Environmental and economic costs and benefits from sustainable certification of coffee in Nicaragua

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Sustainable certifications have been promoted as a means of recognizing environmental benefits and generating economic benefits from sustainable coffee production. A case study is presented from one region of Nicaragua where these benefits were evaluated and two producer organizations were supported to improve their access to sustainable certification. Biodiversity and carbon stocks were found to be more associated with smallholder vs. large-scale farms than with certification per se, but reduced use of agrochemicals and good management of water sources was strongly associated with certification. Economic performance of farmers with different certifications varied, C.A.F.E. Practice and Rainforest Alliance certified farmers had higher incomes but also higher levels of investment than conventional farmers, while organic farmers had a similar level of income to conventional producers but achieved this with a lower level of investment. Producer organizations require substantial external financial and technical support to access these certifications, which may place limitations on the spread of the benefits from sustainable certification to a majority of producers.

Keywords: coffee, biodiversity, environment, C.A.F.E. Practices, carbon, Fairtrade, organic, Rainforest Alliance, Utz Certified, economic costs

THE SUSTAINABLE CERTIFICATION OF COFFEE has grown considerably over the past 10 years from being a niche product to approaching mainstream (Giovannucci et al., 2008). Sustainable certification was promoted by the World Bank and other international donors as part of the strategy to enable producers to obtain better prices after the coffee price fall of 2000–2004 (Castro et al., 2004). There are a number of sustainable standards for coffee; the primary ones are: Fairtrade; organic (which has different national standards); Rainforest Alliance Sustainable Agriculture Network Standard; and Utz Certified. Some leading companies have also brought out their own standards, such

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Company standards aim to ensure that coffee is produced under environmentally and socially beneficial conditions

as Starbucks with Coffee and Farmer Equity (C.A.F.E.) Practices® (Table 1). These standards aim to ensure that coffee is produced under environmentally and socially beneficial conditions, although standards differ in the emphasis and criteria used. These standards and their strong growth are seen as an opportunity to generate environmental, economic, and social benefits in producer communities, benefits which consumers seem interested in supporting. They also generate costs for producers to adjust their production practices and demonstrate their compliance.

The forest-like conditions of traditional shaded coffee systems in Central America and Mexico are considered to provide unique benefits for supporting biodiversity and providing other environmental services (Perfecto et al., 1996; Philpott and Dietsch, 2003; Idol et al., 2011). Most of the sustainable certifications promote shaded coffee (i.e. the producer gains points in the evaluation if the coffee is shaded), and in some cases for having species-diverse shade (in the case of Rainforest Alliance). Only in the case of bird-friendly coffee (SMBC, undated) is it mandatory to have a minimum of shade cover, tree density, species diversity, and number of tree strata. Perfecto et al. (2005) have analysed the trade-offs between productivity (closely associated with income) and biodiversity in shaded coffee systems based on their studies in Chiapas, Mexico. This trade-off is mediated by shade levels, with the assumption that more shade (i.e. more tree cover) is associated with greater biodiversity, but high levels of shade negatively affect productivity. They conclude that substantial premiums are necessary for farmers to be compensated for the lower productivity of high biodiversity systems.

The assumption is that more shade is associated with greater biodiversity, but it negatively affects productivity

Blackman and Rivera (2010) have reviewed 18 studies that have examined the effects of sustainable certification of coffee on socio-economic or environmental impacts. The vast majority of studies were of organic and/or Fairtrade farms, and the scientific peer-reviewed studies only covered these certifications. They considered that only six of the studies had credible counterfactuals and even across all 18 studies less than half identified socio-economic or environmental benefits. In evaluating the environmental benefits one of the challenges has been that farmers with different certifications tend to be concentrated in different regions under different environmental conditions, and thus are not directly comparable. These environmental differences also then affect the economic costs and income associated with these farms. In the current study we compared farms in the same region to establish whether certification differentiates the environmental management and services from those farms, whether they generate economic benefits for farms, and what the characteristics are of those farms. Furthermore, although the costs of farmers managing coffee under different certifications have

Table 1. Comparative summary of the emphasis given to different aspects of sustainability by different standards as applied to coffee producers

