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Amjad Masood
Bernhard Brümmer

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Determinants of Worldwide Diffusion of GlobalGAP Certification

Amjad Masood[1] *Bernhard Brümmer*[2]

Abstract

GlobalGAP is an important private standard in food sector. However, geographic diffusion of GlobalGAP is uneven across the world. We use a panel from 2008 to 2012 for 170 FAO member countries to analyze GlobalGAP diffusion in the agricultural sector as a whole as well as in the crops subsector. So far, studies on standards have been mostly dealing with farm level data and very few consider the case of macroeconomic determinants of diffusion only in case of public standards. We, on the other hand, consider the case of a private standard, namely GlobalGAP and estimate the macroeconomic determinants of GlobalGAP diffusion. For estimation, a Heckman two-stage model is applied using number of GlobalGAP certified producers as well as hectares of area harvested under GlobalGAP as dependent variables. We analyze the impact of network ties and historical relations among countries, and various macroeconomic conditions prevailing in courtiers on diffusion of certification. The study finds that diffusion is positively related common language, presence of auditing facility domestically and better infrastructure. We also find that countries with higher relative size of fruits and vegetables in the agriculture sector, and with more exports of fruits and vegetables to the EU states have higher coverage of GlobalGAP.

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

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[1] RTG Transformation of Global Agri-Food Systems—"GlobalFood", Georg-August-University Göttingen, Heinrich-Düker-Weg 12, 37073 Göttingen, Germany, E-mail: amasood@gwdg.de

[2] Department of Agricultural Economics and Rural Development, Georg-August-University Göttingen, Platz der Göttinger Sieben 5, 37073 Göttingen, Germany

1 Introduction

Private food standards are now increasingly becoming a critical component of governance of global agri-food value chains. Wholesalers in developing countries are asked to fulfill strict standard requirements and the dynamics of these policies are transmitted along the supply chain to producers. By complying with the requirements of the standard, small farmers in developing countries could potentially gain access to global value chains, which in turn creates new economic opportunities for them. In this paper we attempt to understand whether adoption and diffusion of these standards are entirely random or there are factors contributing to this.

Analysis of adoption and diffusion of private food standard is crucial for its welfare implications (Von Braun, 2003). Two relevant concerns regarding this are (1) standards create inequality among farmers who are able and who are not able to comply with the standard requirements. Those who cannot comply are eventually driven out of the export markets (Reardon et al., 2001; Ponte, 2008; Campbell, 2005). (2) Standards play a crucial role in integrating small holders to the international value chains which does not only promote economic welfare of the certified producers, but additionally creates spillover effects in terms of further income and employment opportunities in the developing countries (Maertens and Swinnen, 2009; Minten et al., 2009; Henson and Humphrey, 2010). This justifies why we should understand diffusion of food standards. Countries vary from each other with respect to their geographic conditions, institutional structures and level of economic development; therefore, the capacity as well as pace of adoption of these standards also vary across the countries. In this study we attempt to identify the factors that have been contributing to the varying standard adoption rate.

Over the past decades, there have been studies on the diffusion of standards (Ryan and Gross, 1943, Fisher and Pry, 1972). Perceived benefits form the standard adoption such as, reduction in the consumption of resources and improved competency (Bansal and Bogner, 2002; Melnyk et al. 2002) is a major factor of motivation. Other studies e.g. Terziovski et al. 2003 and Casadesús and Karapetrovic 2005 indicate that standardization helps improving operational performance and greater customer satisfaction. There are a number of studies that analyses global diffusion of ISO standards (Corbett and Kirsch, 2001; Viadiu et al., 2006; Albuquerque et al., 2007; Nishitani, 2010) and establish a positive relationship between ISO 14001 certification and the export propensity, and environmental attitudes. Potoski and Prakash 2004 find that there is a direct

relationship between level of macroeconomic development of a country and the intensity of ISO certification. Neumayer and Perkins 2004 is another study with similar findings. Alburquerque et al. 2007 finds that bilateral trade, geographical proximity and cultural similarity affect diffusion process.

There are quite a few studies on GlobalGAP, a standard relevant to agriculture sector. There are some studies analyzing farm level adoption of GlobalGAP for specific countries. For example, there is a large body of literature that has been contributing to the understanding of standard adoption. For example, Kleinwechter and Grethe (2006) have studied the adoption of the EurepGAP standard in the mango export sector in Peru in 2004-2005. Asfaw et al. 2009 and Kersting and Wollni, 2012 analyzed GlobalGAP adoption by small-scale farmers in Kenya and Thailand respectively. These studies focus mainly on firm level data and identified factors, such as, household characteristics, cost to comply, private-public partnership, and support from donor (Kertsting and Wollni, 2012) as crucial determinants of standard adoption. Most of these factors can be managed either by farmers or the retailer. However, the country level factors, though important for standard adoption and diffusion, are beyond the control of farmers as well as retailers. (Herzfeld, Drescher, Grebitus, 2011). Other authors focused on diffusion of ISO standards at macro level, such as, 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 (2010).

