Drivers influencing farmer decisions for adopting organic or conventional coffee management practices

DRIVERS INFLUENCING FARMER DECISIONS FOR ADOPTING ORGANIC OR CONVENTIONAL COFFEE MANAGEMENT PRACTICES

HIGHLIGHTS

- Qualitative and quantitative methods were used to test drivers of coffee management
- Social identity, coffee institutions, and attitudes play a role in decision making
- Eighteen socioeconomic drivers, some with interacting effects had significant influence
- Technology and membership of organizations influenced adoption of organic practices
- Different factors rather than price premiums promote adoption of certified schemes

ABSTRACT

Colombia is one of the world's most important producers of Arabica coffee (*Coffea arabica*), whose coffee-growing zone coincides with a biogeographic hotspot of biodiversity. Given that coffee agroecosystems are grown by both organic and conventional schemes of management in Santander, a region which produces coffees with specialist distinctive flavours, this study aims to better understand the factors that influence the adoption of these different schemes of management. A combination of ethnographic techniques and quantitative methods were used to examine the predominant drivers of adoption and revealed farmer perceptions associated with coffee farming, and the complexity of interacting factors, that surround their decision making. The results of qualitative analysis suggests that social identity of coffee growers, the existence of farming spaces (lived, perceived, rationalized), the influence of coffee institutions, attitudes about management practices, and social relations of production, all play an important role in the process of decision making. In quantitative terms, we identified 18 socioeconomic drivers, some with interacting effects that had significant influence on the decision to adopt either organic or conventional practices. In particular, at local scale, important factors were technology availability, the type of landowner, formal education of farmers, the role of institutions, membership of community organizations, farm size, coffee productivity and the number of coffee plots per farm. Likewise, economic drivers, such as crop profitability, determined how farmers are involved in trade and market networks at broad regional, national, and international spatial scales. By adopting a more integrated approach, combining qualitative and quantitative methodologies, we characterized the complexity of factors that influencing adoption of coffee management schemes and show that not only financial factors but also a variety of other social factors drive farmer decision making. Identifying the most influential behavioural drivers provides policy with opportunities to better support farmer livelihoods.

KEYWORDS

Coffee agroecosystems, social drivers of crop management adoption, qualitative and quantitative research, CART analysis

1. INTRODUCTION

Globally the two most economically important species of coffee are *Coffea arabica* (Arabica coffee), a high quality coffee which constitutes over 60 percent of world production, and *Coffea canephora* (Robusta coffee) which is of relatively low quality compared to Arabica (ICO, 2013a). Colombia produces Arabica coffee, and has been the world's fourth largest producer after Brazil, Vietnam, and Indonesia (ICO, 2013b). In Colombia, coffee provides livelihoods for 563,000 coffee farming families of which 95% have less than 5 ha of coffee crop (FNC, 2013a). In particular, the Santander department where this study was carried out is recognized at a national level for its production of specialty coffees, namely coffees with unique flavour profiles due to particular geographic microclimates and high quality standards (FNC, 2013b).

Small-scale family farms produce over 70% of the world's coffee in 85 Latin American, Asian, and African countries; many coffee producers live in poverty and manage agroecosystems in culturally and biologically diverse regions (Bacon, 2005). Fair Trade, Rainforest Alliance and organic certifications have become an alternative for conventional coffee growers and an option to let consumers know of a product's attributes and the nature of its production (Hatanaka et al., 2005). Accordingly, the coffee farming included in this study is categorised under four different management and certification schemes:

- Dual certification: Fair Trade (FT) and organic (FT – Organic)
- Dual certification: Rainforest Alliance (RA) and organic (RF – Organic)
- Organic certification: It is certified but not FT or RA
- Conventional: farms use synthetic fertilisers and are not certified

Fair Trade has an emphasis on social development with goals to support democratic producer organizations, provide premiums for social development, improve labour rights, and facilitate long-term trading relationships (Valkila et al., 2010). By comparison, Rainforest Alliance schemes prioritize environmental issues on coffee agroecosystems based on the standards of the Sustainable Agriculture Network (SAN) with broader biodiversity and ecological concerns that include water quality impacts, creation of wildlife corridors, and reforestation (Barham and Weber, 2012).

A conceptual triad of social spaces (Lefebvre, 1991) is useful to understand relationships between farmers and their coffee agroecosystems according to three dimensions, briefly recapitulated as:

- *Perceived space* embraces production modes and the particular locations and spatial sets characteristic of each social formation. Spatial agricultural practice ensures continuity and some degree of cohesion. It embodies a close association between daily routine and rural reality.
- *Conceptualized space* is a conceived space by scientists or planners, and is delineated by both knowledge and power, e.g. the territorial ordering designed by technocrats without considering cultural differences at regional or local scales.
- *Lived space* embodies associated images and symbols such as religion or art signs. This space embraces places and their symbolic value.

The analysis of drivers of coffee management can be conceptually based on the *new ecological anthropology* postulated by Kottak (1999), who recognizes the importance of larger scale. Here the focus is no longer the local agroecosystem, but the intersection of global, national, regional, and local actors, studying the outcome of the interaction of multiple levels and multiple factors. Some ideas from *ecological history* discussed by Cronon (1985) involve changes in the way people create and re-create their livelihood in terms of changes, not only in their social relations, but in their ecological ones as well. The dominance of neoliberalism and globalisation have brought more and more people into trade and market relations which lie well beyond the boundaries of their local ecosystems.

Studying the drivers of coffee management adoption entails an understanding of social, political, economic, demographic, technological, cultural and biophysical factors that directly or indirectly influence decisions at the coffee agroecosystems scale. The core of the approach is to use the understanding of social factors at the farm level to provide better insight in what processes are important in the decision making process of a management adoption (Overmars and Verburg, 2005).

In the context of coffee agricultural practices in Colombia, the adoption of integrated pest management has been associated with education level and the wealth of the farmer as predominant factors (Chaves and Riley, 2001); likewise, the introduction of the “Caturra” coffee variety was linked to factors such as an increase in demand for labour, need for cash inputs, especially fertilizer and hired labour, and risk avoidance behaviour (Stabile et al., 1984). The role of coffee institutions has been important for the intensification of coffee crop production since 1970, when the threat of coffee rust was a critical factor in production (Guhl, 2008). Coffee intensification gave rise to a decrease on coffee crop areas, a reduction on shaded coffee farms and pastures zones as well as increase on other crop areas (Guhl, 2008).

A number of studies have assessed the influence of coffee certification on profits using survey data collected from coffee growers. For example, several have compared Fair Trade and organic cooperative membership with conventional farming (Arnould et al., 2009; Barham et al*.,* 2011; Beuchelt and Zeller, 2011; Bolwig et al*.,* 2009; Méndez et al., 2010; Valkila, 2009). Although these studies vary in terms of the criteria used to measure returns (e.g. prices, productivity, profits, with and without labour costs included), most of them conclude that there are relatively limited price gains and income improvement linked to these certification schemes compared to conventional coffee management. Similar conclusions have been drawn from studies conducted in Mexico and Peru (Barham and Weber, 2012) which have contrasted conventional, Fair Trade/organic, and Rainforest Alliance schemes and have revealed that yields, rather than price premiums, are most important for increasing net cash returns for coffee growing households. This suggests that certification norms that permit the improvement of yields are essential for improving grower welfare and attracting and maintaining growers to these schemes.