Criteria	*Fairtrade www.fairtrade.net*	*Organic (IFOAM) www.ifoam.org*	*Rainforest Alliance http://sanstandards.org*	*Utz Certified www.utzcertified.org*	*C.A.F.E. Practices www.scscertified.com*
Prerequisites	Smallholders within a producer organization	Three-year transition without use of synthetic agro-chemicals	Social and environmental management plan	Traceability along the supply chain	Meet Starbucks quality standards
Environmental criteria	Comply with national and international environmental laws Prohibit use of restricted pesticides	Soil conservation and improvement Shade recommended Restrictions on use of certain manures and minerals	Ecosystem conservation (shaded coffee recommended) Wildlife protection Water conservation Integrated crop management Soil conservation Integrated waste management	Good agricultural practices in soil, fertility, and management	Soil and water conservation Protection of forest and biodiversity Waste management Use of renewable energy Environmental crop management including use of shade and ecological pest control
Social criteria	Democratic and transparent social organization No discrimination of marginal groups		Fair treatment and conditions for workers Occupational health and safety Community relations	Health and safety Access to health, education, and reasonable housing for workers	Minimum salary, liberty of association, no child labour Access to water, health, and education
Economic criteria	Payment of minimum price and social premium (by buyer) Build capacity to directly export Promote social and economic development	Documentation of all administrative, productive, and commercial processes		Administrative system with registration of management practices	Economic transparency in price distribution between actors in the chain

Source: summarized from ANACAFE, 2008
Note: The authors are aware that some standards have been subsequently updated, however these were the prevailing criteria at the time of the study; International Federation of Organic Agriculture Movements (IFOAM)

been evaluated, little has been analysed or discussed concerning the institutional investments that are required to enable farmers to certify under these schemes. Among farmer groups there is investment in internal control processes for group certification, which require both training for farmers and their organizations, and time and money to implement changes to achieve and demonstrate compliance.

Specifically we sought to address three questions:

- Does the certification of farms effectively differentiate farms with better standards of environmental management?
- Does certification provide economic benefits to farmers who undertake these higher environmental standards of management?
- What capacity is needed in producers and their organizations to achieve certification of these environmental standards and access the economic benefits?

From 2006 to 2010 the project 'CAFNET: Connecting, enhancing and sustaining environmental services and market values of coffee agroforestry in Central America', a collaboration between CIRAD and CATIE, sought to evaluate the costs and benefits of certification, and support producer groups in obtaining certification where appropriate. This paper reports on the experience from one of the study sites: PenasBlancas in Nicaragua.

Study site

PenasBlancas is a highland plateau between the departments of Matagalpa and Jinotega in Nicaragua, at the heart of the main coffee-growing region in the country. The reserve is at the southern end of the Bosawas Biosphere Reserve. The area was declared a natural reserve to conserve the remaining forests and water sources that arise from the plateau, but farms were already established in part of the area. The natural reserve has about 2,000 ha of coffee in the core zone, of which one-sixth is unshaded coffee, although nationally 94 per cent of coffee is shaded (MAGFOR, 2002). This has led coffee production to be seen as conflicting with the conservation aims of the reserve, which could be resolved if producers sustainably certified their coffee production, reducing the negative environmental impacts while hopefully sustaining their livelihoods.

Coffee production is seen to conflict with conservation aims, which could be resolved if producers were certified

In the region there is a mixture of large-scale farms and smallholdings. Some of the smallholdings belong to one of three cooperatives: Guardianesdel Bosque, who are environmentally aware but not certified; COOMPROCOM (Multi-sector Cooperative of Organic Coffee Producers of Matagalpa), an organic Fairtrade certified organization; and CECOCAFEN, who are Fairtrade certified with some producers certified organic, Utz or C.A.F.E. Practices. Amongst the

large farms some are also sustainably certified mostly by Rainforest Alliance, C.A.F.E. Practices, or Utz Certified. These processes of certification have been facilitated by the coffee traders, primarily ECOM Trading in this region.

Methods

Environmental services

Environmental services were evaluated on 22 farms divided into 14 smallholder farms (<20 ha) and eight large-scale farms (>35 ha). Seven of the smallholders were certified organic, and four of the large-scale farms were certified either Rainforest Alliance (three farms) or C.A.F.E. Practices (one farm). The environmental services were evaluated in four areas:

- Habitat quality in terms of tree cover, trees per ha, number of native tree species, and number of strata – essentially how similar the plantation is to a forest.
- Carbon stocks in trees and coffee was calculated based on measurement of heights and diameters of trees in four 500 m^2 plots in each coffee farm. Allometric equations approved by the IPCC were used to convert these data into estimates of above-ground carbon stocks.
- Conservation of soil was evaluated by measuring vegetative soil cover and scoring the use of soil conservation practices.
- Conservation of water sources was evaluated by scoring the management of potential sources of contamination and use of water-conservation measures.

