Geographic variation in global diffusion of private food standards: The case of GlobalGAP certification

Amjad Masood
Department of Agricultural Economics and Rural Development,
University of Göttingen, Germany
Email: amasood@gwdg.de

Abstract

GlobalGAP is an important private voluntary standard in food sector. However, geographic diffusion of GlobalGAP is uneven around the globe. We use a panel for three years 2010, 2011, 2012 over 170 FAO member countries to analyze GlobalGAP diffusion at country level for crops sector. For estimation, Heckman random effect model is applied while taking number of hectares in each country harvested under certification as a measure of GlobalGAP diffusion level. Alternatively, we consider number of GlobalGAP certificates issued as well as number of producers accepted under GlobalGAP certification process in each country and carried out estimation using negative binomial model. We analyze the impact of network ties and historical relations among countries, geographic preconditions, and various macroeconomic conditions prevailing in courtiers on the diffusion of certification. The study finds that diffusion is positively related to per capita GDP, infrastructure and governance level in a country. In this way, growers in countries with poor infrastructure and governance are at disadvantage in this regard. We also find that countries with low agricultural production and agricultural exports have comparative lower penetration of the standard. Furthermore, higher share of fruits and vegetables, with more export especially to West European market encourages diffusion process.

Keywords: Standards, Food quality, adoption, Organizational innovation, GlobalGAP

1 Introduction

Private food standards are now increasingly becoming a prevalent part of the governance of global agri-food value chains. Retailers in the developing countries ask for strict requirements of standardization and the dynamics of these policies are transmitted along the supply chain to the growers in the developing countries. Nevertheless, all countries vary to each other in terms of their geographic preconditions, institutional structures, and level of economic development as well as in the composition of various economic sectors. Accordingly, countries differs in their pace of adoption to these standards. Literature on mechanisms of innovation diffusion treats schemes such as GlobalGAP certification as organizational innovation. For organization innovation, for instance ISO certification, there is a range of literature explaining diffusing process, especially at firm level. However, availability of reliable data at world level on voluntary food standards is a major reason to restrict investigation in the area. There are several national certification schemes for good agricultural practices such as Kenya-GAP, ChileGAP and ThaiGAP. At a global scale, however, are two most considerable schemes: GlobalGAP and British Retail Consortium (BRC).

Corbett and Kirsch (2001), Potoski and Prakash (2004), Neumayer and Perkins (2005), King *et al.* (2005), Darnall and Edwards (2006), Alburquerque *et al.* (2007), and Perkins and Neumayer (2012) are studies on the diffusion of various ISO standards. There is a study, Herzfeld et al (2011), that analyzes the diffusion of GlobalGAP certification. The study applies variants of count data models for GlobalGAP certificates count in a cross section setting. The value addition of our study is that we use a panel for three years 2010, 2011, 2012 over 170 FAO member countries to analyze GlobalGAP diffusion at country level for crops sector. For estimation, Heckman random effect model is applied while taking number of hectares in each country harvested under certification as a measure of GlobalGAP diffusion level. Alternatively, we consider number of GlobalGAP certificates issued as well as number of producers accepted under GlobalGAP certification process in each country and carried out estimation using negative binomial model. Despite of the spread of GlobalGAP in 112 countries, the magnitude of certification remains highly uneven throughout the world. Countries are heterogeneous in terms of their macroeconomic characteristics. In this way, it is interesting to analyze the impact of geographic preconditions, variation economic development, institutional structure and other macroeconomic characteristics on the diffusion process of organizational innovation such as GlobalGAP. Due to heterogeneous rate of adoption, there can be implications for the redistribution market access under the influence of such certification schemes. By presenting a case of organizational innovation in agricultural sector, the study adds to the exiting literature on diffusion mechanism

The rest of the paper is organized as follows. After a brief account on prevailing private voluntary standards in food sector, the following section pronounce the nature of GlobalGAP certification scheme. Section 3 offers an insight into the diffusion determinants to provide a conceptual framework to articulate estimation. Data and methods are described in section 4 followed by presentation and discussion of results in section 5. Section 6 concludes the study.