A study in Nicaragua (Valkila et al., 2010) showed that although Fair Trade provides price premiums to producer organizations, a larger share of the retail prices remains in the consuming country (in this case, Finland) relative to conventional coffee trade. Paradoxically, although certified farmers and cooperatives in producing countries do receive some benefits, Fair Trade principally empowers roasters and retailers in consuming countries due to the fact that they are able to charge significantly higher margins for Fair Trade coffees than for conventional coffees. The

premiums paid by Fair Trade consumers, the ethical donations, were found to largely remain in Finland and therefore Fair Trade appears to be an ineffective way of transferring benefits to producer countries. In this way, the rise of specialty coffee market might parallel to a certain extent the global trend by which a high percentage of the coffee market is recently controlled by a few largest roasters (Topik, 2008). The latter can be best understood in the broader historical context of the creation and development of coffee commodity chains. It involved over time multiple connections between production, intermediation, processing, marketing, and consumption. Governance of the chain moved away from the grower to the exporter in the sixteenth century; to the roaster, governments and international institutions in the twentieth century; and today to a few multinational firms (Topik, 2008).

A study conducted in Costa Rica (Wollni and Brammer, 2012) that analysed the 'drivers' that encourage farmers to opt in to certification schemes found that experience in coffee cultivation, more education, larger farms and a pre-existing association with a coffee cooperative were all relevant and positive factors. Farmers might be particularly attracted by the additional income activities that an organization assists with as a safeguard for periods of low coffee prices. On the other hand, a study of the adoption of Fair Trade organic schemes in Mexico revealed that the availability of family labour, liquidity, and location were more likely to affect the decision to go organic (Weber, 2011). One of the most important factors determining whether farmers choose to opt in to a certification process is the functioning of producers' organisations. This was confirmed in the Costa Rican study (Faure et al., 2012).

On the other side, prior studies (Press et. al., 2014) have suggested the role of contending ideologies in restricting the transition from conventional farming to organic wheat production in industrial scale agriculture. Despite evident economic incentives in the High Plains region of North America, barriers to adoption stemmed from (i) ideological conflicts e.g., chemical farming norm is strongly appreciated and rooted in the region; chemical wheat production receives government subsidies, which organic producers do not receive; (ii) struggles for legitimacy among farmers within a market e.g., conventional farmers may refer to the structures of regulatory legitimacy such as input suppliers, banks, insurers, and various federal agencies. Organic farmers, however, may

draw on themes of cultural legitimacy to defend their on farm management practices such as innovation, work in harmony with nature and evoke the traditions of their forbearers; and (iii) the function of supporting institutions in building regulatory legitimacy e.g., structural barriers to changing orientation such as organic input supply issues, transportation and storage problems, and challenges of finding a buyer.

While there have been a number of quantitative studies on the factors driving adoption of specific crops (e.g. Mazvimavi and Twomlow, 2009) and certified coffee (e.g. Weber, 2011), this study combines quantitative and an in-depth qualitative analysis to provide a better understanding of the complexities in the decision making processes. By adopting a more integrated approach, this research aims to improve our understanding of the complex interactions of factors that influence the adoption of particular coffee management schemes. This study focuses on the following key questions: (1) what are the predominant drivers for adopting either organic or conventional management? (2) What are the most significant perceptions of coffee growers in relation to this decision? (3) What is the the likelihood of farming adoption?

2. METHODS

2.1 Study area and data collection

The study was conducted in Ocamonte, Pinchote and El Valle de San José, three towns of the Santander area, a mountainous region where a high proportion of Colombian specialty coffees are produced. Data collection combined qualitative and quantitative approaches as an appropriate methodology for this research. Firstly, a qualitative view in Ocamonte allowed for the capture of in-depth, ethnographic detail that is considered essential for understanding farmers' management decisions. Secondly, the quantitative procedure included a survey of 134 farmers (30 organic and 30 conventional in Ocamonte, 27 organic and 30 conventional in El Valle de San José, 10 organic and 7 conventional in Pinchote). The survey sample in three towns included small-scale coffee farmers, a fact that is common in Colombian coffee-growing regions. Accordingly, the 67 organic farms had an average size of 7.12 ± 1.0 (SE) ha and the 67 conventional farms had an average of 3.41 ± 1.0 (SE) ha. In Ocamonte, where ethnographic research was conducted the average size of organic and conventional farms was 4.3 ± 0.7 (SE) ha and 1.2 ± 0.3 (SE) ha respectively. A survey

206 covered family characteristics, ownership, manual labours and agricultural practices, coffee
207 production costs, yield, income, available infrastructure, social relations of production and
208 interactions with institutions. Given that qualitative information was collected before the survey, it
209 allowed a familiarization with local terms and the identification of preliminary drivers of
210 management adoption which enriched the design of survey. Afterwards, ethnographic information
211 permitted a general contextualization of socioeconomic quantitative data. Therefore survey data
212 from three communities was used to complement the data collected from a small sample of
213 farmers who participated in in-depth interviews, meetings, agricultural practices, sales or informal
214 dialogues, in such a way that fifty potential drivers of management adoption were identified.

215 **2.2 Qualitative methods**

216 Assessing and identifying factors of decision-making processes at farm level may require
217 interaction with subjects, and a nuanced reading of human expression and use of language (Frank
218 et al., 2011). Qualitative methods used on a small sample for exploratory analysis are useful for
219 this purpose. Three variables were analysed: perceptions of land-use, management practices, and
220 the role of institutions in the selection of a land management method. Ethnography was used for
221 gathering empirical data aimed at describing the nature of people (Guber, 2001) in relation to these
222 variables. It consists of the processes and products of research that documents what people know,
223 feel, and do in a way that places those phenomena at specific times in the history of individual
224 lives, including pertinent global events and processes (Guber, 2001; Handwerker, 2002).

225 Three ethnographic methods were considered: firstly first-hand observation of daily activities
226 (participant observations) related to coffee management practices, coffee farmer meetings and
227 purchases at sale points; secondly, semi-structured interviews with 14 small-scale coffee farmers
228 in Ocamonte. The interview protocol was designed to collect detailed qualitative information on
229 themes related to beliefs and attitudes about coffee farms and management practices, and the role
230 of institutions (banks, coffee institution, certification agencies, farmer's cooperatives) on
231 management adoption and land-use. Questions were flexible in the sense that farmer could
232 provide further explanation in case of responses with pertinent information. Eight of the interviewed
233 farmers were members of a cooperative and produced organic coffee; six were non-members and

234 grew conventional coffee. To triangulate institution-related data reported by member-farmers, two
235 coffee organization leaders and one agronomist were also interviewed. The interview texts were
236 qualitatively categorized and coded to identify key themes relating to drivers of coffee management
237 adoption and potential relationships between interview data variables. Thirdly, informal dialogues
238 with farmers, other technicians, and local market agents in Ocamonte and neighbouring towns
239 were carried out. With this methodological triad, findings from detailed farm observations of what
240 farmers are doing, why, and with what effect were identified on the decision of whether to opt into a
241 certification scheme.

