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QUALITY OF VEGETABLE GROWER SOCIAL NETWORKS AND POTENTIAL ROLE FOR ADOPTION OF AGROECOLOGICAL INNOVATIONS: THE CASE OF UBAQUE IN THE COLOMBIA HIGHLANDS

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Abstract:

Studies on adoption and diffusion of agricultural innovations have evolved over time according to the technological transfer paradigms; the linear top-down approaches used during the Green Revolution has led to new participatory and multi-agent perspectives oriented towards sustainable farming practices. Nowadays, more and more authors agree that social interactions are essential factors in the innovation adoption and diffusion process. This research is a sociological study aiming to identify the type of relationships farmers have with other actors that most influence them in their decision process to adopt agroecological practices, and to analyse their communication features. The study was conducted in a municipality close to Bogotá with vegetable growers, potential targets for a technology transfer project run by a research group of the National University of Colombia aiming to reduce the use of agrochemicals among growers. Using snowball sampling, 30 farmers were interviewed using ego-centric network analysis combined with focus group method. Data collected suggested that when farmers are exposed to agroecological innovations, information comes mostly from extension agents and other agricultural professionals who provide also training and with whom they have week ties. These findings coincide with other studies. However, the diffusion of technology among farmers was found low; a lack of social cohesion due to distrust was pointed out as the primary cause. Building up social capital among vegetable growers might be done through flexible and informal associations, such as farmer networks.

Key-words: agroecological innovation, adoption and diffusion process, ego-centric network analysis, vegetable grower

CONTENTS

FIGURES

TABLES

1. Introduction

Innovation, defined as “anything new successfully incorporated into social or economic processes” (Monge et al., 2008), has been inherent to human development. Over time, civilisations have created new tools, applied new practices, and organised people’s lives in new ways, resulting in a diversity of societies. Agriculture might be considered a human activity resulting from a succession of new techniques developed to obtain enough food, fibre and fuel to cover human needs. Agricultural innovations were usually the result of ideas that farmers developed according to local conditions. The spread of this knowledge was done by sharing information within and between family groups, although several authors throughout history have compiled agronomic knowledge in treatises and other sources of information.[1] The development of agricultural sciences managed to transform subsistence agriculture into a system of cash crops production, reaching its peak of technological innovation development with the Green Revolution. With this industrialised agriculture, new actors appeared in the food system, such as researchers, extension agents and input suppliers.

Since then, the transfer of agricultural innovations has followed linear top-down approaches mainly consisting in developing knowledge in research centres (public/private, national/international) and then transferring technologies obtained through extension agents to farmers (Spielman, 2005). Under these agricultural research paradigms, farmers have been considered only as recipients of technology packages created by researchers. Although this system has achieved its goal of increasing yields, it has been in detriment to the environment and social equity; many rural areas around the world are still suffering from poverty and food insecurity, and new challenges such as climate change are added problems that increase the critical situation, especially of smallholders in developing countries. The emergence of new agricultural research models, including an active participation of farmers in the innovation process (e.g. participatory research), consider that innovation results from a combination of different sources of information, is participatory, and uses action research to understand complex situations in constant evolution in agricultural development (Hall, 2007). In this sense, the innovation systems approach[2] is considered to play an essential role in changing researchers and policymakers’ perspective in order to take into account other actors and

[1] For instance, *De re rustica* by Columella (4 – c. 70 AD) is an important source on Roman agriculture (Aguilar, 2006) and in China, the Book of Fan Shengzhi (Fan Shengzhi Shu) collects a series of important agricultural masterpieces at the end of the Western Han Dynasty (206 BC – 8 AD) (“Fan Shengzhi Book,” 2015).

[2] The innovation systems concept is defined as “the network of organizations, enterprises and individuals focused on bridging new products, new processes, and new forms of organization into social and economic use, together with the institutions and policies that affect their behaviour and performance” (World Bank, 2006).

relationships traditionally not included in the innovation process (Spielman, 2005). The major argument in favour of such consideration is that "the agricultural sector is moving into an era of rapidly changing market, technological, social and environmental circumstances that are evolving in often unpredictable ways" (Hall, 2007). Thus comes the necessity to use multi-agent sources of knowledge to develop agricultural innovations (Hall, 2007). Considering farmers as central actors in their own development is crucial so innovation processes have to be designed in line with this idea.

In Colombia, agricultural research has followed the same trends as the rest of the world. The National University of Colombia – UNAL – is one of the most important research centres in the country and its faculties of agricultural sciences have been nationally recognised for their research and transfer of innovation in agriculture. As an internship agreement between ISARA-Lyon and UNAL, the present study focuses on a particular research project coming from a research group of UNAL called *Agricultura, Ambiente y Sociedad* – AGRAS. In recent years, it has been working on safety in vegetable production in areas close to Bogotá by promoting new agricultural practices that reduce the use of synthetic pesticides labelled from highly to moderately hazardous among farmers, a real environmental and health problem in the vegetable supply chain (Universidad Nacional de Colombia, 2014) [3]. At the food system level, the group has also promoted entrepreneurship through strengthening associationism among farmers that are members of irrigation districts to market their products and get better integrated into the supply chain. This year a new project has been proposed to work with tomato and green bean growers in three municipalities of the eastern province of Cundinamarca (Choachí, Ubaque, and Fómeque), during a period of 18 months. The project will be based on the two previous objectives, but this time going further into research on integrated crop management, with an emphasis on technology transfer and farmers' empowerment to spread acquired knowledge while organising new marketing schemes. Even though the main goal of UNAL project is to develop new vegetable supply channels to Bogotá ensuring safe products, the long-term outcome of this project might be to transform conventional farming systems into sustainable ones

[3] Different studies carried out in Colombia analyse pesticide residues in tomato for domestic consumption. The results show that different toxic compound can be found in fresh tomatoes (Arias et al., 2014; Bojacá et al., 2013; Castro et al., 2004) with at least one pesticide detected in half of the samples (Bojacá et al., 2013; Castro et al., 2004) and even in more samples (Arias et al., 2014; Castro et al., 2004). In most cases, the concentration of compounds were below the maximum residue level (MRL) (Arias et al., 2014; Bojacá et al., 2013; Castro et al., 2004). However, in some cases the MRL was largely exceeded (Bojacá et al., 2013). These authors also detected compounds that were not allowed in tomato production (Bojacá et al., 2013; Castro et al., 2004), highly restricted worldwide (Castro et al., 2004), or even not registered in Colombia (Bojacá et al., 2013). This absence of control and technical support is pointed out as a concern since the exposure to pesticides has increased the incidence of toxicity in consumers and farmers, becoming a public health issue (Bojacá et al., 2013). A few papers have also been published in the country where the authors mentioned the effects of pesticide residues on biodiversity and ecosystems (Herrera Rojas et al., 1995), and pollinators (Parra and González, 2000).

where farmers' livelihoods are improved and the negative impacts on the environment are reduced. Thus, some aspects of this project may suggest it follows an agroecological approach. For a more exhaustive description and analysis on this project and its approach, Cf. Appendix I (Section I).

As an agricultural technology transfer project, two essential concepts should be considered: adoption and diffusion of innovations. At the same time as researching on agronomic issues related to soil, water and plants, the resulting technology has to be adopted by farmers participating and then spread to non-participants. What in theory should be easy, considering that all innovations proposed should provide significant advantage compared to farmers' conventional practices, in most cases the adoption and diffusion of innovations does not happen the way it is expected; adoption might not occur or only partially, depending on the type of innovation, and the spread of the innovation can be limited. According to Feder et al. (1982) and Rogers (2003), adoption is a process defined as "the decision to make full use of an innovation, which encompasses the mental process that an individual undergoes from first hearing about to finally adopting an innovation." Consequently, the potential adopter needs to go through stages categorised by Andrew and Alvarez (1982) as "awareness", "trial" and "adoption".

The purpose of the present research was to analyse patterns of farmer's social interactions in order to assess how different actors may influence their decision-making and the willingness to adopt innovations oriented toward sustainable agriculture in the study area. The question to answer is: *What types of relationships and structural features in the farmers' communication networks influence the farmer decision-making process when presented with innovations that move practices away from chemical pesticide use and toward more agroecological approaches?*

The research used sociological survey research methods that focus on farmers in Ubaque, one of the three municipalities where vegetable growers will be involved in the agroecological promotional programme run by the UNAL group. The aim was to assess the relation between farmers' social networks and their attitude toward a change in their farming practices and collective action[4]. Following Social Network Analysis approach, the present research seeks to contribute to enlarge the perspective of the UNAL research project by looking at the social interactions and information flow

[4] Since scholars started to include social relations in different research fields, arguing that people influence each other, ideas and resources flow, they have brought a larger perspective to social sciences. In adoption and diffusion studies, the contribution of social interaction analysis has been beneficial to understand individuals' behaviour within a group. The difference between traditional social science research methods and social network analysis lies in the focus: the former study individuals and their attributes, whilst the latter focuses on individuals' relationships (Hansen et al., 2010). A more exhaustive literature review on social interactions and adoption of innovation processes is found in Appendix I (Section II).

among farmers in the study area. The results of this research can provide relevant information to agricultural researchers, extension agents and even policymakers concerning farmers' attitudes and their roles within their social networks related to communication of agricultural innovations. This information can help external agents develop new strategies to communicate with farmers and transfer agricultural innovations more efficiently[5] in a multi-perspective and non-linear way, as innovation systems framework suggests.

This document is divided in six sections: the first section introduces the context and the subject of study; the second section presents the study area; the third section explains the methodology used to collect and analyse data; the fourth section provides the results of data analysis; the fifth section is a discussion on the results and how they answer the research question; and the sixth section summarises the main points of this study.

2. The Study Area

Although the study area of the UNAL project comprises three municipalities (Ubaque, Choachí and Fómeque), the present research was done only in Ubaque. The three of them are located in Oriente province, department of Cundinamarca. Ubaque is 55 km east of Bogotá (Cf. Appendix II). This is a transitional region between the Andean highlands and the plains, connecting Bogotá with the department of Meta and the Orinoquía region or Llanos Orientales (Eastern Plains). Ubaque has an incredibly varied topography, with areas at 3.600 masl and others close to 1.500 masl. Its climate is also diverse, depending on the altitude. However, considering values for the capital, the climate is tropical wet: 1.823 masl, 18.7°C, and 1.371 mm/y ("Climate data for cities worldwide," 2015). Precipitations have a unimodal pattern (one dry season and one rainy season per year) with the highest amount of rain between May and October ("Climate data for cities worldwide," 2015). Other general information of interest concerning the municipality are found in Table 1.

Table 1 General information of Ubaque

Extension (km^2)	***Number of townships***	***Population (inhabitants)***	***Population living in the capital (%)***	***Population affiliated to Sisben[6] (%)***
104.96	21	7,415	12.65	88

Source: adapted from (Alcaldía de Ubaque, 2015). Available from http://www.ubaque-cundinamarca.gov.co/index.shtml#2

[5] As Bodin and Crona (2009) stated, "Social Network Analysis can thus be used in guiding governing agencies' communication and engagement efforts to maximize efficiency, and/or to target specific subgroups."

[6] *Sistema de Identificación de Potenciales Beneficiarios de Programas Sociales* – Sisben is a national programme which registers people whose basic needs are unmet and for that reason they get access to social subsidies.

The main economic activities in the study area are linked to the agricultural sector, although other activities are present, e.g. tourism. Horticulture is an important subsector and the main crops are potatoes and carrots growing in the higher townships whereas tomatoes (open field and greenhouse), onions and green beans are found in lower lands (Argüello Arias, 2015). Livestock production is becoming an important subsector, especially intensive poultry production. At a smaller scale, other agricultural products are grown, such as maize, coffee, other fruit trees, and aromatic plants.

In general, agriculture in Ubaque is characterised by a small-scale family farming. This municipality is not the most important in terms of vegetable production in Cundinamarca; however, with Choachí and Fómeque, it is an important supplier of tomatoes and green beans to Bogotá (Argüello Arias, 2015). For that reason, the focus of UNAL project is greenhouse tomato and green bean production. Diagnostic studies were conducted by researchers of the group to understand the current management of both crops among farmers who are members of one irrigation district. Findings of these studies are summarised in Appendix III.

Based on these crop management characterisations, researchers concluded that both crops have a series of deficiencies in the technical, agronomic and post-harvesting management leading to low yields[7], high production costs, and inadequate levels of product safety affecting competitiveness of the farming systems (Argüello Arias, 2015). The indiscriminate use of synthetic pesticides is pointed out as the main issue by the research group and farmers (Argüello Arias, personal communication, February 9th, 2015). Indeed, pesticide dosage is in average 280% higher than what is recommended by pesticide producers (Argüello Arias, 2014; Chiguachí, 2014). In addition, mixing different commercial products with the same active ingredient is common, and pesticide waiting periods are usually unknown by farmers so they do not respect them. They do not use any protection equipment when applying pesticide, and when the product is finished, the package is usually burnt (Chiguachí, 2014). In tomatoes, problems related to greenhouse design are high temperatures inside due to low ventilation, low light period due to an inappropriate orientation, and high incidence of pests due to an absence of mesh are also pointed out (Argüello Arias, 2014).

Marketing is done mainly through middlemen. Advantages for farmers: they are directly payed cash and sometimes middlemen supply inputs and give them payment facilities (i.e. credit). Disadvantages: farmers are usually not aware of food prices in the main markets and therefore they are price takers; and since they do not classify their products, they do not get any feedback from

[7] In green bean, yields vary from 12.4 to 15 t/ha which are good values. However, yields in tomato vary from 3 to 8 kg/plant with an average of 4.5 kg/plant, half of yields obtained in other tomato regions of Colombia.

markets on quality standards, thus middlemen buy all goods at the same price (Argüello Arias, personal communication, Ferbuary 9th, 2015).

Other features of the study area are valuable to understand the broader context. Regarding the environment, Ubaque possesses highlands where the ecosystem dominating is *páramo*, a tropical mountainous ecosystem found between the cloud forests and the snow-capped peaks. It is of great importance in the hydrological cycle in the Andean regions. Due to their importance, p*áramos, subpáramos*[8]*,* and other zones of water spring are protected areas in this country where it is forbidden to perform any agricultural or extractive activity (Congreso de Colombia, 1993). While Fómeque has 49% of its territory included in the Chingaza Natural National Park where *páramos* are dominating (Alcaldía de Fómeque, 2015), *páramo de Cruz Verde* in Ubaque is not part of any national park and deforestation is an important issue (*Plan Integral Unico para la Atención a la Población Desplazada - PIU*, 2011). In addition, the environmental authorities have ordered a mining company in Choachí to suspend its exploratory activity in a *páramo* area ("Procuraduría pide que se suspenda minería en Choachí," 2015) after a group of the local population denounced the irregularities of the company's activity. In Ubaque, mining is also becoming an issue; however the environmental movement is still incipient. Therefore, *páramos* are an important environmental feature of the study area, and while it seems there are some concerns regarding its conservation, little has been done so far.

Linked to *páramos*, water is an important issue in the area. The unimodal pattern of precipitations provides little room for farmers to grow all year around. Irrigation systems have become essential to agricultural development in the Oriente province, since they mitigate the socioeconomic effect of recurrent droughts and help family farms better organise their production calendar (Argüello Arias, personal communication, February 25th, 2015). In this province, 21 irrigation districts[9] have been created, 6 of them are located in Ubaque. The project group will focus its research on farmers' associations managing these districts because they considered there is already a basis for collective actions among members of these organisations (Prof Argüello, personal communication, Ferbuary 25th, 2015).

[8]Known also as *páramo bajo,* it is a transitional zone between the upper limit of high Andean forest and *páramo* between 3.000 and 3.500 masl.

[9]Groups of farmers have been organised in associations and with financial support from the Colombian Agency of Rural Development – INCODER (from its Spanish abbreviation), have got access to irrigation infrastructure.

3. Methodology

Bawden (1991, cited by Francis et al. 2003) consider relevant to complement natural science approaches in agriculture with social science methods in order to understand how farmers take decisions. Following this idea, this study combines elements of Social Network Analysis with Focus Group Method (FGM) to assess farmers´ perceptions and attitudes regarding the potential adoption of agroeclogical innovations and how they are influenced by their social networks in their decision-making process.

3.1. Research Question

The main question of this study is: *What types of relationships and structural features in the farmers' communication networks influences the farmer decision-making process when presented with innovations that move practices away from chemical pesticide use and toward more agroecological approaches?* Descriptive network statistics were used to understand which stakeholders most might influence farmers in their decision to adopt new practices that lead to more sustainable farming systems as well as how farmers interact with these actors, and how communication on agricultural innovations flows.

