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Determinant Factors in Adopting Socio-environmental Certifications in Coffee Farms[1]

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Abstract: *Certified coffee production is an opportunity for the grower to differ his product. However, the number of certified producers is still relatively small. In order to contribute to the dissemination of accreditation among farmers, the objective of this study is to identify the factors that determine its adoption, based on a sample of certified and non-certified growers from the south of Minas Gerais, Brazil. Quantitative data were analyzed through logistic regression. Results showed that five variables were significant in explaining the certification adoption: grower's age; role of coffee in family income; attending courses and events; computer use in the farm and crop yield. These results expand the existing knowledge about coffee certifications and can guide actions to increase the number of certified producers.*

Key-words: *Logistic regression, coffee growing, resource based view.*

Resumo: A produção de café certificado **é** uma oportunidade de diferenciação para o cafeicultor. No entanto, o número de produtores certificados ainda é relativamente pequeno. De modo a contribuir para a difusão da certificação entre cafeicultores, o estudo teve como objetivo identificar os fatores que determinam sua adoção, tendo por base uma amostra de produtores certificados e não certificados do sul de Minas Gerais. Empregou-se a regressão logística como técnica de análise dos dados quantitativos. Os resultados obtidos mostraram que cinco variáveis foram significativas para explicar a adoção da certificação: a idade do cafeicultor, a participação da cafeicultura na renda familiar, a participação em cursos e eventos, a utilização de informática na propriedade e o nível de

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produtividade da lavoura. Esses resultados ampliam o conhecimento existente sobre as certificações da cafeicultura e podem orientar ações de ampliação do número de produtores certificados.

Palavras-chaves: Regressão logística, produção de café, visão baseada em recursos.

JEL Classification: C25, Q12.

1. Introduction

Several changes have occurred in recent decades. Society, economy, politics, sports, and others underwent deep changes throughout the twentieth century. For this study, the changes that matter most are those related to agro-industrial chains, highlighting the growing production and certified foods consumption, being coffee one of them.

Foods consumption that meets social and environmental criteria of production is a recent trend (BARBOSA et al., 2010). Consumers are increasingly concerned about where their food comes from. They want to know who produced it, if the environment was respected throughout the process, if workers received a fair wage for their labor. They have a legitimate concern for sustainability throughout the supply chain.

The main coffee certification standards have a blend of environmental, economic and social criteria, and its degree varies according to the Certification Body (COMMITTEE ON SUSTAINABILITY ASSESSMENT – COSA, 2008). These criteria, economic demands, environmental resilience, and social equity are the pillars of sustainability.

For the Brazilian grower, having a certification can guaranteed access to new markets or ensure a better price for their product. The certification allows the producer to differentiate his coffee, which begins to be sold outside the traditional commodity channel. Therefore producing certified coffee is a strategy that can be used by the grower, and it brings economic benefits and increasing competitiveness of Brazilian coffee in the international market.

Supported by the status that certifications have nowadays and the opportunity presented to growers, this study intended to contribute to the understanding of which factors determine their adoption among coffee producers in the Southern region of Minas Gerais, Brazil. Identifying these determinants is the main goal.

There are several studies related to the adoption of new technologies or processes by farmers (OLIVEIRA, KHAN and LIMA, 2005; MONTE and TEIXEIRA, 2006; ISGIN et al. 2008; MONTEIRO and CASWELL, 2009; LIMA et al. 2010). These studies point out farmer and propriety characteristics, such as education degree or crop yield as determinants of new technologies and processes adoption. In general, higher grades of certain variables mean that the farmer is more likely to adopt the new technologies and processes.

The importance of these variables was explained through the Resource-based view (WERNERFELT, 1984; HANSEN, WERNERFELT, 1989; GRANT, 1991; BARNEY, 1995; KRETZER and MENEZES, 2006; PENROSE, 2006) from which the conceptual model of the research was elaborated. From the logistic regression technique,

it was possible to establish the variables that favor the adoption of certifications among farmers.

