Impact of certification on fruit producers in the Sao Francisco Valley in Brazil

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Abstract
Producers and exporters of fresh fruits and vegetables from developing countries like Brazil are increasingly required to demonstrate the safety and traceability of their produce up to the consumption stage. In fact, the Brazilian export market is still relatively underdeveloped, with an export share of only 2.4% of the total produced volume. However, certification may also have the effect of a non-tariff trade barrier, undermining the capability and financial ability of especially small-scale farmers in exporting to international markets. This study, therefore, aims at providing an economic analysis of certification on mango and grapes producers. A survey of 303 grapes and mango farmers was conducted in 2006 in the Juazeiro and Petrolina regions of the Sao Francisco Valley in Brazil. Certified and non-certified farmers as well as those in process to obtain certification were included in the sample. Empirical analysis using a logit model shows that grapes farmers have higher probability to certify than mango growers. There are two variables which have a positive and significant effect: education and experience. However, small-scale farms, the dependency on non-agricultural income and a trust-based arrangement have a negative but significant effect.

Keywords: Certification, fruits, logit model

1. Introduction

Several crises and scandals like the one on Bovine Spongiform Encephalopathy (BSE) have shaken the European food sector over the last decades. Despite public regulations and government control, most of the BSE cases were not detected immediately, consequently leading to a decline in the consumer's confidence in the safety and quality of many food products. As a result, the private sector in many European Union countries developed consumers' protection strategies such as new quality labels based on control throughout the whole value chain (Caswell & Modjuska, 1996).

The European retail chains have assumed a leading role in the formulation of food safety and quality standards. Their international supplier base, especially in developing countries, needs to adapt and comply, if they wish to continue trading with major retailers (FAO, 2007). It is widely recognized that quality and safety standards play an important role for developing countries, especially for their agricultural sectors. There is a growing concern that standards will undermine the competitive progress already made by some developing countries and present insurmountable barriers to new entrants in the high-value food trade (Jaffee et al., 2005). Henson & Loader (2001) find that Sanitary and Phytosanitary Measures (SPS) are the greatest impediment to developing countries' exports to the EU, surpassing transport and other direct export costs, tariffs or quantitative restrictions.

Nevertheless, food safety standards can also have positive implications for developing countries. These countries may gain and maintain access to markets of high-value agricultural and food products, especially in industrialized countries (Henson & Jaffee, 2007). From this standards-as-catalyst angle, the challenge inherent in compliance with food safety and agricultural health standards may well provide a powerful incentive for the modernization of developing countries export supply chains and give greater clarity to the necessary and appropriate management functions. Further, via increased attention to the spread and adoption of good practices in agriculture and food manufacture, there may be spillovers into domestic food safety and agricultural health to the benefit of the local population and domestic producers. Hence, part of the costs of compliance could be considered as investments into the national economy.

Rather than degrading the comparative advantage of developing countries, enhancement of capacities to meet stricter standards could potentially create new forms of competitive advantage. Hence, the process of standards compliance could conceivably provide the basis for a more sustainable and profitable trade over the long term, albeit with some particular winners and losers (Jaffee & Henson, 2004).

Fresh fruits are an example of a traditional agricultural export crop and they illustrate the potential for agricultural diversification and production of high-value crops. Brazil is the third largest producer of fruits among developing countries, after China and India. Its total production was 43.8 million tons in 2004, representing 3.2 % of the production of all developing countries. However, it is estimated that only around 2% of the country fruit production (in terms of volume) is exported generating US$370 million (Brazilian Fruit Institute (IBRAF), 2004).

Grapes and mango exports have been the most successful cases, with around 260,000 tons and 550,000 tons each being cultivated. The regions of Petrolina and Juazeiro, which are part of the Sao Francisco river basin, is responsible for this export performance. This region produced 99% and 88% of the country's grapes and mango exports (IBRAF, 2004). VALEXPORT (2006) estimates that the sector generates a total of 240,000 jobs directly and 960,000 jobs indirectly in the region.

The objective of this study is to identify the determinants of certification among mango and grapes producers in Brazil. In particular, the study assesses whether there are significant differences in the characteristics between mango and grapes producers or not; and whether the impact of the determinants of certification are the same for mango and grape farmers. The paper is structured as follows: after this introductory section, some recent studies will be reviewed in the second section. Section 3 presents the primary data base and methods applied for analysis by outlining the logit model that is used in the study. Section 4 presents the results which will be followed by the final Section 5 with the main conclusions and the policy implications.

