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INSTITUTO DE MANEJO E CERTIFICAÇÃO FLORESTAL E AGRÍCOLA

SUSTENTABILIDADE EM DEBATE

Sustainability is good business for agriculture

Content

Overall summary

This issue of *Sustentabilidade em Debate* brings together three studies that complement each other with the aim of answering the same question: can the adoption of good management practices for production, conservation of natural resources and working conditions be justified economically? In other words, is the adoption or pursuit of sustainability a good deal for farmers?

This question stems from a mismatch between common sense and the experience of Sebrae-MG's Educampo Program, Rabobank and Imaflora with a large number of farmers. As a rule, industry leaders argue that sustainability can be achieved as long as someone foots the bill. This statement embeds the assumption that sustainability is a cost or a competitive disadvantage. The experience of leading organizations in these studies shows otherwise. Farmers affected by programs that contribute to the implementation of sustainability initiatives have reported that investments in agricultural production based on best practices bring economic returns and make their businesses more profitable, competitive and resilient.

To test whether this perception is actually true, SEBRAE, Rabobank and Imaflora joined researchers from ESALQ-USP and from the University of Oxford. Based on robust methods, the three studies analyzed large databases that contain information from dozens of farmers covered by programs designed to stimulate sustainability in several regions of Brazil either through the provision of credit, technical assistance or certification.

This publication presents, in advance and in a simplified and summary form, studies in final stages of postgraduate research that will later be published in detailed academic format.

The main conclusions and recommendations of the studies are the following ones:

1. *Farmers who adopt sustainability and management programs have improved economic performance outcomes. They are, therefore, more competitive.*
2. *This is because these farmers achieve higher productivity, become more efficient and produce at a lower cost. The economic advantages enjoyed on the farms are independent from market benefits or special prices.*
3. *A farmer with high socioenvironmental performance tends to have greater financial health and, therefore, would tend to be a customer with less risk and greater ability to pay for the financial sector.*
4. *A management system is critical for implementing sustainability practices and for improving productivity and the efficiency of production.*
5. *Management systems and sustainability practices can be adopted by small, medium and large farmers. Collective actions favor and increase the scale of adoption for small and medium ones.*

We have not found any dependence between socioenvironmental performance and the wealth or size of farmers.

6. *Credit can influence the adoption and support the implementation of good practices, management systems and sustainability practices in agriculture. A credit policy based on incentives and mechanisms for supporting changes driven by financial agents can induce a process of continuous improvements in the performance of farmers in terms of sustainability. The adoption of such a mechanism tends to be beneficial for farmers and banks.*
7. *Market instruments such as certification contribute to the implementation of management systems and sustainability practices. They can be implemented collectively, thus reducing costs for farmers.*
8. *There is a gap in terms of public policies designed to support the adoption of better management systems by farmers. Weak technical assistance and rural extension programs constitute a major barrier to sustainability.*
9. *The experiences of Rabobank and of the Educampo program (SEBRAE) show the potential of credit and technical assistance to promote and support the implementation of sustainability practices on farms. However, the main public policies for agricultural production do not encourage or support the implementation of management systems and sustainability practices as a core component. Little by little, sustainability parameters are being incorporated into some policies, but still in a marginal way. The metrics of production and productivity that usually measure the sector's success make all the challenges and complexities involved in promoting sustainable production invisible.*
10. *Weak public technical assistance and rural extension (ATER) programs go hand in hand with the increasing role of the private sector as a source of innovation and technology transfer, which is not necessarily intended to improve management systems, sustainability practices and the efficiency of farmers.*

Credit can make a difference for the sustainability of agriculture*

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*Simplified and preliminary version of part of the Doctoral Thesis of Dienice Bini, prepared under the guidance of Prof. Silvia Miranda, PhD (ESALQ-USP)

Summary

Making rural credit available to farmers has been a major public policy intervention to promote the development of Brazilian agriculture. However, despite piecemeal initiatives, it has not incorporated sustainability as a core dimension. This study is intended to evaluate the role of credit in promoting sustainability in Brazilian agriculture based on an analysis of how Rabobank's sustainability policy has been implemented in Brazil. Combining three methods, we tested whether there is a relationship between the financial health and socioenvironmental performance of farmers and whether their socioenvironmental performance improved as a result of their relationship with the Bank. Ability to pay, level of debt, solvency and liquidity were the financial health variables that were used. The socioenvironmental variables comprise parameters related to legal conformity and performance in relation to, for example, the forest code, health and safety regulations (NR 31), waste management guidelines, among others. Other complementary variables were selected such as revenues, assets, the farmer's experience, credit history, crop diversification, dollar variation, which also correlate with financial health.

The results of the study suggest that there is a positive correlation between the socioenvironmental performance and the financial health of farmers. The better the social and environmental performance, the better the financial health of a farmer tends to be and vice versa. We found that the policy, incentives and monitoring of the Bank induce continuous socioenvironmental improvements on the part of its clients, which are more intense in the early stages of their relationship. However, our conclusion is that socioenvironmental aspects are taken into account only marginally in most of the credit schemes available to the Brazilian agricultural sector, despite the availability of some domestic and international initiatives in self-regulation and guidelines for the financial sector to play its role in relation to promoting sustainability, such as the Green Protocol, the ABC program, Febraban guidelines, the Equator Principles and the Banking Environment Initiative.

The experience of Rabobank shows that commitments and initiatives can be adopted for the financial sector and rural credit schemes to actively promote sustainability in the Brazilian agricultural sector. The study provides evidence that the adoption of credit-related mechanisms to promote sustainability tends to result in advantages both for farmers and for the financial sector.

1. Introduction and context

The evolution of Brazilian agriculture over the past 50 years has been marked by territorial expansion, rising productivity levels and increasing shares in several international markets; as a result, Brazil has become a benchmark in food production. This trajectory resulted from the adoption of a set of agricultural policies (minimum prices, agricultural credit, rural extension and agricultural research) that led to improvements in the technology and conditions for stepping up production and productivity in Brazil. This process became known as "Modernization of Agriculture".

Agricultural policies have been used to stimulate the adoption of new technologies and influence farmers toward growing certain crops. The availability of agricultural credit for investment has been a key factor in expanding agricultural mechanization in Brazil. The cost of credit, in turn, has induced the use of modern inputs and influenced decisions about what to grow by focusing funds on certain crops, particularly on export and food crops.

In short, these agricultural policies were intended to modernize and expand agricultural production in Brazil and their objectives have been changing in recent years. They are becoming cross-cutting policies designed to stimulate production but also to meet objectives in terms of food security, environmental protection, agricultural zoning, among others. This shift led to changes in how these policies are implemented, with greater involvement of companies, cooperatives and civil society.

Currently, the Brazilian agricultural sector is funded by three main sources: the public financial system (Banco do Brasil, Caixa Economica Federal and state and regional public banks), private banks, input companies and traders and funds of the farmers themselves. Estimates of market agents roughly suggest that each of the three sources (credit, upstream or downstream companies and the farmers themselves) account for one-third of the sector's financing in Brazil as a whole. There are regional variations, with the financial system prevailing in the south region, due to the predominance of small and medium farmers in it. In the midwest region, where large farmers prevail, the share of companies, traders and self-financing of farmers is more relevant.

Rural credit schemes are currently available for both corporate and family farming as a result of the creation, in 1996, of credit programs focused on family farming (PRONAF) and of a significant increase in

the funds earmarked for them. In their wake, the Harvest Plan allocated R$187.7 billion to corporate farming in 2015-2016 and R$24.1 billion were earmarked for the Pronaf program in 2014-2015.

In this context, rural credit has been used as one of a set of public policies designed to promote the development of Brazilian agriculture by financing fixed costs, investments and crop marketing. The success of rural credit is measured in terms of disbursements of funds, while the success of the Brazilian harvest is assessed in terms of production, productivity and production value. Most studies on the impact of rural credit assess the correlation between credit volume and production or demand for machinery and equipment, but they don't evaluate other possible impacts on the production process, such as productivity gains, cost reductions, new land uses, among others.

Again, agricultural policy tends to be more cross-cutting currently and is beginning to combine production with other aspects such as risks, environmental impacts, technological innovation, among others. This can be clearly seen in the Harvest Plan, which includes credit lines such as the ABC Plan, designed to stimulate low carbon agriculture, although its importance is still marginal in relation to the amount of credit available for the sector (less than 2% of the total credit made available under the Harvest Plan in 2015-16). In addition to this line, there are others which take into account environmental issues, such as Modergro, Moderinfra, Inovaagro and Prorenova.

However, little is still known about the relationship between credit and the quality of the production process or the social and environmental performance of production as key elements. Few studies evaluate the impact of new forms of rural credit on the operating performance of farms.

We can say that, until recently, the conformity of farms with laws and socioenvironmental criteria was regarded as generating new costs and, possibly, higher revenues. Thus, farmers seeking environmental certification seals operated in niche markets where prices had a premium over traditional markets. Apart from this incentive, the seal also provides gains in terms of the image of the company and of its product. But we still know little about the impacts of adopting environmental criteria on productivity and efficiency in production units.

In this context, a larger role can be anticipated for the private financial system in integrating sustainability and social responsibility as relevant attributes for Brazilian agriculture, including for its competitiveness and operational improvement. Thus, the adoption of environmental criteria for granting credit would be an additional incentive for farmers to comply with environmental laws and, as a result, abiding by them becomes a rule of conduct, rather than just a niche strategy.

2. Objective

This study was intended to evaluate the impact of conducting social and environmental risk analyses for making credit available as a means to promote socioenvironmental sustainability and proper

management of agricultural production. Its specific objectives were to analyze the correlation between implementing the Rabobank's sustainability policy and improvements in the environmental performance of its client farmers, as well as to check if there is a link between the financial health and the environmental performance of farmers.

BOX 1 - Rabobank

Rabobank, a Dutch bank born from the merging of agricultural credit cooperatives, is a global leader in the agricultural and food industry. The bank has been operating in Brazil for over 25 years through operations focused on making credit available for agriculture and its current assets amounted to about R$10 billion in 2014. Rabobank has two main business units in Brazil: "Rural & Retail" (for farmers), and "Corporate Clients" (for agribusiness companies). Cooperative and sustainability-related values are seen as pillars of the bank.