The methodology used was based on that proposed by Medina et al. (2006). The study was undertaken as part of the undergraduate thesis work of two students at the National Agrarian University (Cuadra-Mayorga and Alvarado-Narváez, 2009). Variables for habitat quality, soil cover, and carbon stocks were analysed as a two-way ANOVA with farm size and certification as the main factors. If one of these factors was significant, then means of the value for each combination of farm size and certification were compared using a Tukey multiple means comparison. Scores for soil and water contamination and conservation practices were analysed using principal components analysis to evaluate association with farm size and certification.

Economic benefits

The COSA method for multi-criteria assessment of sustainability in coffee (Giovannucci and Potts, 2008) was used to evaluate costs of production and income from 130 farms in the region. The surveys

were undertaken in the four municipalities (El Cua, Jinotega, Tuma La Dahlia, and Rancho Grande) that cover, or are adjacent to, the PenasBlancas Reserve. The sampling of farms extended outside the reserve as the number of certified farms within the reserve was limited. Nevertheless, most of the area is considered to be part of the buffer zone of the Bosawas Biosphere Reserve, and has the same ecological conditions. The aim was to survey 20 farms from each certification and 40 conventional farms, but only 11 Rainforest Alliance farms were available (Table 2). Certified farms were identified from lists provided by cooperatives or coffee traders; conventional coffee farms of similar size were identified in the same communities as the certified farms. Although no data are available of the number of coffee producers in this specific area, it is estimated that there may be a few hundred farms in the PenasBlancas reserve, with a few thousand farms in the four municipalities around it. Farm questionnaires were used to register all coffee management practices and estimate the costs of those practices, the volume of production, and value of sales. This information was used to calculate costs for each management practice (e.g. fertilization, weeding, harvesting, and processing) which were then aggregated to estimate agronomic costs of production. Costs of loans, infrastructure, and management were also taken into account. Farmer questionnaires were undertaken by two surveyors experienced in farm verification processes. They were provided with additional training by the authors and revision and feedback on the content and quality of the questionnaires provided.

Farm questionnaires were used to estimate costs of coffee management practices, production volumes, and value of sales

Coffee productivity, cost of production, total income, and net income were compared between certifications and conventional producers using an analysis of variance. Farm size was included as co-variable; as farm size had a significant ($p<0.04$) effect on net income, the data were divided into farms less than 25 ha and between 25 and 200 ha. The size for separation was based on a regression tree of farm size against net income with a small adjustment (one Fairtrade farm just over 25ha was moved into the less than 25 ha group) to

Table 2. Number of farms surveyed by certification

	Number of farms		
Certification	*< 25 ha*	*> 25 ha*	*Total*
Conventional	33	9	42
C.A.F.E. Practices	9	13	22
Fairtrade	18	0	18
Organic	18	0	18
Rainforest Alliance	0	11	11
Utz Certified	19	0	19

achieve roughly equal numbers of certified and conventional farms in each group to facilitate statistical comparison within those groups.

Building capacity in farmers' organizations to become certified

Two of the producers' organizations (Guardianesdel Bosque, and COOMPROCOM) were supported to take part in an intensive business capacity-building programme run by the Learning Alliance (www.alianzasdeaprendizaje.org) an inter-institutional collaboration between development NGOs and research organizations to support producer organizations. One of the producer organizations, Guardianesdel Bosque, had no previous experience in commercializing coffee; its previous activity was mainly managing a small rural hostel for visitors to the natural reserve. The other, COOMPROCOM, is certified Fairtrade and organic and has been selling coffee to a UK buyer for a number of years. Members of the two organizations took part in five training sessions over the course of 18 months, accompanied by a technical adviser who worked with the organization to develop the business capacity-building exercises. The main themes were: strategic planning; organizational structure and functioning; business management; and service development. The main result from this process was the development of a business plan to improve or develop the services offered by the organization around the commercialization of coffee. Among the options considered to improved commercialization was the role of sustainable certification. The decision whether to seek certification was taken by each organization based on its analysis of the priorities for development of the organization. Nevertheless, the process serves to illustrate the relative importance of certification within the potential commercial development of a producer organization and the steps required for those that do decide to seek a sustainable certification.