2. Literature review

2.1 Theoretical and empirical evidences

The literature outlines different approaches which have been used to examine relationships between certification and value chains. Both issues are closely related since certification may drive integration in the value chain. Special emphasis will be put on empirical examples from the food sector, in particular related to horticultural products.

Carambas (2007) conducts a cost-benefit analysis comparing certified organic and conventional rice producers in Thailand. The net returns for farmers of eco-labeled products were estimated and compared with those of conventional farmers. The difference in incomes per unit of eco-labeled and conventional products depends on the magnitude of the price premium. The costs involved in producing eco-labeled products relate to capital costs due to adjustments to new technologies, additional costs of production and processing and increase in

labor requirements, additional cost of raw material, cost of testing and certification. However, financial, environmental and health benefits also accrue to producers of labeled organic rice. Financial net benefits depend largely on the presence of a price premium.

Cook (2000) analyzes the implications of drivers on fresh fruit and vegetables value chain in the US market. She concludes that the fresh producing industry is clearly leading to a greater vertical coordination of the distribution system via more supply chain oriented procurement models, despite the fact that conventional retailers are lagging mass merchandisers in this regard. The explosive growth of the Supercenter format is a compelling force that will continue to move conventional retailers in this direction.

Schipmann (2006) aims at comparing international and national value chains with regard to potential benefits for smallholders and existing entry barriers to their integration in the chilli sector of Ghana. Her results have shown that international value chain integration may offer additional benefits compared to national value chains. In this manner, smallholders have the ability to improve their production skills and become integrated into higher value chains through appropriate incentives. Besides, the author finds that the integration promotion of the poorer population (e.g. smallholders) into the value chain is a useful instrument to promote large-scale pro-poor growth.

Chemnitz (2007) provides an empirical analysis of the compliance decision behavior and the compliance process of standards related to the Moroccan tomato export sector. The study aims at understanding who the drivers for the compliance decision are, by comparing the determinants of the decision process between certified and non-certified producers. The results suggest that small producers are not particularly disadvantaged in the compliance process. However, less organized and less integrated farmers tend to be less favored, especially in cases when integration diminishes the cost of compliance. Additionally, integration may facilitate the information access from buyers' requirements.

Lu (2005) uses a composite of various indicators to measure the effects of different variables of transaction costs on the technical efficiency of the tomato supply chain. The four categories of transaction costs used are: (a) transportation costs: depending on distance, time, road conditions and availability of own means of transport; (b) information costs: depending on the number of traders visited before selling and the sources of access to market information; (c) negotiation costs: related to the number of visits for reaching an agreement with respect to selling the tomato; and (d) monitoring costs: related to the number of years that the farmer is engaged with the trader.

Neves (1999) analyzes the orange juice chain in Brazil using transaction cost approach as theoretical background. He analyzed the transaction costs between fruit growers and the processing industry. His findings reveal that the transaction costs between fruit growers and the industry still have to be better coordinated for the chain to be more competitive. He suggested to reduce costs, to improve supply guarantee and to enhance trust via contracts. Table 1 presents a summary of the main studies in the horticulture sector. While many authors have discussed empirical approaches to different products, only few studies have focused on the theory (see (Chau, Basu & Grote, 2004) and (Basu et al., 2007)). A more comprehensive approach to standards is certification consisting of a number of different standards and regulations relating to food quality, environmental or social issues. Certification generally aims at providing consumers with better information about the characteristics and quality of food products, thus enhancing market transparency. The question of governance arises when some firms in the chain work according to standards set by others. Standards that are specified also have to be monitored and enforced. Therefore, value chain governance involves institutions for monitoring and enforcing compliance of certification. Specifically in the fruit sector, given the large number of certification systems, it is important to provide an economic analysis to increase the competitiveness and efficiency.