3.2. Conceptualisation and Operationalisation of Variables

This study is based on the research survey method including two parts: (1) analysis of farmer social network structure and the relationships within this frame influencing farmers' innovation-decision process, and (2) assessment of farmers' attitudes regarding the sustainability of their farming systems. The first part was completed by using ego-centric analysis technique which allowed analysing the ego-centric network of vegetable growers in Ubaque. Unlike socio-centric analysis, the other type of social network analysis in which the whole network of a group is studied, the purpose of an ego-centric study is to identify the complete network of a single actor or node. Since the research question focuses on individuals – i.e. farmers – and the different relations – i.e. networks – affecting their attitudes, ego-centric analysis was considered more appropriate.

The ego-centric network analysis method consists of "a central node (ego) and all nodes related to the central node, called alters" (Rauf and Mitra, 2011). Therefore data collected must include attributes about ego (respondent) – e.g., socioeconomic attributes –, name generator (list of alters) – i.e., the actors to whom the ego is connected –, name interpreter (ego´s relationships with

generated list of alters), alter attributes (data collected on the list of alters), and if research is set to study it, alter-alter relationships (connections between alters). Representation of ego-centric networks is done through sociograms, defined by Wasserman and Faust (1994 cited by Rauf and Mitra, 2011) as “a picture in which people (or more generally, any social unit) are represented in two dimensional space, and relationships among pairs of people are represented by lines linking the corresponding points.” Thus network analysis allows to “visualise complex sets of relationships as maps – i.e., sociograms – of connected symbols and calculate precise measures of the size, shape, and density of the network as a whole and the positions of each element within it” (Hansen et al., 2010).

This ego-centric analysis focuses on three aspects considered influencing farmer’s decision-making to adopt agroecological practices: (1) shape of farmers’ ego-centric network, (2) characteristics of actors composing farmers’ networks, and (3) types of relationships existing between farmers and actors composing their networks.

SNA has been found valuable to analyse several events. However, this approach has been criticised because it assumes that within the social system humans participate, individuals’ decision-making only depends on other actors and does not consider that individuals can take decision on their own without external influence (Berkowitz, 1982). Taking into account these limitations helped interpret the results of the present study and to enrich the discussion. Ego-centric data analysis relies on statistical analysis, however, in combination with qualitative methods, it can be useful in providing a context to the network analysis (Rauf and Mitra, 2011). For that reason, the ego-centric analysis was complemented with additional data about farmers´ perceptions and attitudes on the sustainability of their farming systems. Focus group method was used to further understand farmer’s personal beliefs or attitudes.

3.3. Data Collection

Data was collected following the personal network research design (PNRD). It consists of “sampling unrelated and anonymous respondents from a large population and gathering information about their ego networks” (Halgin and Borgatti, 2012). Although personal network surveys can be administered by different means (interviews, given to respondents to fill out, either on paper or via online), face-to-face interviews were conducted in this case.

Since PNRD aims to generate an exhaustive list of alters with whom the respondent has some type of relationship with, the questionnaire was divided into four parts (1) questions concerning farmer socioeconomic aspects and farming system features – i.e., ego's attribute questions –, (2) one question to generate a list of alters – i.e., alter prompt question, (3) factual – e.g., frequency of contact –, attitudinal – e.g., trust in someone –, and direct questions – e.g., type of relation – related to specific information on farmer social interactions regarding their innovation-decision process in agriculture – i.e., alter attributes and ego-alter relationship questions –, and (4) question to see the possible alter-alter relationship – i.e., alter pair question. The alter prompt question can lead to lengthy surveys (Halgin and Borgatti, 2012) and due to time constraints and to avoid respondent fatigue, the last question was only asked for a reduced set of alters (farmers). The questionnaire is in Appendix IV.

Since farmers' populations were not known in advance, the snowball sampling method was used to obtain the sample population. However, there are other reasons to use this sampling method. First of all, it permits an analysis of some features of ego's network that cannot be analysed in case the sample population is randomly fixed in advance; thus, measures such as reciprocity in the relationship can be included[10]. Second, interviewing ego's alters allows a researcher to check accuracy of some respondent's answers, since precision of data from surveys relying on people's recalling can be variable (Chung et al., 2005). It provides more precise attribute data of alters as well as information about alter-alter relationships and, combining alters' attribute data with relational data. It also allows the measure of network composition (e.g. homophily and homogeneity) (DeJordy and Halgin, 2008). Eventually, surveying connected personal network elements allowing to connect them and create a larger network (Coleman, 1958, cited by Kowald et al., 2009), and socio-centric measures can also be included in the analysis (e.g. structural holes, brokerage, embeddedness, etc.). In this case, since only respondent' alters who are farmers were interviewed, a partial network could be generated.

Interviews were conducted in Spanish in two periods: the first one from the 10th to the 13th of July, and the second from the 18th to the 22nd of July 2015. The snowball chain started with a few respondents called "ego-seeds" (Kowald et al., 2009). Some of them were contacted through one of the researchers working on UNAL project, whereas the others were contacted through other acquaintances. Ego-seeds were from different townships to avoid ending easily in a *cul-de-sac.*

[10] Interviewing respondent's alters, one is certain that there is already a relation between ego and alter. Using a random sampling method, the probability of an ego knowing another ego is lower, especially if the population studied is big.

Respondents were asked to report their contacts. The aim was to interview these contacts and ask them to report their social contacts and so on. This sampling method required respondents to provide real names of alters, thus, they could not stay anonymous. For that reason, respondents were asked before the interview to read and sign a participation agreement (Cf. Appendix IV). Interviews were conducted in respondents' farm, although some of them preferred to be interviewed in town for logistic reasons.

Data for the second part of the study was collected using the Focus Group Method (FGM). After finishing with individual interviews, three focus groups were organised (one was the 2nd and the two others the 8th of August 2015) and all respondents that were willing to participate were contacted again and invited to one of the sessions according to their availability. Although the original idea was to select participants in order to create more heterogeneous groups and avoid less interactions in the discussion due to similar opinions in strong social network or clique, time constraints and respondents' availability made it impossible to keep this idea. Under these circumstances, compliance to farmers' schedules was the most appropriate position taken.

A semi-structured questionnaire was elaborated in Spanish in which 10 questions related to sustainable agriculture were asked: based on a definition of sustainable agriculture, the discussion started with a reflection on how close/far they thought farming systems in Ubaque were to it, followed by a series of questions related to their farming systems and economic, social and environmental issues. The discussion ended up with questions related to next steps they could take to improve their farming systems. This qualitative method was expected to provide more insight on farmers' perceptions and opinions on sustainable agriculture and their vision of what their farming systems could look like in the future. The questionnaire and the participation agreement farmers were asked to sign can be found in Appendix IV.

3.4. Data Processing and Analysis

Different software packages have been developed to analyse social networks (Scott, 1996). However, these tools are usually designed for socio-centric analysis, in which different measures of a single network are available using descriptive statistics. In an ego-centric analysis, more than one network is studied with a certain amount of data included for each personal network, since it is a combination of relational data – i.e., network analysis perspective – with attribute data – i.e., conventional social science data (DeJordy and Halgin, 2008). Some tools have been developed

(Egonet and E-Net) to enable to perform these analyses and provide means to export data that can be analysed using other softwares.

In this case, Egonet was used. It is an open source programme that allows “to create questionnaires, collect data, and provide general global network measures and data matrixes that can be used for further analysis by other software” (“EgoNet,” n.d.). It is also possible to combine ego-centric networks to create a socio-centric network, although in the open source version it has not been possible to combine ego-centric networks. For the ego-centric analysis, the questionnaire was created using the format of this programme. Once interviews were done, field data was introduced into the programme and it generated a series of data that were then exported as spreadsheet. With Microsoft Excel 2013, descriptive statistics were used to analyse ego attributes, alter attributes, and ego-alter relationship and communication flow.

Since ego-centric network data does not support extensive structural analysis as in whole networks (Marsden and Campbell, 2012), connecting ego networks to create a partial farmer network was thought to include a structural analysis in the research. Analysing a farmer network (in this case it was a partial network since data collected came from a sample population) was expected to provide some insights on the role some actors play in the network. However, due to the characteristics of the questionnaire, only some features of the partial farmer network could be analysed.

Data from the focus groups was analysed by using notes taken during the sessions and listening to recordings made during the discussions. For each session, main topics discussed were summarised and the main ideas were related to the ego-centric network analysis. In addition to ego-centric network and focus group data collected, informal discussions were held during the field work with some residents that are not farmers. Information provided was also included in this research.

4. Results

4.1. General aspects

A total of 30 farmers were interviewed, 9 women and 21 men, from 10 townships of Ubaque. The geographical distribution of respondents is shown in Figure 1.

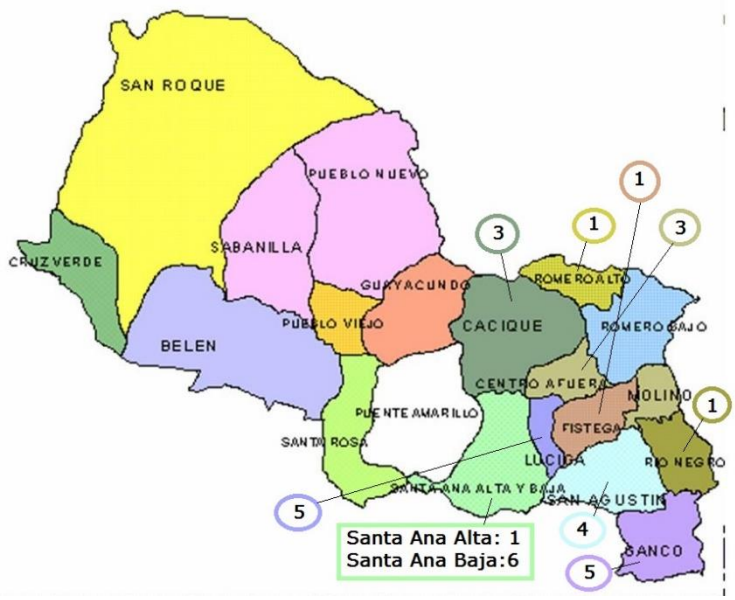

Figure 1 Geographical distribution of respondents

Source: adapted from Alcaldía de Ubaque (2015). Available from: http://www.ubaque-cundinamarca.gov.co/mapas_municipio.shtml?apc=bcxx-1-&x=1419521

The snowball chain started with 6 “ego-seeds” from three different townships (San Agustín, Lúciga and Santa Ana Baja). One ego-seed did not nominate any farmer; therefore, it was not possible to follow the snowball sampling with this respondent. Two ego-seeds provide a large number of nominations, one a few and the last one nominated alters that had already been nominated. The last two ego-seeds correspond to two alters that were nominated but were not able to attend the interview, so their partners replaced them. From 336 alter nominations, 119 alters nominated were defined as farmers. From these nominations, some were nominated more than once. Others lived out of Ubaque and most of them could not be contacted while some farmers that could be contacted were not available for an interview. Only one farmer who was nominated and originally agreed to be interviewed eventually changed his mind. A scheme of the snowball sampling done during this research can be found in Appendix V (Figure A).

The idea of using the snowball sampling method was to be able to interview some of respondents’ alters. With this technique, it was possible to see whether or not egos’ alters nominated them. Reciprocity was also measured, at least partially, since it was not possible to interview all alters of all egos. From 49 nominations among respondents, only 10 were symmetric, i.e. ego’s alter also nominated the former. For a visual representation of symmetric and asymmetric nominations, Cf. Appendix V (Figure B).

4.2. Ego attributes

The first questions of the survey were related to farmers' personal information, such as age, educational level, land tenure, farm size, type of production, home garden, people helping on the farm, and participation in any association. The last questions were related to the last innovation practicing in their farms and how they learnt about it. Results of numeric variables that characterise farmers interviewed are presented in Table 2 and results of non-numeric variables are shown in Table 3.

Table 2 Characteristics of the sample population according to numeric variables (n = 30)

Variable	***Min.***	***Average***	***Max.***	***SD***
Age	26	55	84	12
Farm size (ha)	0,06	0,99	3,80	0,80
Time on the farm (years)	2	24	56	16

Source: Compiled by author 2015

Table 3 Characteristics of the sample population according to non-numeric variables (n = 30)

Variable		***No. of respondents***
Educational level		
	Primary	20
	Secondary	3
	Technical	3
	Higher education	4
Land tenure		
	Ownership	26
	Tenancy	3
	Usufructuary rights	0
	Caretaker	1
Off-farm job		
	No	23
	Yes	7
Help in the farm		
	No	6
	Yes	24

Source: Compiled by author 2015

Respondents' profiles correspond to a middle-age farmer with primary-level studies, although generally not completed. However, 4 respondents are less than 45 years old, the youngest being 26. Regarding education, 3 have a technical diploma and 4 went to university, although in most cases studies were not related to agriculture. Most farmers are owners of their farm with an average size of

1 ha[11] and usually steep. Time farmers have lived on their farms varies greatly, ranging from 2 to 56 years. Most of them have worked a lifetime in agriculture, starting during childhood helping parents; although another job in the past is also common.

Only one respondent reported being from Bogotá and not having any agricultural background. Settled in Ubaque recently, the farmer is starting a project of integrated farming. Those who reported not being owners live as tenants in other farms and only one stated working as a caretaker. Most of farmers do not have an off-farm job, and from those who have one, men reported working as day labourers on other farms, whereas women and one man have jobs unrelated to agriculture. From all respondents, 4 reported having 2 or more farms. Only 6 farmers work alone on the farm while others reported having some help; most of them hired day labourers during some periods of the year. Only one has a full-time worker, and in general all of them are helped by their family (partner and children).

Regarding participation in any association, most respondents reported being members of an association (27). From them, 10 are members of more than one association. Distribution of respondents by type of association is shown in Table 4. Irrigation districts are the associations including more farmers (22). Three irrigation districts were named by farmers: Asodisriego #2, Asoesperanza and Asodat-Roca[12]. Farmer organisations correspond to local associations ASOGANAUBAQUE, UBACAFÉ, AGROPALMAR, ASOPROCURA, and COAGRO Ubaque. At national level, the Colombian Federation of Coffee Growers was mentioned once. In four cases, interviewees reported to be part of a farmer association in the past, but due to a lack of organisation among members they do not exist anymore. Two farmers mentioned having had official positions: one had been councillor of Ubaque and the other is currently the vice-president of the *Junta de Acción Comunal* – JAC of his township[13]. Five were also members of the executive board of their association.

[11] Farm size varies from 0.06 to 3.8 ha. These sizes are the result of the land divisions made during succession. When parents die, children often divide the farm and those who refuse to engage in farming, generally use them as recreation property to go on weekends.

[12] Asodisreigo #2 supplies users from Puente Amarillo, Santa Ana, Lúciga, San Agustín, Ganco, Rio Negro, Fistega, Centro Afuera and Molino; Asoesperanza supplies users from Santa Ana, Lúciga, and Cacique; and Asodat-Roca supplies users from Centro Afuera, Romero Alto and Romero Bajo.

[13] JAC is the smallest executive structure of the State working at the local level (township).

Table 4 Distribution of the sample population according to the type of association (n = 30)

Variable		*No. Of respondents*
Association membership		
	No	3
	Yes	27
	> 1 association	10
Kind of association		
Irrigation district		22
	Asodisriego #2	13
	Asoesperanza	7
	Asodat-Roca	2
*Farmer association**		12
Local assoc.	Cattlemen's association (ASOGANAUBAQUE)	1
	Coffee growers' association (UBACAFÉ)	2
	Fertiliser producers' association (AGROPALMAR)	1
	Onion growers' association (ASOPROCURA)	1
	Agricultural cooperative of Ubaque (COAGRO Ubaque)	1
	Colectivo de Mujeres de Ubaque	8
National assoc.	Colombian Federation of Coffee Growers	1
Administrative organisation	*Junta de Acción Comunal* – JAC	1
Other		1

Source: Compiled by author 2015
*Some farmers reported being members of more than one association.

A particular association which is worth noting was mentioned by eight female respondents. They are members of a farmer association called *Colectivo de Mujeres de Ubaque*. This organisation was initially a female initiative to overcome gender issues, mainly abuse against women. Currently, with the support of a NGO headquartered in Bogotá, the women collective is working on a productive project consisting of eco-friendly egg production. The goal is to empower women through a production activity and they expect to self-finance their social projects.

Although this research focuses on vegetable growers, the sampling method used enlarged the horizon and provided the means to interview farmers that are not vegetable growers, but that used to be. Indeed, from the 30 respondents, 3 reported producing exclusively vegetables as cash crops, 10 stated that livestock was their production activity, and the others reported to have more than one farming activity, generally horticulture combined with livestock. Distribution of farmers according to their agricultural activity is shown in Table 5. Although the majority of farmers reported to have a livestock production, in most cases it corresponds to one or two milking cows, a few laying hens, and/or a few breeding sows providing extra incomes to households. A few farmers reported to include maize in their crop rotation, and 3 farmers including fruits trees in their production systems

corresponded to coffee growers. Only one farmer has a nursery where he sells fruit tree seedlings and other ornamental and aromatic plants, and another produces grass to cut and sell as forage.