In this paper, we take the stand that besides firm level characteristics there could be a number of country specific characteristics which are crucial in terms of diffusion of private standards. Investigating these country specific factors, such as, macro-economic conditions, existing infrastructure, adoption of technologies, could be of huge relevance to the understanding of the cross national differences in standard diffusion (Rogers (2003). Our paper attempts to fulfill the gap in the literature by studying GlobalGAP certification as one of the case studies on standard diffusion. GlobalGAP is a private food standard which is important for exporting to the EU countries. Despite the spread of GlobalGAP in a number of countries, the magnitude of certification remains highly uneven throughout the world (see appendix 1).

We argue that other than firm characteristics, geographic preconditions, variation in economic development, institutional structure and other macroeconomic characteristics have also been

contributing to the issue. In this study, we investigate these factors and attempt to identify the ones which are crucial for GlobalGAP diffusion. Using two steps Heckman modeling, we primarily estimate the macro determinants of GlobalGAP diffusion in agricultural sector. The specific contributions of this study are the followings. First, unlike other studies that mainly focus on firm characteristics, we explore the impact of macro level factors of GlobalGAP diffussion. To the best of our knowledge, the only study that stands close to ours is by Herzfeld, Drescher, Grebitus, 2011 which analyzes adoption of BRC food standards and GlobalGAP using count data model in a cross section setting. We on the other hand use a panel data for five years 2008 to 2012 for 170 FAO member countries to analyze GlobalGAP diffusion. Second, our study uses an extended measure of diffusion than that used in Herzfeld, Drescher, Grebitus, 2011. They use the count of certified producer, and if the country has at least one certified producer in agriculture, as the dependent variable. In addition to the number of certificated producers in agriculture that has crop, aquaculture and livestock production, we additionally take a specific look at the crop sector which accounts for 72% certification in GlobalGAP (GlobalGAP, 2011) of whole agriculture sector. While analyzing the crop sector in addition to the number of certified producers we also used land coverage under the GlobalGAP scheme to capture diffusion[3]. We consider land coverage as a better measure of diffusion than number of certified producers, primarily because larger number of certified producer in a country does not necessarily indicate higher diffusion because of variability in landholding across farmers. Finally, we argue that our study contributes to the existing literature in terms of implications with regards to the further redistribution of GlobalGAP markets worldwide. By identifying the factors that have positive (negative) impact on GlobalGAP diffusion our study would help to design policies targeting adoption of new standards and explore the markets that have still not been explored by GlobalGAP.

The rest of the paper is organized as follows. Section 2 provides details on various aspects of GlobalGAP. Section 3 describes the conceptual framework for addressing the determinants of GlobalGAP diffusion. Data and descriptive statistics are described in Section 4. Methodology is described in Section 5, followed by the results and interpretation of our analysis in section 6. Section 7 concludes the study.

[3] Analyzing land coverage is not carried out for whole agriculture sector as it is relevant only for crops sector and aquaculture and livestock production do not require land.

2 Diffusion of GlobalGAP Certification

GlobalGAP, a pre-farm-gate standard, has established itself as a key reference for Good Agricultural Practice (GAP) in a number of countries[4] where GlobalGAP has been incorporated into their domestic GAP standards in the form of public-private joint ventures (Mitchell, 2008). Started in 1997 as EurepGAP is an initiative by retailers belonging to the Euro-Retailer Produce Working Group[5]. In 2001, EurepGAP receives the first ISO 65 accreditation for Fruit and Vegetables and starts granting its first farmer certificates. With growing concerns regarding product safety, environmental impact and the health, the standard spread throughout Europe and beyond the following years (GlobalGAP, 2013).

Driven by the impacts of globalization, a growing number of producers and retailers around the globe collaborated, gaining the European organization global significance. In 2007, EurepGAP was named as GlobalGAP. While GlobalGAP was originally conceived by a group of supermarkets and continues to be viewed generally as a food retailer protocol, the organization quickly moved in 2001 to re-conceptualize itself as 'an equal partnership of agricultural producers and retailers' (Bain, 2010). Later, the membership scope is broaden to include organizations directly involved in growing and trading food products, certification bodies, consulting companies, agri-chemical companies, and their associations. While GlobalGAP incorporates standards for worker health and safety, and the environment, the focus of GlobalGAP is food safety. GlobalGAP covers certification of all farming activities and farm inputs until the product leaves the farm.