Table 1: Summary of the main studies in the horticulture sector categorized by the approach

Authors	Year	Type of product	Country	Contents	Approach
Carambas	2007	Organic rice	Thailand	Cost: capital costs, raw material, testing and certification; Benefits: financial, environmental and health	Cost and benefit
Gogoe	2003	Pineapples	Ghana	Cost and benefits to implement EurepGAP	Cost and benefit
Cook	2000	F&V	US	Identification of drivers of change	Global value chain
Shipmann	2006	Chili	Ghana	Comparing international and national value chains	Global value chain
Dolan & Humphrey	2000	F&V	UK, Kenya and Zimbabwe	Identifying the key decision-makers and how their requirements for the performance of the chain	Global value chain
UNCTAD	2007	Banana	international	Identification of actors in the chain	Marketing chain
FAO	1989	F&V	international	Understand the link in the marketing chain between farmers and traders	Marketing chain
UNCTAD	2007a	Citrus	Brazil and US	Identify the players in the distributional channel; degree of concentration	Marketing chain
Chemnitz	2007	Tomato	Morocco	Identification of drivers for the compliance decision	Diffusion of innovation
Kleinwechter & Grethe	2006	Mango	Peru	Identification the mechanisms that lead producers to adopt the EurepGAP standard	Diffusion of innovation
Lu	2005	Tomato	China	Transaction costs on the technical efficiency: transportation information, negotiation and monitoring	Transaction cost
Neves	1999	Orange juice	Brazil	Transaction costs between fruit growers and the processing industry	Transaction cost
Carvalho	2003	Fresh fruit	Brazil and UK	Determinants for the configuration of transaction arrangements in the fruit trade	Transaction cost
Lopes	2003	Citrus	Brazil	Characteristics of the standard contract used and the attributes of contracts	Transaction cost

Source: Own compilation based on the literature review (note: F&V= fruits and vegetables)

2.2 Certification schemes in Brazil

There are a few studies on certification which have been carried out in Brazil. Major results will be briefly presented. A more detailed description of the four certification schemes will follow in the next section. The adoption of selected certification schemes in the fruit sector differs by region and product in Brazil. According to the statistics from INMETRO (2007), there are more than 1,500 producers with Integrated Fruit Production (PIF) certification or being in process of having it. They are responsible for nearly 1 million tons of fresh fruit produced on 40 thousand ha. There are a total of 1,521 producers spread over the country producing one of the 16 types of fruits. In the SFV, there are totally 49 mangoes producers and 101 grapes producers who adopted PIF certification.

With respect to organic certification, Darolt (2000) verifies the evolution of organic production in Brazil and points out that the lack of updated statistics makes it difficult to evaluate this alternative agricultural system. Nevertheless, the author gathered data from the organic certifying companies and associations and concluded that around 100 thousand ha have been planted by 4,500 farmers concentrated mainly in the states of Paraná, Sao Paulo, Rio Grande do Sul and Espírito Santo in the year 2000.

Agrotecnologia (2007) presents data regarding the number of farmers with GlobalGAP certificate. In 2007, there were more than 68,000 producers spread all over the world, with approximately 10,000 being fruits and vegetables growers. In total there are only 540 Brazilian farmers who are certified according to GlobalGAP standards. This national figure is - in comparison with the global figure - relatively small. Most of the certified farmers are grapes (45%) and lime growers (33%). In terms of land, soybeans and maize crops require huge areas, occupying 48% of the total area certified involving only 8 farmers. On the other hand, fruit culture is characterized as an activity with intensive labor and is compatible with small productive areas. Therefore, it represents an important alternative to producers who depend largely on family labor force. There are no official data available on Fairtrade certification in Brazil though it does play some role in the survey regions. Implementation of Fairtrade certification started in 2005 only.

The comparative analysis of the four certification schemes which exist in the fruit sector in Brazil has shown that GlobalGAP and the Integrated Fruit Production (PIF) are similar certification schemes. However, they differ with respect to the number of requirements and their distribution over various stages (e.g. production, post-harvesting). In addition, PIF certification requires a book keeping system opposed to GlobalGAP. But since, GlobalGAP auditors accept the book keeping provided by PIF, farmers aiming to adopt GlobalGAP face an easier process when they have already PIF.

Contrary to PIF and GlobalGAP, Fairtrade certification concentrates on producers' organizations and cooperatives where small-scale farmers belong to and not on individual farmers. In addition, a lot of attention is paid to the labor and environmental conditions, besides the guarantee of a minimum price for farmers. With respect to organic certification, the requirements are not directed to a particular product or crop and their level of compliance is not indicated. Major emphasis is put on the production system. Organic and Fairtrade certification do not have an own book keeping for records. All four programs are subject to monitoring but with different frequency. PIF certified farmers are monitored three times a year, GlobalGAP requires monitoring twice a year and Organic and Fairtrade certified producers are monitored once a year.