Credit operations are made up of the following elements

	2014					
Product	Rural	Industry	Trade	Natural person	Other services	Total
Transfers of external funds	2,901,017	139,594	5,123	1,404,913		4,450,647
Export financing Advances on exchange	959,020	1,449,181	204,474	69,358	8,527	2,690,560
contracts (Note 7) (*)	8,451	1,020,532	260,409	1,416	-	1,290,808
Finame	1,071,204	83,445	16,173	20,319	10,597	1,201,738
Working capital	181,437	174,631	11,244	84,145	-	451,457
BNDES	213,087	112,484	5,433	-	-	331,004
Certificate of agribusiness credit rights	-	191,008	-	-	-	191,008
Funcafé	108,824	19,276	19,724	-	5,128	152,952
Guaranteed account	14,691	6,075	13,972	2,116	20,187	57,041
Compror	528	3,437	33,935	-	612	38,512
Vendor	-	3,047	19,931	585	-	23,563
Import financing	-	12,220	-	-	-	12,220
Other credits	-	32,248	-	-	-	32,248
	5,458,259	3,247,178	590,418	1,582,852	45,051	10,923,758

(*) Includes income receivable from advances granted

Source: Consolidated Financial Statements for FY 2014 (Rabobank Brazil)

A socioenvironmental responsibility policy and a governance framework for sustainability have been in place at Rabobank Brazil since 2006. Socioenvironmental due diligence is carried out for all operations that require credit approval even before the beginning of any credit relationship and it is renewed at periodic intervals established in the company's procedure manual.

The differentiating feature of Rabobank's analysis that made it possible for this study to be carried out is that it applies a rating system to measure the socioenvironmental performance of its clients. An environmental score is given to each farmer client in a visit paid to his or her main farm by technical

experts of the bank (agronomists trained in environmental issues). During such visit, aspects related to legal conformity and best production practices are evaluated through a questionnaire. Responses to each question are given a certain score based on specific criteria set by the bank. The scores range from 0 to 1,103 points and are divided into four categories: up to 10 points (good); 11-24 points (regular); 25-39 points (bad); more than 40 points (terrible), i.e. the lower the score, the better the environmental performance of potential clients. The farms are revisited and re-evaluated periodically and their scores can change at every visit.

In addition to being used for internal management and decision-making purposes, the result of such evaluations is, as noted above, also used as an information-sharing and support tool for clients. This information is used in a strategic dialogue with clients and also in the bank's decision-making and management.

3. Material and Methods

In our analysis, we used the financial health indicators and the environmental performance rating of Rabobank's clients in Brazil. The Bank evaluates the environmental performance and financial health of potential clients for checking every credit application, even if a farmer is already a client and had previous applications approved. We used data from evaluations conducted between 2009 and 2013, totaling 1,056 evaluations for 596 farmers. Their farms are located in the states of Mato Grosso do Sul, Mato Grosso, Minas Gerais, São Paulo, Bahia, Goiás and the Federal District. Most of them are professional farmers with an entrepreneurial profile who grow crops such as soybeans, corn, cotton, sugarcane and coffee and raise cattle. Their technological profile and access to information are distinct from those of the average Brazilian farmer. However, they make up a sufficient group to analyze the effect of the credit-granting policy of a financial institution on the environmental performance of its clients.

In our data analysis, we used a combination of three methods to analyze the following correlations: a) the relationship between the environmental performance and the financial health of the bank's clients (ordered logit method and propensity score matching model) and b) the evolution of the environmental performance of clients throughout their relationship with the bank (comparison of averages - T-test). The methods are briefly presented in Table 1 and in greater detail in Table 1 of the annex[1].

[1] *For more details about the methodologies, we recommend Greene (2011).*

Table 1. Methods used in the data analysis

Ordered Logit Models	Propensity Score Matching Model	Mean difference test
Tests separately whether the financial performance of farmers affects their socioenvironmental performance and whether this socioenvironmental performance affects their financial performance	Tests whether the presence or absence of an environmental or social action affects the farmer's financial health	Allows for the evolution of the environmental rating to be evaluated along consecutive evaluations

For each method, sets of variables of the evaluation of environmental performance and financial health were selected. Ability to pay, percentage of self-financing in investment, solvency and liquidity were the financial health variables used in this study. The socioenvironmental variables comprise parameters of legal conformity and performance in relation to, for example, the forest code, health and safety regulations (NR 31), waste management guidelines, etc. Other complementary variables were selected such as revenues, assets, the farmer's experience, credit history, crop diversification, US dollar variation. For more detailed analyses, an environmental index and a financial health index were created that aggregate the several listed variables in only one analysis parameter (Table 2).

Table 2. Variables of the data analysis models

ORDERED LOGIT	
Dependent variable	**Explanatory variables**
1. Farmer's environmental score	US Dollar, Financial Health Index[1], Percentage of financing, Gross Revenue, Net Assets, Focus on Agribusiness, Credit History, Diversification, Experience in Agribusiness
2. Ability to pay 3. Percentage of self-financing 4. Solvency 5. Liquidity	US Dollar, Gross Revenue, Net Assets, Focus on Agribusiness, Credit History, Diversification, Experience, NR 31[2], Waste Disposal[3], Environmental Index[4]
PROPENSITY SCORE MATCHING	
1. Dependent variable: Financial health index (made up of ability to pay, solvency and liquidity)	**Treatment**: Absence of the main applicable licenses, Deforested APP (Permanent Preservation Area), Deforested RL (Legal Reserve), Absence of a registered RL (Legal Reserve), Located in the Amazon biome, Existence of social notification/fine, Poor compliance with NR 31.5 and Poor compliance with NR 31.7 **Control variables**: socioenvironmental score, US dollar, Percentage of financing, Gross revenue, Focus on agribusiness, Diversification, Experience.
2. Dependent variable: Percentage of self-financing (proportion of the loan amount in relation to the total project amount)	**Treatment**: Absence of the main applicable licenses, Deforested APP, Deforested RL, Absence of a registered RL, Located in the Amazon biome, Existence of social notification/fine, Poor compliance with NR 31.5 and Poor compliance with NR 31.7 **Control variables**: socioenvironmental score, US dollar, Solvency, Liquidity, Ability to Pay, Gross Revenue, Focus on Agribusiness, Diversification, Experience

[1]Financial health index: made up of ability to pay, solvency and liquidity;
[2]NR31: index made up of the responses to the 12 questions designed to check poor compliance with NR31 rules on health and safety. The higher the index, the worse the social performance of the farm.
[3]Waste: index composed of the responses to the 7 questions related to waste disposal. The higher the index, the worse the environmental status of the farm.
[4]Environmental index: made up of environmental questions related to deforested APP, deforested ARL, non-registered ARL and existence of environmental notification/fine. The higher the index, the worse the environmental status of the farm.

4. Results

4.1. Ratio between environmental performance and financial health - Logit model

The ordered logit model analysis indicated that the US dollar value and the farmer's financial health index, percentage of self-financing, credit history and experience are the variables that help explain his or her socioenvironmental performance, which is measured by the farmer's socioenvironmental score with Rabobank - Table 3. On the other hand, the farmer's gross income, net assets, degree of diversification and involvement in activities other than agriculture do not affect his or her socioenvironmental performance. Table 4 shows the direction of the effects of each variable for the four categories of the socioenvironmental rating.

It can be seen that the higher the value of the US dollar and the farmer's experience, the worse his or her environmental performance. On the other hand, a higher financial health index, a lower percentage of the loan amount in relation to the total project amount and a positive credit history are related to a better environmental performance. A better financial health and a higher percentage of self-financing increase the likelihood of the highest environmental score (<= 10 points) and reduce the likelihood of 40 or more points (>= 40 points). This means that the highest financial health indicators are recorded for the same individuals with the best socioenvironmental results.

Table 3. Result of the ordered logit model for the environmental rating of farmers

Socioenvironmental score	Coefficient	Standard deviation	P>|z|
US Dollar	1.049	0.629	0.095*
Financial health index	-1.438	0.140	0.000*
Percentage of self-financing	-0.177	0.096	0.065*
Gross Revenue	-0.034	0.180	0.850
Net Assets	0.220	0.170	0.195
Focus on agribusiness	-0.018	0.188	0.925
Credit history	-0.304	0.062	0.000*
Diversification	0.100	0.069	0.150
Experience	0.030	0.011	0.006*

*Significant at 10%.

Table 4. Marginal effect of explanatory variables on the environmental rating of farmers

	Good <=10		Regular 11-24		Bad 25-39		Terrible >=40	
Variable	dy/dx	P>|z|	dy/dx	P>|z|	dy/dx	P>|z|	dy/dx	P>|z|
US Dollar	-0.025	0.121	0.020	0.119	0.004	0.145	0.001	-0.001
Financial health index	-0.035	0.000	-0.028	0.000	-0.006	0.000	-0.001	-0.002
Percentage of self-financing	-0.004	0.078	-0.003	0.084	-0.001	0.080	0.000	0.000
Gross Revenue	-0.001	0.849	-0.001	0.849	-0.000	0.849	0.000	0.000
Net Assets	-0.005	0.187	0.004	0.188	0.001	0.207	0.000	0.000
Focus on agribusiness	0.000	0.925	0.000	0.925	0.000	0.925	0.000	0.000
Credit history	-0.007	0.001	-0.006	0.001	-0.001	0.006	0.000	-0.001
Diversification	-0.002	0.184	0.002	0.183	0.000	0.206	0.000	0.000
Experience	-0.003	0.025	-0.002	0.027	-0.000	0.036	0.000	0.000

For all the financial health indicators that we analyzed (ability to pay, percentage of self-financing, solvency and liquidity), we found a significant environmental variable, suggesting that there is a direct relationship between environmental performance and financial health (Tables 2-9 in the Annex). As examples, farmers with poor environmental conditions are associated with poor ability to pay, just like farmers with poor compliance with NR 31 (health and safety) have lower liquidity.

Thus, the highest socioenvironmental scores were observed among the same individuals with the best financial health, which suggests that these two sets of indicators go hand in hand and that there may be causation between them. More specific studies are needed for more accurate inferences about these relationships.

However, we also observed, albeit less frequently, a correlation between the worst socioenvironmental conditions and a better financial health. This was observed in the higher likelihood of a higher percentage

of self-financing (<60%) in individuals with a lower environmental index and, similarly, of a higher solvency in farms with improper waste disposal.

4.2 Relationship between financial health and environmental performance - propensity score matching

The propensity score matching analysis that complemented the ordered logit model produced results in line with those described in the previous section. In most cases, there is a positive relationship between the financial health of a farmer and his or her socioenvironmental performance in connection with three of the nine socioenvironmental performance variables, which are significant for the financial health indicators. Only for one variable a reverse situation was observed of a correlation between better financial health and worse socioenvironmental performance (Tables 5 and 6).