Sustainable certification was one of the options considered to improve commercialization

Results

Environmental services

Farm size had a significant effect on the quality of coffee plantations as habitats for biodiversity

There was a significant effect of farm size on the quality of the coffee plantations as habitat for biodiversity in all four criteria. Although certified farms also tended to have better ranking in these aspects, it was not statistically significant (Figure 1). Certification had a significant effect on the use of agrochemicals, which was lower in both small- and large-scale farms (Figure 2). Ground cover was only different among farm types in large certified farms having more litter cover. Although not statistically significant, large non-certified farms implemented no soil conservation measures, while some certified and small-scale farmers did apply such measures. Carbon stocks were

marginally affected ($p<0.1$) by both certification and farm size, with a tendency for greater carbon stocks with certification and smaller farm size resulting in the small organic farms having the largest carbon stocks (Figure 3). The major difference was between smallholder organic farms, with above-ground carbon stocks five times greater than large-scale, uncertified farms (significant at $p<0.05$). Principal components analysis showed a high degree of association of large certified farms (labelled Rainforest) with better treatment of water contamination and implementation of water conservation measures (Figure 4), while large-scale uncertified farms were associated with erosion around water sources. Smallholder farms, whether organic or not, were not closely associated with any of these factors, which could be because a small farm is less likely to have water sources on the property.

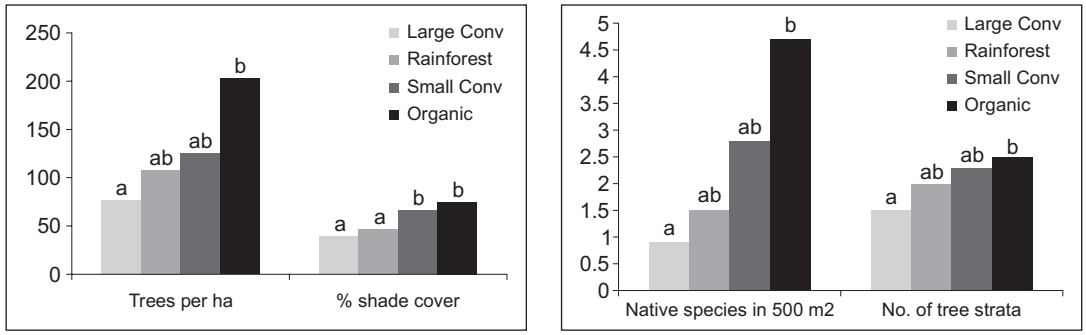

Figure 1. Habitat quality indicators for biodiversity across farm types
Note: Columns that do not share the same letter are significantly different ($p<0.05$)

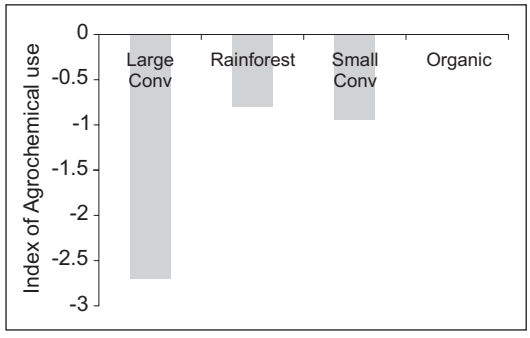

Figure 2. Index of agrochemical use (a product of toxicity and frequency of use – the more negative the more frequent and greater the toxicity of products applied)

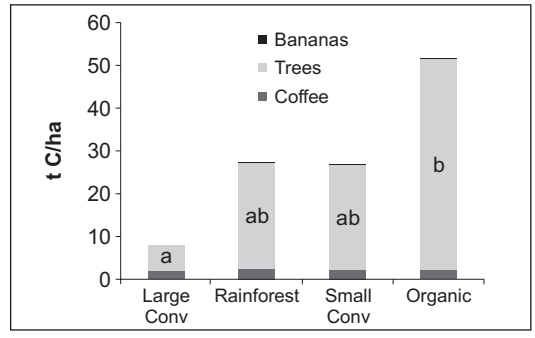

Figure 3. Carbon stocks in trees, coffee, and bananas

Note: Conv = conventional; columns that do not share the same letter are significantly different ($p<0.05$)