3. Data and methods

Data collection

A survey of 303 farmers was conducted between July and October 2006 in the Sao Francisco Valley, on the surroundings of Petrolina (state of Pernambuco) and Juazeiro (state of Bahia) in Brazil. The two-stage stratified sampling technique was applied as outlined by Levy & Lemeshow (1999). The first stratum included small[1] (<12 ha), medium (>13 and <49) and large producers (>50 ha) in both regions. The final step involved the identification of producers with certification, the ones without certification and those in the process of becoming certified. A total of 18 strata were identified. To ensure that this sample population could yield significant results from econometric analysis, a statistical power analysis was made to determine the sample size, whereby expected effect size, i.e. expected differences of means of two populations or the alternative hypothesis, can be detected with a certain power and significant level. This approach requires information on population means (μ) and standard deviation (σ) based on lists of producers. The sample size of each stratum was calculated using the program Russlenth[2].

4. Results and discussions

4.1 Descriptive statistics of the survey

For the mango and grapes producers, a total of 155 surveyed farmers (51%) have no certification, those in process comprise 94 (31%) and those who are already certified comprise 54 (18%). The descriptive statistics based on the survey are presented in the following separately for each type of fruit. It is structured according to the (a) socio-economic factors and the (b) farm characteristics.

(a) Socio-economic factors

The survey collected data regarding socio-economic characteristics of mango and grapes producers, including age, gender and level of education. With respect to age, it was found that the producers are on average 49 years old. It was expected that the ones who have adopted certification would be younger than the non-certified producers since they might be more open to new technologies or practices (D'Souza et al., 1993). However, there is hardly a difference between the two groups: certified producers were on average 48.8, while non-certified ones were 50.5 years old. Thus, the expected result is not supported by the data. Similarly, it was expected, that producers who are certified would have more years of schooling and long-term experiences in growing fruits than the non-certified ones. However, the results show that on average certified and non-certified producers have both 7.7 years of schooling. The farmers in process have the highest level of education with 10.2 years of schooling. The figures on the years of experiences show that certified producers have on average 7.3 years of experience in grapes and 9.2 years in mango production while the non-certified producers have only 5 years and 7 years, respectively. While the years of schooling do not seem to influence the decision to adopt certification, the years of experience do.

The data show that mango and grapes were the main source of income for 91% of the certified producers, for 80% of the producers in process, and for 75% of the non-certified producers. Apart from producing mangoes and grapes, farmers are also involved in the production of other tropical fruits such as coconuts, guava, melons, banana and papaya (15% of non-certified producers and 2% of certified ones). This result reflects the high dependence of the producers on fruits in general, but also indicates a stronger trend towards specialization for certified producers.

[1] Definition of land size according to SEBRAE of Petrolina
[2] Available on the website: http://www.cs.uiowa.edu/~rlenth/Power/ (Accessed on August 2006)

(b) Characteristics of the farms

A comparison of the mean values between the groups clearly indicates that certified mango and grapes farmers have much more land (100 ha and 93 ha) and more irrigated area (40 ha and 29 ha) compared to non-certified (Table 2). Indeed, an irrigation system is necessary for fruit production in the surveyed region. There are two types of irrigation systems: the drip and micro sprinkler which are considered very sophisticated while furrow and conventional sprinkler are less sophisticated. The study reveals that most of the certified farmers use very sophisticated irrigation systems (83%). However, also a high percentage of the non-certified farmers have very sophisticated systems (59%).

The type of used irrigation system plays an important role with respect to the productivity of the farm. The results show that mango yields on average amount to 19.3 tons per ha for non-certified producers, 20.5 tons per ha for producers in process, and 25.9 tons per ha for certified producers. Concerning grapes, the productivity for non-certified producers is nearly 16.3 tons per ha, while for those in process and for the certified ones, 18 and 23 tons per ha are achieved. Thus, certified farmers achieve in the given sample higher yields than non-certified ones. But they also have relatively higher net income. Regarding the average net income of grapes farmers, it was found to be around R$12,700[3] per ha for non-certified farmers, R$15,850 for those in process and R$20,150 for the certified ones. Concerning mango farmers, the average net income is approximately R$9,000 for non-certified farmers, R$8,300 for those in process and R$10,100 per ha for the certified ones[4].