For example, the presence of a deforested APP (permanent preservation area) is associated with a lower financial health index, i.e. non-conformity with the environmental law that forbids deforestation in APPs has a negative effect on the financial health of farmers. In addition, the absence of a registered Legal Reserve is associated with an increase in the percentage of the loan amount in relation to the total project amount (or with a decrease in self-financing - greater dependence on external capital). Again, the worst environmental condition in this regard is associated with a lower financial health indicator.

A significant and positive-sign effect of the Amazon biome variable on the financial health index was observed. In other words, farms located in the Amazon biome usually had higher financial health indices than those located in other regions. This result, which may seem counterintuitive, can be possibly explained by the profile of Rabobank's client farmers, which is different than that of the average farmer in the Amazon region. We assumed that professional farms and farmers in that region are more monitored by public and private agencies and civil society than their peers in other regions as a result of initiatives such as the moratoriums on soybean and livestock and terms of commitment signed by processing industries with the Public Prosecutor's Office.

On the other hand, as an exception, difficulties to comply with requirement 7 of Normative Instruction 31 (Internal Committee for Accident Prevention in Rural Work of the health and safety at work system) have a positive effect on the financial health index, which may indicate that failure to comply with this requirement fully might contribute to a better financial performance of a farmer.

Table 5. Ratio between the financial health index and environmental variables for farmers

	Nearest neighbor without replacement			Kernel with replacement			5 nearest neighbors with replacement		
Treatments	ATT	S.E.	T-test	ATT	S.E.	T-test	ATT	S.E.	T-test
Absence of the main applicable licenses	0.38	0.22	0.29	0.38	0.17	0.59	0.38	0.24	0.34
Deforested APP	-0.02	0.10	-1.93*	-0.02	0.10	-2.65*	-0.02	0.12	-1.57
Deforested ARL (Legal Reserve Area)	0.09	0.16	-1.55	0.09	0.11	-1.07	0.09	0.17	-1.61
Absence of a registered ARL	-0.06	0.07	-1.46	-0.06	0.08	-0.49	-0.06	0.11	-0.31
Amazon biome	0.01	0.15	1.67*	0.01	0.19	1.57	0.01	0.15	1.86*
Existence of social notification/fine	-0.17	0.22	1.12	-0.17	0.22	-0.35	-0.17	0.22	1.13
Existence of environmental notification/fine	0.18	0.16	0.24	0.18	0.17	0.36	0.18	0.16	-0.13
Poor compliance with NR 31.5	0.03	0.08	0.78	0.03	0.15	1.04	0.03	0.19	0.00
Poor compliance with NR 31.7	0.14	0.09	1.94*	0.14	0.09	0.70	0.14	0.11	0.64

* The financial health index is composed of the ability to pay, solvency and liquidity variables.

Table 6. Ratio between the percentage of self-financing and social and environmental variables for farmers

	Nearest neighbor without replacement			Kernel with replacement			5 nearest neighbors with replacement		
Treatments	ATT	S.E.	T-test	ATT	S.E.	T-test	ATT	S.E.	T-test
Absence of the main applicable licenses	49.15	4.42	0.14	49.15	3.43	0.82	49.15	4.47	0.10
Deforested APP (Permanent Preservation Area)	45.39	2.25	-0.47	45.39	2.16	-0.98	45.39	2.62	-0.61
Deforested ARL (Legal Reserve Area)	44.86	2.65	-0.71	44.86	2.04	-0.85	44.86	2.87	-0.88
Absence of a registered ARL	44.70	1.34	-2.02*	44.70	1.45	-2.10*	44.70	1.68	-0.92
Amazon biome	44.95	3.20	0.64	44.95	2.63	0.40	44.95	3.37	0.86
Existence of social notification/fine	50.75	5.30	1.40	50.75	4.56	1.29	50.75	5.30	1.40
Existence of environmental notification/fine	44.19	3.66	1.06	44.19	3.18	0.01	44.19	3.83	1.28
Poor compliance with NR 31.5	45.94	1.47	-0.88	45.40	1.67	-0.53	45.40	2.02	-0.08
Poor compliance with NR 31.7	43.60	1.63	-0.81	43.60	1.60	-1.12	43.60	1.91	-0.80

4.3. Continuous improvement of farmers over time

With the aim of evaluating the evolution of environmental conditions along consecutive evaluations, averages of the socioenvironmental scores were compared. This test checks whether two averages are different. In this study, it will test whether there was any improvement or worsening of socioenvironmental performance along the evaluations.

The test showed an improvement in socioenvironmental scores between the first and second year of evaluation and a trend toward the same scores being registered in following years (Tables 7 and 8). It should be recalled that the lower a score, the better the environmental performance of a farmer. That is, it was seen that the bank's environmental program has a positive impact on the performance of its clients, improving their environmental performance. It is also noteworthy that such ability to influence is greater at the early stages of the bank-client relationship, during which increases in environmental scores tend to be greater as a result of the necessary adjustments for clients to meet the requirements to be granted credit.

Table 7. Descriptive statistics of the environmental score of farmers over the years (2009-2013)

Variable	Observations	Score	Standard deviation
First evaluation	1,056	10.2	9.8
Second evaluation	1,056	9.2	8.7
Third evaluation	771	9.4	8.4
Fourth evaluation	467	9.5	9.9

Table 8. Comparison test of the average environmental score

H0	Evaluation	Score[1]	Standard deviation	t
	First	10.2	0.300225	
First=second	Second	9.2	0.266912	2.3*
	Second	9.2	0.295976	
Second=third	Third	9.4	0.303248	0.59
	Third	9.4	0.405992	
Third=fourth	Fourth	9.5	0.459036	1.5

Significant at 5%

5. Conclusions and considerations for policy-making

The results of the study suggest that there is a correlation between the financial health and environmental performance of farmers. This correlation indicates an association between better environmental performance and better financial health.

In addition, our results allow us to infer other additional considerations and conclusions:

a) Wealth and income do not seem to determine the environmental performance of a farmer, since no correlation was found between income and assets and socioenvironmental scores. This indicates that both large and small farmers can have a positive environmental performance and good financial health.

b) Although credit is essential for agricultural activities, a better environmental performance on the part of farmers is associated with a balance between credit and debt.

c) Farmers who are newer entrants to the agriculture/livestock sector tend to have a better socioenvironmental performance, since the higher the "farmer's experience" indicator, the lower

their socioenvironmental score tends to be. This suggests that in more recent agricultural undertakings greater attention is paid to regulatory requirements and to the need for efficient management. It also shows that younger farmers tend to be more sensitive to sustainability-related issues.

d) A lending policy based on sustainability requirements and on incentives and mechanisms for supporting changes driven by financial agents can induce a process of continuous improvement in the environmental performance of farmers. Changes on the part of farmers tend to be more intense in the early stages of their relationship with the bank, during the process of adjusting their farms to the minimum requirements imposed by the financial agent. The bank may even be one of the funders of the environmental suitability and continuous improvement process.

e) A farmer with a better environmental performance tends to be a lower-risk client with greater ability to pay. It is worth noting that, in the methodology that was used, ability to pay reflects not only revenue generation, but also the taking of loans for crop financing. This indicates that a sound financial planning, proper use of funding and socioenvironmental performance complement each other.

f) The indicators "focus on agribusiness", "crop diversification" and "experience" were identified as statistically significant in explaining ability to pay, also indicating the importance of using other qualitative information for assessing credit applications.

The results and conclusions of the analysis of the implementation of Rabobank's Sustainability Policy point to the potential and importance of funding, credit, and the financial sector to induce and promote sustainability in agricultural production. The results of this study indicate that its adoption tends to be beneficial for both farmers and the Bank, but further studies will deepen the analysis and preliminary conclusions of this study.

However, socioenvironmental aspects are considered in a marginal way in the assessment of credit applications for the agricultural sector, whether for covering fixed costs, investment or marketing. Central Bank Resolution 3,545 prohibits the financing of farms under embargo due to deforestation in the Amazon region, and non-conformity with components of the Forest Code can prevent farmers from accessing official credit as of 2017.

Anyway, this is an approach intended to avoid damages and illegal situations, while sustainability encompasses broader and more advanced concepts. Therefore, while rural credit imposes certain cross requirements (such as conformity with forest laws), its main purpose is making funds available for agriculture and it was not designed to give priority to ensuring sustainability in this sector, which constitutes a need and an opportunity for Brazilian agriculture.

However, this does not occur in the absence of guidelines or parameters for the operations of the financial sector, whether at the domestic, international, voluntary or legal level. A framework already exists for self-regulation and initiatives designed to guide the financial sector in playing its role in relation to promoting sustainability, such as, for example, Febraban's Green Protocol and self-regulation (SARB14), Central Bank Resolution 4,327, the Ecuator Principles and the Banking Environment Initiative.

It should be stressed that the vast majority of the above-mentioned voluntary initiatives and regulatory requirements are marked by command and control arrangements and are intended to exclude farmers who fail to comply with them. There are few examples of initiatives and requirements of this kind that actually promote sustainability through a positive agenda. The Low-Carbon Agriculture Program (ABC), under which credit is granted for investments in mitigating GHG emissions, is one of the few exceptions.

BOX 2 - Socioenvironmental initiatives in the financial system

The Green Protocol is a voluntary commitment of the Brazilian banking sector that was signed by public banks in 1995 and by private banks in 2009. It recognizes that banks can play a key role in inducing sustainable development and sets out guidelines for their activities in several dimensions. Central Bank Resolution 4,327 was issued in 2014 and provides for guidelines to be observed in the establishment and implementation of the Socioenvironmental Responsibility Policy by financial institutions, while standard SARB14 sets out rules for making and implementing such policy. At the international level, the document containing the Equator Principles was drawn up as a socioenvironmental risk management protocol for projects. More recently, the Banking Environment Initiative (BEI) was organized by a group of banks with the aim of identifying ways to focus capital collectively on promoting sustainable development. Along with the Consumer Goods Forum, the BEI contributed to creating the Soft Commodities Compact, which is intended to mobilize the banking sector to contribute toward promoting changes in commodity supply chains so that their production is part of the effort to achieve the zero deforestation target by 2020.