Table 5 Distribution of respondents according to their agricultural activity (n = 30)

Agricultural Activity		***No. of Respondents***
Horticulture		19
Livestock		26
Fruit trees		4
Cereals		4
Forage		1
Ornamental plants		1
Home garden		
	No	19
	Yes	11

Source: Compiled by author 2015

In livestock systems, the main production is poultry. Laying hens are raised in outdoors or in barns, depending on the production. All vegetable growers, except one aromatic plant grower, use synthetic pesticides and fertilisers, although most of them incorporate organic residues to the soil before planting since they have observed it has a positive impact on plant growth. Ten respondents stated producing their own compost or vermicomposting; the others just incorporate organic residues from the kitchen without any previous treatment. Two respondents reported changing their pest control management by reducing or avoiding the use of synthetic pesticides from high and very high toxicological levels. In general, farmers plant along the slope; only a few do it along the contours[14].

Only tomatoes are grown by some farmers in greenhouses. Crop rotation is common in open field, although farmers do not follow agronomic criteria to decide the sequence of crops – e.g., differences in nutrient uptake depending on the species and host plants for a same pest or disease. Decision criterion usually responds to market price. Cash crops grown by the sample population are: *Aloe vera*, beans, butternut squash, coffee, green beans, guatila (*Sechium edula*), lemon verbena (*Aloysia citrodora*), lime, maize, melissa, onions, peas, plantains, rue, stuffing cucumbers (*Cydanthera pedata*), sweet peppers, thyme, and tomatoes. Tomatoes, green beans, peas, sweet peppers and

[14] One farmer explained during the interview that he has used drip irrigation for 8 years. He went to another town to visit farms and learn about the system operation. He stated that sowing along the contours was the only way to make a more efficient use of water, and prevent soil erosion. Another farmer reported having taken a course with SENA about agroecological practices; however, she recognised not planting along the contours, as she learnt, because she is accustomed to sow along the slope. According to her, it takes some time to get use to a new practice.

stuffing cucumbers are the main crops produced by the sample population. Maize is included into the crop rotation generally when there are pest problems that are difficult to control with pesticides.
Some respondents reported to be livestock or fruit tree producers but were vegetable growers a few years ago. More precisely, 6 of them stated having given up vegetable production 4 to 6 years ago and one is in process of changing his crop production to have a fruit tree plantation. Only one farmer did the opposite: he used to have livestock and shift to plant production[15]. Reasons to stop producing vegetables are: high instability of market prices, too time consuming without getting a positive return, and in one case the respondent mentioned health problems due to excessive use of agrochemicals. The oldest farmer interviewed stated that part of his farm land is almost abandoned since he is retired, and his nephew only works on one part which has access to irrigation. Other respondents whose land does not have access to irrigation also reported having problems to go on with farming activity.

Concerning home gardens, 11 respondents reported having a home garden that is generally managed without synthetic pesticides and only in one case synthetic fertilisation was used. Vegetable growers that stated not having a home garden usually take part of their cash crop production for their own consumption. Two farmers said they wanted to have a home garden; even the *Unidad Municipal de Asistencia Técnica Agropecuaria* – UMATA[16] gave them some seeds to grow their own vegetables. However, due to lack of time, in one case, and the lack of resources to protect the garden from damage caused by hens in the other case, they did not have one. Another respondent stated he is considering having his own home garden soon because he is concerned with his family food security and food safety. Products grown by respondents in their home gardens are: arracacha (*Arracacia xanthorrhiza*), avocados, beetroots, cabbage, carrots, cassavas, cauliflower, chard, coriander, feijoa (*Acca sellowiana*), figs, lettuce, lulo (*Solanum quitoense*), maize, melissa, onions, parsley, peaches, pears, plantains, potatoes, pumpkins, radishes, spinach, sweet potatoes, and zucchinis.

Concerning the last innovation farmers were practicing on their farm, type of innovation and how they learnt about (i.e., the last questions of the ego attribute part), Table 6 summarises data collected. Most respondents said practicing something new on their farm; in three cases the innovation corresponded to new synthetic pesticides recommended by input sellers. In the other cases, new practices were mentioned, the main one “producing organic fertiliser”. “Producing forage for poultry project” was mentioned by women participating in the *Colectivo de Mujeres de Ubaque.* Even though

[15] This respondent explained he has a project on organic *Aloe vera* and thyme production and he is considering creating a farmer association to commercialise these goods.
[16]UMATA is the extension agency managed by the municipality.

an extension agent from UMATA is training them, the idea came from themselves; observing that hens were damaging pasture where they are raised by overgrazing; women thought they need to include a supplement to feed them. Since grain-based supplements are highly expensive, they decided to produce their own fodder.

Drip irrigation and use of organic fertiliser and pesticides were reported by vegetable growers from Asodisriego #2 as part of a project supported by INCODER – the national agency for rural development – consisting of producing organic vegetables and creating a farmer association to commercialise them[17]. The public agency provides technical support and inputs, although some of respondents reported not having hearing from INCODER officials for a while. They only get organic inputs from a supplier. All respondents participating in this project stated they were not convinced of organic input effectiveness and for that reason they were still using agrochemicals.

"Good agricultural practices", including "waste management of agricultural inputs", was mentioned by one farmer who is in the process of certification by *Instituto Colombiano Agropecuario* – ICA – the national regulatory agency of the agricultural sector. The reason is that he wanted to get access to new market channels for his products. He stated that he is obtaining information and recommendation from the national association of vegetable and fruit growers – ASOHOFRUCOL. The "integrated farming" was mentioned by a respondent who became a farmer recently. Her source of information for her project has been mostly web sites about organic agriculture and agroecology. Four respondents were trying new crops, mostly fruit trees (coffee). Only one stated he was growing tomatoes for the first time this year.

Five farmers reported having participated in the first UNAL project on clean tomato and green bean production; however, most of them stated not following researchers' recommendations presented in the protocol given to them. Some considered the information not clear enough and would have liked more training or another way to transfer information. Others stated they did not see the advantages of applying these new practices.

[17] One respondent explained that this project was a proposal members of the irrigation district made to apply for a programme of INCODER aimed to support small irrigation districts. It included three sections: vegetable production, cattle production and poultry production. He said that they came to know about this programme through one INCODER official who worked in the implementation of Asodisriego #2.

Table 6 Information on innovations: amount of farmers practicing something new, type of innovation, and source of recommendation/information (n = 30)

Innovation		***No. of respondents***
Practicing something new		23
Not practicing something new		7
Type of innovation		
Practice	Extensive poultry system	1
	Producing forage for poultry project	7
	Producing organic fertiliser	10
	Producing organic pesticides and insect traps	1
	Integrated farming	1
	Drip irrigation	3
	Waste management of agricultural inputs	1
	Good agricultural practices	1
Input	Organic fertiliser and pesticides	6
	Synthetic fertiliser and pesticides	3
	New crop	4
Recommendation/information		
Farmer		9
Input seller		3
Extension agent		12
Public officials		5
Other		3

Source: Compiled by author 2015

4.3. Ego-centric networks

The main compositional metric that can be observed in ego-centric network analysis is the size, i.e. the number of alters nominated by a respondent. From a total of 336 nominations, the average network size is 11.2 alters, although it varies from one respondent to another (SD = 4.8), with a range from 4 to 25 alters. Figure 2 shows the size of each female respondent's personal network and distribution of alters per category and Figure 3 shows it for male respondents. In addition, each figure shows the number of new practices reported by respondents. Two respondents nominated more than 20 alters (one female and one male), coinciding with the two ego-seeds that nominated most farmers interviewed. Alters' distribution according to alters' gender and respondents' gender also diverges: female respondents nominated more female alters (63 female alters vs. 39 male alters – unknown 2), whereas male respondents' networks were predominantly masculine (154 male alters vs. 40 female alters – unknown 38).

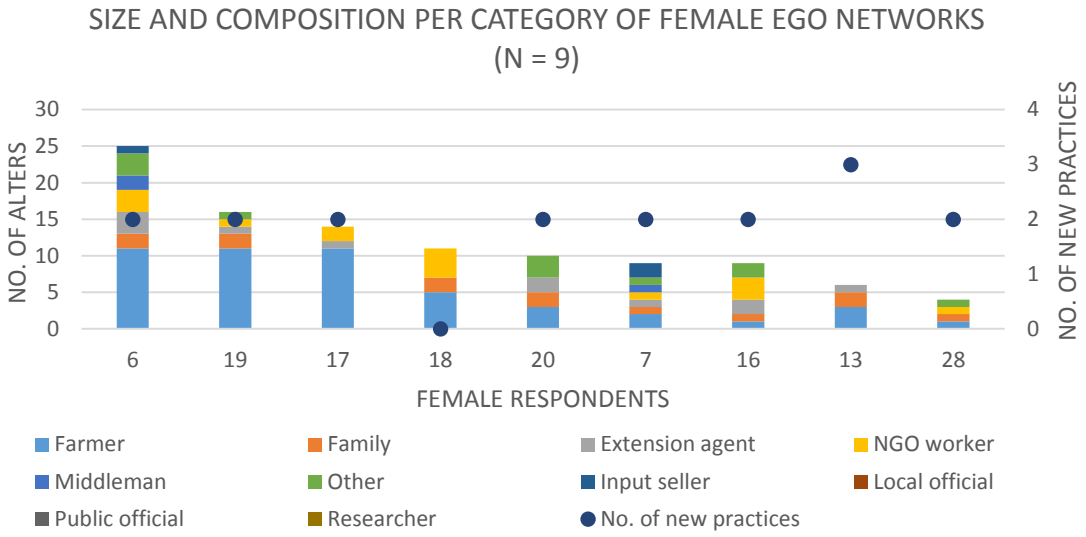

Figure 2 Size and composition of ego network and No. of new practices per female respondent
Source: Compiled by author 2015

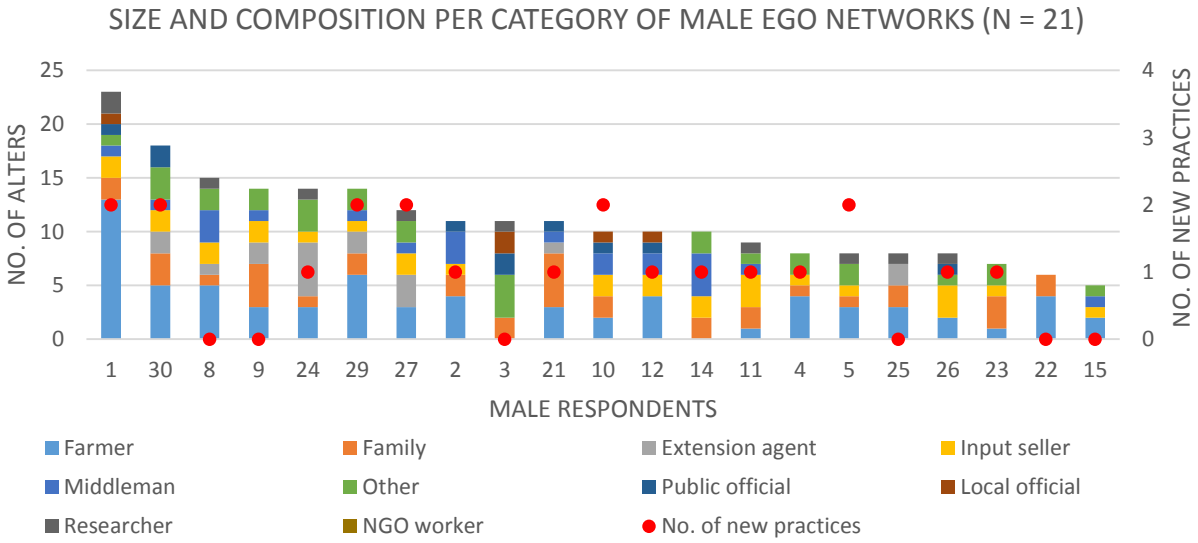

Figure 3 Size and composition of ego network and No. of new practices per male respondent
Source: Compiled by author 2015

Ego-centric network analysis implies obtaining personal network for each farmer interviewed. Since it is not possible to show all of them, sociograms gathering the average of alters per female and male ego are shown in Figure 4. Male egos nominated alters in all categories except “NGO worker”. In the case of female egos, the categories in which nobody was nominated are “Public official”, “Local official”, and “Researcher”. In this case, female respondents did not mention UNAL researchers because they are not vegetable growers, the main target group of UNAL project. This group works

with other female farmers, but in this study no female farmer participating in the UNAL project was nominated. As a result, it was not possible to interview more female vegetable growers.

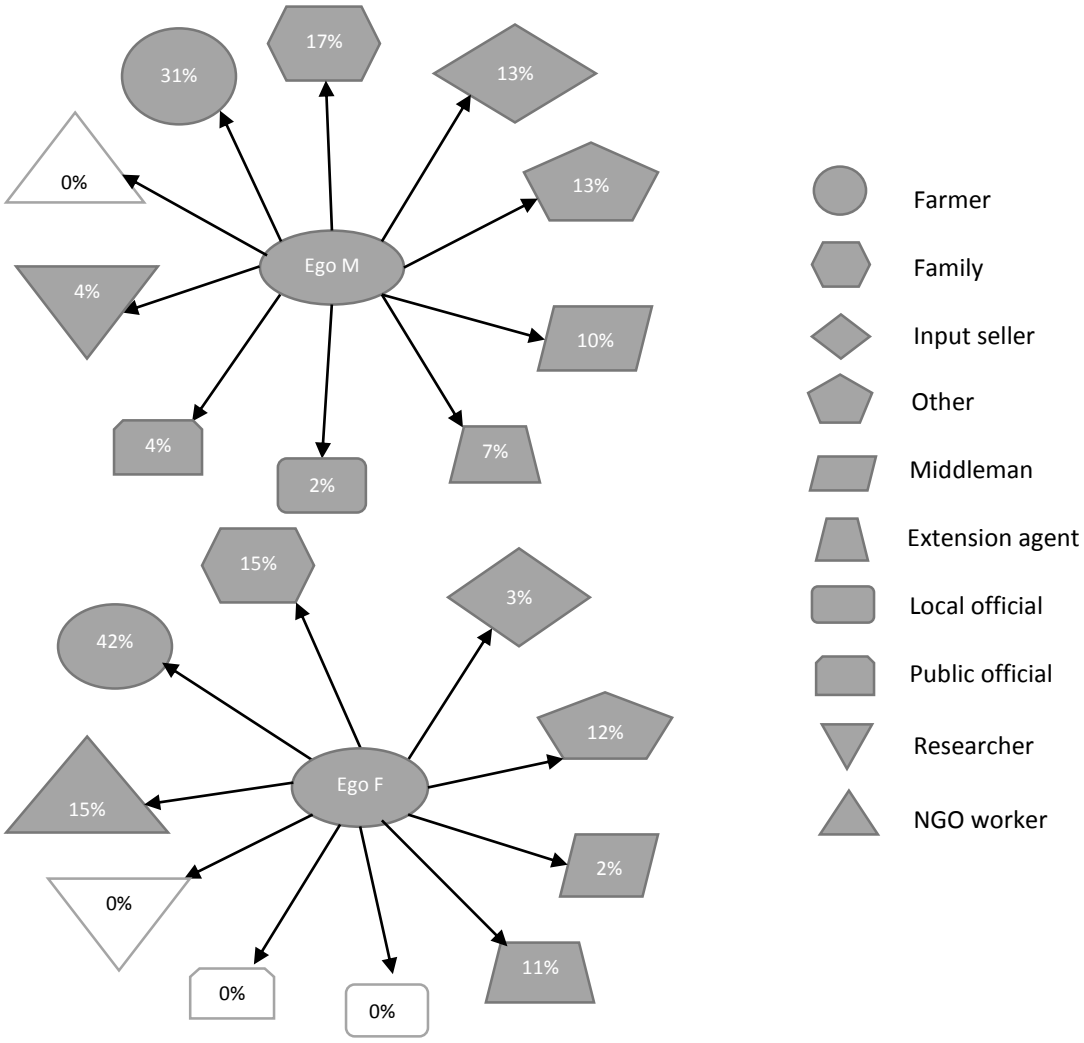

Figure 4 Sociograms for male (above) and female (below) ego
Percentages correspond to the average of alters nominated by respondents and each shape refers to a type of alter according to a categorisation done during the survey.
Source: Compiled by author 2015

4.4. Alter attributes

As shown in Figure 4, during the survey respondents were asked to nominate alters and include them in categories. Ten categories were considered according to the type of actors that could be expected in a farmer's network related to agriculture: Family, Farmer, Extension agent, Input seller, Middleman, Public official, Local official, NGO worker, Researcher, and Other. When farmers included nominated

alters in “Family” and “Other” categories, they were asked to specify their occupation. In addition, kinship of family alters was also asked.

