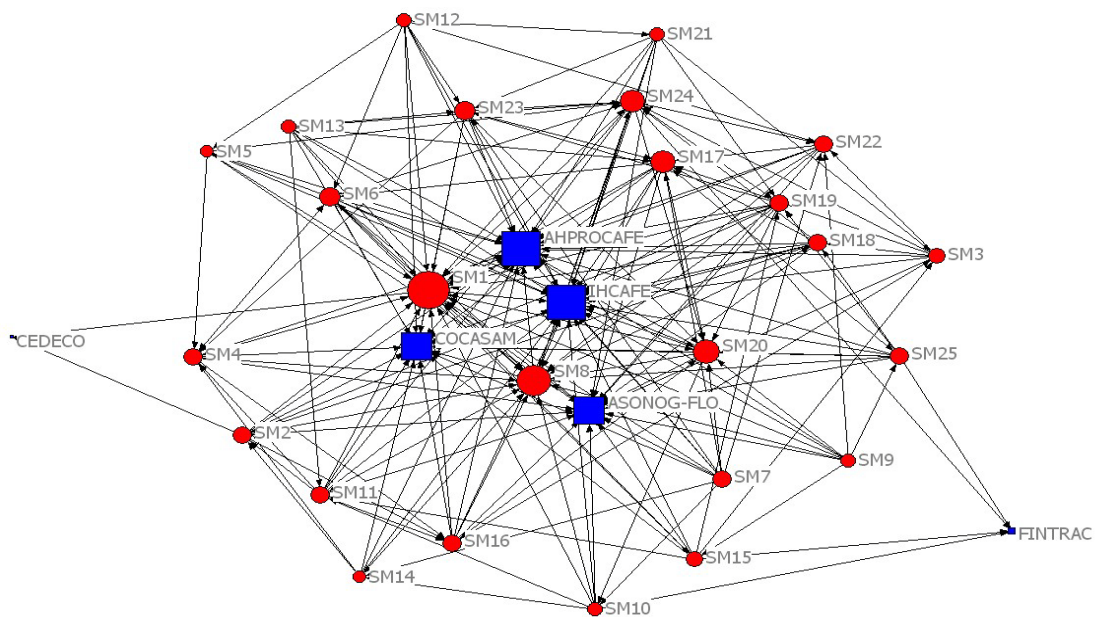


Figure 3.
Producer-agent information exchange network for coffee innovations in San Marcos community

Comparing the three networks we find that they differ both in terms of the type and number of agents that facilitate the exchange of innovation-relevant information as well as the intensity with which this information is exchanged. Table 3 compares some important properties of the three networks. The density of the network in El Pacon, meaning the number of relationships divided by the number of possible relationships, is significantly lower than in the two other networks. Average geodesic distance, the shortest path from any given actor to another, is very similar between the networks: It only needs two steps to pass from any given actor to another. Mean in-degree centrality, meaning the average number of relationships actors maintain allowing them to absorb innovation-relevant information, is comparatively low in El Pacon. The mean betweenness centrality, meaning the average of the number of times that actors are located on the shortest path between any two actors in the network, again is comparatively low in El Pacon. Mean eigenvector centrality, roughly describing the average distance of an actor to all others in the network, is also lower in the El Pacon network. In conclusion we can say that the innovation-relevant information exchange network in El Pacon is characterized by intensive interactions, it is more difficult for actors to pass or receive information to and from others.

Table 3.
Common properties of information exchange networks

Network Property	El Pacon	Las Crucitas	San Marcos
Number of producers	25	28	25
Number of agents	15	6	6
Density	0.070	0.195	0.229
Average geodesic distance	2.089	2.095	1.959
Mean in-degree centrality (normalized)	6.969	19.519	22.581
Mean betweenness centrality (normalized)	0.726	2.827	2.243
Mean Eigenvector centrality (normalized)	16.393	22.616	23.906

4.5 Agents' Sources of Information

We also collected data on how main agents engaged in the development and diffusion of knowledge and technology in coffee production and in particular which are their sources of information. However, the picture is biased towards those agents that operate in the three communities studied, because we started from these communities and, following the snowballing principle, only organizations named here were then further contacted and interviewed with regard to their relationships and sources of information. Further, we could only track back the source of information up till the national border; actors outside of Honduras were not interviewed.

The resulting agent-to-agent network, a type of ego-network from the view of the three communities, is depicted in Figure 4. Development agencies are depicted in red, buyers in grey, exporters in blue, certifiers in pink and input providers in black. The arrow points at the actor that has been identified as a source of information. The figure confirms the central role of IHCAFE, both its technical assistance as well as its research branch, as a source of innovation-relevant information in the sector. Figure 4 is illustrating the high degree of interweavement of public and development agencies and private sector agents. What cannot be shown in Figure 4 is what agents considered being the ultimate source of information: While some agents found IHCAFE to be the best source of knowledge and technology others also pointed to the Certification Agencies and ultimately at CATIE's research department, the former PROMECAFE research unit (now taken over by CIRAD and ECOM Coffee Group), and GTZ. For the case of processing machinery some input providers also mentioned the important role of devices developed in Brazil and Colombia.

has enabled IHCAFE to continue being a relevant agent, despite its limitations in terms of staffing and finance. IHCAFE may consider a more sophisticated strategy to institutionalize this function. This also points to the issue if any of the agents could be the sole provider of innovation-relevant information. The study suggests that single sided relations with farmers are not effective. Rather it is the combination of support from public and private agents, together with the information from peers in the own community, that ultimately trigger the producer's decision to innovation.

Policy makers and designers of development programs should take into account the way public and private agents collaborate in successful innovation trajectories. Development agencies would face substantial limits if the producer does not have a good perspective to market their products. And modern buyers, as well as input providers, do much more than selling inputs and buying products, they come with substantial knowledge and can facilitate its diffusion as well as the use of new technologies.

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