2 Background

2.1 Private food standards

Developed world import most of its food from developing countries. With an enhanced awareness about food safety and quality in consumer markets, food supply chains nowadays are governed by not only by public regulations like SPS and TBT but also by private voluntary standards. Private standards can be seen as filling a 'void' in international rules. For instance, GlobalGAP standard that outlines requirements for 'good agricultural practices' in the phase of primary production where international standards are scarce (Henson and Humphrey, 2009). In fact, private standards set a higher standard for particular food product attributes, and provide additional requirements for the end-product than the requirement lay down by public regulations. The contents of private regulations are readily reviewed, in order to incorporate consumers' varying preferences, for the sake product differentiation and price premium. Hence, in spite of the pre-existence of public standards, private standards emerged rapidly during last decades.

There is a great range of private food standards and regulations differing among each other in term of freedom of complacence: some standards are voluntary while others are mandatory or de facto mandatory. Private food standards also vary in terms of their geographic scope. Some standards are individual such as Nature's Choice (Tesco), Filières Qualité, Field-to-Fork. Some are collective national standards e.g. Assured Food Standards, Qualitat Sicherheit and Farm Assured British Beef and Lamb. There are still some other collective standards with international scope such as International Food Standard, Marine Stewardship Council, Forest Stewardship Council and GlobalGAP

2.2 GlobalGAP standard

GlobalGAP is one among the leading certification scheme in today's world food sector. Initially started as EUREPGAP in 1997 by retailers associated to the Euro-Retailer Produce Working Group (EUREP), it was reincarnated into GlobalGAP in 2007 as more and more producers and retailers around the globe got connected over time. Primarily a pre-farm-gate process standard, GlobalGAP has increasingly been considered as a key reference for Good Agricultural Practice (GAP) for worldwide food safety affairs. In countries including Austria, Chile, Denmark, France, Germany, Japan, Kenya, Mexico, New Zealand, Spain, and the UK, the GlobalGAP has been incorporated into their domestic GAP standards, usually in the form of public-private joint ventures (Mitchell, L., 2008).

GlobalGAP covers certification of all farming activities and farm inputs until the product leaves the farm. The scope of GlobalGAP coverage includes crops, livestock and aquaculture supply chains. GlobalGAP membership of livestock suppliers constitutes 7.8 percent, aquaculture 19.8 percent and majority of GlobalGAP suppliers are crop growers with a share of 72.4 percent. To facilitate certification across varying farm size across the world, GlobalGAP offers four options of certification. Option 1 is for individual producer certification while Option 2 is for a group of producers. Similarly, Option 3 and Option 4 are for individual and group respectively but in the case where certification approval carried out through a benchmarking of some other standardization scheme into GlobalGAP. In the certification process, GlobalGAP follows a 'one auditor through the farm gate' principle, and by a mechanism of

benchmarking, pre-existing schemes which conform to GlobalGAP requirement are approved. Synchronizing the requirements of different schemes and standards, in this way, trims down the costs, administration, time, efforts, and labels international recognition, benefitting the producers, suppliers and retailers

GlobalGAP has been spreading worldwide rapidly. In 2004, there were almost 18000 certified producers under the standard (then EureGAP) which has grown up to 123115 till 2012 [see appendix (a)]. The scheme possesses a network of 1400 trained inspectors and auditors working for 142 accredited certification bodies certifying 409 agricultural products in 112 countries (GlobalGAP, 2012). However, there is great geographic variation in the diffusion of GlobalGAP. There are countries e.g. Chile, Italy, Kenya, Peru, South Africa, with relatively much higher coverage of the standardization scheme. On the other hand, out of the 112 countries with GlobalGAP membership, there are countries e.g. Jamaica, Venezuela, Indonesia, with only one or few certifications.