“Farmer” is the largest group with 119 nominations, as it has already been said. Like farmers interviewed, this category includes vegetable growers, livestock producers, and fruit tree growers, especially coffee growers. “Family” included a total of 50 nominations. Kinship of family members included partner (22%), children (18%), siblings (22%), grandparents (4%), nephew/niece (12%), cousins (16%), and brother-in-law (6%). Half of relatives are farmers and 20% have other professions, all related to agriculture (agricultural input seller and agricultural engineer). For the others, no data was available.

“Other” included 41 alters nominated with different functions. It is worth noting that some respondents did not nominate a person but a group of people (e.g. association) or provide a generic name for people they did not remember their names (e.g. veterinarian from X). Therefore, even though they were counted as one alter, in reality it could be more people. The focus in this case was to know the type of alter respondents nominated (i.e. their functions). Half of alters corresponded to agricultural engineers and veterinarians working independently or in an agricultural input store as advisers. Direct buyers (22%) were also mentioned (restaurants, herbal medicine laboratory, etc.), followed by associations (15%), and input suppliers (7%). The latter included one tomato seedling supplier, one organic input supplier working for INCODER project, and one pig droppings supplier.

“Input seller” is the fourth largest category, with 32 nominations. A few alters were nominated several times, since there are only 4 agricultural input stores in Ubaque. Other suppliers are located in other municipalities. “Middelman” counted 25 alters, some of them from Ubaque and others from Bogotá. “Extension agent” had 29 nominees, mainly agricultural engineers and veterinarians working or having worked in the UMATA. Although this extension agency is a unit funded by the municipality of Ubaque, these nominees were not included in the “Local official” category since they have a specific function in the agricultural sector of Ubaque. Some trainers from *Servicio Nacional de Aprendizaje* – SENA – were also considered as extension agents. They were mentioned a few times when respondents reported having participated in training courses related to composting, production of organic pesticides, and other practices considered eco-friendly for different crops.

“NGO worker” (15 nominations) and “Researcher” (10 nominations), included workers of the NGO supporting the women project for the former and UNAL researchers working on tomatoes and green beans for the latter, although one respondent mentioned being in contact with other UNAL

researchers with whom he has organised workshops and seminars. “Public officials” included 10 alters corresponding to officials from INCODER. The last category “Local officials” was a small group including 5 alters who were mostly officials of the *Banco Agrario*, the bank in charge of managing resources linked to agricultural sector.

Most alters live or work in Ubaque, and one third comes from other municipalities, mainly Bogotá. Location of alters is shown in Figure 5. Farmers nominated are generally from the same township, whereas public officials, researchers and NGO workers come from Bogotá.

Figure 5 Location of alters considering their residence or work place (n = 336)
Source: Compiled by author 2015

4.5. Ego-alter relationship and communication

After the question to generate alters (alter prompt), interviewees were asked questions about alters’ attributes and then questions related to their relationship and communication with them. Respondents were asked to report the type of relationship they had with each alter they nominated. Three options were possible: “Confidant”, “Friend”, and “Acquaintance. In addition, they were asked to report the time of knowing each other (“Less than one year”, “Less than five years”, “Less than ten years”, and More than ten years”).

Table 7 shows the number of nominees per category according to their relationship with ego and the time of relationship. Family members were predominantly considered as confidants, farmers were generally defined as friends and in some cases confidant, whereas the rest of alters were mostly acquaintances. Time of relationship varies more, even though family and farmers were known mostly for more than ten years. Input sellers and middlemen are the two categories presenting the higher amount of alters considered acquaintances but known for more than ten years. The most recent

relationships are with extension agents (former extension workers that were replaced recently), NGO workers (the women project has started three years ago), and researchers (UNAL has been working in the region for two years).

Table 7 Type and time of relationship between ego and alters (n = 336)

Type of relationship	***Time of relationship***	***Fam****	***Far***	***EA***	***IS***	***Mid***	***PO***	***LO***	***NGO***	***R***	***Other***
Confidant	< 1 year	0	0	0	0	0	0	0	0	0	0
	< 5 years	0	**3**	0	0	0	0	0	0	0	0
	< 10 years	0	0	0	0	0	0	0	0	0	0
	> 10 years	**48**	**20**	0	**2**	**1**	0	0	0	0	0
	Unknown	0	0	0	0	0	0	0	0	0	0
Friend	< 1 year	0	**1**	0	0	0	0	0	0	0	**2**
	< 5 years	0	**13**	**2**	**2**	0	0	0	**5**	**2**	**2**
	< 10 years	0	**1**	0	**2**	**1**	0	0	0	0	**1**
	> 10 years	**2**	**67**	0	**7**	**10**	0	**1**	0	0	**3**
	Unknown	0	0	**1**	0	0	0	0	0	0	0
Acquaintance	< 1 year	0	0	**10**	0	**1**	**1**	0	0	**1**	**7**
	< 5 years	0	**3**	**7**	**5**	**4**	**2**	**1**	**10**	**5**	**6**
	< 10 years	0	0	**5**	0	**2**	**4**	**2**	0	0	**3**
	> 10 years	0	**7**	**2**	**11**	**4**	0	**1**	0	**1**	**14**
	Unknown	0	0	**2**	0	**1**	**1**	0	0	0	**2**
Unknown	< 10 years	0	0	0	**3**	0	0	0	0	0	0
	Unknown	0	**4**	0	0	**1**	**2**	0	0	**1**	**1**

Source: Compiled by author 2015
*Fam = Family; Far = Farmer; EA = Extension agent; IS = Input seller; Mid = Middleman; PO = Public official; LO = Local official; and R = Researcher

Regarding respondents' communication with alters, different questions were asked about how information related to agriculture flows based on the frequency of talks and whether there was any communication. Variables used were: "Communication on farming issues", "Communication on other topics", "Ego asking for help", "Ego asking for advice on innovation", "Alter asking for advice on innovation", "Recommendation from alter", Recommendation from ego", "Communication on community issues", and "Alter communication on community issues". As a reminder, each respondent could have more than one alter per category, and depending on the alter, the answer could be different; for instance, if a farmer had two alters in the "Farmer" category, frequency of communication could be "daily" or "always" for one, and "weekly" or "sometimes" for the other. Consequently, the results shown in the following tables represent the number of respondents that stated having a certain frequency of communication with an alter per category. The total is not 30 because one respondent could be counted more than once.

For “Communication on farming issues” farmers were asked to respond how often they talked about agricultural issues with alters. The results are shown in Table 8. Family is the category that most respondents reported to have daily communication on farming issues with. Communication with farmers, extension agents and input sellers occurs mostly weekly, whereas for the other categories communication is predominantly monthly or a few times a year. In addition to ego-alter relationship question, respondents were asked to report how often they communicate with alters regarding other topics not related to agriculture. Table 9 provides the results. Here again family members are reported to have the most frequent communication on topics unrelated to agriculture. Communication with farmers and NGO workers on other topics happens mostly often or sometimes, whereas respondents generally do not talk about topics unrelated to agriculture with the rest of the alters.

Table 8 Frequency of communication between ego and alters related to “farming issues”
Data corresponds to the No. of respondents (n = 30)

Category	Daily	Weekly	Monthly	A few times a year	Unknown
Family	16	6	6	3	2
Farmer	7	16	14	5	1
Extension agent	0	7	6	4	4
Input seller	0	6	9	6	0
Middleman	0	6	1	7	2
Public official	0	2	3	2	2
Local official	0	0	1	2	1
NGO worker	0	1	6	0	0
Researcher	0	0	1	5	4
Other	2	2	8	10	5

Source: Compiled by author 2015

Table 9 Frequency of communication between ego and alters related to “other topics”
Data corresponds to the No. of respondents (n = 30)

Category	Always	Often	Sometimes	Never	Unknown
Family	23	4	16	3	4
Farmer	26	20	42	27	4
Extension agent	1	0	3	23	2
Input seller	3	0	6	23	0
Middleman	4	0	2	17	2
Public official	1	0	0	6	3
Local official	0	0	1	2	2
NGO worker	3	6	4	0	2
Researcher	0	0	1	6	3
Other	2	0	5	27	7

Source: Compiled by author 2015

When interviewees were asked to whom they ask for help when they have a problem on their farm, most farmers reported to request input sellers, others, and family members always or often. “Other” category referred to agricultural engineers and veterinarians. In the case of farmers, answers were more varied; one third of respondents reported request other farmers’ help always and often, one third sometimes and another third never ask help to their peers. Extension agents are requested very little. More details are shown in Table 10.

On the other hand, when respondents were asked to whom they ask for information or advice about something new they want to practice on their farms, alters’ categories changed. Even though most farmers reported never requesting any alter for advice on innovations, those who do reported farmers, extension agents, input sellers and others (agricultural engineers and veterinarians) as their main source of information or advice. The frequency varies between always and sometimes (Table 11). In the other direction, 14 respondents stated that their farmer alters never asked them for advice while practicing something new; 8 reported being asked sometimes, 6 always, and 3 often.

Table 10 Frequency of communication between ego and alters related to “asking for help”
Data corresponds to the No. of respondents (n = 30)

Category	***Always***	***Often***	***Sometimes***	***Never***	***Unknown***
Family	9	4	8	8	2
Farmer	6	3	11	13	1
Extension agent	3	3	2	10	2
Input seller	11	3	3	3	1
Middleman	0	0	0	14	1
Public official	1	0	3	3	1
Local official	0	0	1	3	0
NGO worker	1	0	1	2	3
Researcher	0	0	2	6	2
Other	9	2	4	9	3

Source: Compiled by author 2015

Table 11 Frequency of communication between ego and alters related to “asking for advice”
Data corresponds to the No. of respondents (n = 30)

Category	*Always*	*Often*	*Sometimes*	*Never*	*Unknown*
Family	6	0	3	18	1
Farmer	7	2	8	15	2
Extension agent	5	1	3	9	2
Input seller	5	1	3	10	1
Middleman	0	0	0	14	1
Public official	0	0	0	7	2
Local official	0	0	0	4	1
NGO worker	1	0	0	3	3
Researcher	2	0	0	6	2
Other	7	2	2	10	3

Source: Compiled by author 2015

Respondents were also asked to report whether they recommended innovations to other farmers. The question was also asked in the other direction including all alters. In general, respondents stated alters usually do not recommend to them innovations; only extension agents, public officials, and in some cases, farmers and family do recommend them to use innovations. On the other hand, 17 respondents said they recommend what they are practicing on their farm to their peers, usually referring to synthetic pesticides.

The two last questions asked were related to communication on community issues. Interviewees were asked how often they asked for help or were asked for help when there was any issue affecting the community. The majority of responses were “never” in both cases.

4.6. Partial farmer social network

The partial social network of respondents was done counting the number of times a same alter was nominated. From 336 nominations, 33 names were repeated once or more. In all categories there were alters nominated more than once (10 farmers, including farmers that were also family members, 3 extension agents, 4 input sellers, 1 middleman, 2 public officials – SENA and INCODER, 1 local official – Banco Agrario, 4 NGO workers, 3 researchers, and 5 others). Alter with most nominations was an input seller (ten times), followed by an extension agent (nine times), and another input seller (seven times). Among farmers, three of them were nominated four times, two of them three times, and five of them twice. Not all of these farmers were interviewed, thus their personal networks were not analysed.

4.7. Focus group discussions

Three focus group sessions were organised to gather more information on farmers' opinions on sustainable agriculture and how they see the present and future of their farming systems. One session was held in San Agustín with five farmers from this township and Ganco. The second one was organised in town and seven farmers from the *Colectivo de Mujeres de Ubaque*. The last one was in Santa Ana Baja, and five farmers were present.

During the first focus group, the discussion revolved around the need for vegetable growers to diversify their production if they wanted to keep producing. One of the participants (a coffee grower and former vegetable grower), described as a feature of sustainability the importance for a farmer to be backed by an organisation which provides technical assistance to improve production, ensures commercialisation of products, and gives support in bad situations. The problems of vegetable production pointed out by participants were a lack of internal organisation of production at the farm level, and a lack of organisation among growers and an incipient institutional support at the food system level; the latter due to the fact that products are not for export, unlike coffee and other exotic fruits[18]. When they were asked about elements influencing the success of a farmer organisation, trust was pointed out as the essential component for any collective action. According to them, farmer associations in Ubaque were usually controlled by one or a few persons that managed resources according to their personal interest, instead of for the common profit. For that reason, farmers were less willing to participate in any association. Eventually, participants emphasised the necessity of a leader able to gather farmers under a common goal and gain trust through honesty.

The second aspect that emerged from the discussion and that was also considered essential for the sustainability of farming systems in Ubaque, was the importance of being flexible when market prices are too low, something recurrent in the vegetable sector. They agreed on the fact that instead of not harvesting, farmers should find alternative uses for their harvests. For that, participants highlighted the necessity of having contacts (e.g. livestock farmers interested in buying vegetables to feed their animals). Concerning the use of agrochemicals, they stated it was necessary to reduce the use of synthetic products. However, they were sceptical on the effectiveness of organic pesticides considering that some of them were trying them out due to INCODER project. They blamed harsh climatic conditions in the region that make it difficult to control pests without synthetic pesticides. Participants did not mention other practices that are usually included in organic farming. Regarding

[18] According to participants, vegetable growers are not backed by strong guilt such as the coffee grower federation which has an important lobbying power at the national level.

the impact of their farming practices on consumers' health and the environment, they stated that the most polluting production system was greenhouse tomato.

The second session being with farmers belonging to the women association, the discussion was more focused on their project. For them, sustainability of farming systems was lost when agriculture was transformed to produce commodities. According to them, they do not currently see a future for youth in agriculture. Regarding their farming systems, they also considered that farmers need to be involved in some kind of farmer organisation, as they and other groups of growers are (e.g. onion and potato growers). Trust was also highlighted as an essential factor for organisation success, combined with motivation, responsibility, and a common vision. The challenges they encounter working in groups were finding time to meet all together as well as active participation from all of them.

They stated being aware of health and environmental issues related to conventional farming; for that reason they were working on producing without agrochemicals (forage they are producing is free of synthetic inputs). In addition, some of them highlighted the importance of producing their own food, although others stated it was too time consuming having a home garden. Two of them who used to be vegetable growers reported not considering producing vegetables again because they had a really bad experience with this type of production. Eventually, they all agreed on the necessity to receive more support from institutions, especially from research institutes and UMATA because they considered it essential to have more education on organic agriculture; according to them, the majority of farmers still think organic farming cannot be profitable.

The last focus group was held with five farmers, all of them vegetable growers. The discussion also revealed the importance for farmers to be involved in any type of organisation in order to keep producing. Nevertheless, they explained the scepticism among them to join an association, giving the same reason as the first group. In addition, they stated that most farmers dislike participating in projects proposed by public agencies and research institutes (including creating farmer organisations) because they expect receiving money directly from the institutions, while generally funds are used to create the association, for infrastructure and other common facilities. According to participants, in Ubaque most farmers are accustomed to living from state subsidies and somehow this has distorted their perception of help.

Concerning the sustainability of their farming systems, they stated being pessimistic regarding the future, especially due to market price oscillations and high costs of inputs, including labour. One

farmer stated that vegetable growers should be backed by a national association which should provide subsidies for agricultural inputs or payment facilities in the input stores. When they were asked why they did not try to reduce the use of agrochemicals and produce more organically, their response was similar to the first group; they highlighted the great incidence of pests and diseases in the area and the low effectiveness of organic pesticides. In addition, as in the first group, most of participants stated that open field crops were not toxic as greenhouse ones since products were "cleaned" by rain and the sun. During the discussion, one farmer mentioned that there were different intercropping possibilities that help reduce pest incidence; the other participants were not aware of this knowledge. Regarding organic fertilisation, they stated they were willing to learn how to produce their own compost. They considered that UMATA should have more leadership, although they recognised it already leads some interesting campaigns such as appropriate waste management of agrochemical inputs.

The conversation also revolved around the possibility to farm as in ancient times, when farmers used to produce for their own family. Though, one farmer highlighted the role of farmers to feed the whole population by asking what would happened with urban population if farmers decided to produce only for themselves and their families. Moreover, they mentioned the importance of recovering local seeds since they have characteristics that can help farmers reduce the use of agrochemicals (e.g. pest resistance); but for that there is a need to educate consumers for instance they stated that old varieties of green bean or peas have an unattractive appearance and middlemen usually do not buy them. Creating a local seeds bank by farmers was proposed by one of the participants.

Concerning labour, farmers reported a lack of labour available because of the decreasing amount of farmers in Ubaque, especially in their township. This resulted in increasing production costs. One participant said that in order to live as a farmer in Ubaque it was necessary to have another income (e.g. receiving a pension); according to another farmer, young people do not have a future as farmers so they have to leave and settle in cities and when they are retired, then they can go back to farm, as some farmers have done. However, when they were asked about one tradition consisting of exchanging labour services – *mano vuelta* – they stated that there are still some farmers practicing it and they recognised that in addition to the economic benefit it has (i.e. it reduces labour cost), it provides social benefits such as strengthening farmers' ties and allowing farmers to think about something else and not only on their farm issues.