6. Remark regarding data protection

During the development of research, all measures were taken to guarantee the security of the Rabobank data used in this study and full confidentiality about client information. To list a few: (a) a confidentiality agreement between the parties was signed, guaranteeing protection of the database (b) all individual client information was erased from the databases, in order to preclude the clients identity and to protect any confidential or sensitive information; (c) absolute data – whenever possible – was transformed into indexes, eliminating any sensibility; (e) databases were treated within the bank premises, using the bank computers and systems in order to guarantee full security of the data (the researcher had to spend time in the bank's office), (e) once all the data was treated (therefore, no longer confidential or sensitive), econometric modeling still only occurred on the research center (CEPEA) premises, subject to access and security protocols to fulfill the conditions of the confidentiality agreement.

7. Additional references

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Annex

Table 1. Methods used in the data analysis

Ordered Logit Models*	Propensity Score Matching Model*	Mean difference test
The results of ordered logit models make it possible to know how the explanatory variables affect the probability of occurrence of each category of dependent variables. It makes it possible to know not only the significance of the variables, but also the direction of their effects.	This model evaluates groups of variables. Treatment variables are those one might want to test if, when present, they affect the values of the response variables. Control variables are used to pair observations. It is meant to identify similar individuals for a set of control variables, allowing for those individuals to differ only with regard to the presence of a certain treatment. It requires that the treatment variable is 0 or 1 (individual with or without treatment) and that the dependent variables are continuous.	It allows for the evolution of the environmental rating to be evaluated along consecutive evaluations.

Table 2. Ordered logit for the ability to pay dependent variable

atp	Coefficient	Std. Error	Z	P>|z|	[95%] IC	
US Dollar	-1.595	0.323	-4.940	0.002*	-2.228	-0.962
Gross Revenue	0.002	0.002	1.340	0.180	0.002	0.002
Net Assets	0.002	0.002	1.610	0.100*	0.002	0.002
Focus on agribusiness	0.118	0.072	1.640	0.09*	-0.023	0.259
Credit history	0.072	0.031	2.300	0.021*	0.011	0.133
Diversification	0.064	0.033	1.930	0.054	-0.001	0.129
Experience	-0.016	0.085	-0.190	0.853	-0.182	0.151
NR 31	-0.012	0.053	-0.220	0.824	-0.115	0.091
Waste disposal	-0.005	0.047	-0.100	0.917	-0.096	0.087
Environmental index	-0.148	0.048	-3.060	0.002*	-0.242	-0.053

Table 3. Marginal effect of the explanatory variables on the likelihood of occurrence of each of the categories of ability to pay.

	<1.0x the loan amount		>=1<1,5x the loan amount		>=1,5<=2,0x the loan amount		>2x the loan amount	
Variable	dy/dx	P>|z|	dy/dx	P>|z|	dy/dx	P>|z|	dy/dx	P>|z|
US Dollar	0.064	0.002	0.133	0.002	-0.178	0.002	-0.213	0.002
Gross Revenue	-0.004	0.186	-0.007	0.185	0.010	0.182	0.001	0.180
Net Assets	-0.001	0.115	-0.003	0.115	0.002	0.111	0.002	0.108
Focus on agribusiness	-0.005	0.107	-0.010	0.107	0.013	0.103	0.016	0.101
Credit history	-0.003	0.027	-0.006	0.026	0.008	0.024	0.010	0.022
Diversification	-0.003	0.060	-0.005	0.060	0.007	0.056	0.009	0.054
Experience	0.001	0.853	0.001	0.853	-0.002	0.853	-0.002	0.853
NR 31	0.005	0.824	0.001	0.824	-0.001	0.824	-0.002	0.824
Waste disposal	0.002	0.917	0.004	0.917	-0.001	0.917	-0.001	0.917
Environmental index	0.006	0.004	0.012	0.004	-0.016	0.003	-0.020	0.002

Table 4. Ordered logit for the financing percentage ratio

Financing percentage	Coefficient	Std. Error	z	P>|z|	[95%] IC	
US Dollar	-0.757	0.315	-2.400	0.016*	-1.375	-0.139
Gross Revenue	0.016	0.002	2.450	0.014*	0.032	0.029
Net Assets	0.025	0.020	1.270	0.203	-0.014	0.064
Focus on agribusiness	-0.007	0.071	-0.090	0.926	-0.146	0.133
Credit history	-0.052	0.031	-1.660	0.096*	-0.112	0.009
Diversification	0.028	0.033	0.830	0.404	-0.038	0.094
Experience	-0.022	0.088	-0.250	0.799	-0.196	0.151
NR 31	0.052	0.054	0.980	0.327	-0.052	0.157
Waste disposal	0.055	0.047	1.180	0.240	-0.037	0.147
Environmental index	0.125	0.049	2.550	0.011*	0.029	0.221

Table 5. Marginal effect of the explanatory variables on the likelihood of occurrence of each of the categories of Percentage of self-financing.

	Self-financing <40%		Self-financing from ≤50 to ≥40%		Self-financing from > 50≤60%		Self-financing >60%	
Variable	dy/dx	P>|z|	dy/dx	P>|z|	dy/dx	P>|z|	dy/dx	P>|z|
US Dollar	0.098	0.017	0.046	0.020	-0.003	0.440	-0.180	0.016
Gross Revenue	-0.021	0.015	-0.098	0.018	0.074	0.435	0.039	0.015
Net Assets	-0.033	0.203	-0.015	0.208	0.001	0.491	0.006	0.203
Focus on agribusiness	0.009	0.926	0.040	0.926	-0.030	0.927	-0.016	0.926
Credit history	0.007	0.097	0.003	0.101	0.002	0.462	-0.012	0.096
Diversification	-0.004	0.404	-0.002	0.406	0.002	0.558	0.007	0.404
Experience	0.003	0.799	0.001	0.799	0.002	0.807	-0.005	0.799
Nr 31	-0.007	0.328	-0.003	0.330	0.002	0.528	0.013	0.327
Waste disposal	-0.007	0.240	-0.003	0.244	0.002	0.500	0.013	0.240
Environmental index	-0.016	0.011	-0.008	0.014	0.001	0.435	0.030	0.011

Table 6. Ordered Logit for Solvency

Solvency	Coefficient	Std. Error	z	P>|z|	[95%] IC	
US Dollar	-0.663	0.333	-1.990	0.047*	-1.315	-0.010
Gross Revenue	-0.013	0.010	-12.550	0.001*	-0.014	-0.011
Net Assets	0.043	0.038	11.290	0.005*	0.036	0.005
Focus on agribusiness	0.009	0.084	0.110	0.914	-0.155	0.173
Credit history	0.072	0.035	2.060	0.039*	0.004	0.140
Diversification	-0.021	0.038	-0.550	0.586	-0.095	0.054
Experience	0.141	0.097	1.450	0.146	-0.049	0.331
NR 31	-0.079	0.060	-1.310	0.190	-0.197	0.039
Waste disposal	0.095	0.053	1.780	0.075*	-0.010	0.200
Environmental index	0.088	0.057	1.550	0.122	-0.023	0.199

Table 7. Marginal effect of the explanatory variables on the likelihood of occurrence of each of the categories of solvency.

	Solvency <60%		Solvency >=60<=70%		Solvency >70<=80%		Solvency >80%	
Variable	dy/dx	P>|z|	dy/dx	P>|z|	dy/dx	P>|z|	dy/dx	P>|z|
US Dollar	0.010	0.063	0.050	0.049	0.096	0.049	-0.159	0.047
Gross Revenue	0.002	0.005	0.095	0.009	0.018	0.006	-0.003	0.007
Net Assets	-0.067	0.007	-0.033	0.003	-0.062	0.004	0.010	0.008
Focus on agribusiness	-0.014	0.914	-0.007	0.914	-0.001	0.914	0.002	0.914
Credit history	-0.001	0.054	-0.005	0.042	-0.010	0.041	0.017	0.039
Diversification	0.002	0.587	0.002	0.585	0.003	0.586	-0.005	0.586
Experience	-0.002	0.163	-0.011	0.149	-0.020	0.148	0.034	0.146
NR 31	0.001	0.204	0.006	0.192	0.011	0.192	-0.019	0.190
Waste disposal	-0.001	0.091	-0.007	0.078	-0.014	0.077	0.023	0.075
Environmental index	-0.001	0.135	-0.007	0.123	-0.013	0.124	0.021	0.121

Table 8. Ordered logit for the liquidity of farmers

liquidity	Coefficient	Std. Error	z	P>|z|	[95%] IC	
US Dollar	-0.649	0.305	-2.130	0.033*	-1.247	-0.052
Gross Revenue	-0.028	0.062	-4.460	0.005*	-0.040	-0.015
Net Assets	0.009	0.019	4.710	0.004*	0.052	0.013
Focus on agribusiness	0.081	0.068	1.190	0.235	-0.053	0.215
Credit history	0.084	0.030	2.800	0.005*	0.025	0.143
Diversification	0.051	0.033	1.550	0.122	-0.014	0.115
Experience	-0.051	0.086	-0.590	0.554	-0.220	0.118
NR 31	-0.128	0.053	-2.430	0.015*	-0.232	-0.025
Waste disposal	-0.028	0.046	-0.620	0.533	-0.118	0.061
Environmental index	0.022	0.048	0.470	0.640	-0.071	0.116

* Significant at 10%

Table 9. Marginal effect of the explanatory variables on the likelihood of occurrence of each of the categories of liquidity

	Liquidity* <1x		Liquidity >=1x		Liquidity >1.2<=1.5		Liquidity >1.5x		Liquidity >2x	
Variable	dy/dx	P>|z|	dy/dx	P>|z|	dy/dx	P>|z|	dy/dx	P>|z|	dy/dx	P>|z|
US Dollar	0.056	0.035	0.053	0.036	0.027	0.045	-0.028	0.041	-0.134	0.033
Gross Revenue	0.024	0.008	0.023	0.060	0.012	0.002	-0.012	0.002	-0.057	0.006
Net Assets	-0.077	0.006	-0.073	0.001	-0.038	0.002	0.038	0.070	0.018	0.002
Focus on agribusiness	-0.007	0.237	-0.007	0.237	-0.003	0.245	0.003	0.242	0.017	0.235
Credit history	-0.007	0.006	-0.007	0.006	-0.004	0.012	0.004	0.009	0.017	0.005
Diversification	-0.004	0.125	-0.004	0.125	-0.002	0.133	0.002	0.132	0.011	0.122
Experience	0.004	0.554	0.004	0.554	0.002	0.556	-0.002	0.555	-0.011	0.554
NR 31	0.011	0.017	0.011	0.017	0.005	0.024	-0.005	0.022	-0.026	0.015
Waste	0.002	0.533	0.002	0.533	0.001	0.534	-0.001	0.534	-0.006	0.533
Environmental index	-0.002	0.640	-0.002	0.640	-0.001	0.641	0.001	0.641	0.005	0.640

*Liquidity = current assets/current liabilities

Socioenvironmental certification of farms is economically advantageous*

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*Simplified and preliminary version of part of the Doctoral Thesis of Dienice Bini, prepared under the guidance of Prof. Silvia Miranda, PhD (Esalq-USP)

Summary

Socioenvironmental certification has been an important tool for promoting innovation and sustainability in agriculture. However, it is argued that scaling it up would imply high costs for farmers that must be offset by economic market benefits. This implies the assumption that implementing certification and sustainability schemes represents both a cost and a competitive disadvantage for farmers. The objective of this study was to assess the effect of socioenvironmental certification on the economic performance of certified farms.