Table 2: Farm characteristics of mango and grapes farmers

Variables Mean value	Non-certified N=155	Producers in process N=94	Certified N=54	Ch², t test
Mango				
Land size (ha)	20.0	18.2	101.0	0.003***
Irrigated area (ha)	10.3	11.7	39.8	0.000***
Yield (tons per ha)	19.3	20.4	25.9	0.003***
Total income (R$)	125,263	141,236	1,215,991	0.000***
Income (R$/ha)	17,050	8,325	10,076	0.000***
Production costs (R$)	58,314	62,831	463,108	0.000***
Costs (R$/ha)	7,965	7,631	11,814	0.000***
Total net income (R$)	67,048	78,405	752,882	0.327
Net income (R$/ha)	9,085	8,325	10,076	0.887
Grapes				
Land size (ha)	34.7	8.2	93.5	0.194
Irrigated area (ha)	14.4	6.3	28.9	0.198
Yield (tons per ha)	16.3	17.9	22.9	0.014***
Total income (R$)	188,878	348,396	606,227	0.006***
Income (R$/ha)	28,947	31,513	42,748	0.016***
Production costs (R$)	89,279	160,348	324,250	0.083***
Costs (R$/ha)	16,249	15,666	22,612	0.005***
Total net income (R$)	99,598	188,048	281,977	0.012***
Net income (R$/ha)	12,698	15,847	20,145	0.085***

**** Statistically significant at 1% level;** at 5% level; * at 10% level*

Source: Own compilation

[3] 1US$ = R$2 at the time of data collection

[4] The total income refers to the fruit production only, however other income sources were found to be negligible.

4.2 Econometric estimates for the mango and grapes models

The logit regression results from the econometric analysis (coefficient, odds ratio, standard deviation, marginal effect, p-values and 95% confidence intervals) for grapes are presented in Table 3 and for mangoes in Table 4. The dependent variable is a dummy variable reflecting the decision of the producer to adopt certification or not. The results reveal that the adjusted Wald test for the model indicates that it is highly significant at 1 percent level. The R^2 is 0.13 and 0.14 for grapes and mangoes, respectively. Thus the Hosmer-Lemeshow test shows that both models present a good fit. The area under the ROC curve for the regressions is 0.75 for both cases which reveals that the model presents adequate discrimination. Likewise, the link test presents results according to the expectations meaning that the model does not have relevant omitted variables. The correlation tables have shown that there is no case of coefficient higher than 0.4.

The first variable to be analyzed is the type of fruit that the farmers are harvesting. Comparing the results of mango and grapes farmers, mango and grapes present an odds ratio of 0.43 and 2.05, being statistically significant at the 1% and 5% levels. The results indicate that producers, who are mango growers, have lower chances to certify while those who concentrate on grapes production are two times more likely to certify. Producers with a higher level of education are more likely to adopt certification. The odds are the same for both fruits: 1.09 and also the differences between the groups are highly significant.

The small size of the farm contributes negatively to certify. Both, mango and grapes growers have an odds ratio of 0.53, which means that farmers who possess less land than 12 ha have two times lower chances to certify. Burton et al. (1998) mention that in the United Kingdom, managers of smaller holdings are more likely to adopt certification, but farm size *per se* does not explain the timing of that decision. The dependence on the income obtained from non-agricultural sectors also has a negative impact on the decision. In the case of grapes farmers, the chances decrease by 2.5 times while for mango ones, the chances decrease by 2.7 times. It indicates that the higher the dependence on non-agricultural income, the less likely the farmers are to certify. For each additional year of experience the chances to adopt certification increase 9 times. The contract arrangement "trust-based" contributes to decrease the level of producers to certify by 2.3 times. The results are statistically significant at the 1% level. The uncertainty of favourable arrangements and payment conditions may influence the decision making.