2. Literature review

2.1. Resource based view

According to Kretzer and Menezes (2006), resource-based view (RBV) is a recent approach that aims to explain through internal resources of the organization its competitive edge against competitors. According to Hansen and Wernerfelt (1989) this approach is one of two commonly used to explain the performance of firms. The other, according to the authors, is prior to RBV, and it is based on the economic tradition and focuses on external factors to explain performance. Barney (1995) offers an example of this approach, prior to RBV, using the SWOT matrix, which takes into account the strengths and weaknesses of the firm (internal aspects) and its relation to seizing opportunities and neutralizing threats. In this sense, the author explains that a more rigorous analysis of the external environment is only "part of the tale". One must also consider the internal factors, however, as noted by the author, the analysis of these factors evolved more slowly than the tools for analysis of the external environment. Since the 1980s, the RBV has drawn attention from the academic world.

The origin of VBR is the seminal work of Edith Penrose (WERNERFELT, 1984), entitled The Theory of the Growth of the Firm, from 1959. In this paper, the author defines the company with a "set of productive resources" (PENROSE, 2006). These resources would consist of tangible objects, such as facilities, equipment, natural resources, raw materials and others, and also of human resources, which are the laborers, and the people responsible for finance, administration and others. Barney (1995) adds to the notion of internal resources of the firm considering them as being composed by financial, physical, human and organizational elements which it uses to produce goods or services.

For Kretzer and Menezes (2006) the company resources, capabilities and internal skills compose its main source of competitive edge. Hansen and Wernerfelt (1989) found evidence that the internal aspects of the organization can be even more important than those related to economic aspects. According to Kretzer and Menezes (2006), the analysis of the competitive advantage of a company starts with a review of what can be done for it, using internal resources which are available at one specific moment. In this case, it possible to see that for RBV, the competitive advantage of the firm depends on the set of features it has.

For Grant (1991) the resources and capabilities of the firm are important for the definition of long-term strategies, which is justified by two assumptions: a) internal capacities guide basic strategy and b) the resources and capabilities are the main source of profit for the company. The author proposes a model in which resources (internal) lead to definition of the capabilities of the firm, i.e., what it can do best with them. Those which, in turn, lead to competitive advantage, which can be understood as what the firm has or is able to perform to outperform its competitors on some level. Based on this advantage, the strategy is defined, in order to make the best use of resources available.

According to Brito and Carvalho de Vasconcelos (2005) many studies in the North American context proved the importance of firm effect on the variance of corporate performance. This effect demonstrates that the internal aspects are relevant when compared to other factors, such as time or activity segment. In a study conducted by the authors in the Brazilian context, it was found that the firm effect is more significant than the time or sector to explain the difference in performance of companies operating in the country. This evidence reinforces the importance of RBV to explain why firms differ in performance and attainment of competitive advantage.

2.2. *Conditions of adoption of technologies, processes and certification in agro industry context*

Oliveira, Khan and Lima (2005) studied the determinant factors for technology adoption in banana crop of Cariri, State of Ceará, Brazil. Research has shown that socioeconomic variables that show a positive relationship with the adoption of technologies were: banana crop as the main agricultural activity of the farmer; education degree; place of residence; access to technical assistance; access to credit; grower's age; land ownership; and income level. The authors consider that the fact of banana cultivation is the main activity of the property influences in the adoption of technologies, since it depends on the bulk of the family income. This makes farmers engage in higher yields of this crop. The education degree allows the producer to have greater ease in understanding new management techniques, in addition to improving property management (HOLANDA JÚNIOR and CAMPOS, 2003). As for the place of residence, the positive relationship with the use of technology occurred for producers residing in the property, therefore, with more time to devote to the activity. Technical assistance was important, since the producers which participated in this study were new to the activity. For the other variables the authors used the findings from studies of other researchers.

In a more recent study, also in Ceará, Lima et al. (2010) investigated the determinants of adoption of technology in the cashew culture. The determining factors were: access to credit, cashew cultivation as the main activity, the price paid for the product and a larger area cultivated with "cajueiro-anão precoce"(Early Dwarf Cashew), which is a variety technologically superior. In this study, the education degree of the producer was not significant.