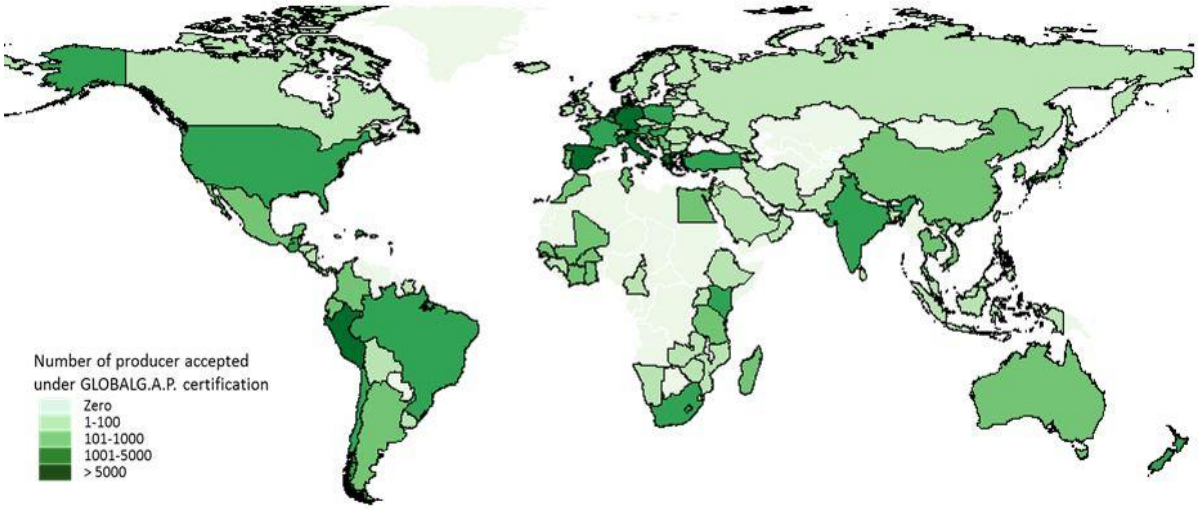


Figure 1: Geographic variation in the diffusion of GlobalGAP
Source: own graphic

Looking at the standard's penetration among continents, Europe constitutes 74 percent, the largest portion of GlobalGAP coverage. The percent share of Asia, Africa, Americas, and Oceania is 9 percent, 4 percent, 11 percent, and 2 percent respectively. The map given above clearly shows the geographic variation of GlobalGAP certification scheme. West Europe and some of the South America countries have the highest magnitude of certification, whereas most of Africa and parts of Asia have no certification at all. Russia, Eastern Europe as well as some of the Asian and African countries have mild penetration of the GlobalGAP standard.

3 Conceptual framework for diffusion process

Awareness in the consumer markets for food safety and quality is rapidly increasing. In order to fulfil consumers demand retailer, especially in developed countries are setting strict regulations to standardize procedures and product attributes. Initiated by retailer in the same context, GlobalGAP is spreading around the globe rapidly. Such certification schemes are treated in literature as organizational innovations. There has been considerable work analyzing the diffusion process of organizational innovations. Magnitude of certification is positively related with various macroeconomics variables (Neumayer and Perkins 2004, Potoski and Prakash 2004); certification is influenced by export propensity (Corbett and Kirsch 2001); network ties such as bilateral trade and geographical proximity encourages diffusion process of organizational innovation (Alburquerque *et al.* 2007). Firms seek certification when their partners lack credible information (King *et al.* 2005). In this way, through a GlobalGAP certification scheme, retailer convey quality signal to consumers. On the other hand sides of supply chain, growers participate in the certification process in order to earn market access to export market. Customer pressure and the external image are two of the main driving forces to certification (Darnall and Edwards, 2006).

The magnitude of GlobalGAP standard can expressed by three indicators: (a) number of GlobalGAP certificates issued; (b) number of producers accepted under GlobalGAP certification process; (c) number of hectares harvested under GlobalGAP certification. Approval of certification is done against lists of critical control points (CCP) for all required procedures and product attribute. For instance, maintain sanitation facility, labeling, training the farm workers, water testing etc. Compliance to these requirements accrues some cost, both in terms of fixed cost and variable cost. On the other hand, compliance to the certification scheme brings benefits for growers in term of enhanced competency for market access to EU. GlobalGAP is primarily required by west European markets. A representative growers aiming at enhanced competency for market access to export market is assumed to opt for certification if she finds compliance cost to certification is exceeded by discounted benefits. In this way, aggregating overall number of certified producers in one country is the measure of GlobalGAP certification in that country. Many of the conditions existing at country level which affect certification process are beyond the control of an individual producer. These factors affecting the diffusion process can be divided into four categories. First category constitutes the existence of GlobalGAP certification body and the availability of any benchmarking option. Second category includes various macroeconomic conditions prevailing in a country. Third category is the network ties that connect the various entities associated with food trade while the last category describes the characteristics of agriculture sector.