Along with individual interviews and focus groups, informal conversations were held with other inhabitants of Ubaque. Although the climate change issue was not highlighted by respondents, one

interlocutor mentioned how climate in Ubaque had changed during the last decades and he attributed this change to deforestation of highland areas, including *páramo*, to grow potatoes. His conclusion was based on his observations on changes in crop distribution; according to him, crops traditionally grown in lowland of Ubaque (e.g. green beans) can be currently produced at intermediate altitudes and those usually produced there, are now grown in highlands (e.g. onions).

Another interlocutor focused on how social issues affecting the municipality are the result of a series of inappropriate administrations. Corruption was pointed out as a big challenge for the local government and he stated that inhabitants (mostly farmers) did not do anything to change the situation. According to him, social programmes designed by the national government based on direct subsidies have resulted as a means to keep population under control[19]. This idea was also pointed out by some farmers during the focus group.

The last informal discussion was on how farmer ties had been lost due to changes in agriculture and society in general, and how it would be important for the sustainability of farming systems in Ubaque to recover this sense of community. The interlocutor gave the example of *mano vuelta* and how peasants used to share food once a week among neighbours. Another topic he mentioned was the knowledge of Pre-Hispanic populations and the importance for farmers today to recover this knowledge. As an example he gave the use of terraces to prevent soil erosion.

5. Discussion

It is challenging to determine all possible alters in ego's world, since in ego-centric analysis data collected comprise only nominations by ego, thus the choice to not nominate someone is not observed (Halgin and Borgatti, 2012). Despite these limitations, the ego-centric analysis done in this study reveals the main actors playing a role in the sample population's personal networks as well as those of them providing respondents with more information on agroecological innovations, and the type of relationship they have.

The research question was: *What types of relationships and structural features in the farmers' communication networks influences the farmer decision-making process when presented with innovations that move practices away from chemical pesticide use and toward more agroecological*

[19] The state programme he referred to was *Familas en Acción*. It has been reported several times in the Media how some politicians at national and local level have used this programme to "buy" votes during elections.

approaches? To answer this question, the results of this study show that weak ties existing between farmers and professionals working in different national and local institutions is the principal means for the former to learn about agroecological innovations and to some extent, to adopt them. However, the strong ties existing among farmers do not seem enough for them to diffuse innovations and overall to really move toward more agroecological approaches. As pointed out by Toborn (2011), "adopting innovations on individual fields or farms can achieve impacts, but when communities work together collectively, they will produce more sustainable benefits." These findings are discussed below.

Concerning farmers' networks, there is a wide variation in number of alters among the sample population – i.e., the difference between the largest and the smallest networks was 21 alters. However, a large majority reported a number of alters around the average (11.2). From the literature reviewed, there is no data that can be referred to regarding network size. In general, ego-centric analyses have been used to determine the type of actors and the intensity of ties within ego network (Rauf and Mitra, 2011) without specifying whether personal network size had any influence; in another case, questions about personal networks were limited to a certain amount of alters (Kohler et al., 2001) hence the network size was not considered either. Taking into account socio-centric network analysis, Bandiera and Rasul (1996) pointed out the importance of sharing information as determining the adoption decision – i.e., the more talkative a farmer is concerning agricultural issues, the higher the probability to decide to adopt an innovation, but it does not imply that having more alters influence the decision process. Monge et al. (2008) on their review on social network approach indicated that there is an inverse relation between network size and the most common variables predicting adoption – e.g., cohesion. In this study, although a statistical correlation cannot be established, it was not possible to observe any trend between the size of respondents' networks and the number of new practices reported.

Since not all alters were interviewed during the field work and respondents were not asked more questions about alters' attributes in order to avoid making the interview longer, it was not possible to calculate similarities between ego and alters (homophily) and similarities among alters (homogeneity). However, it was possible to make some observations. Regarding homophily, the majority of nominations corresponded to other farmers, generally from the same township or from a neighbouring one. Only a few respondents nominated farmers living in another municipality. Alters' ages were not asked, but from the information resulting of the snowball method, it is possible to say that egos and farmer alters have generally similar ages. On the other hand, alters' production system was not necessarily the same as egos', showing a certain degree of dissimilarity. Homophily effects in social network studies can be found in the literature. According to Brass et al. (2004) and

McPherson et al. (2001), in groups of actors with similar social, organisational, and strategic characteristics, the spread of innovation is faster because copying people similar to us is easier and more relevant. However, being too similar can also prevent adoption; social groups forming cliques share generally the same information, leaving little room for receiving new ones. Thus, "diffusion requires a certain level of heterophily (and weak ties) for information to flow among subgroups" (Bodin and Crona, 2009).

Looking at the whole personal network, in general more than one category was used to classify alters. Farmers' personal networks are composed mainly of other farmers, family members, input sellers, extension agents, and other agricultural professionals – i.e. agricultural engineers and veterinarians – not working in extension. Alters forming personal networks vary by gender, however, it is worth noting that these results might be influenced by the female respondents who were mostly members of a same organisation and developing a same project. As a result, a certain heterogeneity exists that might open egos to receive new information.

In this study, the type of relationship defined by respondents varied largely depending on the category of alters. Although family members were considered mostly confidants, farmers mostly friends and the rest of alters acquaintances, in practice these relationship considerations do not represent a significant difference in the information flow regarding agricultural issues[20]. Indeed, respondents stated talking frequently with family and to some extent with other farmers about agriculture, but when they have a problem they rely more on input sellers[21], and when they want advice on an innovation, extension agents and other agricultural professionals are mostly requested. In addition, the exchange of information and recommendation about agricultural innovations among farmers seems quite low[22]; this idea is strengthened by farmers' comments during focus groups and in some individual interviews which referred to the lack of trust and rivalry that seems to exist in some cases, making it difficult to

[20] Reciprocity in respondents' relationships could not be estimated for all egos' relationships. However, interviewing some egos' alters made possible analyse it partially. As it has been shown, asymmetric nominations were more frequent than symmetric ones. In addition, comparing the answers from one ego with alter's responses referring to the former, some inconsistences were found – e.g., time of knowing each other is different – and also differences concerning perception of the relationship – e.g. one considered the other as friend while the latter considered the former as acquaintance. Inconsistences can be due to "the problem of recall and informant accuracy" (Petróczi et al., 2007). Defining relationships is very difficult since it is related to emotions. Moreover, friendship can be defined in many ways, depending on cultural aspects, age, gender, etc. in this research, even though respondents considered other farmers their friends, in general their communication is about agriculture and they do not share other types of relations.

[21] This is due to the fact that for respondents, "problems in their farm" were mostly related to pests.

[22] Even if recommendation rate can be considered low, respondents usually specified during the interviews that they would like to exchange more information with their peers, but that the latter do not take into account their suggestions.

share information on agricultural issues. However, in some cases farmers reported to rely more on their farmer friends than on any other actor in the vegetable chain.

It could be considered that stronger ties may be found between egos and their families and other farmers, whereas weaker ties may exist between egos and the other categories of alters, especially extension agents, agricultural professionals, public officials, and researchers. This statement only applies if type of relationship, alter's location and frequency of communication are considered. "Strength of a tie is a quantifiable property that characterises the link between two nodes" (Petróczi et al., 2007). Granovetter (1973) defined it as "a (probably) linear combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie." In addition, the linear combination of these indicators are considered positive (only positive feelings are included) and symmetric (the relationship is reciprocal) (Granovetter, 1973). Moreover, the four variables defining tie strength are "independent", although highly "intercorrelated". In this case, type of relationship, time of relationship and frequency of communication vary greatly among categories and the situation considered. Moreover, reciprocity could not be observed and when it was, differences in responses were common. The strength of ties is thus not possible to measure.

Regarding the partial social network, structural measures were not possible to analyse since it was not possible to ask questions about all alter-alter relationships. Therefore, the only observation that can be highlighted is that there are some actors in farmers' social networks that might have a central position if a whole socio-centric network of farmers in Ubaque were done. They corresponded mainly to input sellers and extension agents. The former could be explained by the fact that conventional systems still predominate agriculture in Ubaque. The latter could be seen as an initial step toward a change in farming systems. UMATA in Ubaque has existed for 13 years (time until 2011) providing technical assistance and proposing new agricultural projects and training to farmers. However, the majority of farmers still do not go to ask for its services (*Plan Integral Unico para la Atención a la Población Desplazada - PIU*, 2011). It is possible that in the last four years things have changed.

Monge et al. (2008) stated in their Bolivian case study that social capital can be measured as "the quantity and quality of villagers' participation in farmers' organisations". In this research, the majority of farmers interviewed are members of at least one formal association. This might suggest a strong social capital among farmers sampled. However, observations from the results and from what it was perceived during the field work show a different picture. Distrust was seen as a limitation to undertake collective actions, such as creating new farmer associations or developing a new system to transport

products, combined with certain degree of individualism from some farmers and a lack of people demonstrating leadership[23]. The lack of cohesion among farmers was also perceived during the field work which can explain the low diffusion of innovations (Haythornthwaite, 1996). Therefore, building social capital seems to be the most challenging aspect among farmers, especially vegetable growers, according to respondents. According to Monge et al. (2008), "adoption of innovations [is] a form of collective action which is very often the case for adoption of sustainable agriculture and natural resource management innovative practices." This implies that if sustainable vegetable farming and food systems in Ubaque are to be desired, all actors in the supply chain must work together and support farmers in building up this social capital. Following the same idea, Emery and Flora (2006) used community capitals model[24] in an evaluation of a community transformation initiative in Nebraska and their conclusion was that social capital is the starting point to succeed in the "spiralling-up" process[25] analysed.

Most agricultural projects proposed to farmers conditioned them to create formal associations (i.e., in order to get funds for a project, farmers have to create an organisation legally constituted). In most cases, these projects failed because of the reasons already mentioned. To overcome this limitation, the promotion of more informal and flexible associations, such as networks, might help farmers gain trust among each other. Bonding social capital, i.e. close redundant ties, are necessary to build community cohesion (Emery and Flora, 2006). Creating networks where farmers recover old traditions such as *mano vuelta*, could be a good start to strengthen farmers' ties. Ubaque has a great potential to develop farming systems that are more diverse, due to the different climatic regions of the territory[26]. This network could be another possibility for farmers to share more time and resources, other than information on the new agrochemical they are using. Bodin and Crona (2009) reported that "in agriculture and agroforestry, important information on new technologies and more sustainable management practices is generally shared through informal social ties". Social learning is also enhanced by local informal institutions or networks (Peach Brown and Sonwa, 2015). Some farmers also showed having traditional knowledge on the use of intercropping for pest control; others presented a certain degree of curiosity that makes them acquired some knowledge by themselves.

[23] Similar findings are presented by Cotrino Peña (2014) in a research done in Fómeque where he studied the viability of a collective commercialisation of vegetables by farmers belonging to an irrigation district.
[24] This model uses seven capitals as reference to evaluate community and economic development projects: natural, cultural, human, social, political, financial and built (Flora et al., 2005).
[25] ""Spiralling-up" represents a process by which assets gained increase the likelihood that other assets will also be gained" (Gutierrez-Montes, 2005, cited by Emery and Flora, 2006).
[26] Farmers already grow a diversity of crops, as it was reported from the home garden question. Moreover, some vegetable growers expressed their interest to recover traditional seeds and to create a seeds bank.

Enhancing farmer networks where they can share this knowledge can be also a way to diffuse more efficiently innovations.

Even though community issues related to environment were generally not highlighted by respondents (only one mentioned her involvement in the fight against mining in the *páramo* and an informal interlocutor mentioned the changes in altitudinal crop distribution and climate[27]), Ubaque is not safe from global challenges such as climate change. Informal networks should also be promoted to discuss and find solutions for these types of issues. As reported by Bodin and Crona (2009), "to solve simple problems is positively correlated with high network centralisation, while solving more complex problems requires more diverse structures." In the case of networks, the structure might be more horizontal, providing means for all participants to propose solutions, whereas in more vertical structures, this occurs less often.

The role of public and private institutions should be to support these types of networks, by providing "arenas for interaction, encouraging broader participation and funding for coordinators or facilitators" (Bodin and Crona, 2009). UMATA, the local extension agency, seems the most appropriate institution to coordinate actions of stakeholders at the national and local level to facilitate the development of sustainable farming and food systems, according to farmers' responses. Irrigation districts, since they gather a high number of farmers, might also function as bridges in the information and resources flow between public institutions and farmers. In addition, strengthening ties among these associations, for instance by sharing knowledge and experiences on water management, may help engage in larger projects such as protection and conservation of *páramo*, taking into account that water used by irrigation district users come from there.

Concerning personal attributes, the results show that most farmers are over 50 years of age. However, it is worth noting that there were two farmers younger than 35 in the sample population. Both of them reported practicing something new in their farm, and their sources of information are varied: alters, the Internet, forums, fears and literature. It seems that even though their personal networks were not very large (less than the average), it does not prevent them from having access to information on agricultural innovations. It might be considered that their networks are larger, but they are composed of people with whom they do not have strong ties (e.g., contacts established

[27] Studies on changes in altitudinal distribution patterns of vegetation due to climate change are not available in Colombia. However, interlocutor's observations can be supported by Morueta-Holme et al. (2015) findings on a study done in the Chimborazo volcano that compared data on vegetation distribution with those collected by Alexander von Humboldt more than 200 years ago.

during a fear). These findings show that there might be some differences between generations of farmers concerning channels used to access information on innovations. More studies on differences in the way people communicate and access information depending on the age could be relevant.

As it was pointed out by UNAL researchers, currently vegetable growers in Ubaque are facing certain issues that jeopardise the continuity of their farming systems. Uncertainty of market prices and high production costs highlighted several times by farmers make them economically vulnerable. Conversion to other farming activities have been a solution for some of them. Nevertheless, this situation does not appear to be a novelty in vegetable production in the region; the oldest farmer interviewed was a pioneer tomato and green bean grower in Ubaque. His story reveals that vegetable prices have always been unstable, thus he had had to change his crop production several times in order to keep his farming activity. Before growing vegetables, he grew maize, cassava and arracacha like all farmers in the lowlands of Ubaque (potatoes were grown in the highlands). When a teacher from SENA arrived in Ubaque and introduced tomato crop in the 1950s, he started with a few farmers to produce it. Then green beans were introduced, but when prices started to fall down, he changed to other vegetables (sweet pepper, cabbage, beetroot, and onions), sugar cane, and fruit trees.

The conventional production system dominating horticulture in Ubaque is presenting some limitations and in general farmers are aware of that. The main concern of farmers is the economic unsustainability of their systems, although some farmers are also concerned about consumers' health and theirs, as well as environmental issues linked to the overuse of agrochemicals. While the former are still reluctant to adopt alternative systems due to poor results with organic pesticides[28], the latter present a certain degree of interest in adopting agroecological practices[29]. This openness to this type of innovations is important for external and local entities working on transfer of technology because

[28] The perception of benefit is highlighted here and goes along with one of Toborn's (2011) conclusions about the likeliness farmers have to adopt resource conserving innovations, which increases when they see the benefit of at least part of the innovation in the first two years. In this case, some farmers stated having tried out the organic inputs provided by the INCODER project, but they did not see better results than using agrochemicals. It remains unclear how extension agents transferred the technology and knowledge related; from farmers' perspective, the information did not seem enough since some of them stated that they had not seen for a while the INCODER officials.

[29] For farmers that had adopted other agroecological practices – e.g. composting, producing fodder organically, integrated farming –, it seems that information, training and support received by SENA, UMATA and some associations were sufficient to implement innovations and to see significant advantage. According to Monge et al. (2008), the efficiency of extension and innovation programmes is defined by the intensity of interactions with actors promoting the innovation as well as the possibility farmers have to transform theoretical knowledge into practical application. In the INCODER project it might be that these interactions have not been sufficient.

it provides a basis to work more on developing projects oriented towards sustainable farming systems.

Contrary to initial expectations, respondents and participants in focus groups were glad to be part of a study about their social interactions, despite previous projects and studies. The negative though previous to field work came from the fact that farmers in Ubaque had gone through many different projects and studies, and one more could have been too much for them. However, they expressed their interest in providing information on their social relationships because it was the first time for them that someone was interested in understanding this aspect of their lives. Few studies on social interactions have been conducted in this region. It seems relevant to continue research on this topic, since as it has been said, social capital and collective action are limited among farmers.

6. Conclusion

The sample population size of this research is very small to be able to infer social relations of farmers in the study area, especially because one region of the municipality was not covered (highland) and potato producers were not included. However, this study can be seen as a first approach to social networks of vegetable growers in Ubaque by providing a snapshot of the current situation of vegetable production and the main actors interacting with them.