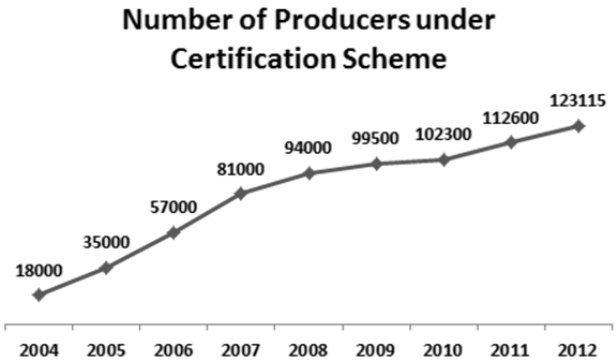
In the recent years, GlobalGAP has been growing rapidly. The standard possess a network of 1400 trained inspectors and auditors working for 142 accredited certification bodies certifying 409 agricultural products in 112 countries (GlobalGAP, 2012). Figure 1 illustrates the considerable enhancement in the magnitude of diffusion of GlobalGAP in terms of number of producers. In terms of geographic areas, GlobalGAP has been extending across the world with Europe accounting for 74 percent, the largest portion, of the GlobalGAP coverage. GlobalGAP

[4] These countries include Austria, Chile, Denmark, France, Germany, Japan, Kenya, Mexico, New Zealand, Spain, and the UK

[5] This group includes retail giants Tesco, Safeway, Sainsbury's, and marks & Spencer, together with Dutch retailer Royal Ahold

membership of livestock suppliers constitutes 8 percent, aquaculture 22 percent and majority of GlobalGAP suppliers are crop growers with a share of 70 percent. Within crops subsector, major focus of GlobalGAP certification is fruits and vegetables

Figure 1-The Spread of GlobalGAP over Time



Source: GlobalGAP, 2012

In several countries there are local standardization schemes such as Chile GAP, Thai GAP. The GlobalGAP standardization scheme involves benchmarking procedure[6] to include those farmers complying with these local schemes wherever the compliance level is equivalent to that required by GlobalGAP. There are four options for GlobalGAP certification. Option-1 means GlobalGAP certification for san individual farmer. Option-2 is GlobalGAP certification for individual farmers following the benchmarking mechanism. Similarly, Option-3 and Option-4 mean group certification for GlobalGAP and benchmarked local scheme, respectively. (GlobalGAP, 2013).

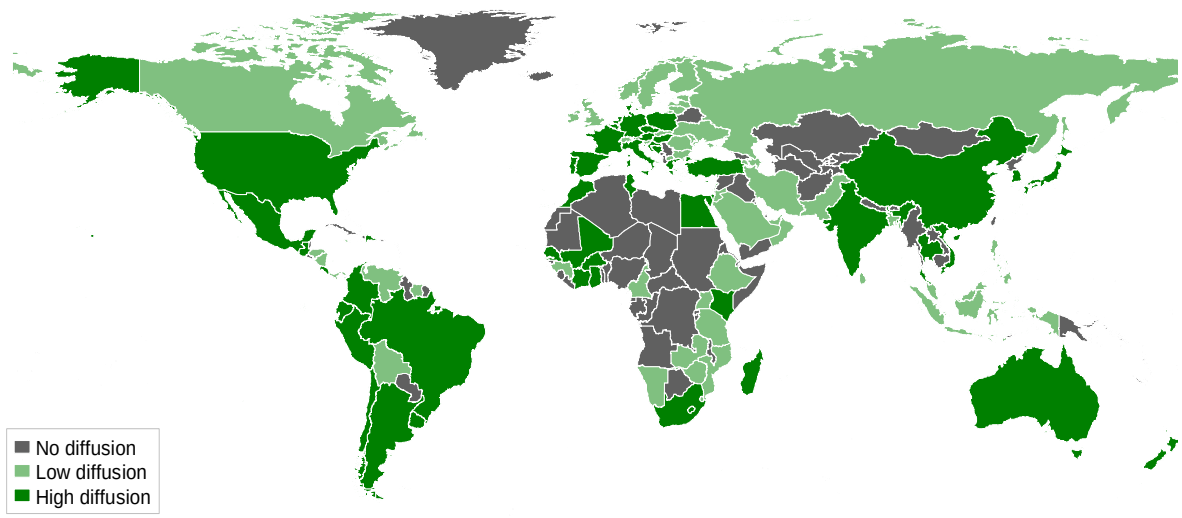
There is huge geographic variation in the diffusion of GlobalGAP There are countries e.g. Chile, Italy, Kenya, Peru, South Africa, with relatively much higher coverage of the standardization

[6] The main objective of benchmarking process is to avoid duplicity of compliance procedure. Hence, benchmarking procedure follows a 'one auditor through the farm gate' principle. 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.