(a) 'Pro-GAP' conditions

One component of compliance cost is auditing charges. In case of the availability of certified auditor domestically in a country, the auditing cost would be lower, hence trimming down total cost. Obviously, lower the cost, higher the adoption rate. In this way, it can be argued that the existence of GlobalGAP certification body in a county would increase the magnitude of participation in the standardization scheme. Barrett et al (2002) showed that domestically available auditing facilitates encourage diffusion .In order to avoid duplication and complexity in the certification process, GlobalGAP often apply a benchmarking process to approve growers certified by other schemes that fully conform to the GlobalGAP System. The

growers already participating in some local GAP scheme are already familiar and motivated towards certification process. In this way, existence of such an option of benchmarking is expected to help diffusion process.

Table 1: Determinates of diffusion GlobalGAP at country level

(a) 'Pro-GAP' conditions	- Availability of certification body - Benchmarking option
(b) Network ties	- Colonial relationship - Export to EU - Trade openness
(c) National macroeconomic conditions	- Economic Development - Governance - Population
(d) Sectoral characteristics	- Production volumes - Sectoral composition

(b) National macroeconomic conditions

Characteristics of the national environment influence geographic spread of organizational innovation. The level of infrastructure development is an important aspect in this regard. For instance, firms in a country with better transportation and communication system enhances competitiveness of the respective country's products on export markets. Consequently, growers are hypothesized to more incentive to participate in a standardization scheme meant to fulfill a specific export market. Organizational innovations diffuse not only between nation-states, but also within them (True and Mintrom, 2001). Therefore, poor communication infrastructure makes it less likely getting access to information about export requirements and the likelihood of interaction between potential adopters. In a study about diffusion of ISO certificates, Neumayer and Perkins (2005) find a positive correlation between infrastructure and frequency of certification.

Commin and Hobjin (2004) find a positive between real GDP and technology adoption, showing that rich economies not only invent new technologies but also have leading position in the adoption of these innovations .So diffusion of innovation can be seen much as a trickle down effects where richer economies leading the adoption. Governance consists of the traditions and institutions by which authority in a country is exercised (Kaufman et al, 2009). Governance in a country shapes the functioning of its institutions, hence governance level prevailing in a country affect diffusion of organizational innovation. Herzfeld et al (2011) find higher penetration of GlobalGAP certificates with better conditions of 'rule of law – a governance indicator.

(c) Transnational network ties

Firms are embedded in extensive relational networks that link customers, suppliers, and a host of governmental and nongovernmental organizations. These networks exiting at domestic and international level shape patterns of geo-corporate behavior (Sturgeon 2003). Trade is one of the most important transnational networks which connects customers in one country with suppliers in another and communicates supply-chain pressures (Smith 2003). For example, Hughes (2000) demonstrates the compliance of Kenyan floricultural suppliers to the strict requirements asked by British retailers. Hence export competing firms have significant incentives to adopt the standards. Secondly, networks offers interaction among different entities involved hence provide a way for mutual learning, for instance, about profitability of specific organizational innovations (Gertler 2001). Taken jointly, these arguments strongly suggest that countries that export a higher share of their agricultural output to EU markets, especially to Germany and Netherlands, are expected to have more GlobalGAP certification in order to compete for market access.

The patterns of diffusion across the countries are not only influenced by the contemporary linkages but also by historic such a colonial ties. Colonial tie enhances economic activities among countries and this concept has been widely used in gravity trade models. For instance, Neumayer (2003) indicated that former colonial linkages influence patterns of consensual aid in great deal. Given the aforementioned insights from the literature, former colonies of European Union member states, particularly of Netherlands and Germany are expected to have high penetration of Global GAP program.

(d) Sectoral characteristics

A firm's specific economic sector plays a significant role in its receptivity to certain organizational practices, strategies, and standards. The values of certain innovations to the organizations vary across their economic sectors e.g. higher penetration of ISO 9000 standards in manufacturing based economies is reported by Neumayer and Perkins (2005). Similarly, Acharya and Ray (2000) showed that industrial sector has proceeded most rapidly in acquiring certifications. Thus, the number of GlobalGAP certified enterprises in a country is expected to be effected by the magnitude of its agriculture sector and its relative share in country's overall GDP. In this way, economies with agriculture as a minor sector are expected to a little interest in GlobalGAP certification. The number of GlobalGAP certifications can be affected by the composition of agriculture sector, its productivity and export competency. Initially GlobalGAP was initiated with its certification modules for fresh fruits and vegetables and over time its portfolio of standards extended to other agriculture sectors. Herzfeld et al (2011) support the idea that given the history of GlobalGAP certifications across globe, countries with significant and more productive horticultural sector in agricultural production are expected to acquire more certifications.