Monteiro and Caswell (2009) analyzed the adoption of EurepGAP traceability model between pear producers in Portugal who export to the UK. The most important factors influencing the adoption of EurepGAP standard were twofold: a) the producer being part of an association of producers where the standard was already adopted and; b) having farming as their sole source of income (full time farmer). As limiting factors, producers with higher age, lower education levels, and also lower yield were found. The authors explain that the increased adoption of traceability among full time producers is attributed to the fact that they are more dependent on income from the activity and they don't rely on other short term options. Thus, they are more likely to adjust to the new requirements than farmers with other sources of income.

Monte and Teixeira (2006) identified six variables that influence the adoption of the coffee pulping technology among farmers from Venda Nova do Imigrante, Espírito Santo, Brazil. This technology is more sophisticated than what is usually found in most producing regions of the country, hence the need to determine the conditions of its adoption. The significant predictors were: associations among producers; education degree of the producer; use of own capital; crop yield; profit from the activity; and producer training. The explanation for education degree lies in the fact that the higher it is, the easier the producer will adjust to the required knowledge, as in Holanda Junior (2003). Profitability becomes important because, according to Monte and Teixeira (2006), a bigger income gap between the old and the new technology increases the possibility of it being adopted. As for training, we have to rely on the fact that new technologies require proper preparation of the producer. The positive relationship between higher yields and adoption of pulping was expected by the authors, since higher levels of productivity mean that the grower makes a more efficient use of production factors and has a lower unit cost, therefore, he has more resources to invest in technology. Lastly, the association was significant. Producers associated with the local cooperative were more willing to adopt the technology. The authors explain this relationship is due to the courses offered by the

organization, which better enable producers to adopt technology.

Isgin et al. (2008) investigated the adoption of precision farming technologies among farmers in the state of Ohio, United States. Positive and significant relationships for use of these technologies were found in the use of computers in the property, farm size, soil quality and age of the producer. Negative relationship was observed for the debts of the producer. According to the authors, except for age, the relationship of other variables was as expected.

Francisco, Pino and Vegro (2005) identified the determinants of adoption of information technology among the coffee growers of the State of São Paulo, Brazil. The main determinants were: density (plants per hectare); coffee crop area; education degree; time in the activity; percentage of new plants in the field; participation in any cooperative or association; residency in the city; percentage of inventory stored on total production; and percentage of coffee plant coverage on the total area of the property. Furthermore, the results indicate that there is a difference in the level of adoption of information technology among different productive regions.

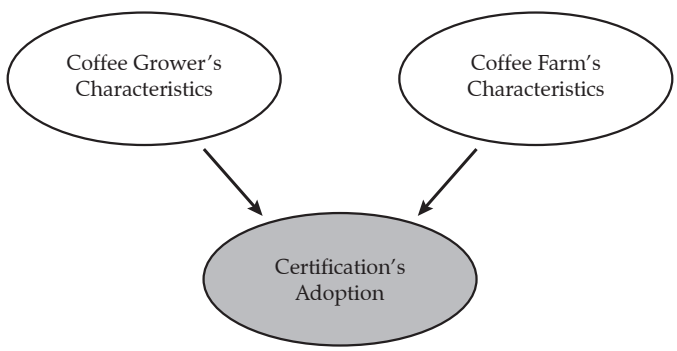
Grolleau, Mzoughi and Thomas (2007) identified factors that lead to the adoption of environmental certifications by French companies in the food processing business. The internal determinants, those related to the characteristics of the firm were firm size, prior experience with a similar type of certification and working in the meat processing industry. The relationship between firm size and adoption of process or product technologies is in agreement with other studies. On the prior use of another certification, the authors explain that if the patterns of certification are similar, the adoption of the second pattern will require lower costs for the entrepreneur, because it is expected that the lessons learned from previous experience will facilitate the process. The study also shows that there are differences between the different sectors of activity of the companies, with firms operating in the meat industry, being the most likely to adopt some sort of certification.

3. Conceptual model

The Resource Based View explains competitive advantage through internal resources at the firm's disposal. A simplified model which explains the adoption of certifications by the coffee industry based on these resources (Figure 1) was elaborated.