Table 3: Logistic regression results on the certification decision for mangoes producers

Variables	Odds ratio	Robust Std. Err.	z	P>|z|	95% CI	
Mango	0.412	0.129	-2.83	0.005***	0.223	0.761
Gender	1.078	0.411	0.20	0.842	0.510	2.278
Education	1.097	0.333	3.03	0.002***	1.033	1.165
Manager	1.106	0.385	0.29	0.771	0.559	2.188
Size	0.530	0.160	-2.10	0.036**	0.293	0.958
Non_agri_income	0.393	0.140	-2.61	0.009***	0.195	0.793
Years_experience	1.094	0.040	2.46	0.014***	1.018	1.175
Type_irrigation	1.128	0.348	0.39	0.695	0.616	2.067
Irrigated_area	0.489	0.272	-1.28	0.201	0.164	1.461
Trust_relat	0.393	0.137	-2.67	0.008*	0.198	0.778

Dependent variable: certified and non-certified producers; n=303
*** Significant at 1% level;** 5%; * 10%

Adjusted Wald Test	F(10, 303)=33.13 p<0.0003
Pseudo R2	0.1198
Hosmer-Lemeshow goodness-of-fit test	Chi2(8)= 5.72 p< 0.6785
Area under the ROC curve	0.7353

Source: Own calculations

Table 4: Logistic regression results on the certification decision for grapes producers

Variables	Odds ratio	Robust Std. Err.	z	P>|z|	95% CI	
Grapes	2.194	0.678	2.54	0.011**	1.197	4.020
Gender	1.101	0.430	0.25	0.805	0.511	2.370
Education	1.094	0.340	2.92	0.003***	1.030	1.163
Manager	1.155	0.400	0.42	0.676	0.586	2.278
Size	0.525	0.157	-2.15	0.031**	0.292	0.944
Non_agri_income	0.363	0.132	-2.77	0.006***	0.177	0.743
Years_experience	1.091	0.047	2.34	0.019***	1.014	1.174
Type_irrigation	1.120	0.344	0.37	0.711	0.613	2.047
Irrigated_area	0.478	0.267	-1.32	0.188	0.159	1.434
Trust_relat	0.397	0.138	-2.65	0.008**	0.200	0.795
Dependent variable: certified and non-certified producers; n=303						
*** Significant at 1% level;** 5%; * 10%						
Adjusted Wald Test			F(10, 303)=28.49 p<0.0015			
Pseudo R2			0.1177			
Hosmer-Lemeshow goodness-of-fit test			Chi2(8)= 6.59 p< 0.5813			
Area under the ROC curve			0.7359			

Source: Own calculations

4.3 Econometric estimates for the decision of adopting two versus one certificate

This analysis focuses on the 148 certified grapes and mango producers in the Juazeiro/Petrolina region. The regression estimates were done separately for each fruit aiming to assess the determinants that lead farmers decide to adopt one or more certification schemes. The adjusted Wald test for the models indicates that the models have good explanatory power at 1% level. The R^2 is 0.36 and 0.51 for the grapes and mango models, respectively. For both models, the Hosmer-Lemeshow test presents a good adequacy, the ROC curve presents adequate discrimination and there are no omitted variables. The regression results are presented in Table 5 and Table 6.

For both models, the variable subcontracting a packing house plays a major role in the decision to adopt two certificates. Considering that fruits are perishable, farmers who utilize the packing house from the groups, cooperatives or associations they belong to, have better conditions to maintain the fruits with high quality. Mango farmers who have less planted area have 11% lower chances to adopt a second certificate at 5% level. Although for grapes farmers, having more planted hectares impact positively, the variable is insignificant. However, factor as the total labor (insignificant in the grapes model) increases slightly the probabilities.

In addition, each more year of trading with the current buyer decreases the chances by 50% and 31% to adopt the second certificate for mango and grapes, respectively. Further analysis in the marketing chain shows that in both models, there is a negative and significant (only for mango) effect to adopt two certificates if the buyer comes with a truck to the farm to collect the production. Living in the city decreases the chances to adopt a second certification scheme by approximately 85% for both types of farmers. Once the farmer has one certification, the social network and the distance to places where courses are held no longer contribute with further information. Further, there are some variables which are not statistically significant. The variables whether a manager runs the farm and having a sophisticated irrigation system impact positively on the decision-making. For mango, age has a positive sign and education a negative one, whereas the opposite results were found for grapes.