4 Data and methodology

4.1 Data

The study comprises of secondary data from various sources. All data about GlobalGAP is taken from GlobalGAP Headquarters, Cologne, Germany. These data include number of certificate, number of certified producers and number of hectares certified under the standard, information about certification bodies as well as benchmarking data. Data on colonial relations is taken from CEPII. World Development Indicators data is used for various development indicators including cellular mobile phone subscriptions, telephone subscriptions and internet subscriptions. GDP, GDP per capita and population data is also taken from the World Bank. The study borrows information on governance indicators form Kaufman et al (2013). Trade data is taken from UN Comtrade at HS02 level whereas agricultural sector data is taken from FAO. The data on the count of participation in Technical Committee of ISO is taken from ISO.

4.2 Methodology

The magnitude of GlobalGAP standard can expressed by three indicators: (a) number of GlobalGAP certificates issued; (b) number of producers accepted under GlobalGAP certification process; (c) number of hectares harvested under GlobalGAP certification. Number of certificate shows the aggregate number whether its individual certificates i.e. Option1 and option 3 certification, or the group certificates Option 2 and Option 4 which is benchmarked certification. Group certification involves varying number of small farmers. Hence two countries with equal number of certificates, in terms of accuracy, may have different magnitude of GlobalGAP penetration inherent to the variation in the group size. On the other hand, number of producers accepted under GlobalGAP certification process shows an accurate number of producers participating in the certification process. However landholding size differs among producers as well as among countries. Measure of GlobalGAP incidence in terms of hectares is more exact in this regard but hectare count restricts the analysis to crops based certification excluding other scopes of GlobalGAP coverage including livestock and aquaculture.

GlobalGAP coverage constitutes 7.8 percent of certification in livestock sector, 19.8 percent in aquaculture, while the rest of 72.4 percent in crops – the major sector. In our analysis, we consider hectares as a measure of GlobalGAP incidence in a country. We consider a three year panel for 170 FAO member states[1]. In order to rule out any possibility of simultaneity, we take one year lag. So our panel consists of values for independent variable for year 2009, 2010 and 2011 whereas dependent variables are for year 2010, 2011 and 2012. As there are several countries with no certification at all. It asks for Heckman error correction. In the first stage regression, we use number of participation by each country in the Technical Committee of ISO as an exclusion variable for the probit model. The committee is involved in process of international standard setting process under ISO framework. Each country can play its role to an extent depending upon the nature of its ISO membership. The frequency of a country's participation in

[1] Our study involves data from various sources. There is no data at all for certain countries in one database or the other. Secondly, there are excessively missing values of key variables for some countries, hence they are dropped. Additionally, Germany and Netherlands are dropped as no country exports to itself. Resultantly, we are left with 170 countries in the panel.

such events indicates its posture toward standardization and this idea is used as an instrument to capture the probability of a country in GlobalGAP certification scheme. The participation in the committee, however, does not influence the magnitude of GlobalGAP certification, hence an appropriate instrument for Heckman probit stage. In the second stage regression, we considered only the nonzero positive values of dependant variable. The diffusion of GlobalGAP is highly skewed [see appendix (b)] across countries whether it is taken in terms of certificates, producers or hectares, even when we normalize certified hectares over total hectares harvest per country. So we used log of the nonzero positive values in the second stage regression.

Additionally we estimate the GlobalGAP diffusion in terms of number of GlobalGAP certificates issued as well as for number of producers accepted under GlobalGAP certification process. Both of these variables are count data. Literature shows that OLs is inferior estimators than other models such as Poisson and Negative Binomial model. In our study, the dependent variable have over dispersion i.e. the variance exceeds the mean. The basic assumption of Poisson is the equality of variance and mean. Therefore, GlobalGAP in case of over dispersion, negative binomial is more suitable estimator.

5 Results

5.1 Descriptive statistics

In table 2 we present the descriptive statistics of variables in the analysis. The sample is divided in by country's GlobalGAP participation status. Mean land covered by GlobalGAP in the participating countries is 26082.16 hectares, mean number of certificates is 217.88 and certified producer is around 960. Table 2 also shows interesting differences between participating and non-participating countries with participating countries have better governance, infrastructure, higher export and income. Also participating countries are having better trade relation with the EU countries. Colonial relationship is shows the similar difference. Therefore, these variables are expected to impact GlobalGAP diffusion positively. We additionally tested for significance of the differences between the participating and non-participating using t-test (not reported) countries with respect these observables and except fruit and vegetable export average of all other variables are statistically significant.