242 **2.3 Quantitative method**

243 A questionnaire was developed to obtain detailed information on field management practices, crop
244 yields and social relations of production. Questionnaire design, question content and question
245 wording were defined and decided based on ethnographic information gathered previously. A
246 format using tables was adapted from household surveys designed by the World Bank (World
247 Bank, 2009).
248 Given that there were only 67 organic farms with a certification seal (Fair Trade organic, Rainforest
249 organic, solely organic) on this region at the time of survey, the location of organic farms
250 determined the selection of the 67 conventional farms. Taking into account the Colombian
251 territorial organization of farms in “veredas” – each “vereda” groups several farms – conventional
252 farms were chosen according to their belonging to the same vereda where organic farms were
253 located, in order to have similar environmental conditions. Based on this survey, drivers that
254 influenced the selection of organic and conventional coffee management systems were analysed.

255 **2.4 Data analysis**

256 Fifty potential drivers previously identified from ethnography and survey were analysed with non-
257 parametric Chi-square and Kruskal-Wallis methods in order to identify factors with significant
258 effects on management. These statistical analyses were performed using the software GenStat
259 (11th edition). The Chi-square tests were used to test the statistical significance of the association
260 between drivers and the type of management. The significance of the impact of drivers associated
261 with coffee productivity, production costs, incomes and profitability was tested by means of the

Kruskal-Wallis method. From the fifty possible drivers originally identified, nineteen drivers (Table 1) were grouped as social, institutional, location and market factors, were identified as the most significant driving forces that were likely to have influenced the selection of organic and conventional coffee management systems. *Social* factors include details that are relevant for understanding farmers' context of crop management adoption (e.g. education, membership of collectives). *Location factors* involve characteristics of farmers (e.g. land owner), and farm attributes (e.g. farm size, technology availability, productivity, costs) that are particular to a farm and that are useful in understanding the processes of management adoption. *Institutional* drivers comprise institutions and their strategies (e.g. credits, incentives, assistance) with influence in shaping decisions of farmers. Finally *market* drivers add economic factors of relevance on making decision processes (e.g. profitability, income, satisfaction with prices).

Table 1 – Drivers selected as the most significant factors

INSTITUTIONAL	SOCIAL	LOCATION FACTORS	MARKET
1. Technical assistance 2. Number of contacts with technicians in 12 months 3. Participation on meetings 4. Satisfaction with institutional incentives	1. Membership of community organizations; benefits received as member of community organizations; satisfaction with incentives 2. Population density 3 .Years of formal education 4. Learning method	1.Coffee productivity: Kg per ha; cargas[a] per ha 2. Production costs: Pesos per carga; USD per carga 3. Land owner 4. Number of coffee Plots 5. Farm size 6. Technology availability 7. Off-farm job	1. Coffee dependence: percentage of total income from coffee 2. Satisfaction with sale Prices 3. Profitability 4. Income per carga: Pesos per carga; US$ per carga

[a] One coffee carga=125 kg of coffee

Classification and Regression Trees (CART) was used in order to estimate the probability of a farmer adopting organic or conventional practices based on a number of drivers of farmers' decision-making. The basic algorithm underlying CART is to repeatedly partition a data set into more and more homogeneous groups, using variance minimizing algorithms to determine the most parsimonious tree. The output is represented graphically as a dichotomous tree that is relatively easy to interpret (De'ath and Fabricius, 2000; Williams et al., 2009; Zheng et al., 2009). The analysis was performed using the software Salford Predictive Miner (version 6.6). Following and adapting the approach of Williams et al. (2009), optimal models were found by examining trees for four factorial combinations of drivers, social (six variables), institutional (six variables), location

(seven variables), and market (five variables) that maximized the proportion of variance explained. Optimal sized models were based on relative error values, having established that relative error can range between 0 and 1, with lower values indicating better performance.

Initial CART analysis resulted in very large trees which were pruned back to an optimal sized tree based on relative error rates. Potential overfitting of tree models can be avoided with the small size of the trees since smaller trees are often highly accurate models (Steinberg and Golovnya, 2006). Collinearity between variables commonly hinders statistical analyses, frequently making it difficult to precisely estimate the distinct effect of a particular independent variable on a dependent variable of interest (York 2012). CART presents an approach to handling collinearity: the analysis allows only one of any set of correlated variables to enter the model at any given split, which prevents the model from including correlated variables. As CART splits the data into progressively smaller groups in fitting the tree, the collinearity among predictor variables may change, and variables that could be highly correlated across all the data may be less so in subsets of the data (Ferraro et al., 2009).

3. RESULTS

3.1 Qualitative assessment

3.1.1 The identity of coffee growers

Identity is a powerful organizing presence in social life, in the sense of belonging to sociable recognizable corporate groups (Leve, 2011) and farmers in this study illustrate the weight of social identity. For instance, most of farmers responded "*all my life*" when asked how long they have been growing coffee. Thus coffee farming has been an activity and identity passed down through generations. People not only live *from* coffee but also *with* coffee whose high quality gives prestige and recognition when they sell their production. Two farmers stated: *"This is the art we know..."* and [Coffee is] *"the best future we have sown..."*. Coffee growing is more than a productive labour, is an activity through which farmers express ideas, dreams and expectations. The collective character of this activity is also frequent in speech since they use "*we"* instead of "*I",* pronouns which can be indicative of social group association. However, according to ethnographic information, it is often that young generations - who are sons/daughters of coffee farmers - have

migrated to urban spaces in search of higher education, different jobs, even to enrol in the army. That behaviour represents a matter of growing concern since impacts the relief for the coffee cultivation. It is noteworthy that parents have certain responsibility on this attitude since they frequently allude to “better conditions for future of children than those we have to live”. There may, therefore, be a fracture between current farmers and their descendants with consequences for continuity in the future of coffee farming.

3.1.2 Perceptions of coffee farm spaces and surrounding environments

In order to better understand perceptions it is important to place them in a theoretical framework that helps to understand relationships between farmers and agroecosystems. For this we have used the work of Lefebvre (1991) that describes a conceptual triad of social space.

Firstly, a space as directly lived in farms that are seen as sacred spaces where religious symbols are part of the coffee plots. For instance, religious symbols connected with the Catholic Church (e.g., crosses of different size with or without flower ornamentation) are put on the coffee fields especially at early phases of growth plantation in order to entrust its prosperity to God. On the other hand, during prolonged dry conditions, a priest can perform religious ceremonies in the farms aimed to achieve that the rain comes to the zone. There are terms that describe the sacral character of land including “land is a great God blessing”, “land is primordial, is everything”, is “our life”, “is like a woman, a mother who has to be cared for”, “the biggest treasure”. The implications of those perceptions allow to understanding why and with what effect on the farm people are doing actions. According to some farmers, to reach a high level of organic production requires dedication, hard work and almost devotion to farms, e.g., organic agricultural practices that favour the nourishment for the soil and coffee plant roots, regular management of shade especially at the starting period of the crop, inter alia. In line with this, some farmers who apply organic practices expressed a sacred relationship with land, and rejected actions such as the use of herbicides on nearby farms with sugarcane crops. In more general terms, older farmers and coffee landscapes are very closely related and stories are attached to particular places e.g., the health of the land and that of the forebear people are closely intertwined. The history of coffee growers is described and revealed in their land usage.