The studies on the determinants of adoption of other technologies and processes demonstrate that, within the context of agribusiness, the internal characteristics determine or facilitate the adoption of technologies, processes and certifications. The internal environment variables that are able to explain the adoption

Figure 1. Conceptual model of adoption of certification



Source: Research data.

of certification were selected from these studies. Variables for both the producer and property were set. Characteristics considered for growers were age, place of residence, role of coffee in family income, BM&F BOVESPA use (futures market), internet access, attending courses and trainings. Characteristics related to the property were: The person in charge of management; Area used for coffee cropping; Average yield per hectare; Computer use in the property; Use of irrigation; Processing method.

This model shows that the variables mentioned may increase or reduce the likelihood of adoption of certification by the surveyed farmers. For example, attendance in courses or training. In this case, the greater the attendance in these events, the greater the likelihood of adoption of the certification. Details the model is operated are presented in the methodology.

4. Methodology

4.1. Population, sample collection and data analysis

This is work has a quantitative nature. Farmers from southern Minas Gerais were set as the population being studied, which is around 35 thousand according to a survey done by Bliska et al. (2009). Accidental sampling was used due to technical infeasibility.

Sample consisted of 154 farmers. The sample is divided equally between certified and non-certified producers, with 77 participants in each group.

The certified producers were surveyed in two ways, namely: a) in person, through interviews performed by the researcher on site and b) through e-mail.

Surveys answered by email were only 9, and were obtained through the owners or managers of farms with Utz and Rainforest certification. All of these people who were surveyed had a college degree or graduate degree, which reduces the chance of errors in filling out the information. The outliers were excluded from the sample (see section 5 of this paper). Data were collected between July 2010 and October 2011.

Data was analyzed through the Statistical Package for Social Sciences, SPSS v.17.

4.2. Logistic regression and operationalization of variables

Survey data were analyzed using a logistic regression or binomial logit model (binomial regression). This technique is part of the qualitative response models. According to Greene (2003) there are several models under the generic term "qualitative response models, but they have in common the use of a dependent variable that is an indicator of discrete response, as in a decision between yes or no". According to the author, when the feature is presented in a dependent variable, the conventional regression methods do not work.

The binary variable of this model is defined as the presence, or not, of a certification in coffee farming. If the producer has some certification, the value 1 is assigned, and if he does not, the value 0 is assigned (Yes = 1, No = 0). Thus it is possible to identify which factors influence the adoption of environmental certifications in the activity.

Thirteen explanatory variables were defined to integrate the logistic regression models. Previous studies to find the determinants of the adoption of technology or processes in the agribusiness were used to choose the variables

The following is a description of the variables used and the expected relationship between them and the dependent variable:

a) **Farmer's Age (AGE):** Nominal variable that measures the age of the farmer in years through pre-established strata.
b) **Place of residence (RESIDENCE):** Dummy variable (or binary). (Dummy = 1 if the grower resides in urban areas; = 0 if he resides in a rural area). It is expected that farmers living in rural areas are more likely to adopt the certification, because

they would have more time to devote to the activity.

c) **Degree of the producer (EDUCATION):** Nominal Variable to assess the education degree of the producer, based on the usual classification: elementary school, high school, college degree, post-graduate degree.

d) **Person in charge of management (MANAGER):** nominal variable that identifies who is in charge of managing the property. It is expected that farms with hired managers are more likely to be certified, since administrative functions are performed by a trained employee.

e) **Role of coffee crop in the family income (ROLEINCOME):** nominal variable that measures, through strata, the percentage of the household income that comes from coffee growing. A positive relationship with the adoption of the certification is expected, since families who have a greater dependence on the activity tend to seek alternatives to increase its revenue.

f) **Use of the BM&FBOVESPA to guarantee price (BMF):** dummy variable that identifies the use, or not, of the BM&F to guarantee the price. (Dummy = 1 if the grower uses the tool; = 0 if he does not use it). It is expected that farmers who guarantee future market prices through the BM&F are more likely to be certified.

g) **Attendance in courses and / or training (COURSESTRAINING):** nominal variable that measures, through strata, the frequency in which the grower attends courses or training. We expected a positive relationship with the adoption of the certification since these events improve grower's knowledge.