Table2: Descriptive Statistics

Variables	***Non-participants***		***Participants***	
	Mean	***SD***	***Mean***	***SD***
Number of GLOBALG.A.P certified hectares			26082.16	61714.94
Number of GLOBALG.A.P certificates			217.88	518.21
Number of GLOBALG.A.P producers			960.70	3218.81
Existence of GLOBALG.A.P auditor domestically			0.35	0.48

GLOBALG.A.P benchmarking option			73.15	573.49
Colony of multiple EU state	0.27	0.45	0.16	0.36
Governance Indicator: Rule of Law	-0.39	0.85	0.12	0.97
Governance Indicator: Regulatory Quality	-0.51	0.78	0.27	0.87
Mobile cellular subscriptions (per 100 people)	76.81	45.84	97.90	34.40
Telephone lines (per 100 people)	13.24	14.98	22.15	17.35
Internet users (per 100 people)	22.44	24.27	40.27	26.47
Population	1.2E+07	2.8E+07	5.7E+07	1.8E+08
GDP per capita	6412.15	13517.5	11428.84	14592.74
Value of crops exported to DEU/NLD	3.6E+07	1.1E+08	7.7E+08	1.7E+09
Value of total crops exports	4.2E+08	8.9E+08	5.9E+09	9.2E+09
Share of crops exports over total exports	0.12	0.08	0.10	0.07
Fruit & Vegetable production	8.18E+06	6.51E+07	1.08E+07	4.30E+07
EU region dummy	0.02	0.15	0.23	0.42

5.2 Regression analysis

Following table reports the estimation results of global gap diffusion. We use three measures of diffusion: size of agricultural land covered by GlobalGAP producers, number of certificates and number of producers. As discussed before, diffusion of global gap is not random; we could measure impact of global gap participation only for the gap participating countries. Since, the impact for those who have not participated is not observed in case they would have participated estimated coefficients from our regression models would be biased. Therefore, to tackle the selection issue we use Heckman two step models which first estimate GlobalGAP participation as a function of number of observables using probit estimation; calculate the inverse mills ratio (IMR) and then in the second stage regress the diffusion variables (non-zero) on the observables and the IMR. Significance of IMR would imply presence of selection bias in the data. In the selection model exclusion variable (number of participation in technical committee of ISO) appears with a positive coefficient and this impact is significant at 1%. In order to determine whether random effect or fixed effect model is to be implemented we carried out Hausman test that generates chi square is 14.89 (prob = 0.14). Therefore, we could use random effect model for purpose. Since the distributions of the diffusion variables are highly skewed we use natural logarithm. These results are shown in model 1, 2 and 3. In addition we also report the regression results of number of certificate and number of producers. Since these variables are count variable in nature we use count data modeling. As shown in the descriptive statistics since mean of number of certificate is lower than their standard deviation, negative binomial models are preferred over the Poisson and we only report the estimation of the negative binomial estimation. We also estimated model 1 with hectares at level, and the results remains the same. Therefore, we did not report this estimation.