The results confirmed that the economic performance of certified farms is better than that of non-certified ones. Certification contributes to greater productivity, higher revenues and efficiency in production. It was seen that the price of a certified product was not different between certified and non-certified farms and that the direct costs of certification did not influence their economic results. These findings suggest that the main economic advantage of certification is enjoyed inside the farms, as a result of their better management and greater efficiency. Therefore, certification is economically justified regardless of market benefits, which are expected initially but tend to decrease naturally over time.

Thus, incentives to certification or other interventions that can contribute to the sustainability of a farm and can generate positive externalities should be supported and their adoption should be sped up by the market and public policies, such as credit programs and technical assistance to management and good agronomic and socioenvironmental practices.

1. Introduction

Over more than a decade after the first environmental certification systems for forest and agricultural/livestock production were created, Brazil remains a pioneer and leader in their development and implementation. Several commodities are certified, some of which are past the niche stage for certification on a large scale (Table 1).

Table 1. Evolution of the proportion of the certified global production of some commodities, aggregating some environmental certification systems (Source: SSI, 2014)

Commodity	2008	2012
Coffee	9%	38%
Cocoa	3%	22%
Palm oil	2%	15%
Tea	6%	12%
Cotton	1%	3%
Banana	2%	3%
Sugar	<1%	3%
Soybeans	2%	2%

However, despite the significant growth observed in the proportion of the certified global production of some commodities in the past five years, more recent data show that this production has stabilized and has been growing at lower rates based on three main arguments:

a) Consumers (corporate or individual consumers) do not recognize or appreciate certified products.
b) Implementing a certification system in rural areas is expensive. The assumption is that the indirect costs to make the necessary adjustments for certification and the direct costs of audits that farmers have to bear constitute a disadvantage for them.
c) As a result of the two previous arguments, several companies that buy commodities are creating their own sustainability assurance systems rather than maintaining or increasing their adherence to certification schemes as a tool for ensuring the supply of raw materials of "sustainable" origin. Companies usually develop their own systems based on sustainability rules or standards that are less stringent, less transparent and less robust for checking the products.

The first and second arguments suggest that certified products should be priced differently, under the assumption that the cost for producing them is higher and, therefore, certification constitutes a competitive disadvantage that can only by justified by the market differential of certified products. If there is no willingness to pay more on the part of a link in the chain, there is no reason to certify a product and to implement certification schemes in rural areas.

2. Objective

Considering that certification has been one of the main tools to stimulate innovation and ensure higher levels of sustainability in rural areas, the main objective of this study was to evaluate the effect of

socioenvironmental certification on the economic performance of certified farms. The analysis compared economic performance parameters of a large number of certified and non-certified farms.

3. Material and Methods

The economic analysis was carried out using data from 78 coffee-producing farms located in *cerrado* (savanna) areas in the state of Minas Gerais participating in the Educampo Program of SEBRAE-MG. This is an education project that delivers managerial and technical training courses to groups of farmers with the aim of improving farm management and thus making them more efficient and competitive. One of the main actions of this program is that of supporting the financial management of the farms by analyzing their performance in the light of their production costs and revenues and of a set of economic performance indicators. The Educampo Program also supports farmers in their efforts to adjust and improve their farms to be granted socioenvironmental certification.

SEBRAE-MG made available economic data from 107 farms for the study and, after necessary statistical treatments, we used data from 24 farms certified by the Sustainable Agriculture Network - Rainforest Alliance (all of which were collectively certified in groups) and from 54 similar non-certified farms to carry out our analysis. Data from the Educampo Program for two consecutive years (2011/2013) were used to attenuate the effects of variations in the biennial coffee production and other effects, such as data on climate fluctuations and on input and coffee prices.

In addition, also with the aim of isolating the effect of variables other than certification, we conducted the statistical analysis applying an econometric approach, using the differences-in-differences method. This method allows for the difference between certified and non-certified farms to be evaluated in relation to their first year of participation in the Educampo Program, making it possible to discard pre-existing differences between groups and to estimate the isolated effect of certification. Revenue, cost, productivity, profit and gross margin were the main variables that were analyzed both by planted area and by coffee bag.

To complement our analysis, we also interviewed a panel of more than 60 farmers (including owners of certified and non-certified farms). The main objective was to evaluate the perception of farmers on the value of certification and its effects in terms of leading to improvements in their farms and business.

4. Results

No statistical difference was observed in production costs (per planted area and coffee bag) between certified and non-certified farms. However, a difference was detected in gross revenue, as an increase of R$2,412 per hectare was observed for certified farms after certification, while the revenue of non-certified farms declined. This increase in revenues was due to higher productivity gains in certified farms

after certification (increase of 9.4 bags/ha against 2.5 bags/ha in non-certified farms), since there was no change in production costs or in the price of certified coffee (Table 1).

Contrary to expectations, no statistical difference was detected in the price of coffee between certified and non-certified farms before or after certification. There was in fact a decrease in the price of coffee between the base year and subsequent years, which might be due to market conditions that affect both groups equally. And despite the absence of a statistical difference, a sharper drop was observed in the price of certified coffee (R$38.1, against R$26.2 for non-certified coffee), confirming the downward trend in the premium for certified coffee (Table 1).

Additional details include the fact that although all the components of the actual operating cost of production were seen to be statistically equal in certified and non-certified farms, we observed a downward trend for some items in certified farms, such as in administrative costs and in the costs of fertilization and of pest and disease control (Table 2). It should be emphasized that the direct costs of certification (annual spending with audits) are allocated to the Administration budget item, indicating that they do not affect this item negatively and much less the total cost of production.

Table 1. Difference in the difference between economic performance indicators for certified and non-certified coffee farms

Variable	Group	Average*	Standard deviation	T-statistics
Gross Revenue - R$ / ha	Certified	2,412.6	4,286.2	-2.341*
	Non-certified	-62.5	4,963.4	
Actual Operating Cost / bag	Certified	-56.7	48.6	-0.0431
	Non-certified	-54.5	243.1	
Actual Operating Cost / ha	Certified	-99.7	2,392.5	-1.12
	Non-certified	522.3	1897.4	
Total cost / bag	Certified	-64.1	61.7	0.313
	Non-certified	-87.5	367.4	
Total cost / ha	Certified	354.3	2,599.0	-0.661
	Non-certified	784.5	2,987.1	
Coffee price - R$ / bag	Certified	-38.1	107.0	0.650
	Non-certified	-26.2	97.1	
Productivity - bag / ha	Certified	9.4	9.9	-2.39*
	Non-certified	2.5	11.2	

* Statistically significant difference of 95%.

Table 2. Difference in the difference between operating costs in certified and non-certified coffee farms

Variable	Group	Average	Standard deviation	T-statistics
Management - R$ / ha	Certified	-407.4	2,557.4	-0.986
	Non-certified	71.7	510.3	
Soil fertilization - R$ / ha	Certified	-192.2	2,955.5	-1.351
	Non-certified	661.6	1,092.8	
Leaf fertilization - R$ / ha	Certified	-101.4	533.5	0.078
	Non-certified	-113.1	563.3	
Control of pests and diseases - R$ / ha	Certified	-553.3	2504.7	-1.215
	Non-certified	64.9	479.6	
Control of spontaneous plants - R$ / ha	Certified	85.5	306.3	1.849
	Non-certified	-64.1	335.4	
Crop management - R$ / ha	Certified	-19.7	156.4	-1.117
	Non-certified	89.0	403.8	

* Statistically significant difference of 95%.

As a result of increased productivity, revenues and the parameters of profitability per area (profit/ha and margin/ha) were higher for certified farms. Both increased by more than R$2,000/ha in certified farms and decreased by more than R$500/ha in non-certified farms. However, no difference was detected in profit and margin for parameters of profitability per coffee bag (Table 3).

Table 3. Difference in the difference between economic performance indicators for certified and non-certified coffee farms

Variable	Group	Average	Standard deviation	T-statistics
Profit - R$ / bag	Certified	17.5	108.5	0.427
	Non-certified	52.9	361.8	
Profit - R$ / ha	Certified	2,160.4	4,491.3	2.446*
	Non-certified	-846.7	4,701.2	
Gross margin - R$ / bag	Certified	10.1	115.0	-0.156
	Non-certified	19.9	243.0	
Gross margin - R$ / ha	Certified	2614.4	4,510.1	2.687*
	Non-certified	-584.8	4,914.2	

* Statistically significant difference of 95%.

In addition, we analyzed variables related to the profile of certified farmers or variables that affect the propensity of a farmer to seek certification. Education and the existence of some other type of certification on a farm increase the likelihood of finding a certified farmer. Having a non-agricultural

source of income reduces the probability of certification, i.e. farmers exclusively dedicated to agriculture are more likely to seek certification. Moreover, technical parameters related to production and infrastructure (irrigation, type of crop, depulper), experience, age and even planted area do not alter the probability of a farmer seeking certification, indicating that there is no relationship between structural or technological conditions and certification (Table 4).

Table 4. Parameters of likelihood of certification of a farmer.

Treatment	Coefficient	Std. Error	P>z
Age	-0.028	0.026272	0.271
Education	1.24	0.499515	0.015*
Experience	0.08	0.041744	0.233
Another certification	6.02	1.5907	0.000*
Specific market	0.45	1.429066	0.752
Coffee type	2.43	2.272666	0.283
Another farm income	-0.32	0.304841	0.28
Another non-farm income	-0.98	0.347332	0.005*
Depulper	0.02	0.024895	0.321
Mechanical harvesting	0.18	0.445167	0.677
Own dryer	1.20	0.994974	0.226
Irrigation	0.67	0.363273	0.063
Environmental concerns	0.58	0.437608	0.182
Planted area	0.001	0.003396	0.76

*P>z lower than 0.05 implies significance at 95%.