Secondly, a pragmatic space embodies the daily experiences and routines. Coffee farming is perceived in utilitarian terms by virtue of fruit production, people's occupation, and economic returns for family wellbeing. Land which produces coffee can thus be more appreciated than other land-uses. Forest is in essence associated with coffee crops and is valued particularly for its ability to shade coffee plants. Coffee areas have become fragmented as they have been passed from parents to children by property inheritance or purchasing: farm sizes have been reduced and it is likely that family groups are neighbours with different ties of kinship. At the same time, farmers have also increased their crop areas because coffee profits have allowed the acquisition of new plots. Hence the coffee space is dynamic and changing.

Finally a rationalized and more instrumental space conceived by members of the coffee institute and certification agencies. The origin of shade grown coffee by small scale farming can be traced to the 1960s in the study area. The coffee institute has played a key role in increasing the area of growth by providing extension programs to farmers aimed to improve local agricultural practices. Representatives of Fairtrade labelling organization arrived in the region in 1994 by means of the coffee institute. Conventional coffee was purchased under Fairtrade (FT) certification once a farmers' cooperative was legally constituted. The arrival of FT did not generate significant changes in the usual manner of farming coffee since conventional management of crops easily satisfied rules in compliance with FT standards. The benefit of FT for farmers become to manifest around 2002 when international coffee prices fell to extreme low values and the cooperative received an important amount of money to compensate that situation. Those resources were heavily invested in different improvements at local and farms levels (e.g., housing, post-harvest processing of coffee, roads).

In parallel with that situation from 2002 onwards, a FT certifier initiative for farming under organic conditions was suggested to local producers. However, their transition to organic was certainly hard for most farmers because it altered their farming practices with effects on their agricultural spaces and daily routines e.g., paperwork; introduction of new wastewater treatments and compost making process; emphasis on rigorous screening during post-harvesting process; coffee was planted using better arrangements of plots; strict separation of sugarcane plots with hedges to

protect coffee plantations against possible effects of very specific chemical inputs that were allowed to use in that plots; recycling of materials; increased reforestation especially along the border of water streams. From farmers' perspective one of the most important consequences of adopting organic management was the decline in the amount of yield during the period of transition (up to three years) to get the certification. Despite benefits received, that reduction apart from farm requirements have discouraged new farmers to opt for organic management.

For a few farmers, however, transition was not as drastic. They had been applying manure and mulch/wastes of sugarcane processing without using synthetic fertilisers. Thus, adopting a new orientation was not as difficult for them.

In this way, institutional priorities gave rise to the improvement in farmer life quality and the manner in which they cultivated coffee, especially in the first decade of the twenty-first century. Thus an active role of space, as supplementary knowledge and action, became operational in the construction of a particular mode of production: farms that yield certified organic coffee.

Further, in line with Strand et al.'s (2014) results, through management decisions and ultimately the process of creating their coffee fields, farmers strengthen their identities through day-to-day activities in their material world. For instance, a farmer indicates: "new systems of waste water treatment arose when *we became organic*"; similarly, other farmer expresses "*We, the organic farmers,* receive additional training*".*

3.1.3 Attitudes about management practices

In accordance with farmers view, organic farms require the involvement of more days of work, dedication and care compared to conventional farms, especially during the initial stages of coffee crop. The duration of the production phase on conventional plants may be longer than organic crops. Coffee production is lower on organic than conventional schemes. However, the use of organic minerals alongside organic manure may increase the level of yield; the application of minerals has been practiced in some farms since 2006. The use of shade cover may depress coffee production if it is more than 50% since it may delay cherry maturation. In comparison, there is a relevant role of shade in reducing the use of certain fertilisers through deposition of leaf litter.

Additional effects of adopting organic schemes on the daily lives and practices of farmers include the change of emphasis from oral tradition to written records of practices. Since organic certification arrived at zone, all coffee activities and involved finances must be recorded, which has caused certain difficulties due to the time spent on this task and the fact that detailed writing has not been a habit.

3.1.4 The role of the coffee institute

According to ethnographic information, the role of the coffee institute involves both a channel intermediary in the marketing system and a farming institute in rural and policy life. Sometimes that performance has been a controversial issue at local and national levels taking account of its participation as market competitor/trader, regulator of bean quality standards, policy maker and promoter of not only coffee farming but also of the national union of coffee growers. From a historical perspective, that institute was the only one that survived after most coffee-growing countries abated their coffee organizations with the dissolution of the International Coffee Agreement in 1989 (Topik 2008).

As a result of multiple roles, several events have taken place: the establishment of coffee crops with commercial purposes; technical assistance by means of agricultural extension services; investment of coffee sales in infrastructure; the introduction of certification seals; and trade of coffee at international level. In all, this has had effects on the landscape with the promotion of organic and conventional schemes of management, whose growing demand for market has been a factor of land-use change.

In this context, the coffee institute has had a strong influence as advisory agent on the decision-making of farmers to opt for certified organic schemes since it facilitated the entry of Fair Trade (FT) into Santander region. This took place in 1994 when a meeting was promoted to connect representatives of Fair Trade organization, a trader, and coffee growers of the zone. Around 2008 the coffee institute assumed also the role of trader of FT coffees as part of its mission to export specialty coffees (including organic coffees of different seals as Rainforest Alliance (RFA)). As a result, the coffee institute also became a competitor as others traders, taking part in the race to export certified and conventional coffees. The fact to assume a role as trader of FT and RFA in the

region had economic repercussions on the net value of premium offered to organic farmers because from an institutional perspective, there was an interest to equate premiums offered to organic production under FT with RFA. As a result and contrary to farmer expectations, there was not a large distinction between premiums of FT and RFA seals as happened during the coffee crisis in 2001/2002, and therefore the economic incentives to grow organic coffee did not resulted in better situation for organic farmers under FT certification. In the face of such circumstances, some farmers opted for certification seals whose requirements allow the use of certain agrochemicals.

Thus, the type of certification seal is relevant at local level since Fair Trade (FT) prioritize better prices and working conditions, and Rainforest Alliance (RFA) gives pre-eminence to conservation efforts based on standards for Sustainable Agriculture (e.g., wastewater treatment, protection of wildlife). In terms of work habits, there are several FT requirements that had to be fulfilled by farmers at the moment of the field work of this study; inter alia, avoiding child labour and the accomplishment of cooperative projects aimed to improve the well-being of farmers. Those project aims - even those designed to favour coffee yields - are based on democratic decisions making since cooperatives receive the FT certification. FT is open to small farmer organizations which must be owned and governed by themselves. In practice there are subtle differences in the way those conditions are satisfied: farmer organization decisions are strongly influenced by the coffee institute; the subject of child labour often collides with local tradition of teaching coffee agricultural practices to children, which has also an impact on the relief for the coffee farming; the involvement of board members takes time and effort which affects their dedication to daily agricultural tasks.

Producer organizations are paid a FT minimum price for washed Arabica or the market price if higher. Farmers who have currently Fair Trade or Rain Forest Alliance with organic certification believe to receive a significantly higher sale price as compensation for low level of production and the dedication of farmers. Unfortunately, the final payment they receive in net cash does not always correspond to their expectations. Fair Trade certifications provide a minimum price to farmers and a social premium to cooperatives; however this study observed that these premiums did not necessarily translate into higher incomes for farmers. Distinction between FT and RFA

certifications was particularly evident during the coffee crisis in 2001/2002 when coffee prices fell to an extreme low of US$45 cents per pound. During this time only Fair Trade farmers received the highest value of monetary premium to compensate the extremely low price. Thus, international low prices highly favour growers with FT seal.