Table3: Estimation of Global Gap Diffusion

Dependent variables	**Heckman RE Estimates**			**NB Estimates**	
	ln (hectares)	**ln (certificates)**	**ln (producers)**	**certificates**	**producers**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Auditor	6.49***	2.26***	2.37***	1.31***	1.40***
	(0.73)	(0.19)	(0.30)	(0.35)	(0.29)
Benchmarking	0.00***	0.00	0.00***	0.00	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Multiple EU colony	3.14**	1.02***	1.76***	0.65	1.47***
	(1.25)	(0.30)	(0.31)	(0.42)	(0.38)
Rule of law	-0.83	0.09	-0.38	0.79***	0.23
	(1.92)	(0.43)	(0.42)	(0.27)	(0.29)
Regularity quality	1.02	0.32	0.40	-0.07	0.22
	(2.70)	(0.44)	(0.47)	(0.21)	(0.26)
Mobile phone	-0.01	-0.00	-0.00	0.00	-0.00
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Telephone	0.05	0.00	0.02	-0.02	0.03***
	(0.05)	(0.02)	(0.02)	(0.01)	(0.01)
Internet	0.05	0.02*	0.01	0.00	0.01*
	(0.04)	(0.01)	(0.01)	(0.00)	(0.01)
log(Population)	0.77*	0.42***	0.20	0.55***	0.13
	(0.46)	(0.11)	(0.14)	(0.11)	(0.09)
ln(GDP per capita)	7.20**	3.21***	1.76	2.45**	2.36**
	(3.27)	(1.02)	(1.21)	(1.15)	(0.99)
ln(GDP per capita square)	-0.49**	-0.20***	-0.12	-0.14**	-0.17***
	(0.21)	(0.07)	(0.08)	(0.07)	(0.06)
Crops exports to DEU/NLD	0.00**	0.00**	0.00***	0.00*	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Crops exports	-0.00	-0.00**	-0.00**	-0.00***	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Share of crops export over total	-11.56	0.97	-0.05	2.45	1.15
	(14.97)	(2.01)	(3.81)	(1.70)	(1.80)
Fruit and vegetable production	0.00	0.00	0.00***	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
EU region	-0.02	0.23	0.03	0.48	0.64
	(0.57)	(0.25)	(0.29)	(0.38)	(0.39)
IMR	-0.03	0.04	-0.07		
	(0.22)	(0.05)	(0.07)		
Constant	-36.43*	-18.07***	-7.67	-16.41***	-9.14*
	(19.51)	(4.94)	(6.49)	(5.43)	(4.68)
Observations	266	266	266	267	267
No of country	96	96	96	97	97

Note: Robust Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Panel heckman estimates reports standard errors after bootstrapping

Looking the random effect estimates we find presence of audit has positive and significant impact on all our diffusion measures across all the models implying that auditing system generates higher efficiency; assure higher quality of the crops which then increases GlobalGAP coverage. Bench mark has positive impact on hectares and on hectares and producers again in all model, however, we could not find any

significant impact of bench mark for certificates. Furthermore, we find colonial relation between EU countries also impacts GlobalGAP diffusion positively. This finding might lead to the conclusion that former colonial status influences GlobalGAP diffusion. Governance indexes and the infrastructure variables mostly remain insignificant in the panel models; however, positive impact of girl in model 4 indicates better governance increases number of certificates. Hence, a better institutional environment helps firms to take advantage of modern organizational innovations. Again better infrastructure seems to increase number producers under global as access to internet and telephone improves worldwide connectivity and also impacts spread of information or knowledge transfer. We also find a positive impact of population size of the countries indicating that larger countries host significantly more land, certificates and producers. GDP in our model exerts positive impact; however negative coefficient of the squared GDP indicates that the impact of income is diminishing in nature. Finally looking at the export variables we find total export of crops to Germany and Netherlands appears to be important for GlobalGAP diffusion might be due to the fact Germany and Netherland are two major economies in Europe using GlobalGAP standard and thus intense trade relation with these countries is likely to impact GlobalGAP diffusion positively. Final, total export of crops exerts a negative impact which appears puzzling. One explanation could be higher export share of agriculture products also indicates country's dependence on agricultural sector, which also indicates a lower economic status of the country. This then negatively affects GlobalGAP participation.

6 Conclusion

The study analyzes the diffusion mechanism of GlobalGAP certification at country level. We used a three year panel over 170 FAO member countries. We consider all three measures of GlobalGAP estimation: number of GlobalGAP certificates issued, number of producers accepted under GlobalGAP certification process, number of hectares harvested under GlobalGAP certification. For continuous dependent variable i.e. hectares, we used Heckman random effect model whereas for certificate counts and producer counts, we applied negative binomial model. So far the spread of the standardization scheme has been highly skewed around the globe. In order to examine the driving elements of diffusion, we consider factors including the geographic preconditions, network tie and historical relations of countries as well as various indicators for economic development and governance level prevailing in a country.

It is found that countries with high agricultural export, especially to west European market show higher participation in GlobalGAP. In this context, the incentive to participate in GlobalGAP is low for other countries with agriculture as a minor sector having no significant agricultural exports especially to west European markets, GlobalGAP. Nevertheless, there will potentially countries adapting to the standardization later on. In our estimation, we find that domestic availability of certification body reduces auditing cost, hence encourages certification. In some countries, there are national regulations for good agricultural practices. For growers familiar to local GAP schemes, therefore, participation in GlobalGAP is easier. This implies that countries having some 'pro GAP' structures at national level are comparatively more competitive in international arena.