5. Conclusions and considerations for policy-making

The results confirmed that there are differences in the economic performance of certified and non-certified farms. It is noteworthy that such difference was found even in a scenario of expected short distances between certified and non-certified farmers. This is because the farmers covered by the study are certified in groups or collectively. They are mainly medium and small farmers who initiate the certification process with a lower audit and socioenvironmental performance score than that of large, individually certified farms. In addition, the control group (non-certified group) is above the average group of coffee farmers, as it relies on a major farmer assistance program - the Educampo Program of SEBRAE-MG. Therefore, an even greater impact of certification is expected for a certified farm than for a median farmer who is not assisted by a program of some kind to improve the management and sustainability of his or her farm.

Therefore, our conclusion is that certified farms have greater productivity and higher revenues and tend to have a lower cost and, as a result, they have a better economic performance than non-certified farms. The highest productivity rates and revenues, combined with equal production costs which nevertheless tend to be lower for certified farms, suggest that these are not only more profitable, but also more efficient than non-certified farms.

Finally, the results according to which the price of coffee is not different between certified and non-certified farms and the direct costs of certification does not affect this result suggest that the main economic advantage of certification is the one enjoyed inside the farms, as a result of their better management and greater efficiency. Therefore, certification is economically justified regardless of market benefits, which are expected initially but tend to decrease naturally over time, as is already happening in coffee farms. This conclusion is in tune with that of a similar international study. The main caveat about our study is that it did not consider the investment costs involved in adjustments for certification purposes, which can be substantial for most farmers. This aspect should be studied in greater detail in the future.

The panel of farmers revealed that their perception is in tune with the results of this study. During the panel interviews, the farmers indicated that they can identify and recognize the positive effects of certification on managerial aspects of their farms and on improving the management of their processes and compliance with labor and environmental laws. Many participants reported that they are seeking certification because it allows for a combination of better management, product differentiation and participation in specific markets.

Thus, the incentive for certification or other interventions that can contribute to promote sustainability in farms and generate positive externalities should be supported and be sped up by the market and by public policies such as technical assistance programs to improve farm management and the adoption of good agricultural and environmental practices. Public and private financial support should also be provided to finance the investments required to ensure a better agronomic and environmental performance.

6. Acknowledgments

This study was supported by a grant from the Global Innovation Initiative, a joint effort of the United States and the United Kingdom to strengthen global multilateral collaboration through grants to university consortia focused on science, technology, engineering, and mathematics (STEM)-related issues of global significance that foster cutting-edge multinational research and strengthen institutional international partnerships. The grant is sponsored by the U.S. Department of State, Bureau of Educational and Cultural Affairs.

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Management is a need for continuous improvements and sustainability in agriculture

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Summary

The complexity of farm production has increased, requiring a new level of organization of the agricultural business and making a sound management increasingly important for the survival and competitiveness of each production unit. This study was intended to evaluate the relationship between management and the environmental and social performance of farms using a database with information from 435 audits carried out in 80 individual farms and 23 groups of certified coffee farms between 2006 and 2014. Our conclusion is that there is a positive correlation between conformity with management criteria and the socioenvironmental performance of certified coffee farms. This suggests that having an efficient management system in place on a farm contributes to it having a positive socioenvironmental performance. We also concluded that having an efficient management system in place and resulting high performance is possible for both large and for small and medium-sized farmers and that it can be implemented by means of collective actions that make economies of scale possible. Given the importance of management for ensuring sustainability in rural areas, we stress that there is a gap in terms of public policies that can actually contribute to improving farm management in Brazil. Weak public technical assistance and rural extension (TARE) programs go hand in hand with the increasing role of the private sector as a source of innovation and technology transfer, which is not necessarily intended to improve management systems, sustainability practices and the efficiency of farmers.
Therefore, a comprehensive, independent and efficient ATER is required to improve the management of rural production and consequent achievement of sustainable production.

1. Introduction

Production and productivity in Brazilian agriculture have increased significantly in recent decades. In recent years, the requirement and need for sustainability have also been on the rise, increasing the complexity of agricultural production and requiring a higher level of organization of the agriculture and livestock business. In this context, sound management becomes increasingly important for the survival and competitiveness of each production unit and for improving control, production and operations of the business with the aim of meeting legal requirements and ensuring a minimum level of positive socioenvironmental performance, efficiency gains and cost savings.

However, farm planning and daily farm operations are usually focused on increasing production and productivity (translated in tons and tons per ha), mainly based on the necessary operational activities involved in managing crop units. This approach is limited and insufficient for a productive farm or unit to realize the responsibility and opportunity of sustainability and for promoting an integrated vision of natural resources, landscape, people, stakeholders and the long-term needs of these assets and of the business itself.

Management is a broad concept associated with that of Administration that refers to providing direction, using managerial skills, controlling. It is an organized way of setting and achieving goals and objectives and of supporting informed decision-making through analyses based on values, principles, plans, roles and procedures in an organization. Ideally, it is associated with a continuous improvement process. The PDCA (Plan-Do-Check-Act) cycle is a facilitator of continuous improvement (Figure 1).

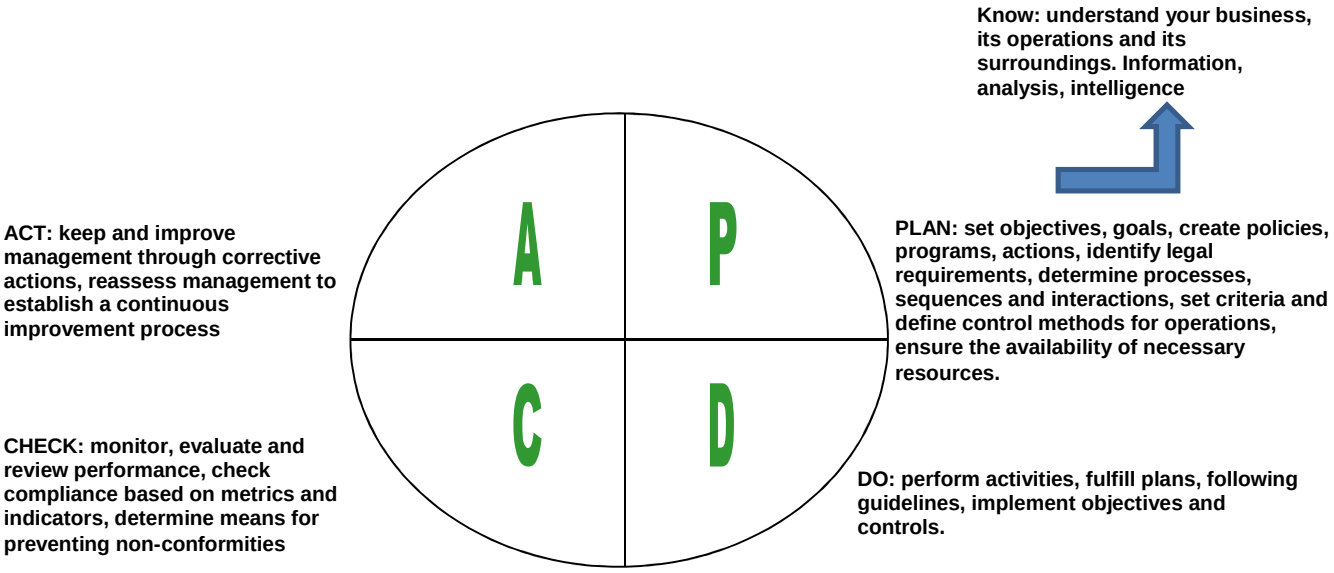

Figure 1. Model of the cycle of planning and continuous improvement

2. Purpose and methods of this study

The **main goal** of this study was to evaluate the contribution of management to the environmental and social performance of farms. For this purpose, a database was used that contains information from all audits conducted in individual coffee farms and groups of coffee farms certified by Imaflora through the agricultural certification system of the Sustainable Agriculture Network (SAN)/Rainforest Alliance

Certified™. Altogether, non-conformities detected in 435 audits in 80 individual coffee farms and 23 groups of coffee farms were analyzed between 2006 and 2014.

Based on this data set, the **specific objectives** of the survey were the following ones:

a) exploring the correlation between the performance of certified farms against management and social and environmental performance criteria;
b) identifying the main difficulties for achieving good governance and social and environmental performance;
c) checking whether the performance of certified farms improves over time and
d) assessing whether there is a difference in the above-mentioned parameters between farms certified individually or in groups and according to the size of the individual farms.

For this purpose, the criteria set out in the certification standards of the Sustainable Agriculture Network (SAN) were classified into three groups:

1) Management criteria: these are mainly criteria related to principle 1 of the SAN standard that require the adoption of a social and environmental management system to ensure compliance with certification requirements and provides for the need for legal conformity, planning, records, analysis and training for continuous improvement of the undertaking. Criteria related to environmental, social and agronomic principles were also included in this group which deal with plans, procedures and records and have a main management component to the detriment of an expected result or specific performance.

2) Social criteria: criteria related to principles 5, 6 and 7 of the SAN standard that include aspects related to labor relations, to health and safety at work and to the relationship between the farm or group of farms with the community and their surroundings. Criteria related to the management of these principles were included in the Management group as a reinforcement.

3) Environmental criteria: criteria related to principles 2, 3, 4, 8, 9 and 10 of the standard, which comprise aspects related to biodiversity conservation, soil and water conservation, use of pesticides and waste management.

The statistical analysis to check the correlation between compliance with the management criteria and social and environmental criteria was conducted using the Pearson coefficient test. The significance of the correlations was then analyzed through the T-test. For each analysis, the data for non-conformities were stratified between groups of farms and individual farms. For all the analyses, minor non-conformities (NCs) were given a weight of 0.5, while major NCs were given a weight of 1, according to the compliance measuring system used by the SAN-Rainforest Alliance system.

*Under the conditions set for the study, for a farm to be certified by the SAN-Rainforest Alliance system, it must satisfy 16 critical criteria and comply with at least 80% of all the other criteria contemplated in the 10 principles of the standard that address social, environmental and agronomic dimensions. It must also comply with at least 50% of each principle contemplated in the standard. Failure to fully comply with a certain criteria results in non-compliance that can be classified as a minor or major non-compliance, according to the extent of the non-compliance.