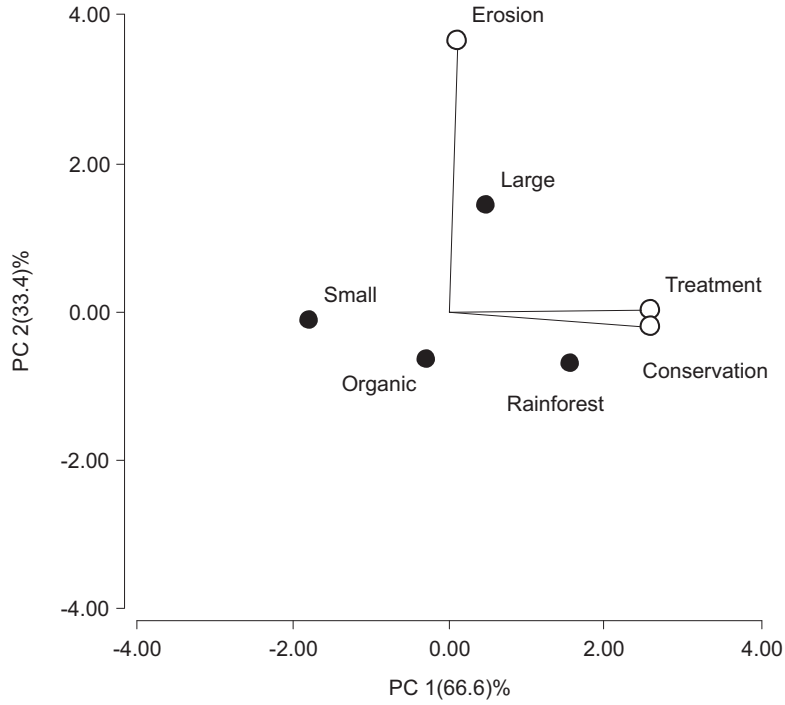

Figure 4. Principal components analysis of relationship between farm type and: 1) treatment of contamination sources; 2) erosion around; and 3) conservation practices associated with, water sources
Note: Small and large are uncertified conventional farms of this scale

Table 3. Costs and income from coffee production under different standards

	Productivity (kg/ha)	*Gross income (US$/ha)*	*Production costs (US$/ha)*	*Net income (US$/ha)*	*Price (US$/kg)*	*Ha of coffee*
<25ha of coffee						
Conventional	840 AB	1,921 A	1,084 ABC	836 AB	0.45 A	5.6 A
Fairtrade	1,023 AB	2,689 AB	1,336 BC	1,351 AB	0.54 A	4.0 A
Organic	499 A	1,745 A	529 A	1,216 AB	0.74 B	4.0 A
C.A.F.E. Practices	1,335 B	3,530 B	1,734 C	1,795 B	0.53 A	12.8 B
Utz Certified	661 A	1,426 A	676 AB	748 A	0.44 A	5.3 A
>25 ha of coffee						
Conventional	872 A	2,025 A	1,193 A	829 A	0.47 A	40.1 A
Rainforest Alliance	1,430 A	4,256 AB	1,784 A	2,472 A	0.61 B	82.6 AB
C.A.F.E. Practices	1,518 A	4,381 B	1,839 A	2,541 A	0.58 B	100.6 B

Note: Values that do not share the same letter after them are significantly different at $p<0.05$

Economic benefits

Economic variables were significantly affected by area of coffee in production but not by farm altitude. Therefore farms were divided into two size categories, with less or more than 25 ha of coffee. Within these groups, farm size did not significantly affect economic variables, although there were significant differences in the average farm size under different standards: larger farms for C.A.F.E. Practices and Rainforest Alliance certifications than the conventional farms. There was also a significant difference in the altitude of farms under different certifications among the small farms, but there was no significant relationship between altitude and coffee price as may have been expected. Thus as farm size (after separation into greater and less than 25 ha) and altitude did not have a significant correlation with economic variables, we consider that the comparison between certifications is valid.