Although vegetable growers in Ubaque are still using conventional practices, they are aware of the unsustainability of their farming systems, mainly regarding economic aspects. National and local institutions providing technical assistance and promoting new agricultural projects aiming to improve farmers' livelihoods and the food chain are present[30], even though the outcomes of some projects do not always seem the expected ones. People working in these institutions are pointed out by farmers as the main agents that bring them information on innovations, support them to initiate a new project, and provide them training so they can easily adopt a new practice. Most of the new practices reported by farmers could be considered as agroecological, according to the review by Wezel et al. (2014). The relationship with these actors is based on what could be considered weak ties. In this sense, these findings are consistent with Granovetter (1973) "strength of weak ties" which shows "the importance of weak ties for the transmission of new ideas" (Haythornthwaite, 1996; Prell et al., 2009).

[30] Unlike some farmers' opinion on a lack of institutional support, it seems that many projects are promoted to improve farmers' production systems and livelihood, and some of them are focused on vegetable growers.

Nevertheless, sustainability of horticultural systems in Ubaque seems to be threatened not only by the excessive use of agrochemicals by farmers and their difficulties to commercialise their products and obtain better prices; other challenges related to demographic issues (e.g. population aging) and environmental issues (e.g. deforestation in *páramo* areas) must be included in the global problematic, although certainly there must be more. Transferring technology to farmers is necessary, but not sufficient to develop real sustainable farming and food systems. Social equity and environmental responsibility are inherent to economic success of farmers; following this idea, strengthening capacity of innovation among farmers might be a good way to create more resilient systems. Thus participation and interaction seem to be essential in the innovation process. In order to design programmes that promote agricultural innovation projects in this municipality, it seems appropriate to develop in parallel activities that build up social capital among farmers and improve communication. Promoting informal and flexible forms of association, such as traditional networks in which farmers can exchange resources (e.g. seeds and labour) and knowledge, might be a good start to enhance trust among them and strengthen cohesion necessary to facilitate information flow. Achieving this means that more efficient adoption and diffusion of innovations processes might be expected.

Involving young people in agricultural innovation projects appears to be relevant if a reversion of the rural exodus process is desired. Creating more awareness on environmental issues is also relevant and might also create a sense of environmental responsibility among farmers and strengthen their willingness to work for an environmental governance. Some researchers and extension agents might also look for the most appropriate ways of communicating with farmers, so they could avoid losing time and resources providing information and input without obtaining expected outcomes. Of course these suggestions must be included in a larger policy framework of rural development coordinated by national and local institutions. UMATA might play an essential role of bridging stakeholders at the national level with the different local agents involved in the vegetable supply chain and other sectors, including input sellers, agents that are still very important in farmers' networks.

This idea returns to the innovation systems approach presented in the introduction. The inclusion of all stakeholders in the development of an innovation policy framework in the local horticultural sector is presented as the most appropriate option to make a more efficient use of resources allocated to the various innovation projects promoted in the territory. For that, further research should be done to better understand interactions among agents. Socio-centric network analysis of the different farmer associations, including irrigation districts, might be relevant to conduct in order to more precisely see which actors play essential roles in the flow of information and resources.

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Appendix I: Theoretical background

In this section, an argumentative explanation on why UNAL project may be considered as a promoter of an agroecological transition in the study area is presented. Then, a brief review on concepts and approaches developed around the study of adoption and diffusion of innovations in agriculture is provided.

Section I: The agroecological approach of UNAL project

Although the driving force of UNAL project is food safety, looking at the structure of the project and the research that will be carried out, there is some evidence showing that the outcomes of this initiative goes beyond the mere production of innocuous vegetables; the impact of the project, if well-implemented, may lead farmers involved toward an agroecological transition.

A precise definition is not provided, but agroecological transition might be seen as a process of change from an established agricultural model or paradigm to a new one. According to Buttel (1995, cited by Costabeber, 1998), two agroecological transitions occurred in the last century that have shaped agriculture worldwide: from a traditional low input/output agriculture to the Green Revolution driven by productivity, and from the latter to the paradigm of Sustainability based on a more equitable and efficient use of resources. The present case study focuses on the second agroecological transition.

In the introduction, UNAL project was described as an initiative to promote a change in agricultural practices among tomato and green bean growers. The goal is on the one hand, to implement innovative farming practices to produce innocuous vegetables for consumers, especially in Bogotá[31], at the same time reducing farmers´ production costs and/or increasing yields and therefore increasing their incomes; on the other hand, innovative organisational strategies are expected to create a business environment among vegetable growers so they can obtain greater margins[32] and provide

[31]Bogotá is a metropolis with approximately 7.850.000 inhabitants (SDP, 2015). Most of the vegetables consumed in the capital of Colombia come from the municipalities of Cundinamarca and Boyacá, the main vegetable producing departments (Corporacion Colombia Internacional, 2013; Delegatura de Protección de la Competencia, 2012; Ministerio de Agricultura y Desarrollo Rural, 2007).

[32]At the food system level, there is a lack of integration of the supply chain; a high concentration of agents is found on the wholesaler and retailer side while producers are not organised, or very little, resulting in a great dependency of the latter on middlemen who control prices at farm gate (Corporacion Colombia Internacional, 2013; Garavito et al., 2009; Ministerio de Agricultura y Desarrollo Rural, 2007).

innocuous vegetables[33] with more stabilised prices to consumers. The overall impact should be an improvement in community livelihood, food safety and the environment.

Concretely, it means developing and transferring agricultural technologies that will help farmers reduce their use of synthetic pesticides. Around this idea, the project articulates in three areas: (1) tomato crop management in which research on fertirrigation and management of soil fertility, identification of the most appropriate certified seeds for the region, and integrated pest management will be carried out; (2) green bean crop management in which the focus will be on a selection of the most suitable local cultivars for the new agricultural practices, the development of a farmers' organisational scheme for production and commercialisation of selected seeds, implementation of drip irrigation systems, management of soil fertility and plant nutrient demand, and integrated pest management; and (3) two farmers' associations producing compost will be supported to improve composting and vermicomposting processes to obtain the certification from *Instituto Nacional Agropecuario* – ICA (the competent authority to regulate the life cycle – manufacture, use and disposal – of fertilisers and phytosanitary products).

Agronomic research will be developed by undergraduate and master's students in 8 parcels called PIPA – *Parcela de Investigación Participativa* – (4 for tomato and 4 for green bean) consisting of 1.000 m^2 each and established in farmers' fields or greenhouses. In each parcel, 25 farmers will participate during the 18 months of the project in the maintenance of crops and share their experience with researchers. In all cases, trainings will be made to transfer knowledge derived from research and technologies developed. At the end, a few farmers will be selected to become rural extension workers after six-months training and thus ensure an appropriation of knowledge and technologies and their diffusion by farmers themselves.

Marasas et al. (2012) state about agroecological transition: "This new interdisciplinary approach, which encompasses forms of participatory action research to methods that allows deeper understanding of the experimental complexity in which Agroecology develops, motivates researchers to create new knowledge and farmers to gradually change old paradigms". For them, the goal is "to reach equilibrium in the agroecosystem management" to reduce the negative impact the Green Revolution paradigm has had on societies and the environment by implementing "biodiverse,

[33]The national vegetable consumption is very low (35 kg/person/year); among different reasons, the lack of safety due to an excessive use of agrochemicals and irrigation with highly polluted water is pointed out (Ministerio de Agricultura y Desarrollo Rural, 2007).

sustainable, resilient and efficient agricultures". The idea of using the PIPA model to develop research could be seen as a participatory action research since researchers and farmers will use these parcels to exchange knowledge and experiences to solve local problems through the use of innovations adapted to the context. Non-educational training can be seen as a mean to progressively change farmers' minds and go from a systematic approach to solve farming problems to a more systemic approach. Looking at the agroecological practices Wezel et al. (2014) compile and describe in their review, some practices are found similar to what UNAL project wants to promote: selection of cultivars adapted to the agroecological conditions of the study area, using drip irrigation, split fertilisation according to plant demand and use of organic fertilisation, and integrated pest management. Although most of the practices are at the cropping system and field scale, without considering any practice at the landscape level (e.g. management of landscape elements to promote biodiversity), all rely "on increasing efficiency by reducing input consumption and increase crop productivity, or on substitution practices that substitute an input or a practice" (Wezel et al., 2014).

Another relevant aspect is that these innovations will have a positive impact at the global scale; for instance, improvements in composting are expected to reduce emissions of greenhouse gases such as methane and nitrous oxide. It might be a small contribution to climate change mitigation, but it is still a contribution. Besides, the organisational aspect is also important to highlight. Bringing farmers to work together for a common goal (e.g. product commercialisation or spreading innovations) is also a basic component of agroecology (Altieri, 2009); building up social capital is a "complex and necessary process of socio-productive change" (Marasas et al., 2012). For all these reasons, UNAL project is seen as a promoter of an agroecological approach. Taking this into account, this study was developed around this project.

Section II: Social network analysis of adoption and diffusion processes

This research is framed in a research project that seeks to transfer new agricultural technologies to vegetable growers in order to increase the productivity of their farming systems and that consumers obtain safe vegetables. Therefore, adoption and diffusion processes must be taken into account. Although in theory innovations are supposed to bring improvements and therefore should be adopted easily and uniformly, the reality shows that these cases are exceptional (Feder et al., 1982). Scholars are not unanimous on when studies of innovation adoption in agriculture have started, but some authors suggest as a starting point the work by Ryan and Gross (1943) on the switch to hybrid corn seeds among farmers in two communities in Iowa, in which the importance of communication processes was emphasised (Monge et al., 2008). Since then, many rural sociologists and economists

have focused their research on understanding the adoption decision, identifying the factors influencing it and measuring the degree of diffusion to propose econometric models explaining adoption and diffusion of agricultural innovations (Feder et al., 1982; Monge et al., 2008; Toborn, 2011).

The early research on adoption process was mainly carried out by economists, who developed models including socioeconomic variables affecting it, such as farm size, risk and uncertainty, human capital, labour availability, credit constraint, tenure, supply constraints, and aggregate adoption over time (Feder et al., 1982). To some extent, farmer's exposure to information is also highlighted as a proxy (Feder et al., 1982). Studies in developing countries were focused on factors affecting adoption of what Toborn (2011) calls "Embodied, exogenous innovations" – i.e. high yielding varieties, GM crops, fertilisers, and pesticides. This focus is explained by the spread of the Green Revolution technologies in many countries, especially in Asia and Latin America. Sunding and Zilberman (2001) provide an extent review on adoption and diffusion process, presenting a categorisation of agricultural innovations and an explanation of different econometric adoption models.

In more recent years, authors have incorporated social interactions in their econometric models to explain the adoption of agricultural innovations by farmers (Monge et al., 2008), arguing that adoption is overall related to the experience individuals acquired from their interactions with their neighbours (Berger, 2001). According to Tuomi (2002, cited by Monge et al., 2008), "All innovation is social innovation. Innovation does not happen "out there" in the world of objects. [. . .] Innovation can properly be understood only by studying the social basis of innovation." Going a step further, Feder and Savastano (2006, cited by Monge et al., 2008) state: "One key observation highlighted in many studies is the role of social links and community structure in the diffusion process. Communications and information relating to new knowledge were shown to be embedded within the more general fabric of social interactions among individuals. The pattern of information flows received and transmitted by individuals is thus related to their social environment, the network of their contacts, and their status within that network."

The incorporation of a range of networking parameters in the study of adoption decision has permitted research on factors affecting the adoption of what Toborn (2011) calls "Packages of disembodied agronomic and managerial innovations". This category includes Conservation Agriculture, Integrated Soil Fertility Management, Soil and Water Conservation, Integrated Pest Management, and Agroforestry, *inter alia.* These innovations, unlike the first category, represent a systemic vision of agriculture with economic, social and environmental objectives, and thus requiring a holistic approach

to analyse their implementation by farmers. In this context, adoption of innovations is seen “as a form of collective action, which is very often the case of sustainable agriculture and natural resource management innovative practices” (Monge et al., 2008).

According to Smale (2005, cited by Monge et al., 2008), the new paradigm of innovation diffusion including social interactions is more suitable to address the adoption of low external input technologies than the previous “individualistic and profit-maximising approaches”. The limited capacity of conventional economic models to explain innovation, viewed usually as a linear process driven by research (Hall et al., 2005), is the reason the World Bank (2006) defines the concept of innovation systems: “the network of organizations, enterprises and individuals focused on bringing new products, new processes and new forms of organization into social and economic use, together with the institutions and policies that affect their behaviour and performance.” Consequently, this definition presents “an interactive, systemic, and dynamic nature of innovation” (Monge et al., 2008), and provides a “basic framework for understanding and promoting agricultural innovation” (Hall et al., 2005).

Technology adoption and diffusion research is currently done following three main approaches: econometric and modelling methodologies to understand adoption decisions; studies of learning and social networks in adoption decisions; and continued local micro-level studies to understand adoption for policy purposes (Doss, 2006, cited by Toborn, 2011). Monge et al. (2008) provide a review on the main concepts and approaches applied nowadays to the study of innovation adoption from a social interactions perspective: Economic perspectives; Organisational Science perspectives; Socio-psychological perspectives; Social Capital and Collective Action perspectives; and Rural Communication and Extension perspectives. Some concepts are common to these different perspectives. Trust, risk, uncertainty, learning process, communication, and influence are some of them. The last perspectives reviewed by Monge et al. (2008) is the Social Network perspectives. In a certain way, they encompass the concepts shared by the others. As a starting point of the use of Social Network approach in diffusion studies, Monge et al. (2008) refer to studies carried out during the 1950s and 1960s in the medical field focused on the spread of use of new medication among physicians. The findings of these studies were that doctors more connected to others were the first adopters of the innovative treatment. Since then, Social Network Analysis has been frequently used in fields as varied as natural resource management, marketing, epidemiology or family planning. However, in agriculture there has been little research using this approach (Monge et al., 2008).

Embracing ideas of different authors, Haythornthwaite (1996) states that “Social Network Analysis (SNA) focuses on patterns of relationships between actors and examines the validity of resources and the exchange of resources between these actors.” The resources exchanged can be “tangibles” (goods, services or money) or “intangibles” (information, social support or influence). A network consists of actors, identified as “nodes”, who are connected by “ties”. SNA not only identifies these connections (structure of the network), it also studies the relationships shaping and keeping these ties (content of the network) (Haythornthwaite, 1996).

Social network analysts distinguish SNA from other approaches through three features: SNA is opened to any type of social system and does not focus only on strong-bounded social groups; the unit of study is not the individual (e.g. persons, organisations, states) but how individuals and their relationships are affected by the structure of their ties; and network analysis seeks to understand how structure and composition of ties affect norms instead of considering that behaviour is shaped by socialisation into norms (Berkowitz, 1982). Empirical observation of actors, their relationships and how they exchange resources is therefore the core of SNA and different metrics have been developed to apply it based on the principles of graph theory (Haythornthwaite, 1996).

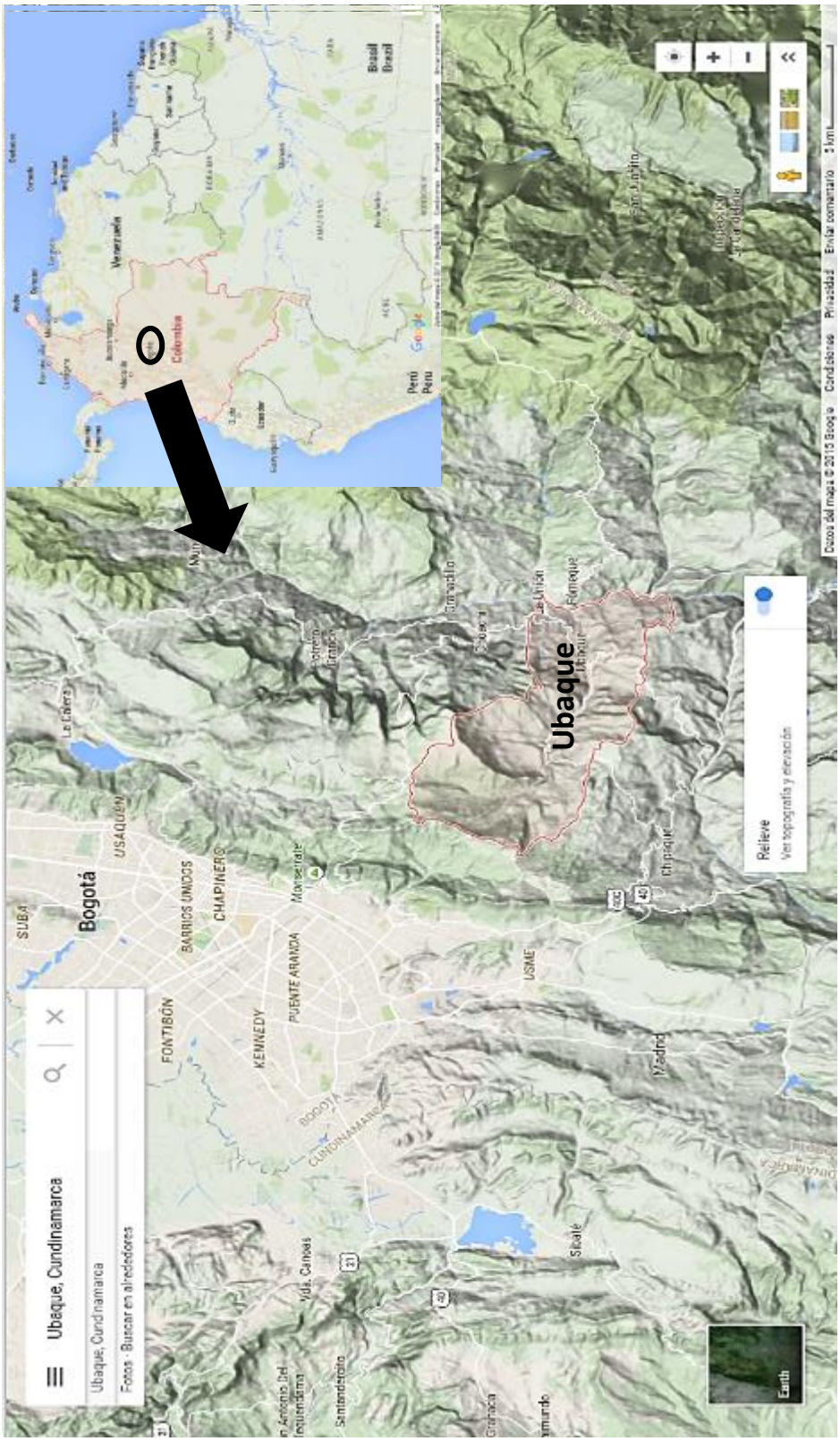
Adoption studies are usually done years after an innovation has been released; it helps measure, at the farmer level, the spatial and temporal use of the technology (Martínez and Gómez, 2013). In this case, the study precedes the implementation of UNAL project thus the adoption process cannot be studied. However, after reading literature on social networks and diffusion processes, one assumption in designing this research is that individuals are always influenced by other people during any decision-making process. In the current case, when farmers are exposed to agricultural innovations, depending on the degree of their connections with other farmers and stakeholders and the type of relationship they have, the likelihood of adopting a new technology will be higher or lower.