3. Results

3.1 Correlation between management and social and environmental performance

A positive correlation was found between compliance with management criteria and social and environmental criteria. That is, the higher the compliance with the management criteria, the higher the compliance with the criteria related to social and environmental performance or result (Figures 2 and 3). In other words, the more complete and efficient the farm management system, the better its environmental and social performance. This positive correlation was clearly detected both for individually certified farms that for farms certified as a group. Both in the social and in the environmental analysis, the intensity of the correlation was higher for farms certified as a group, but statistically equal to that of individually certified farms.

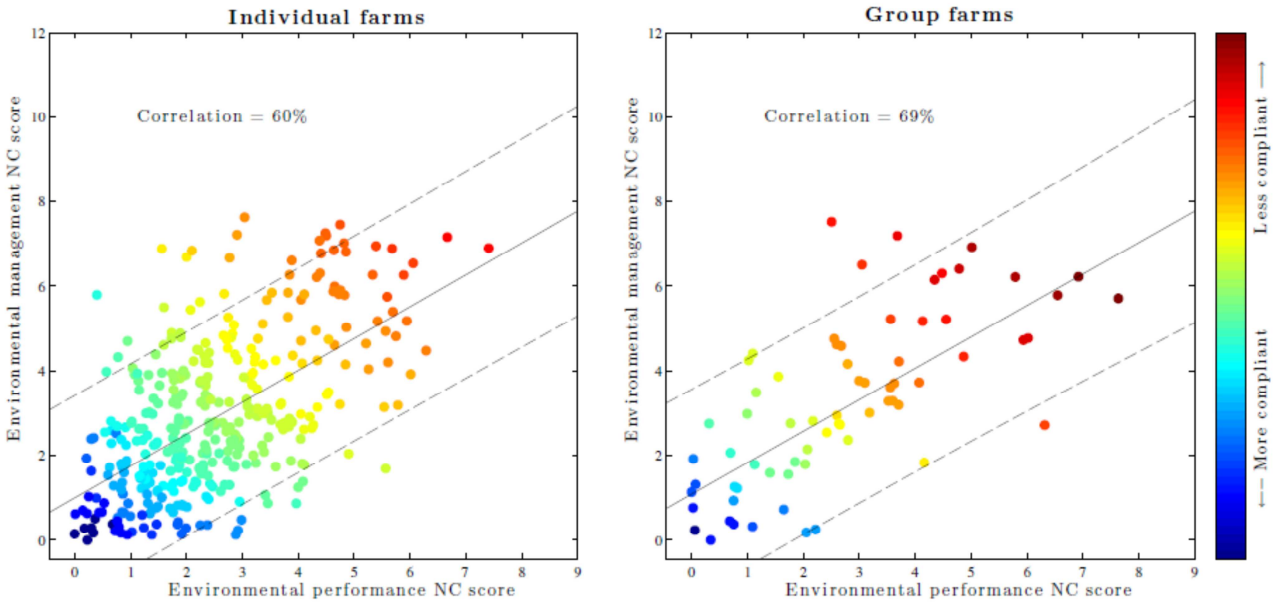

Figure 2. Correlation between compliance with environmental and management criteria on individually certified farms (left-hand side) and on farms certified as a group (right-hand side). The closer to zero, the lower the non-conformities in each dimension (environmental and management dimensions) and, therefore, the better the performance. Minor non-conformities = 0.5; major NCs = 1.

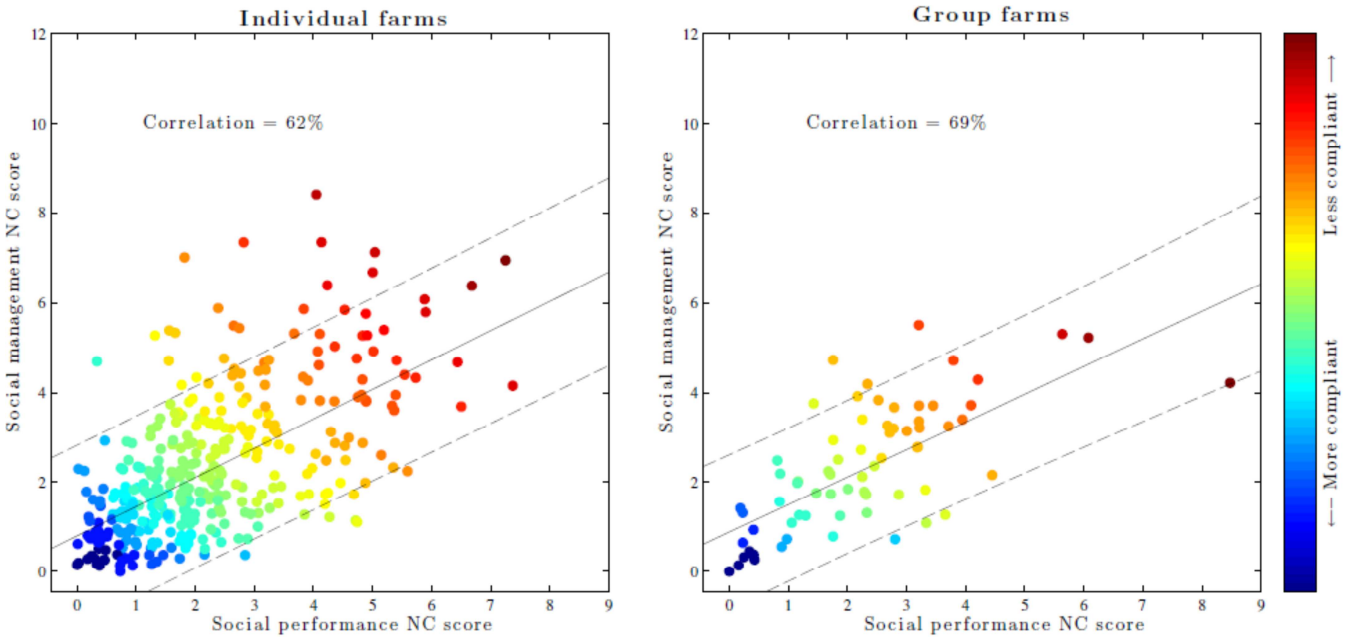

Figure 3. Correlation between compliance with social and management criteria on individually certified farms (left-hand side) and on farms certified as a group (right-hand side). The closer to zero, the lower the non-conformities in each dimension (social and management dimensions) and, therefore, the better the performance. Minor non-conformities = 0.5 major NCs = 1.

1.2 Difficulties for management and for social and environmental performance

Difficulties to comply with the SAN certification standard in order to have an ideal management system and the best social and environmental performance possible (as expressed in the most frequent non-conformities) were quite similar for individually certified farms and for those certified as a group (Tables 1-4).

For management, the main challenges are establishing and operating an integrated management system with more frequent non-conformities for the presence of a comprehensive program with objectives, policies, procedures, schedules, people in charge and records (criterion 1.2), full compliance with social or environmental laws (criterion 1.1) and implementation of a continuous improvement program based on an analysis of the records of the agronomic, environmental and social results of the farms and necessary corrective actions to prevent the recurrence of non-conformities (Criterion 1.7).

Still with regard to management and planning, special mention should also be made of very frequent difficulties faced by the farms to plan and implement an integrated pest management system (IPM - criterion 8.1) combining various approaches to prevent and control pests and diseases, minimizing the

use of pesticides. Finally, the farms face challenges to set up a wage payment system for registered workers that is appropriately explained to them (Criterion 5.4).

The main difficulties faced by the farms to have a positive social performance include the need for meeting comprehensive health and safety at work requirements (criterion 6.6., related to complying with the NR-31 standard in Brazil), implementing an education program covering general certification requirements, topics related to the environment and to hygiene and health for workers and their families (criterion 5:18), controlling the time limit for workers to be exposed to pesticides while applying them (criterion 6.14), excessive overtime (criterion 5.7) and the supply of drinking water that meets international quality parameters as duly confirmed by analyses (criterion 5.15) - Tables 1 and 2.

The main difficulties faced by the farms to have a positive environmental performance include the need for protecting and recovering riparian areas (APPS - permanent preservation areas - criterion 2.6), having plant barriers to isolate people and infrastructure items from areas in which pesticides are applied and from dust (criterion 2.7), having a concession formally granted by local authorities for water use (criterion 4.2), reducing the use of the most toxic pesticides (criterion 8.5), promoting crop rotation, reducing the use of pesticides (criterion 8.2) and ensuring controlled and efficient use of water in irrigation (criterion 4.3) - Tables 3 and 4.

Table 1 - The five most frequent non-conformities with **social** criteria in individual farms

Criterion	Topic of the criterion	#Major NCs	#Minor NCs	Relative Frequency (%)*
6.6	Use of IPEs and compliance with the NR 31 standard	46	180	100.0
5.18	Education program for workers and their families	16	124	57.4
6.14	Control of the exposure of workers to pesticides while applying them	37	80	56.6
5.15	Drinking water supply	23	68	41.9
5.14	Provision of safe and clean accommodation for temporary workers according to the law	22	67	40.8

*the criterion with the highest number of non-conformities was defined with 100% of relative frequency

Table 2 - The five most frequent non-conformities with **social** criteria by groups of farms

Criterion	Topic of the criterion	#Major NCs	#Minor NCs	Relative Frequency (%)*
6.6	Use of IPEs and compliance with NR 31	12	33	85
7.5	Collaboration with local environmental education efforts	10	17	61.7
5.18	Education program for workers and their families	4	27	58.3
6.14	Control of the exposure of workers to pesticides while applying them	6	21	55
5.15	Drinking water supply	4	16	40

Table 3 - The five most frequent non-conformities with **environmental** criteria by individual farms

Criterion	Topic of the criterion	#Major NCs	#Minor NCs	Relative Frequency (%)*
2.6	Protection and recovery of native riparian vegetation - APPs (Permanent Preservation Areas)	59	138	94.1
2.7	Barriers of vegetation between crops and locations with human presence	42	172	94.1
4.2	Concessions for water use	33	118	67.6
8.5	Plan for reducing the use of more toxic pesticides	34	80	54.4
8.2	Crop rotation and reduction in the use of pesticides	19	73	40.8

Table 4 - The five most frequent non-conformities with **environmental** criteria by groups of farms

Criterion	Topic of the criterion	#Major NCs	#Minor NCs	Relative Frequency (%)*
2.7	Barriers of vegetation between crops and locations with human presence	13	30	93.3
4.2	Concessions for water use	12	24	80.0
2.6	Protection and recovery of native riparian vegetation - APPs (Permanent Preservation Areas	8	27	71.7
4.3	Control and efficiency of water use for irrigation	5	24	56.7
8.2	Crop rotation and reduction in the use of products to reduce the use of pesticides	4	21	48.3

3 Continuous improvement

Compliance with the certification standard and the management and socioenvironmental performance of individual farms were slightly better (with a statistically significant difference) than those observed for farms certified as a group. Individual farms had, on average, 2.04 non-conformities (NCs) with management criteria per audit, while farms certified as a group had an average of 3.13 NCs. Following a similar pattern, individual farms had an average of 2.14 social NCs, while those certified as a group had an average of 2.87 social NCs per audit.