3.1.5 Social relations of production

In general terms, current coffee farmers are from the 45 to 70 year age bracket and most of their children study and contribute little to coffee and agricultural work. Young people generally prefer living in nearby towns or distant cities in order to study or work. The perceptions reveal a dichotomy of visions – urban life where study and other jobs are possible or rural life with no such options – and this has consequences such as a shortage of coffee pickers during harvest and a low level of generational change that encourages continuity of coffee farming.

On the other hand, the coffee harvest is enriched by the principle of *'reciprocity',* and facilitated by exchanges of tasks between family members or neighbours. Communal work relations are common and coffee has generated equity in terms of benefits to everybody, owners and workers. There is a gender division of labour on conventional farms, whereby men tend to specialise in coffee work within the local area, and women tend to specialise more in unpaid coffee work within the family farm. By contrast, where crops are farmed organically, it is common for spouses to work together, growing coffee within their own small farm. Relations between age groups around coffee farming are common since it is usual that women and aged people partake in meetings related to farmer's cooperative. Spouses work together on farm and wives administer home finances with coffee profits, and ensure food provision. Off-farm employment is common on conventional farms for husbands and adult children.

Cooperatives of coffee farmers offer important benefits to members as access to information, training, coffee commercialization, and projects aimed to improve health, education, or production. Farmers express the relevance of meetings to improve agricultural practices or adopting certified schemes of farm management.

3.2 Quantitative assessment

3.2.1 Drivers of coffee crop management choice

Statistically significant associations between social factors and a crop management type were found for the farms surveyed in three communities of Santander. Table 2 shows the results of the analysis of significance between the different types of social drivers and the management type. This table shows the results that had a significant effect on a crop management category. The Chi-square test is significant at 0.001 level, indicating a strong association between a crop management and specific factors. For instance, the benefits received from membership of community organizations (χ^2 = 39.9, P < 0.001) and the availability of technology (χ^2 = 76.4, P < 0.001). Other important factors include the learning method of coffee agricultural practices, population density and benefits received of community organizations. It is interesting to note that coffee growers have learnt organic coffee production by themselves including learning from their parents, and also by training sessions on meetings with institutional assistance. By contrast, conventional farmers have learnt mostly by themselves. Smaller population density is common on organic farms compared to higher number on conventional schemes. All organic farmers are members of community organizations, although this is expected because organic certification for small farmers operates through groups.

A highly significant relationship (P < 0.001) between coffee management and location factors was also found, such as technology availability, the nature of land ownership, farm size and the number of coffee plots per farm. In this regard, the existence of adequate technology, married couples as land owners, more than six coffee plots per farm, and more than five ha of farm size were common on organic farms. In contrast to the farmer perceptions, higher values of coffee productivity (P = 0.004) and smaller values of coffee production costs (P = 0.003) were associated with organic farms. By comparison, farms with high off-farm employment (P = 0.002), basic technology, only one owner (husband or wife or other family member), less than five coffee plots per farm, and less than five ha of farm size were all associated with conventional management of coffee farms.

Institutional factors were also associated ($P < 0.001$) with organic farms such as enough technical assistance, a higher number of contacts with technicians or agronomists, full participation in meetings and satisfaction with incentives offered by the coffee institution. Conversely, insufficient technical assistance, smaller contacts, minor participation and dissatisfaction with incentives were related to conventional farms. Market factors such as a major dependence on coffee incomes were associated ($P < 0.001$) with organic farmers, who expressed more dissatisfaction with prices offered despite higher levels of both profitability and incomes. In comparison, less dependency, more satisfaction with prices, and smaller profitability were associated with conventional coffee growers.

536 Table 2 – Analysis of significance between social factors and the type of coffee crop management

537 in three communities of Santander

538

DRIVERS	DRIVER CATEGORIES	ORGANIC FARMERS (n = 67)	CONVENTIONAL FARMERS (n = 67)	CHI-SQUARE TEST	
				Chi-square value (χ^2)	P value
SOCIAL FACTORS					
Years of formal Education	0 to 5 years 6 to 16 years	50 17	59 8	4.06	0.044
Learning way	Independent experience Coffee institution Both	31 4 32	47 8 12	14.1	<0.001
Membership of community organizations	Membership No	67 0	45 22	34.85	<0.001
Benefits received with membership	Only training Training, credits, inputs, money No benefits	28 39 0	26 18 23	39.88	<0.001
Incentive satisfaction	Full satisfaction Conformity	56 11	44 23	5.77	0.016
Population density	Between 0.07 and 6 persons/ha Between 6 and 60 persons/ha	64 3	46 21	18.14	<0.001
LOCATION FACTORS					
Technology Availability	Basic Adequate	9 58	57 10	76.4	<0.001
Land owner	Husband Married couple Wife, other	40 17 10	39 1 27	25.35	<0.001
Coffee plots number	1 to 5 plots 6 to 10 plots > 11 plots	26 27 14	55 11 1	31.01	<0.001
Farm size	< 5 ha 5 to 10 ha >10 ha	37 16 14	57 8 2	17.13	<0.001
Off-farm job	Yes No	28 39	46 21	9.91	0.002
				KRUSKAL-WALLIS TEST	
Coffee productivity (kg/ha)		974.8 ± 90.4	680.3 ± 72.2		0.004
Costs (US$/125 kg)		295.5 ± 43.6	417.8 ± 46.1		0.003
INSTITUTIONAL FACTORS				CHI-SQUARE TEST	
Technical assistance	Enough Insufficient	65 2	44 23	24.79	<0.001
Contacts with agronomists on last twelve months	0 to 5 contacts 6 to 12 contacts	48 19	64 3	15.27	<0.001
Meetings participation	Yes No	67 0	50 17	26.05	<0.001
Satisfaction with Incentives	Satisfaction Dissatisfaction	56 11	44 23	5.77	0.016
MARKET					
				KRUSKAL-WALLIS TEST	
Profitability (%)		169.2 ± 27.9	97.5 ± 19		<0.001
Incomes per carga (US$ per 125 kg)		499.2 ± 6.9	456.7 ± 7.7		<0.001
				CHI-SQUARE TEST	
Coffee dependence: Income from coffee	5-40% 41-80% 81-100%	19 25 23	30 30 7	11.94	0.003
Satisfaction with sale prices	Satisfaction Dissatisfaction	46 21	61 6	10.94	<0.001

539

3.2.2 Interaction between drivers

The CART model (Figure 1) explaining the largest amount of the variance (75%) in the adoption of organic and conventional schemes of management had five nodes using six location variables (coffee productivity, production costs, number of coffee plots per farm, farm size, type of land owner and technology availability). The results indicated that the most important factor in determining the adoption of organic practices was the availability of adequate technology, since farmers with access to it were 79% likely to adopt these practices (Terminal Node 3). The type of landowner was the second most important driver since a further split occurred as a result of this factor. With limited access to technology and only one land owner (e.g. head of home, husband or wife), there was 89% probability of keeping conventional practices (Terminal Node 1). In contrast, farmers with a married couple as owners were 100% probable of adopting organic management (Terminal Node 2).