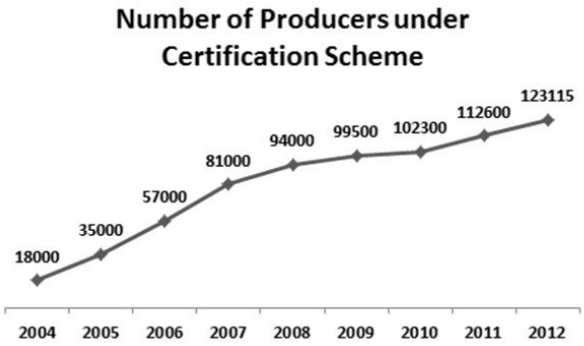
Analyzing the role of transnational network ties in certification, it is found that countries more connected through trade or colonial relation to West European markets are leading adopters of GlobalGAP. It implies that certification might reinforce retailer-supplier relations within networks, a hurdle to new entrants.

We find a positive relation between certification magnitude and per capita GDP, economic development and governance level in a country. As these factors affect diffusion of standardization at country level are beyond the control of individual grower. It implies a relatively low probability to enter into certification scheme for producers in developing countries with poor infrastructure, bad governance and lower per capita GDP.

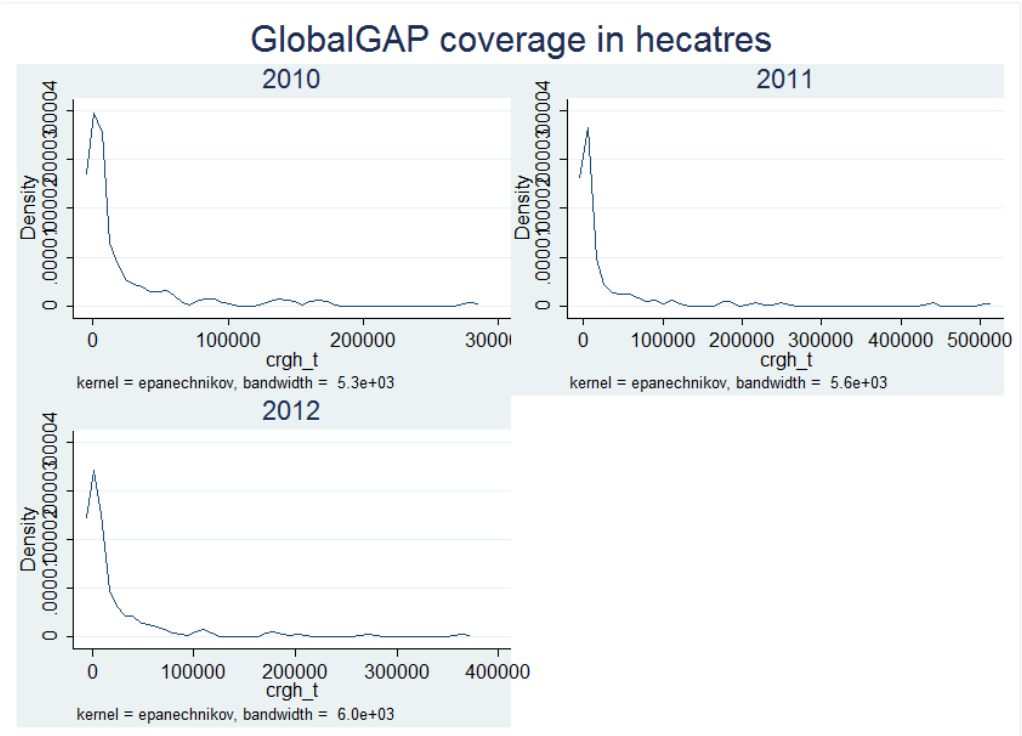
There are some limitations of this study. First, we analyze GlobalGAP diffusion with respect to consumer markets in West European states especially Germany and Netherlands. Secondly, considering hectares as a measure of GlobalGAP restricts the study to the crops scope which represent three fourth of the total GlobalGAP membership. Additionally, there is available certain mechanisms for finical aid and other support to the growers which facilitates the adoption in certain countries. Due to lack of data, we could not consider this aspect in our estimation. Further investigations, therefore, are needed to analyze the diffusion process of certification schemes in agrifood sector.

7 Appendices

Appendix (a): Spread of GlobalGAP standard over time



Appendix (b): Distribution of GlobalGAP certification across countries



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