Among smallholders, productivity was significantly lower for organic and Utz Certified producers compared with C.A.F.E. Practices-certified producers, but so were their costs of production (Table 3). Organic producers obtained a significantly higher price than all other smallholders. Net income was highest for C.A.F.E. Practices-certified producers, but only significantly higher than the Utz Certified producers. Among large-scale producers, those certified Rainforest Alliance and C.A.F.E. Practices obtained significantly better prices than the conventional producers. Although net income was three times higher for certified large-scale producers than conventional farms this was not statistically significant, but gross income was significantly higher for C.A.F.E. Practices farms. The lack of a significant effect on net income is probably due to the small sample size and high variance.

Organic coffee producers obtained a significantly higher price than all other smallholders

Building farmer organization capacity to produce and market certified coffee

Although the generic process was similar for the two organizations, because of their different initial capacities, their advances were distinct. Guardianesdel Bosque started with ordering the roles of the board members and defining the processes for good management of the organization. With this basis they were able to review their objectives in consultation with the membership and plan based on the resources they had available. Ultimately, this resulted in a strategic plan and a business plan to collect and market coffee produced by the members. They were supported in the implementation of the plan by FondeAgro, a collaborative agricultural development project between the Swedish International Development Agency and the Ministry of Agriculture, Livestock and Forestry. The organization collaborated

A marketing cooperative made credit available to pre-pay members for their coffee

It was necessary to strengthen a commercialization route over which members had some control before considering certification

in the formation of a second-tier marketing cooperative with other organizations to jointly develop the capacity for exporting coffee, and through which credit was made available to pre-pay members for their coffee. This enabled members to sell their coffee at better prices than those offered by local intermediaries, receiving a premium of $0.40 per kg. Also they managed to establish commercial links with an exporter, exporting two containers of coffee through the second-tier marketing cooperative. Having established this commercial capacity, the current plan is to become certified Fairtrade and possibly either C.A.F.E. Practices or Utz Certified, as they consider this will promote practices that will protect the natural reserve in which they live. The primary lesson is that it was necessary to strengthen the internal capacity of the organization and a commercialization route over which they had some control before considering the possible benefits of certifying their members to generate differential market benefits.

The other organization, COOMPROCOM, started with a member ship of 52 farmers and has been certified Fairtrade since 2004, with 82 per cent of production certified organic (the balance is mainly areas in transition to organic). Although an established cooperative, the first stage was similar to Guardianes: conducting a review of the structure of the organization and clearly defining the roles of the different board members and staff. This has been important for clearly assigning and improving the quality of services for financing, collection, and marketing of the coffee. An internal revision of the cooperatives plans, initially by the board and subsequently in consultation with the membership, enabled a review of the strategic vision of the cooperative. Although the organization wished to remain faithful to the environmental values it had found in organic production, a number of members were concerned about the low productivity of organic production, which was barely compensated by the higher price.

Nevertheless, over the two years of improvements in the services offered by the cooperative, this contributed to an increase in membership from 122 to 181 farmers (between 2008 and 2010), and increased the volume of organic coffee sold from 4,500 sacks (of 46 kg) to 5,350 sacks, a 19 per cent increase. The additional production was sold to a different buyer to reduce dependence on their sole UK buyer. Even though they had no complaints about that buyer, it was considered good business practice not to depend on one market. Subsequently, with the aim of further expanding membership and markets, and providing an alternative to organic production, it was decided to seek an additional certification. Therefore the cooperative decided to explore having certification with Rainforest Alliance. This would sustain their environmental principles but enable those members who wished to invest in higher productivity than was

Certification with Rainforest Alliance would sustain their environmental principles but enable members to invest in higher productivity

considered achievable under organic production. To obtain the certification, various steps had to be completed:

1. First the cooperative had to undertake a diagnostic survey of the farms that wished to participate to evaluate whether they would meet the criteria for this certification, or what improvement would have to be made to do so. This work was done by contracting an external specialist who had detailed knowledge of the certification criteria and was paid for by the CAFNET project.
2. The cooperative had to develop an internal control system, and plan for continuous improvement and an environmental management plan. For this, the cooperative received financial and technical support from a national development agency, FUNICA, which also supported the farms in making changes to comply with the standard.
3. The final stage is to order the external inspection and find a buyer for the coffee. For the 15 farms being considered for inspection, the cost of certification is approximately $3,500.