On the other hand, despite an overall trend toward better compliance with the standard and a better performance both in terms of management and in relation to social and environmental dimensions after certification over time, this trend is more intense on farms certified as a group (Figure 4). However, the evolution trend is not particularly intense, as there are farms whose performance improves while that of others worsens over time – that is, both of them correct previous non-conformities (by solving problems or pending issues) while allowing new NCs to occur (new problems or pending issues arise even after certification).

Considering these fluctuations, the farms improved their performance on average in terms of eliminating non-conformities. Thus, the farms improved their performance over time, with an average elimination of non-conformities of 0.23 and 0.36 for social and environmental issues. This improvement was more

significant on farms certified as a group, for which improvements of 1.16 and 0.87 were observed per audit on average for social and environmental issues.

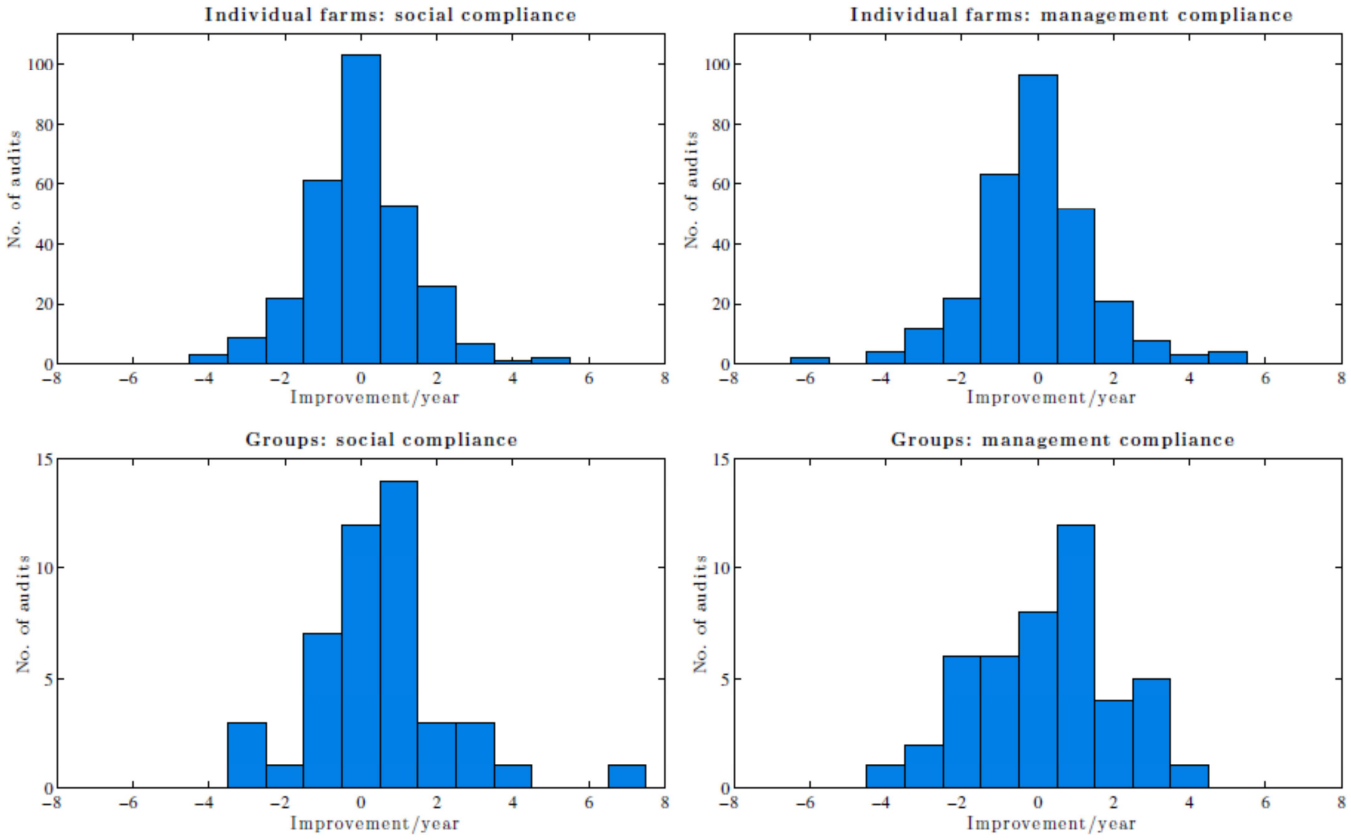

Figure 4. Histogram of the evolution of the social performance of individually certified farms and farms certified as a group. Zero means the same certification score or performance observed in the previous year. Figures below zero represent setbacks and those above zero indicate improved performance and a higher audit score from one year to the next.

3.4 The size of the farms

A small but statistically significant positive correlation was observed between performance in management and environmental performance in relation to the size of the certified farms. The larger the certified coffee production area, the better the performance of the farms in the three dimensions: in the management, social and environmental dimensions. The Pearson correlation coefficient between performance in management and social performance is 62% for individually certified farms and 69% for farms certified as a group.

4. Conclusions and considerations for policy-making

The results of the survey indicate that there is a positive correlation between conformity with management criteria and the social and environmental performance of certified coffee farms. This suggests that the availability of an efficient management system on a farm contributes to it having a positive environmental, social and agronomic performance and enjoying all of its possible benefits: greater productivity, greater efficiency, lower wastage and lower costs.

We also found that even farms that are already certified and have a high environmental and agronomic performance tend to evolve over time, as they have a management and continuous improvement system in place and an external mechanism that motivates and requires them to improve the results of their certification audits with the aim of enjoying an economic market benefit. We therefore recommend that agricultural certification systems should include components that require and encourage sound management as a key element in their rules or standards.

However, the trend toward improvements oscillates up and down and the occurrence of small setbacks is part of an activity that is strongly affected by external factors such as climatic variations, drops in production, abrupt changes in the price of raw materials and end products, particularly in the market price of commodities.

In any case, given the frequent occurrence of non-conformities and of areas requiring improvement on certified farms, it became clear that they are facing difficulties to implement a comprehensive management system that contemplates operating, environmental, social and productive dimensions and is based on a long-term continuous improvement system. The main challenges facing Brazilian agriculture in the area of sustainability range from basic issues such as legal conformity and ensuring drinking water supply for rural workers to more complex issues such as plans and actions for health and safety at work, biodiversity and water conservation and control and reduction of pesticide use.

Stratifying our analysis between individually certified farms and those certified as a group, we also came to the conclusion that having an efficient management system and consequent high performance is possible for large, small and medium farmers. Sound management and high performance can be ensured by means of collective actions such as certification of farmers as groups led by a common administrator and manager with a highly trained staff to meet the needs of the farmers. This allows for economies of scale to be achieved both in terms of numbers of farmers and of costs for implementing and maintaining the system.

Given the importance of management for ensuring sustainability in rural areas, we stress that there is a gap in terms of public policies actually capable of improving farm management in Brazil. The weakening of technical assistance and rural extension programs has resulted in major weaknesses to improve the management of farms. According to the agricultural census of 2006, less than 10% of all managers of

farms in Brazil have a college degree, while 80% of them do not receive any technical guidance and less than 10% of them receive such guidance on a routine basis.

Simple figures such as these indicate that the lack of technical assistance and rural extension (ATER) programs is more pronounced than that of credit for the development of Brazilian agriculture. While there are situations in which not all the amount allocated to credit is contracted in a harvest, the availability of ATER programs for small and medium farmers is lower than would be necessary for several reasons, ranging from the insufficient number of technical staff to the lack of infrastructure items and insufficient penetration for effective action.

At the same time, the role of the private sector in leading innovation and technology transfer to Brazilian agriculture has been increasing. The private sector is specialized and focused on services and products related to production (fertilizers, pesticides, machinery), to the detriment of a systemic view of the business and of the production system of each farmer. For example, farmers are often funded by a pesticide company and receive advance payments from them in the form of a product designed to fight a pest or disease they don't even know will actually occur. This increasingly common situation clearly shows that the assistance provided by the input industry contributes little to improving the management, sustainability and efficiency of farmers.

ATER programs should even play the role of guiding farmers on how to deal with this situation of funding by input companies, as in addition to the above-mentioned problems, a negative trade relationship may develop. The relationship between purchase of inputs/sale of produce is often unfavorable to farmers because they lack the required knowledge to analyze the transaction properly.

There are few exceptions of public or private interventions that actually contribute to improving farm management and to strengthening farmers and their autonomy, such as SEBRAE's Educampo Program, which has been contributing to strengthen the technical and managerial skills of medium-sized farmers in some production chains.

The experience of Educampo is only one of a few which show that the lack of ATER programs in Brazil is not due to the lack of arrangements and possibilities for combining public and private resources. Brazil has a legal framework for ATER programs (General ATER Law of 2010 and derived programs such as Pnater and Pronater) that contemplates a plural system under which various public and private actors can provide technical assistance to farmers. In 2014, Anater (the national ATER agency) was set up, but there is still no clear definition as to how it should operate. The rural credit law of 1965 itself provides for funds for hiring ATER services, but it is not effective and needs to be updated.

Therefore, the serious problem of the lack of ATER programs in Brazil involves elements related to governance, financing and actual operation that need to be appropriately addressed for them to be effective for public, private, local, regional and national actors who have the responsibility or intention to

contribute to the development of Brazilian agriculture, such the federal, state and municipal governments, cooperatives, NGOs and other institutions operating in this sector. Therefore, a comprehensive, independent and efficient ATER program is required to improve the management of rural production and consequent achievement of sustainable production.

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