In terms of technology, the availability of enough equipment is related to the respective phase of coffee production: growing, harvesting, and processing. Field tools necessary for growing conditions include those aimed for soil preparation with adequate supply of essential mineral elements, seed propagation, planting, fertilisation, shade management, pruning, and weed control. In Colombia, harvesting is a manual selective picking of the ripe coffee cherries and the prevailing mode of processing is the wet process. The latter is a method that requires the use of specific equipment and considerable quantities of water. It is the phase in which the availability of technology portrayed the most significant benefit for farmer labour and time-saving. It involves the use of devices/machinery for classification of fruits, removal of pulp and mucilage from ripe cherries, consecutive drying of washed coffee, and successive screening of beans according to quality principles. After the process, the parchment skin or pergamino is thoroughly dry and crumbly; that will be removed in the off-farm hulling process. Coffee is sold by farmers in parchment to the respective purchase point.

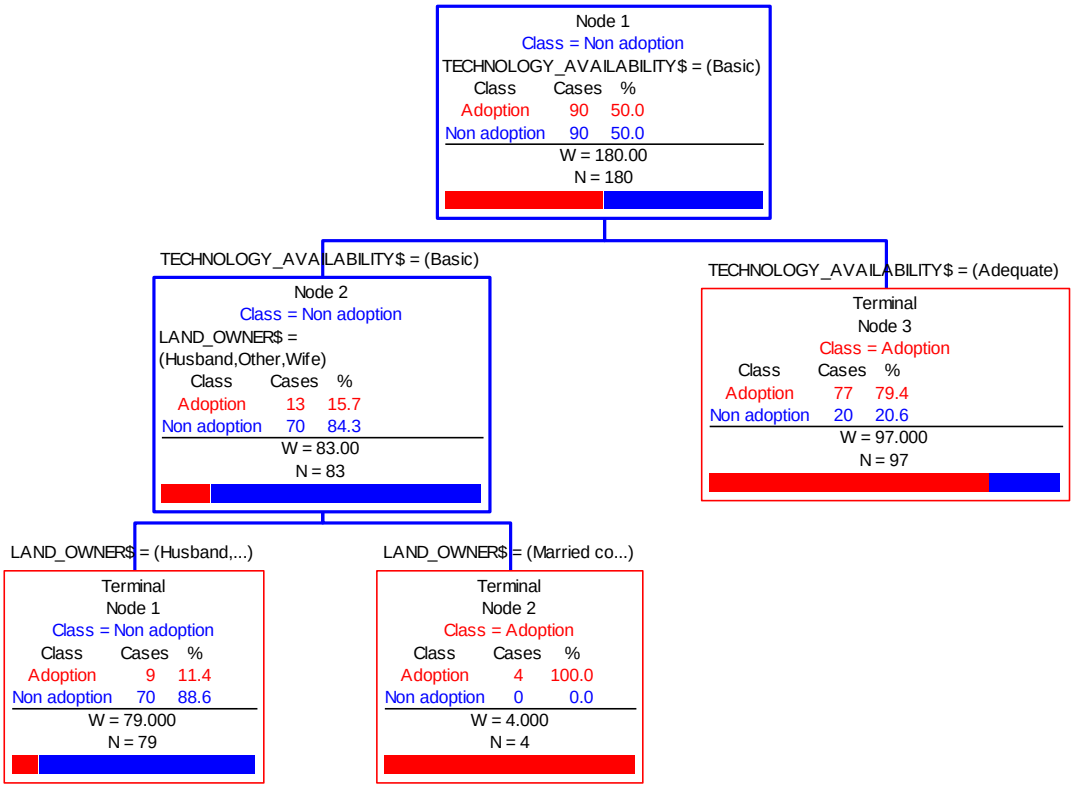

Figure 1. CART diagram describing how adoption of organic crops is influenced by location drivers. Each node (square) displays the total number of farmers in that group (N) and the number of growers according to two categories: adoption of organic practices in red, or non adoption (i.e. conventional practices) in blue. The model is read from top down until terminal nodes appear. Tree diagram allows identifying the most important drivers affecting adoption: availability of adequate technology and married couples as land owners in the case of organic management; compared to basic technology and individual owners (husband, wife, other) in the case of conventional schemes.

4. DISCUSSION

In order to improve our understanding of the complex interactions of factors that influence adoption of a coffee management type, an approach that integrates quantitative and qualitative studies was adopted. Survey analysis (quantitative) identified the most significant drivers while ethnographic assessments (qualitative) allowed the contextualization of these drivers within a more in-depth understanding of farmer-farm relationships.

4.1 Drivers affecting coffee management adoption

The following drivers were found to be significant determinants of management adoption (Table 2) and their importance is also broadened with information based on ethnographic research.

Years of formal education: More years of formal education were found to influence the adoption of organic farms, which is consistent with studies of Wollni and Brammer (2012) in Costa Rica. Conversely, fewer years were common among conventional farmers. This suggests that farmers with more education tend to be more willing to innovate.

Learning of agricultural practices: Farmers who attend training sessions organised by the coffee institution are more willing to adopt organic management. This indicates that information availability plays an important role (Wollni and Andersson, 2014).

Membership of community organizations: The role of community organizations is key since being part of a collective promotes the adoption of agricultural practices, encourages cooperative working, the strengthening of social networks and the sharing of benefits. Partaking in these collectives indicates the belonging to social networks which have an important role in promoting exchanges of information and resources. This observation is in agreement with Faure et al. (2012) in Costa Rica who show that producers' organizations assume a leading role in certification adoption processes. By comparison in Santander, small farmers' cooperatives are influenced on the selection of certification seals by the coffee institute who also acts as coffee trader.

Compared to results of Geiger-Oneto and Arnould (2011) in Nicaragua, Peru and Guatemala, our study also finds that technical assistance and meetings participation was higher for coffee

producers who engaged in Fair Trade (FT) collective initiatives than did nonparticipants. However, in our research women participation was noticeably higher than that of men. Further, farmer criteria of better quality of life were common on members of the cooperative whose housing and farms displayed improved physical conditions.

On the other side, it is argued by Geiger-Oneto and Arnould (2011) that the impact of FT organizations may vary across countries. Our results also support and expand it since several factors have influence on the benefit that coffee farmers receive; for example the actor network involved in the process. That network includes in general terms all or a combination of the following: farmers, cooperative of farmers, the coffee institute, a certifier agency, FT inspector, miller, trader, roaster/buyer, retailer, and consumers. Within the network, one of the key roles is focused on the trader, who makes price negotiations, establishes a connection between local cooperatives and a particular roaster, and ensures that the requirements of transport, storage, milling and delivery are fulfilled. That role is deeply rooted in the dynamics of market since it interweaves the interests of growers, processors and buyers/retailers. As such, this strongly influences the amount and type of gains for farmers at local scale.

Availability of technology: Labour saving technology includes machines and implements (Erenstein, 2006) which facilitate post-harvest tasks such as removing coffee beans from the fruit, washing and drying. Adoption can be encouraged if the technology is operator labour-saving (Fernández and McBride, 2002) as may be the case with organic coffee farming.