Indeed, Bandiera and Rasul (1996) concluded that sharing information is a determinant factor in adoption decision among farmers in Northern Mozambique. In addition to the number of contacts an individual can share information with, other structural features of networks have shown relevancy. Monge et al. (2008) highlighted the importance of the intensity of interactions and the position of an actor within a network, concluding that farmers in their Bolivian case study with more centralised position could have more possibilities to transmit information on an innovation to other farmers. Since his study on the strength of ties in a network, Granovetter (1973) has been cited in several papers which point out that the degree of strength of nodes’ relationships influence the possibility for a business to expand (Rauf and Mitra, 2011), for individuals to increase the flow of new information

(Bodin and Crona, 2009), and defines the process through which individuals make decisions (Kohler et al., 2001). According to Haythornthwaite (1996), strong ties suggest willingness to share information, although more and different information may come from those to whom an individual is weakly tied because of their connection to other networks.

In the case of UNAL new project in the eastern province of Cundinamarca, it seems relevant to conduct a study on social processes affecting adoption decisions as a complement of the agronomic and economic research that will be carried out. The analysis of farmers' social interactions and how they communicate about agricultural issues with different actors is expected to contribute to the process by which vegetable growers will get a greater exposure to UNAL innovations (knowledge and technologies) that eventually they will adopt and diffuse. Since the present study focuses on decision-making processes related to innovation adoption in agriculture and learning processes, SNA seems an appropriate approach to carry out this study.

Appendix II: Geographical Location and Relief of Ubaque



Source: Adapted from Google map 2015

Appendix III: Crop Management Practices in Greenhouse Tomato and Green Bean

Tomato management practices	Description
Soil preparation	Because of the high cost of investment in infrastructure, time between two crops does not exceed 12 days; soil is not compacted and thus a shallow tilling is done manually known as *repique*. Only the first time tillage is done using a yoke of oxen or a tractor.
Planting	One week before seedlings are brought, soil is disinfected with fungicides. The same week, furrows are made and irrigation system is checked. Planting rate is varies from 30,000 to 34,780 plants/ha.
Crop maintenance practices	Pruning and hanging plants to facilitate erect plant growth. Fertilisation and irrigation are done manually.
Fertilisation	From the second week after planting. Few farmers count with soil analysis data and pH is not modified. Fertilisation is done manually with irrigation, i.e. products are mixed in a 200 L pail with water and spread with a stationary fuel pump. The first three weeks an organic-based solution enriched with N and P is applied, as well as phosphoric acid. From the fifth grape, different synthetic compounds are used to supply macro and micro nutrients. Some farmers apply pig droppings and the organic fertiliser Bocashi.
Pest control	Main pests are *Neoleucinodes elegantalis, Prodiplosis longifila* and lesser extent *Bemisia tabaci,* and mites. Main diseases are *Botrytis cinerea, Fusarium* sp., and *Alternaria* sp. Farmers use the same products as for green bean crop and applications are also done weekly and even a few times a week.
Irrigation	Since fertilisation is done with irrigation, water quality analysis is not done and it is usually done manually, i.e. hose watering.

Source: adapted from Argüello Arias (2014)

Green bean management practices/marketing	Description
Soil preparation	Generally tillage done using a yoke of oxen. Occasionally use of tractor. Tracing and digging holes is done the same day by family members and/or day labourers. Seeding rate: 21,000 – 33,000 plants/ha (plant spacing is 0.3 m and row spacing is 1.15 m).
Pre-plant fertilisation	Fertilisation is done without any technical criteria (e.g. soil analysis data). Use of chicken manure or pig droppings (4 bales per 1 kg of seed sown). Some farmers adjust pH applying lime or dolomite lime but because soils are acid due to Fe and not Al, they trigger ionic unbalance.
Sowing	Seeds come from the last harvest or are bought from a farmer specialised in producing seeds, thus seeds are not certified. There are four main varieties used. Usually 1 – 3 kg of seeds are used to cover on average 0.7 ha. Generally 2 day labours per 1 kg of seeds sown are required.
Set of sticks	
First fertilisation and hilling	Use of synthetic fertiliser: 13-26-6
Pest control	**Common diseases:** *Alternaria* sp., *Colletotrichum lindemoniathum, Oidium* sp., and *Phytophthora infestans*. **Control of *Alternaria* and *C. lindemoniathum***: Difenoconazole, Azoxystrobin, and Fentin hydroxide applied with a week apart. **Other products used:** Dithiocarbamate, Cymoxamil, Benzimidazole, and Dimethomorph fundicides.
	Common pests: *Bemisia tabaci, Frankliniella occidentalis, Tuta absoluta, Spodoptera* sp., and *Agrotis* sp. **Control:** Methomyl, Lambda-Cyhalotrin, Methamidophos, Profenofos, Chlorpyrifos, Abamectin, Methyl-Parathion, Carbofuran. *B. tabaci* is the main problem and is controlled weekly. Farmers reported that currently this insect presents resitance to Dimethoate and Thiocyclam hydrogen oxalate.
	Weed control: done mechanically with ploughing, manually and with synthetic herbicides (Paraquat and Glyphosate).
Irrigation	Those who are members of irrigation districts usually use sprinkler irrigation or they hose watering each plant.
Deleafing	During the first month of crop development, 30% of basal leaves are removed from each plant to avoid excess moisture and *C. lindemoniathum* attack. Foliage is left on the ground increasing risk of whitefly and pathogens.
Hanging	Each plant is hanging by a thread to the arbour built.
Second fertilisation and hilling	Use of synthetic fertiliser: 15-4-23-4, 18-18-18 or 17-6-18-6-2
First harvest	From 75 days after sowing, a first harvest is done.
Harvest	6-7 harvests done 5 days apart. Sometimes 3 harvests per week are done. Harvests are synchronised with local market days (Tuesday, Thursday and Sunday).
Commercialisation	Green beans are packed in sisal sacks of 62.5 kg and transported in a jeep to local markets (Ubaque or Cáqueza). There they are sold to middlemen who stockpile the product and carry it by truck to wholesale markets in Villavicencio and Bogotá.

Source: adapted from Chiguachí (2014)

Appendix IV: Questionnaires and participation agreement

Cuestionario para el/la agricultor/a

El propósito de este cuestionario es recoger datos de agricultores relacionados con su situación socio-económica, sus sistemas productivos y sus interacciones sociales respecto a al intercambio de información sobre innovaciones agrícolas. Los datos recogidos serán utilizados en el análisis de la estructura de las redes sociales de los productores y el tipo de relaciones dentro de sus redes y ver cómo estos influyen en sus procesos de decisión.

Antes de la entrevista, el entrevistado será informado de los antecedentes de la entrevistadora, el contexto y el propósito de la investigación y de la entrevista y el tiempo que durará la entrevista. Adicionalmente, el entrevistado recibirá una explicación sobre el procesamiento de los datos, clarificando que las respuestas serán mantenidas anónimas. Finalmente, se le preguntará al entrevistado si es posible contactarlo nuevamente para alguna clarificación o para saber si acepta participar en el grupo focal.

Fecha de la entrevista:

A. Preguntas de tipo: Ego

Productor y su finca

1. ¿Cuál es su nombre?
2. ¿Me podría dar su número de teléfono?
3. ¿Me podría decir su edad?
4. ¿Cuál es su nivel de estudios?

   Primaria = 1; Secundaria = 2; Técnico = 3; Superior = 4
5. ¿Cuál es el nombre del predio?
6. Localización del predio:

- Dirección:……
- Coordenadas GPS (el principal edificio del predio):
- Altitud del predio: …….m

7. ¿Cuál es la situación de tenencia del predio?

   Propiedad = 1; Arriendo = 2; Derechos de usufructo = 3
8. Tamaño del predio: ……..ha
9. ¿Hace cuánto lleva administrando su predio?
10. ¿Tenía otra actividad antes? ¿Qué hacía?

    ……
11. ¿Cómo aprendió a cultivar?

……
……

12. ¿Tiene otro empleo fuera del predio?

    Sí = 1; No = 0

13. ¿Cuál es el porcentaje del tiempo dedicado al empleo fuera del predio?

14. ¿Otra persona ayuda/trabaja con usted en el predio?

    Sí = 1; No = 0

15. ¿Quién le ayuda/trabaja con usted?

    Esposo/a = 1; Hijos = 2; otro familiar = 3; trabajador(es) tiempo completo = 4; jornalero(s) = 5

16. ¿Es usted miembro de alguna asociación/organización?

    Yes = 1; No = 0

17. ¿Qué tipo de asociación?

    Distrito de riego = 1; organización para la comercialización = 2; movimiento campesino (nacional/internacional) = 3; otro (especificar) = 4

Sistema productivo

18. ¿Cuál es su actividad agrícola?

    Horticultura = 1; Pecuaria = 2; Otra (especificar) = 3

19. Horticultura: ¿Qué es lo que produce? ¿Cuánto produce por cosecha?

    Tomate = 1; habichuela = 2; Papa = 3; aromáticas = 4; otro (especificar) = 5

    …….

20. Pecuaria: ¿Qué es lo que produce? ¿Cuánto produce al día/semana/mes/año?

    Bovino (carne) = 1; Bovino (leche) = 2; Avícola (huevos) = 3; Avícola (pollo) = 4; Otro (especificar) = 5

    ……..

21. ¿Tiene una huerta a parte para el consumo familiar?

    Sí = 1; No = 0

22. ¿Qué produce en esa huerta? ¿Utiliza usted las mismas prácticas que en el/los cultivo/s comercial/es?

    ……
    ……..

23. ¿Hay algo nuevo que está utilizando en su predio?

    Práctica = 1; herramienta = 2; insumo = 3

24. Nueva práctica: ¿Cómo se enteró de su existencia?

……
……
……....

25. Nueva herramienta: ¿Cómo se enteró de su existencia?

……
……
……

26. Nuevo insumo: ¿Cómo se enteró de su existencia?

……
……
……

B. Preguntas de tipo: Alter Prompt (pregunta puntual para generar la lista de alteri en la red personal del ego)

27. ¿Con quién habla usted de temas relacionados con la actividad agrícola y/o pecuaria? (Por favor, indique nombre completo y apellidos).

C. Preguntas de tipo: Alter

Esta sección del cuestionario se centra en las diferentes relaciones dentro de su red. Cada pregunta requiere que usted estime el grado de interacción con cada una de las personas que nombró anteriormente.

28. ¿En qué categoría incluye usted esta persona?

Familia (especificar parentesco y profesión) = 1
Productor = 2
Extensionista = 3
Vendedor de insumos = 4
Intermediario = 5
Funcionario público (INCODER, ICA, etc.) = 6
Funcionario local (alcaldía, Banco agrario, etc.) = 7
Trabajador de una ONG = 8
Investigador de una institución pública/privada = 9
Otro (especifique la profesión) = 10

29. ¿Cómo definiría usted su relación con dicha persona?

Estrecha, de confianza = 1; de amistad = 2; conocido = 3

30. ¿Hace cuánto que conoce esta persona?

1 = menos de un año; 2 = menos de 5 años; 3 = menos de 10 años; 4 = más de 10 años

31. ¿Dónde vive esa persona?

1 = misma vereda; 2 = mismo municipio; 3 = otro municipio

32. ¿Con qué frecuencia trata usted con esa persona de temas agrícolas?

1 = a diario; 2 = semanalmente; 3 = algunas veces al mes; 4 = algunas veces al año

33. ¿A parte de temas agrícolas, con qué frecuencia se encuentra con esa persona para hablar de otros temas o hacer otras actividades?

0 = nunca; 1 = a veces; 2 = con cierta frecuencia; 3 = siempre

34. Cuando usted tiene algún problema en su finca (por ejemplo, una nueva plaga, muchos sedimentos en su Sistema de irrigación), ¿con qué frecuencia le pide ayuda o consejo a esta persona?

    0 = nunca; 1 = a veces; 2 = con cierta frecuencia; 3 = siempre
35. Cuando usted está considerando implementar una nueva práctica agrícola (por ejemplo, laboreo mínimo, nueva densidad de siembra, etc.), ¿con qué frecuencia le pide usted información/consejo a esta persona?

    0 = nunca; 1 = a veces; 2 = con cierta frecuencia; 3 = siempre
36. Cuando usted está considerando utilizar una nueva herramienta agrícola (por ejemplo, aspersor para la irrigación, etc.), ¿con qué frecuencia le pide usted información/consejo a esta persona?

    0 = nunca; 1 = a veces; 2 = con cierta frecuencia; 3 = siempre
37. Cuando usted está considerando utilizar un nuevo insumo agrícola (por ejemplo, semilla certificada, pesticida orgánico, etc.), ¿con qué frecuencia le pide usted información/consejo a esta persona?

    0 = nunca; 1 = a veces; 2 = con cierta frecuencia; 3 = siempre
38. Considerando la última nueva práctica que implementó en su finca, ¿quién de la lista le proporcionó información al respecto o se la recomendó?

39. Considerando la última nueva herramienta que implementó en su finca, ¿quién de la lista le proporcionó información al respecto o se la recomendó?

40. Considerando el último nuevo insumo agrícola que utilizó en su finca, ¿quién de la lista le proporcionó información al respecto o se lo recomendó?

41. **Práctica:** ¿Quién le proporcionó la más importante/útil información?

42. **Herramienta:** ¿Quién le proporcionó la más importante/útil información?

43. **Insumo:** ¿Quién le proporcionó la más importante/útil información?

44. **Práctica:** Considerando la última nueva práctica que implementó, ¿se la recomendaría usted a esta persona (de la lista de productores)?

    Sí = 1; No = 0
45. **Herramienta:** Considerando la última nueva práctica que implementó, ¿se la recomendaría usted a esta persona (de la lista de productores)?

    Sí = 1; No = 0
46. **Insumo:** Considerando la última nueva práctica que implementó, ¿se la recomendaría usted a esta persona (de la lista de productores)?

    Sí = 1; No = 0
47. De la lista de productores que usted dio al inicio, cuando esta persona se está planteando implementar una nueva práctica agrícola, ¿con qué frecuencia le pide a usted que le dé información o consejo?

    0 = nunca; 1 = a veces; 2 = con cierta frecuencia; 3 = siempre
48. De la lista de productores que usted dio al inicio, cuando esta persona se está planteando implementar una nueva herramienta agrícola, ¿con qué frecuencia le pide a usted que le dé información o consejo?

0 = nunca; 1 = a veces; 2 = con cierta frecuencia; 3 = siempre

49. De la lista de productores que usted dio al inicio, cuando esta persona se está planteando utilizar un nuevo insumo agrícola, ¿con qué frecuencia le pide a usted que le dé información o consejo?

    0 = nunca; 1 = a veces; 2 = con cierta frecuencia; 3 = siempre

50. Cuando existe algún problema que afecta la comunidad (por ejemplo una nueva política que afecta el manejo del recurso hídrico, un nuevo proyecto minero, etc.), ¿con qué frecuencia recurre usted a esta persona para pedirle apoyo?