h) **Internet Access (INTERNET):** dummy variable for the use or not of internet by the grower. Dummy (= 1 if the grower uses the internet; = 0 if he does not used). It is expected that farmers who use this feature are better informed than the rest, so they better understand the benefits of accreditation, and are more likely to do so.

i) **Computerized Farm (COMPUTERIZED-FARM):** Dummy variable for the use, or not, of computers on the property. Dummy (= 1 if computers are used; = 0 if they are not used). We expected a positive relationship between the use of IT and the adoption of a certification, as information technology may improve management skill, if they are used for this purpose.

j) **Average yield (YIELDHECTARE):** Nominal variable that measures, using a scale, the average yield per hectare in the past two seasons. We expect a positive relationship between productivity and the adoption of a certification because higher levels of productivity indicate that the producer is efficient, so possibly he is more likely to adapt to new standards.

k) **Coffee crop area (COFFEEAREA):** Nominal variable that measures, using a scale, the area used for coffee growing, in hectares. We expect a positive relationship between the size of the area used for coffee growing and the adoption of a certification, since larger areas require a higher level of management, which may facilitate the implementation of new standards.

l) **Irrigation Use (IRRIGATIONUSE):** Dummy variable that identifies the use, or not, of irrigation by the grower. (Dummy = 1 if the crop is irrigated; = 0 if it is not irrigated). Farmers who use irrigation technology are expected to be more likely to adopt certifications.

m) **Processing Method (PROCESSING-METHOD):** nominal variable that measures, through a scale, process technology used by farmers. Three levels were set for the processing methods: Natural, Peeled and pulped, each being higher than the previous. It is expected

that farmers who produce peeled coffee are more likely to adopt the certification than those who produce natural coffee, just as it is expected that those who produce the fermented coffee are the most likely among the three groups, to adopt certification.

5. Results and discussion

The choice of variables that would integrate the equation in fact was based on the correlation matrix. Through it, the variables that were significantly correlated with the dependent variable were selected. In this step, the RESIDENCE, EDUCATION, MANAGER, INTERNET and IRRIGATIONUSE variables were excluded for not having a significant correlation.

We have also performed the test for multicollinearity among the remaining variables. The recommendation is that tolerance values (TOL) smaller than 1 and variance inflation factor values (VIF) greater than 10 indicate a problem in the equation. None of the explanatory variables presented problems. All the values of TOL were greater than 1 and all the VIF values were lower than 10.

To improve the equation setting, outliers were used to exclude observations. As a criteria for this exclusion the value of the statistic of Z Residual (ZRED) was considered. Field (2009) suggests that values greater than 3.0 and smaller than (-3.0) may influence the model and should be considered as a serious problem. In this study, the exclusion of outliers helped expand the explanation for data variance.

Between outliers and missing data, thirteen observations were taken, from the 144 obtained from the surveys. Thus, the total number of observations for the equation was 131, of which 69 were from certified growers and the other 62 from non-certified.

Three of the eight variables initially inserted into the regression were not significant in the logistic regression. Thus, the set equation was calculated based only on five significant remaining variables. The summary of the data of the model is presented in Table 1.

The five significant forecasters in explaining the adoption of certification by farmers in southern Minas Gerais were: "Farmer's Age" (AGE); "Role of coffee crop in the family income" (ROLEINCOME); "Attendance in courses and / or training" (COURSESTRAINING); "Computerized Farm" (COMPUTERIZEDFARM); "Average yield" (YIELDHECTARE).

The chi-square statistic was significant at the 1% level, indicating good adhesion of the equation to the data. The Hosmer and Lemeshaw was not significant, demonstrating that the data predicted by the model is in accordance with the

Table 1. Results of the logistic regression

Independent variables	Wald	Exp(B)	95% C. I. for Exp (B)	
			Lower	Upper
Intercept	16,514***	00,000		
Age	09,967***	03,639	001,632	008,115
RoleIncome	14,813***	23,303	004,689	115,816
CoursesTraining	12,315***	04,645	001,970	010,953
ComputerizedFarm	11,381***	68,854	005,890	804,884
YeldHectare	08,491***	03,601	001,521	005,526
Chi-square			126,805***	
R^2 of Nagelkerke			0,828	
Hosmer and Lemeshaw			0,998	
Accuracy (%)			88,5	

n = 131; ***p<0,01; **p<0,05; *p<0,10.