From making the decision to obtain this certification to being ready to apply for it took two years. Achieving this required both financial and technical external support from at least two separate sources – even though the cooperative already had experience in organic coffee. It has to be remembered that as a group certification, if one of the farms inspected fails then all farms are rejected. This places considerable responsibility on the internal inspections to ensure that all farms put up for external revision are compliant. Furthermore, even if the farms pass the first year, there is a requirement of continuous improvement, so compliance rates must be higher for the following year's inspection. At the time of writing, the cooperative is negotiating its first container (of 225 sixty kg sacks) of Rainforest Alliance-certified coffee.

Discussion

Smallholder farmers have greater tree density and diversity in their coffee plantations

In general, smallholder farmers have greater tree density and diversity in their coffee plantations, which is further accentuated among organic producers. This is in part related to the needs of small-scale producers to derive multiple benefits and products from their coffee plantations, including fruits, timber, and firewood (Schibli, 2001), whereas large-scale producers concentrate on the main crop, coffee, and use simpler and easier to manage shade systems. Quispe (2007), comparing farms with different certification in Costa Rica, found that Fairtrade-certified farms had higher shade levels and greater tree diversity, although they were also found at lower altitude than

other farms, which would tend to promote more use of shade. Nevertheless, although there was a tendency for certified farms to have better indicators of habitat for biodiversity, they do not appear to strongly differentiate those farms with the highest biodiversity. Thus the compensation that Perfecto et al. (2005) contend is required to conserve biodiverse coffee systems is not clearly met.

Carbon stocks were essentially a reflection of these differences in the presence of shade trees on the coffee farms. As summarized in Idol et al. (2011), high above-ground carbon stocks in shaded coffee are largely determined by the presence of large diameter free-growing trees. The estimates of carbon stocks for large-scale farms are typical of simple legume-shaded systems and those of smallholder farms of diversified shade systems, while those of the organic farmers, at around 50 t/ha, are typical of forest-shaded coffee (Idol et al., 2011). As highlighted by Haggar and Noponen (in press), although there are several studies of carbon stocks in shaded coffee, data is lacking on the temporal dynamics of these stocks to know what level of net sequestration may be occurring.

For water conservation practices and use of pesticides, there was a clear effect of certification on large-scale farms improving these practices and reducing contamination of water sources. Quispe (2007) also found that organic producers had higher percentage ground cover and less evidence of soil erosion than producers under other certifications, although no clear trend was seen in the current study. Similarly Blackman and Rivera (2011) quote a study (by Blackman and Naranjo) that found organic producers in Costa Rica use less agrochemicals and implement more soil conservation measures than conventional producers.

C.A.F.E. Practices producers had the highest net income, owing to higher productivity and investment in production

Among the smallholder producers, the C.A.F.E. Practices-verified producers had the highest net income per ha, although this was largely due to having higher productivity and the highest investment in production. These farmers also had on average larger areas under coffee, over 10 ha, which would generally be correlated to a greater economic capacity to invest. It should also be recognized that the farms had the highest altitude and were at the optimum altitude for coffee production (1,000–1,200 m above sea level), which also provides the high quality coffee that Starbucks, the owner of the C.A.F.E. Practices standard, requires. Millard (2006) also found increased income of C.A.F.E. Practice-verified farms in a joint Starbucks/Conservation International project in Mexico, the primary reason for which was the higher prices paid to verified farms. This was between 2001 and 2002, however, when international coffee prices were at a historic low and less than half the price of coffee during the current study.

The organic producers presented a contrasting strategy of low investment in production but, because of the premium price,

Organic producers' strategy of low investment achieved the same income as other producers because of premium prices

achieved the same level of income as other producers who had a greater investment. Thus this strategy seems to suit producers with poor access to external financial resources and limited capacity to invest themselves. Other studies have criticized organic production for its low productivity (van der Vossen, 2005) or indicated that it only represents an option against other low-input systems but essentially keeps farmers in poverty (Valkila, 2009). Although we agree that organic production had lower productivity and greater income can be achieved through higher-intensity non-organic management, organic production generates a net advantage for producers who may be otherwise unable to intensify their production systems. There is also probably an interaction between the socio-economic status of producers and the environmental variables. Organic producers probably have the best habitat quality indicators and highest carbon stocks because they have little capacity to intensify the management of their coffee (which would usually entail reducing and simplifying the shade) rather than these environmental benefits arising as a result of being organic.