    0 = nunca; 1 = a veces; 2 = con cierta frecuencia; 3 = siempre

51. Cuando existe algún problema que afecta la comunidad (por ejemplo una nueva política que afecta el manejo del recurso hídrico, un nuevo proyecto minero, etc.), ¿con qué frecuencia esta persona recurre a usted para pedirle apoyo?

    0 = nunca; 1 = a veces; 2 = con cierta frecuencia; 3 = siempre

D. Preguntas de tipo: Alter Pair

52. De la lista de personas que usted indicó como de confianza, ¿se conocen entre sí?

    Sí = 1; No = 0

53. De la lista de personas que usted indicó como de confianza, ¿cree usted que existiría una relación entre ellas si usted no estuviera?

    Muy probablemente = 2; quizás = 1; poco probable = 0

Solicitud de participación en proyecto de investigación

"¿Cómo pueden las redes de productores promover prácticas sustentables de producción y comercialización? Una investigación por encuesta de los sistemas hortícolas en las zonas montañosas de Colombia"

Antecedentes y Propósito

El propósito de este estudio es analizar las interacciones sociales existentes entre los productores de hortalizas de la provincia Oriente de Cundinamarca, con el fin de identificar las relaciones que más influyen en la toma de decisión de los productores respecto a la adopción de innovaciones agrícolas. También se busca estudiar la estructura de la red de productores con el fin de comprender cómo se transmite la información dentro de dicha red, identificando el papel que juega cada actor. Este proyecto se desarrolla en el marco de un convenio entre la Universidad Nacional de Colombia (en adelante UNAL) e ISARA-Lyon (Francia) para la tesis de maestría de la estudiante Katalina Sánchez González, con CC 52955389 de Bogotá. La maestría es en Agroecología y es un programa europeo impartido entre ISARA-Lyon (Francia) y Norwegian University of Life Sciences (Noruega).

La selección de personas a entrevistar para este estudio se hizo a través del Ing. Diego Chiguachí, de la Universidad Nacional, quien estableció el primer contacto con algunos productores. Después de haber entrevistado a los primeros participantes, se sigue el método llamado « bola de nieve », que consiste en entrevistar a personas que hayan sido nombradas por los entrevistados anteriormente. Por dicha razón su participación ha sido requerida.

¿Qué implica participar en el proyecto?

Este proyecto consta de dos partes: un análisis de las redes sociales de los productores relacionadas con temas agrícolas y un análisis de la opinión de los agricultores respecto a temas relacionados con la sustentabilidad de los sistemas productivos. Para ello se hizo un primer estudio del contexto de la zona donde se realiza el proyecto, con información obtenida de diferentes fuentes (internet y proyectos que ha realizado la UNAL en la zona, proporcionados por el Profesor Heliodoro Argüello y el Ing. Diego Chiguachí). La toma de datos de campo se hace mediante entrevistas individuales para obtener información sobre las relaciones de los productores con otros actores de la zona de estudio y mediante entrevistas grupales (grupos focales) con las que se busca obtener información complementaria, para comprender mejor la opinión de los entrevistados.

Las información recogida en las entrevistas individuales en una primera parte, gira entorno a datos personales (nombre de la persona, edad y nivel educativo), datos sobre el predio (tenencia, superficie, localización) y aspectos relacionados con el sistema productivo (cultivos, producción, trabajadores). En una segunda parte, las preguntas están orientadas a establecer una lista de personas con las que se habla de temas agrícolas y qué tipo de relación tiene con dichas personas. La información de las entrevistas grupales gira entorno a la opinión de los productores respecto a los sistemas productivos y su sostenibilidad. Los datos de las entrevistas individuales se recogerán por escrito sobre papel y luego se introducirán en un programa informático especialmente diseñado para el análisis de redes sociales (Egonet). Los datos de las entrevistas grupales serán grabados en formato audio y la estudiante junto con un asistente tomará apuntes sobre la discusión.

¿Qué pasará con la información sobre usted?

Todos los datos personales serán tratados de forma confidencial. La lista de nombres serán almacenados separados del resto de datos personales. La única persona que tendrá acceso a los datos personales será la estudiante que los almacenará en su computador personal al que se accede

mediante una contraseña. Los datos en formato papel serán igualmente guardados por el tiempo que dure el proyecto, así como las grabaciones audio, esto durante la fase de análisis de datos.

Tanto en el documento final de la tesis como en la presentación para la sustentación, sus datos personales no serán revelados de modo que usted no podrá ser identificado.

El proyecto está programado para realizarse el 10 de julio de 2015 (fecha de la primera entrevista) hasta la sustentación que será a más tardar a principios de octubre del mismo año (aún no está fijada una fecha). Después de finalizado el proyecto, sus datos en formato papel y digital así como la grabación audio podrán ser transmitidos al Prof. Argüello de la UNAL, con previa autorización de su parte. De lo contrario, serán eliminados.

Participación voluntaria

Es voluntario participar en el proyecto y usted puede en cualquier momento decidir dejar de participar sin necesidad de dar ninguna razón. Si decide retirarse, todos sus datos personales permanecerán en el anonimato.

Si desea participar o si tiene cualquier pregunta relacionada con el proyecto, puede contactar a Katalina Sánchez González al 3124746351 o al Profesor Heliodoro Argüello al (1)3156924.

El estudio ha sido notificado a la Oficina de Protección de Datos para la Investigación de los Servicios Noruegos de Datos en Ciencias Sociales.

Consentimiento para la participación en el estudio

He recibido y entendido la información suministrada sobre el proyecto y estoy dispuesto a participar en:

□ La entrevista individual y la entrevista grupal

□ Sólo la entrevista individual

Además acepto que mis datos personales sean almacenados durante el tiempo necesario al desarrollo del proyecto. Así mismo doy mi acuerdo para que en caso necesario, mis datos sean transferidos al Profesor Argüello.

(Firma del participante, fecha)

Cuestionario para el Grupo focal

Preguntas para el Grupo focal sobre la sostenibilidad de los sistemas productivos

Preguntas para iniciar la discusión

1. ¿Qué tan cercana o lejana ven esta definición de la realidad de sus sistemas productivos?
2. ¿Cuáles son los elementos que podrían hacer más sostenible la producción agropecuaria en Ubaque? ¿Y cuáles existen ya?

Preguntas exploratorias

3. ¿Podrían mencionar tres prácticas agrícolas que mantendrían en su finca y tres que les gustaría cambiar? ¿Por qué?
4. ¿A parte de razones económicas, cuáles serían sus motivaciones para adoptar una nueva práctica o insumo agrícola en su finca?
5. ¿En qué forma creen ustedes que los productos de su finca impactan (positiva o negativamente) sobre la salud de los consumidores o sobre el medio ambiente?
6. ¿Han oído hablar de la agricultura orgánica/ecológica? ¿Estarían interesados? ¿Por qué?
7. ¿Creen ustedes que personas externas pueden ayudarlos a hacer sus sistemas productivos más sostenibles? ¿Quiénes consideran ustedes actores apropiados para ello y cómo les gustaría que los ayudaran?
8. ¿Qué estarían ustedes dispuesto a hacer/aportar para crear sistemas productivos más sostenibles?
9. ¿Qué factores creen ustedes son necesarios para reforzar la colaboración entre los productores de la región?

Pregunta final

10. ¿Desearían hacer un último comentario sobre lo que hemos discutido?

Consentimiento para participar en la Entrevista de Grupo

Usted ha sido invitado a participar en una entrevista de grupo para la investigación que está llevando a cabo la estudiante Katalina Sánchez González en el marco de su tesis de maestría en Agroecología, titulada "¿Cómo pueden las redes sociales de productores promover prácticas sustentables de producción y comercialización? Una investigación por encuesta de los sistemas hortícolas en las zonas montañosas de Colombia". La maestría es un programa europeo impartido por ISARA-Lyon (Francia) y NMBU (Noruega) y la tesis se está haciendo en el marco de un convenio de pasantía con la Universidad Nacional de Colombia.

El propósito de dicha entrevista grupal es recoger la opinión de los agricultores sobre temas relacionados con la sostenibilidad de sus sistemas productivos. La información colectada durante la sesión de grupo va a ser utilizada para complementar los datos recogidos en las entrevistas individuales a las que se sometió previamente.

La discusión durante la entrevista de grupo durará aproximadamente 1 hora y 30 minutos. Usted participará con otras 6 a 9 personas en la discusión. Dichas personas son otros productores de la región. Puede escoger si desea participar o no en la entrevista de grupo y retirarse de la sesión en cualquier momento. Aunque la discusión durante la entrevista será grabada para facilitar la toma de datos, sus respuestas serán tratadas de forma anónima y ninguna identificación será posible a partir del informe.

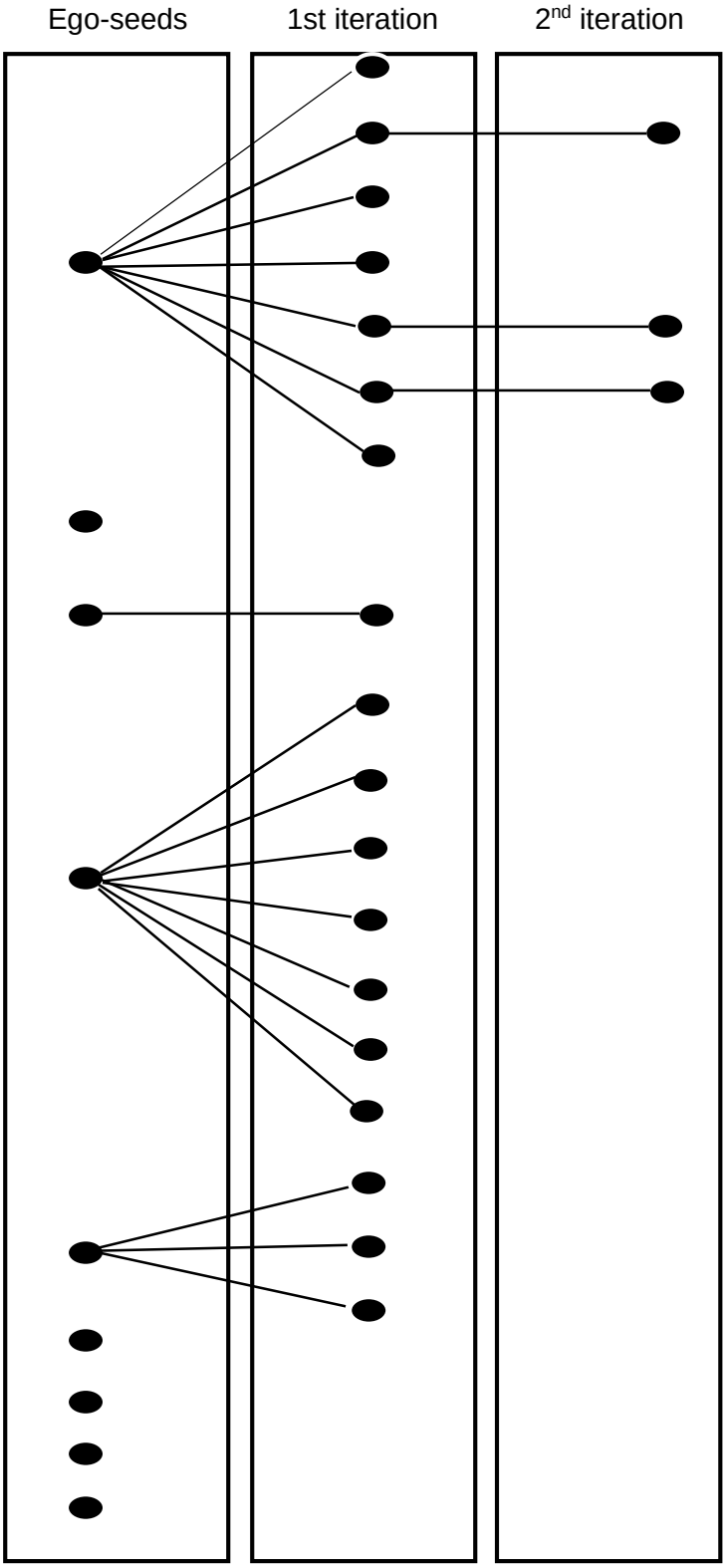
No existe respuesta correcta o incorrecta a las preguntas de esta entrevista. Queremos escuchar distintos puntos de vista y queremos oírlos de cada uno de los participantes. Esperamos que usted sea sincero(a) en sus respuestas incluso en caso de estar en desacuerdo con el resto del grupo. Por respeto a los demás, pedimos que sólo una persona hable al tiempo durante la discusión del grupo y que las respuestas dadas por los demás participantes se mantengan confidenciales.

Entiendo la información que acabo de leer y acepto participar plenamente en la entrevista de grupo bajo las condiciones expuestas arriba:

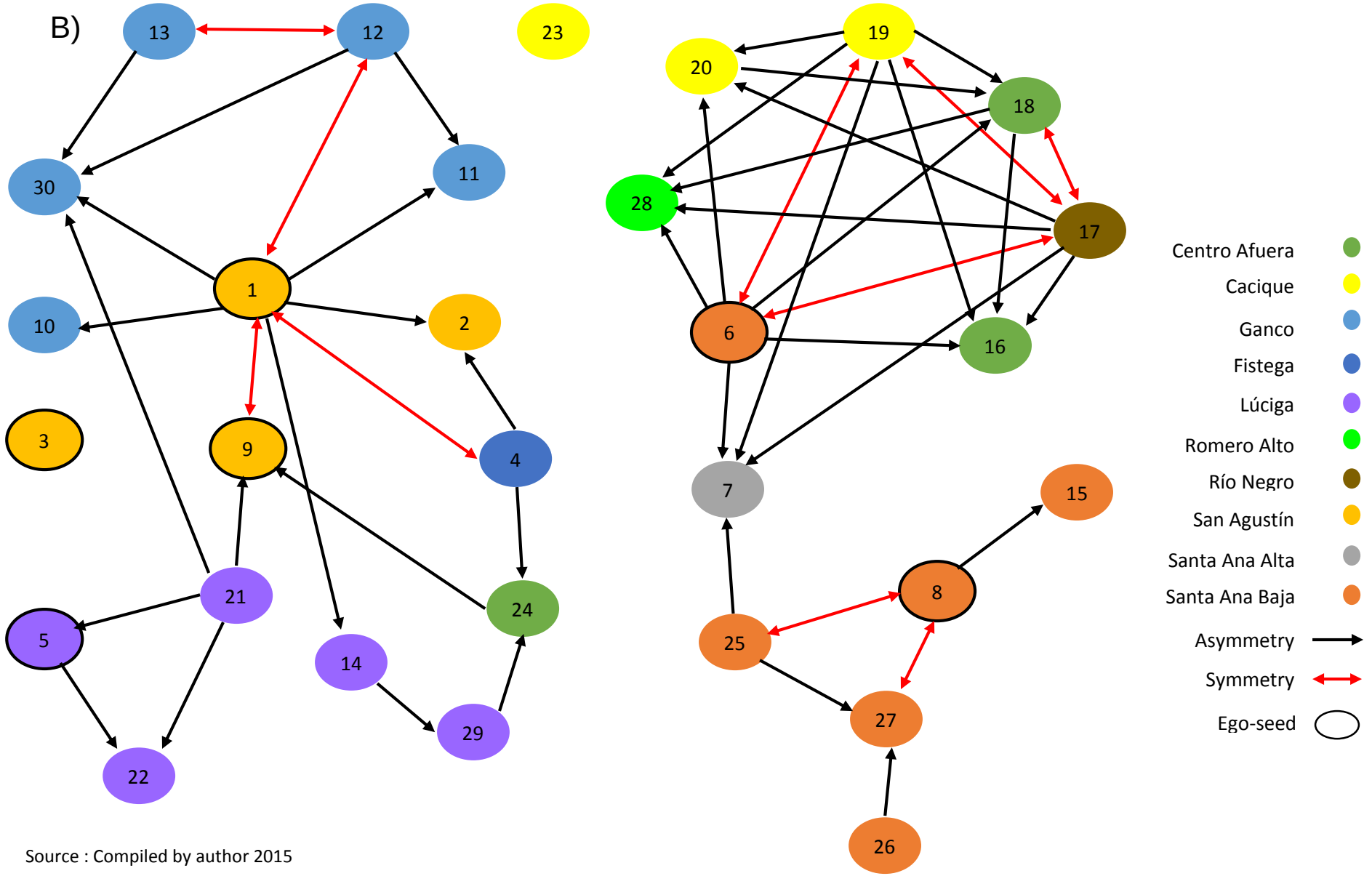
Firma:_____ Fecha:_____

Appendix V: Scheme of the snowball sampling method (A) and sociogram of the sample population (B)

A)



Source : Compiled by author 2015



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