Source: Research data.

collected data. This model had an accuracy of 88.5 %, which means it was able to predict, with this level of accuracy, in which of the two groups, certified or non-certified, each observation is framed. The Nagelkerke R^2 was 82.8%, indicating that this is the percentage of data variance that is explained by Overall Equation, a very satisfying result.

The Wald statistic was significant at 1% for all forecasters. These showed positive values for Exp (B). Positive values for Exp (B) indicate that the increase in the values of the predictor increases the odds of a "Certificate" output occur. That is, the increase in each of the significant predictors increases the probability that the grower is certified.

The age of the accredited producer showed a positive relationship with the use of certification, which means that older farmers have higher chances of having any certification. This result differs from expected. Other studies that used age as a predictor, found a negative relationship between it and the adoption of new technologies or processes (MONTEIRO and CASWELL, 2009; OLIVEIRA, KHAN and LIMA, 2005). The results observed in this study suggest that certification is valued by older coffee growers. It is difficult to pinpoint the exact reasons for this; a new exploratory work on this specific aspect would be required to do so. However, it may be that coffee growing in southern Minas Gerais is going through a change stage, with increasing concern about alternatives for production and marketing of their product.

There is a positive relation between when coffee plays an important role in the producer's family income and the adoption of a certification can be explained by the need, having greater dependence of this activity, for farmers to seek ways to secure better prices and increase their competitiveness. To Monteiro and Caswell (2009), producers who have only agricultural activity as a source of income are more likely to adapt to new demands from the market.

Producers with computers in their properties have more chances to be certified than those who do not use this technology. The certification process requires a series of administrative proceedings by the grower, thus the use of information technology tends to facilitate the process of adaptation of the grower to the new required standards, since they expand the capacity of processing and storage of property information.

The average yield per hectare of coffee crop also was factor that was able to increase the chances of the property being certified. For high rates of yield, the producer needs to master technical knowledge about his activity (management, pruning, pest and diseases) and also administrative, which for Monte and Teixeira (2006) indicate a more efficient use of production factors. For the authors, the coffee grower with higher levels of yield have lower production cost per bag, so they get higher revenues from the coffee sale, providing more resources to invest in product and process technology.

The producer attendance in courses and training also increases the chances of having accreditation. This result was also obtained by Monte and Teixeira (2006). Attendance in such events capacitates the producer, adds new knowledge and even allows an exchange of experiences with other producers. Thus, it is expected that farmers become more aware of the certification benefits and become better prepared for their implementation.

6. Conclusion

This paper aimed to identify the determinants of adoption of certification among farmers in southern Minas Gerais. Five variables were significant in the logistic regression: Farmer's Age, role of coffee crop in the family income, attendance in courses and/or, computerized Farm and average yield. The only outcome that was different from the expected was the age variable.

The other four significant variables for explaining the adoption of certification are found in the literature as determinants of adoption of other processes and technologies in agriculture.

The explanations offered in previous studies also seem to fit the case of certifications.

The methodology, logistic regression, met the objectives, but there are limitations to it. The generated model shows which variables are characteristics of certified farmers, but it is not possible to establish whether they actually determined the adoption of the certification or if the changes happened after the adoption of the certification. We can use yield per hectare as an example. It makes sense to consider that, at least for some farmers, the adoption of certification has increased yield, instead of a high yield increasing the chances of adopting a certification. However, to clarify the temporal aspect, a new research is required. The matter can be deepened in future studies.

Moreover, we must remember that the sample is accidental, so the result obtained cannot be considered as the entire population of certified growers in southern Minas Gerais. Still, the results are consistent with other studies of this type, which may indicate their consistency.

The results obtained can still be useful for policy making by the state government. If there is an interest in promoting the adoption of certifications in the state, the first step could consist of training farmers in order to boost their productivity, increase attendance in courses and events and fund the purchase of computers for the farms. In addition, older growers and the ones that are more dependent on the activity could receive specific training, since these two features were also determinants of adoption of the certification.

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