Land owner: The marital status of farmers is an important determinant of whether organic methods are adopted or not: married couples are more likely to opt for this style of farming. This may be explained by the increased workload associated with organic coffee plantations, especially at the beginning of the crop cycle when a joint effort is required. In the case of conventional farms, only one land owner (e.g. head of home, husband or wife) is the predominant figure who makes decisions regarding farm management. Different studies related to crop adoptions (e.g. Hamadou et al., 2005; Overmars and Verburg, 2005) suggest that land ownership is the most important factor determining organic adoption since it requires significant investment.

Farm size and coffee plot numbers: In Colombia, 95% of coffee farming families have less than 5 ha of coffee crop (FNC, 2013a), a circumstance that was found to be particularly common on conventional farms in the study region. Contrary to expectations, organic farms have a greater number of coffee plots and bigger farm areas compared to conventional farms in the study site. Concurring with Weber (2011) in Mexico and Wollni and Brammer (2012) in Costa Rica, it appears that larger growers are more likely to go organic. Small area farmers are less likely to incur the costs of joining a cooperative and converting to organic production; similarly, larger farms are more likely to have the liquidity to afford mineral inputs that can boost productivity and profitability.

Coffee productivity: As with farm size, productivity was found to be higher on organic farms compared to those farmed conventionally. In this study, high productivity was found to be a key factor encouraging farmers to adopt organic methods and there was clear evidence that farmers are motivated by the successes on neighbouring farms. According to previous studies (e.g. Haggar et al., 2011) and results obtained in this study with farmers' perceptions and survey data, high levels of production on organic farms are feasible if certain conditions are guaranteed, e.g. adequate fertilization with natural minerals and organic manure in terms of frequency and amount; shade management according to the age of plantation; frequency of pruning. It can therefore promote local adoption of this management. In accordance with farmers, it should be noted that some research studies (Perfecto et al., 2005; Valkila, 2009; Van der Vossen, 2005) suggest declining yields from organic crops, especially during transition from conventional to organic production.

Production costs, profitability and incomes: The level of coffee profitability, production costs and meaningful incomes were also found to be drivers of management adoption since they can encourage or discourage neighbouring farmers to adopt a management type. The study conducted by Barham and Weber (2012) in Peru and Mexico confirmed that yields rather than price premiums are most important for coffee growers. Farmers are motivated to continue to participate in certified schemes if both the price and productivity improve producer welfare. The local market illustrates the integration of farmers into global trade and market relations which lie well beyond the boundaries of their local agroecosystems. In this regard, 24% of Colombian coffee exported

668 between 2007 and 2012 were specialty coffees with a certification seal, and 69% were
669 conventional coffees (Muñoz 2012, 2011). Globally, speciality coffees have been estimated to
670 constitute 8% of world exports and are perceived as having the potential to grow, thanks to greater
671 consumer interest in this type of coffee (ICO, 2013c). Thus, conventionally grown coffees represent
672 a substantial market segment globally (92%), and a continuous supply is required. The results of
673 this study concur with those of Weber (2011) who studied variations in price received over a
674 season by Mexican Fair Trade organic growers in relation to their cooperative size, product quality,
675 and location. Similarly, Beuchelt and Zeller (2011) describe in Nicaragua that higher farm-gate
676 prices do not lead necessarily to higher per capita net coffee income, as yield levels, production
677 costs, family and land size, as well as labour availability play important roles.
678
679 *Income from coffee and off-farm job:* organic farmers are heavily dependent on coffee farming
680 income, which is interrelated to the total amount of time available for farming and non farming
681 activities. Farmer off-farm employment may constraint adoption of management-intensive organic
682 practices due to it competes for farm managerial time (Fernández and McBride 2002).
683
684 *Satisfaction with sale prices:* a sense of great satisfaction was expressed by conventional farmers
685 compared to organic coffee growers. Our study suggest that this finding may decrease the
686 probability of organic farming adoption given several observations; less time and effort involved in
687 conventional practices compared to organic schemes; substantial reduction on yield especially
688 during the phase of transition to organic management; the time at which survey was conducted
689 coincided with higher and favourable coffee prices.
690
691 *Institutions:* Interviews and observations in the field elicited that the national coffee institute plays
692 multiple roles: it has overall responsibility for Colombia's coffee policy, acts as a trader, conducts
693 coffee research (although organic coffee agriculture receives little attention from research
694 priorities), regulates quality standards for the coffee export market, provides extension programs to
695 farmers, and also over-sees the coffee-growers' guild. It acts at local, regional, national and
696 international levels.

According to Press et al. (2014), adopting an organic orientation may raise issues of regulatory legitimacy acting at a wide scale. Thus, the economic regulatory structure has had to adapt gradually to the new challenges involved in organic certification processes e.g. input supply, ability of finding a buyer, transportation and storage requisites. Small coffee growers have faced those challenges by the intervention of their trader i.e., the coffee institute.

In our case, that institute also defines legal and procedural requirements with interest in trading specialty coffees, including not only organic coffee. According to field observations, an offer of organic coffee to potential buyers can allow purchasing other certified coffees. In this way, the purpose is to ensure a stock of organic coffee that aids to hook the sale of other specialty coffees. In this instance it is interesting to note that only a minority of specialty coffees is organic i.e., 1.3% of total cover of coffee land-use in Colombia are organic plantations which contribute 9.5% to global market (Farfán et al., 2015).

Press et al. (2014) have also highlighted the role of ideological conflicts between organic and conventional farmers as potential barriers to changing management. However, our study finds that these types of tensions are not frequent and thus both schemes of management are perceived as legitimate. More broadly, a tension can take place between affiliated members and non members of the rural cooperative for accessing to a fair distribution of benefits such as training, input supply, and credits.

The role of this institute may be comparable to others such as the Mexican Coffee Institute (INMECAFE) (Eakin et al., 2006) and the Brazilian Coffee Institute (BCI) (Jarvis, 2005). These institutions were government regulated agencies and had overall responsibility for coffee policy and the control of prices. These organizations were abolished in order to limit government action and to allow the market to operate freely.

4.2 Interaction between drivers

The drivers described above act simultaneously, and could act synergistically, on decisions regarding the adoption of different management systems. Quantifying the influence of multiple drivers can lead to identification and prioritization of actions and policies to promote organic or

conventional farming. The CART analysis determined important factors that eventually affect adoption of organic and conventional management, in a sense that although there are many factors that affect adoption decision, there are two which have the most predominant effect when interactions are analyzed; these were: the availability of technology and the type of landowner. It is evident that the availability of technology facilitates post-harvest tasks and it is important to note how this driver interacts with who is the landowner is, e.g. married couples, instead of individuals were common owners on organic farms. This point underscores the role of family in decision-making, to continue a particular method of farm management associated with the use of technology.

The use of CART models as a statistical tool to identify interacting drivers has a novel value compared to the reviewed studies of crop adoption. For instance, other studies tested independent factors in the adoption of sustainable agricultural practices by means of multivariate probit models (Ndiritu et al., 2014). Similarly, separated determinants of adoption of conservation farming practices were analysed using tobit and fractional probit models (Arslan et al., 2014).