Table 5: Logistic regression results on the decision of mango farmers to adopt two versus one certificate

Variables	Odds ratio	Robust Std. Err.	Z	P>|z|	95% CI	
Age	1.022	0.032	0.70	0.482	0.961	1.087
Education	0.996	0.081	-0.04	0.969	0.849	1.170
Manager	1.988	1.928	0.71	0.479	0.296	3.313
Living_city	0.173	0.180	-1.69	0.091*	0.022	1.325
Ha	0.806	0.045	-2.13	0.033**	0.810	0.991
Total_labor	1.061	0.023	2.71	0.007***	1.016	1.107
Type_irrig	2.747	2.141	1.30	0.195	0.596	3.661
Sub_packing	3.684	3.211	2.29	0.017***	1.501	7.469
Trans	0.184	0.171	-1.82	0.069*	0.299	1.137
Year_buyer	0.502	0.082	-4.18	0.000***	0.363	0.693

Dependent variable: farmers having one and two certificates; n=148
*** Significant at 1% level;** 5%; * 10%
Adjusted Wald Test F(10, 148)=48.01 p<0.0000
Pseudo R2 0.5122
Hosmer-Lemeshow goodness-of-fit test Chi2(10)= 102.63 p< 0.9852
Area under the ROC curve 0.9378

Source: Own calculations

Table 6: Logistic regression results on the certification decision of grapes farmers to adopt two versus one certificate

Variables	Odds ratio	Robust Std. Err.	Z	P>|z|	95% CI	
Age	0.985	0.025	-0.55	0.581	0.936	1.037
Education	1.020	0.064	0.33	0.745	0.901	1.156
Manager	1.087	0.970	0.09	0.925	0.189	6.245
Living_city	0.156	0.132	-2.18	0.029**	0.029	0.826
Ha	1.073	0.107	0.72	0.474	0.883	1.305
Total_labor	1.003	0.009	0.41	0.684	0.985	1.022
Type_irrig	1.860	1.266	0.91	0.362	0.490	3.062
Sub_packing	3.785	2.087	2.66	0.008***	1.824	6.490
Trans	0.261	0.360	-0.97	0.330	0.017	3.899
Year_buyer	0.694	0.145	-1.74	0.082*	0.460	1.047

Dependent variable: farmers having one and two certificates; n=148
*** Significant at 1% level;** 5%; * 10%
Adjusted Wald Test F(10, 148)=31.71 p<0.0008
Pseudo R2 0.3649
Hosmer-Lemeshow goodness-of-fit test Chi2(10)= 142.15 p< 0.3417
Area under the ROC curve 0.8905

Source: Own calculations

Conclusion and policy recommendations

In developed countries, particularly in the European Union and the United States, demand for higher levels of food safety has led to the implementation of certification programs that address more types of safety-related attributes and impose stricter standards. Certification systems play an important role in any market that is burdened with a high degree of information asymmetry and quality uncertainty. Thus, producers and exporters of fresh fruit and vegetables from developing countries like Brazil are increasingly required to demonstrate the safety and traceability of their produce up to the consumption stage. The producers also

have to show that they have taken all possible precautions in terms of food and environmental safety along the chain, assured via a certification scheme.
Some descriptive statistics results are shown from the comparative analyses between certified and non-certified farmers of grapes and mango from the survey areas. An analysis of the characteristics of the farmers concludes that certified farmers are generally not better educated than non-certified ones. The high dependence on the income from fruit production combined with a sophisticated irrigation system leads to higher net income for all certified farmers. In addition, certified farmers of the four types of fruits have higher productivity, more land allocated to the specific fruit and more years of experience in the field. Mango and grapes certified and in process farmers have invested high amounts in new infrastructure. Despite the higher costs per ha, they receive net income which is slightly higher for the certified farmers but slightly lower for the farmers in process.

The econometric analysis has shown that grapes growers are more likely to certify than mango ones. There are two variables which have a positive and significant effect: education and experience. However, small-scale farms, the dependency on non-agricultural income and a trust-based arrangement have a negative but significant effect. The results from model adopting one versus two certificates revealed that utilizing the packing house from the group, cooperative or association plays the major role in the decision to adopt two certificates. In addition number of employees working on the farm has also a positive effect. Variables such as 'years trading with the buyer' and 'living in the city' have a negative and significant influence on the decision making. Transportation and planted ha is only negatively significant for mango farmers.

In the survey regions, it is important that organizations promote and give incentives to farmers to participate in training courses, workshops and discussions with experts. They should also provide updates related to certification, disseminate information on new varieties and help finding solutions for plagues and diseases in the orchards. Information should equally reach farmers living in rural villages and on the farm. Unfavourable factors are the distance from the rural village to the city center, where usually training courses and workshops are held, and the lack of adequate facilities. In this line, organizations should promote regional and local meetings.

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