The Utz Certified producers had a similar limited capacity to invest, but prices were no better than conventional producers, although it should be recognized that the Utz Certified farms came from the lowest altitude, for which coffee prices would be expected to be lower (although no statistical correlation was found). Fairtrade-certified producers had an intermediate performance, not statistically different from either conventional or C.A.F.E. Practice-certified farms, but generally significantly different from organic and Utz. It should be remembered that the Fairtrade social premium is used for community-level social investments. Although the producers may benefit from this (e.g. educational materials for their children to attend school) it does not directly contribute to farm income. Among large-scale producers, both Rainforest Alliance and C.A.F.E. Practice-certified farms achieved greater productivity and net income than conventional farms, but also for a considerably higher level of investment. Once again although no correlation between farm size and income was found, it may be that the larger average farm size of the certified farms would indicate a greater capacity to invest in production and take advantage of the benefits of certification.

Blackman and Rivera (2010) critique many studies for their lack of credible counterfactuals (i.e. whether the controls or conventional farms represent a true comparison of what the certified farms would have been like if they had not been certified). Overall they conclude that both economic and environmental benefits from certification vary between studies: some indicate greater use of environmental practices by certified farms, but others found little difference when the environmental services themselves (e.g. bird diversity) were

compared, although most of the environmental service studies were for relatively few farms (about 20 as in this study), which creates a high probability of selection bias. Likewise, they find variable evidence for economic benefits; although prices were often higher for certified producers, this often does not translate into clear economic benefits for producers. The data from this study were similar in this respect, but we consider this difficulty more a function of the complex socio-economic reality of the producers than a definitive lack of impact from certification. Nevertheless, undoubtedly certification entails real costs as can be seen from the experience of the two producer groups. Another important limitation of all the studies was lack of tracking of changes over time as a farm passes from conventional to certification, which provides a complementary perspective on the changes that certification can facilitate.

Individual certification is only viable for large-scale producers with expertise to handle the certification process

Producers can access certification through different routes; the first option of individual certification is only viable for large-scale producers with established technical expertise to handle the certification process. There are two options for group certification: either through being members of a producer organization (and thus sharing the costs of certification), or through an exporter who organizes the certification and assumes the costs of establishing the internal control processes and documentation, as well as the costs of certification itself. In either case, the costs of these services need to be deducted from the sales income from the coffee. The difference is that in group certification the producers (or their organization) are the owners of the certification and they can negotiate the certified coffee with whomever they like, whereas if the certification is held by the exporter, the producer is obliged to sell through the exporter if they wish to use the certification.

In group certification, producers own the certification and can negotiate with whomever they like

As can be appreciated from these case studies, obtaining the certification required substantial investment for which the producer organizations received external financial and technical assistance. In these cases, the external assistance came from different donor-funded development assistance. Without this support the main option for producers to cover these costs is through an alliance with an exporter. Even then, this requires considerable social organization within the producer organization to achieve agreement from members, establish the internal control systems, and ensure compliance amongst members. The two years that it took COOMPROCOM to achieve the Rainforest Alliance certification is typical of the experience of other cooperatives with whom the authors have worked, where it has taken between 18 months and three years for them to meet the requirements to achieve certification.

Conclusions

Sustainability standards differentiated some environmental management practices, but for others farm size was more important

There may be a need for several different certification processes for different types of farmer

Although the geographic scope and sample size of this study was limited, we can come to some general conclusions, at least for this region, with respect to the initial questions. For the farms studied, the sustainability standards did differentiate between some environmental management practices of producers (primarily use of agrochemicals and water management), but for other environmental characteristics (habitat quality for biodiversity and carbon stocks), farm size was more important than certification. There was evidence that, in general, certification does bring some financial benefit to producers, but different certifications appear to meet the needs and demands of different socio-economic groups of producers. Organic certification suits small-scale producers with a low capacity to invest, while C.A.F.E. Practices or Rainforest Alliance was more suited to producers with a higher capacity to invest. This is an important justification of why there may be a need for several different certification processes, as they differ in acceptance by different types of farmer, but they all appear to differentiate from conventional producers in some respect. The experience of the two producer organizations shows that, despite these benefits, there were considerable administrative costs and technical capacities that were required to access certifications. To the authors' knowledge, no producer group has accessed sustainable certifications without external financial and technical support either from coffee traders or development assistance, as illustrated by these two cases. This must be considered a limitation to the expansion of the environmental and social benefits that can be derived from the participation of coffee growers of all types in the sustainable certification of their businesses.

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