4.3 Benefits of combining ethnography and survey methods

The survey data and ethnographic information revealed that farmers' decision making is influenced by diverse, overlapping and interacting factors. Ethnographic research can thus provide additional information that cannot be quantified or recorder in a survey. For instance, Rueda and Lambin (2013) state elements that define the success of certification schemes in five municipalities of Santander based on both interviews with key informants and a household survey. Such elements entail price premiums alongside training, access to information, technology, social networks, resources, and access to specialty coffee markets. In comparison, our study not only confirms these elements, but also broadens the surrounding context with influence on decision-making process at farm level. This includes the identity of coffee growers associated with place-based ties, the triad of social farming spaces, institutions acting at national and local scales, the social relations of production, plus attitudes about management practices and other farmer factors. It constitutes a more complete frame of reference for understanding the local context in which coffee farmers adopt organic or conventional schemes of management.

753 The use of mixed analysis makes visible different views: from an institutional standpoint, seeing
754 landscapes in terms of commodity production can mean that they are treated as isolated entities
755 with extractable units. Thus at regional, national and global levels the treatment of coffee is, as a
756 commodity traded at market, valued for the price it can earn. From farmers' view, coffee
757 agroecosystems are not simply cash crops; it has been fully part of human social life and a piece of
758 local identity.

759 Ethnographic information from a small sample of farmers in Ocamonte complements the survey
760 data collected from other farmers in Ocamonte, El Valle de San José and Pinchote. For instance,
761 farmers who participated in interviews expressed their dissatisfaction with premiums, prices and
762 low yields on organic crops, especially during transition from conventional systems. In contrast,
763 survey data illustrate higher yields and profitability on organic plantations when the intensity of
764 management is held constant across farms of larger size, and once transition challenges have
765 been overcome. Although the growers' marketing performance depends largely on the quality of
766 coffee produced plus external factors linked to market and certification schemes, this approach
767 combines the strengths of a survey linked to ethnography, allowing a better understanding of
768 coffee farmers' decisions.

769 The combined analysis of quantitative data (e.g. factors affecting management adoption identified
770 from the survey) and qualitative analysis (e.g. factors identified by the ethnographic study) allows
771 for a more holistic understanding of the local context. The wealth of information generated through
772 the ethnographic viewpoint can also help to explain the results from the quantitative analysis. For
773 instance, population density was found to be low, with even organic farms showing very low values
774 (1.7 ± 0.3 people/ha) compared to conventional farms (6.9 ± 1.3 people/ha). This situation is
775 related to the migration of farmers' children to urban areas revealing a problematic condition of
776 unusual generational change that is likely to threaten not only the availability of family labour for
777 production and harvesting, but also the continuation of future coffee farming. On the other hand,
778 small-scale farming was found to be predominant on conventional farms (e.g. 1.2 ± 0.3) ha on 30
779 conventional farms compared to 4.3 ± 0.7) ha on 30 organic farms in Ocamonte). This could reflect
780 that coffee farms have become fragmented as they have been passed from parents to children by

means of property inheritance. Smaller areas may also favour off-farm employment which was found to be higher on conventional farms. Given the high level of interdependence between involvement of family and labour intensity in organic production, off-farm employment may constrain adoption of management-intensive crops (Fernández and McBride, 2002). Thus, it may explain the high dependency on income from coffee yields reported by organic farmers.

Compared with data recorded by other studies (e.g. Eakin et al., 2006; Frank et al., 2011), the use of two sets of data – qualitative and quantitative – provides an improved method with which to achieve a more complete understanding of factors (e.g. social identity, participation in cooperatives) involved in shaping coffee growers' decisions regarding climate change.

4.4 Policy implications

4.4.1 Implications for public policy

Contrary to generalized perception, our findings suggest that organic practices show important levels of productivity. Thus, we advocate increased and continued support for research and rural extension services into organic agricultural systems, with special attention to different types of mulch and/or manures such as those generated in sugarcane processing. On the other side, given that organic farms utilize different types of inputs, the strengthening of marketing system would be advised in order to ensure constant availability of those that are not produced within the farms (e.g. mineral salts, certified manures). It could support certification norms that promote the improvement of yields which in turn attract and maintain growers on organic schemes.

Driver analysis suggests that the policy of government and donors should focus on investments in the farm and business management skills of coffee growers as well as the strengthening of social programs (e.g., children's education aimed to increase self-esteem as coffee growers). Public support for local cooperatives may be useful in order to avoid potential liquidity constraints since their existence depends heavily on its trade with a particular seal. Thus policy measures can include the enhancement of extension services aimed at supporting price negotiations, opportunities to facilitate technology access and production programs with organic inputs.

809 4.4.2 Implications for general managerial practice

810 Our analysis shows that adopting organic schemes of management is promoted by multiple drivers
811 at local scale such as high yields, significant price premiums at individual and collective levels, the
812 role of producer cooperatives, availability of technology, and married couples as land owners. At
813 broader spatial scales, despite the fact that there is a trend towards a progressive increase in
814 consumer demand for organic products, the percentage of market that also demands conventional
815 coffees is remarkable. Thus, managers might gain insight from analyzing those drivers of adoption
816 and the cultural context related to identity of coffee growers, overlapping farming spaces, attitudes
817 about management, social relations of production, and the pivotal role of the coffee institute. In the
818 long term, the biggest challenge of coffee grower cooperative is to play a central role in trading
819 coffee.

820 **5. CONCLUSION**

821 Our results provide evidence indicating which drivers in the farm scale can affect the adoption of
822 either organic schemes of management or the maintenance of conventional practices. The
823 combination of qualitative and quantitative approaches has proved to be the most appropriate
824 methodology since it enabled the most significant drivers of management adoption to be identified
825 while ethnographic assessment allowed the contextualization of these drivers within a more in-
826 depth understanding of farmer-farm relationships. This study provides new insights into the
827 importance of adopting complementary approaches in order to offer a better perspective on coffee
828 production and farmer decisions, since these lie well beyond the boundaries of their local
829 agroecosystems. It clearly emerges that management decisions are not only based on financial
830 factors but on a variety of other circumstances (e.g. identity as coffee growers, the type of
831 landowner, technology, the role of coffee institutions), which are relevant to policy making and
832 development planning. Based on the results of analysis we seek to enrich food certification
833 debates and policy measures that help programs to improve the adoption of certified management
834 schemes. Farmers that adopted organic practices were more educated, included married couples
835 as decision makers, had larger farms with technological tools to facilitate postharvest tasks, and
836 were associated with a cooperative. In line with these findings, organic farms achieved higher

837 production levels than conventional coffee farmers. On the other hand, further studies are needed
838 to provide socioeconomic data in years of low, or even depressed, coffee prices to make
839 comparisons of drivers, since those reported in this study were derived from periods when higher
840 and favorable coffee prices prevailed.

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970 SUPPORTING INFORMATION

971 Additional supporting information may be found in the online version of this article:

972 **Appendix A.** Questionnaire used on coffee grower homes in relation to coffee agricultural
973 practices, productivity and land uses.

974 **Appendix B.** Driver screening: Fifty drivers categorized into social, labour, environmental,
975 institutions and market categories.

976 **Appendix C.** Fifteen combinations of drivers analysed by CART models using information from 67
977 organic and 67 conventional farms.