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.

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.

Figure 2 - Geographic Variation in the Diffusion of GlobalGAP



Source: Authors own depiction based on the data for year 2012

3 Conceptual Framework for Diffusion Process

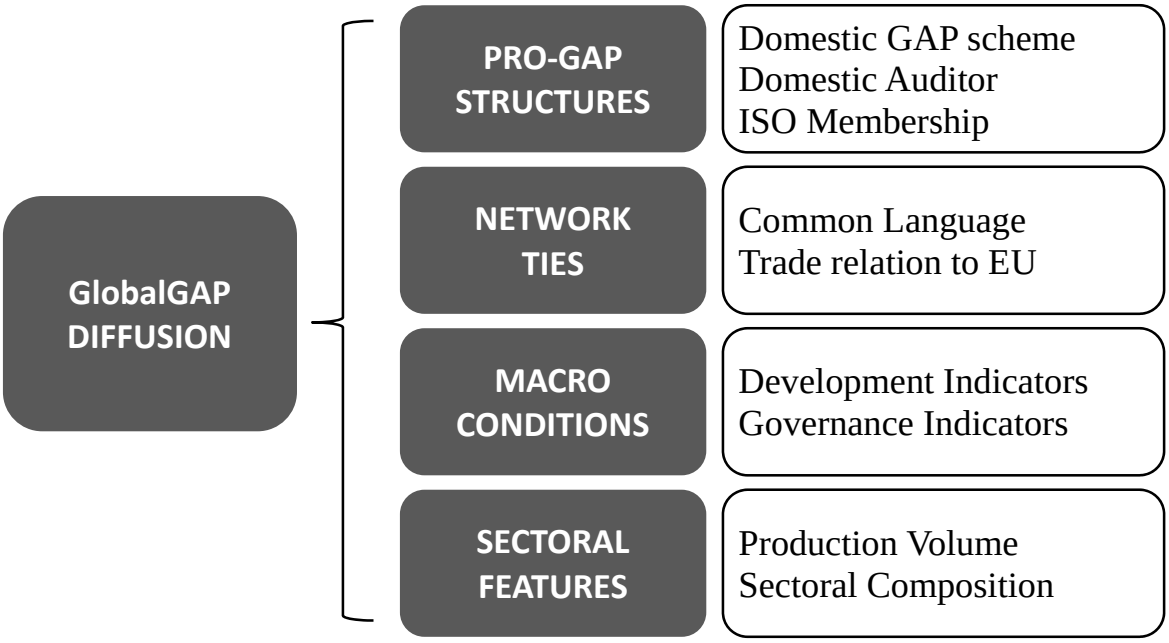
Awareness in the consumer markets for food safety and quality is rapidly increasing (Henson and Reardon, 2005). In order to fulfil consumers demand retailer, especially in developed countries are setting strict regulations to standardize procedures and product attributes. Initiated by retailer in the same context, GlobalGAP is spreading around the globe rapidly. Such certification

schemes are treated in the literature as organizational innovations. There has been considerable work analyzing the diffusion process of organizational innovations. The 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). Furthermore, firms seek certification when their partners lack credible information (King et al. 2005). In this way, a product certified by GlobalGAP scheme conveys quality signal to importer. On the other side of the 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 be 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.

Figure 3 provides a schematic framework of the determinants of standard diffusion and in the following subsections 3.1 to 3.4, we discuss these determinants of diffusion.

Figure 3 - Conceptual Framework for the Diffusion of GlobalGAP



Source: Authors' own diagram based on above discussion

3.1 'Pro-GAP' Structures

One component of compliance cost is auditing charges (Kolk 2000; Darnall and Edwards, 2006). In case of the availability of certified auditor domestically in a country, the auditing cost would be lower, hence trimming down total cost. In this way, the lower the cost, the higher will be 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.

3.2 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 intensity 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.

3.3 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). Taking it together, these arguments strongly suggest that countries that export a higher share of their agricultural output to EU markets 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 and common language. Language commonality enhances economic activities among countries and this concept has been widely used in gravity trade models. GlobalGAP started from Europe and EU states such as Spain, Netherlands, Italy, Germany, France and Belgium are the top consumer market for GlobalGAP certified food. In this regards, language commonality with these states can be a factor of GlobalGAP diffusion in a country.

3.4 Sectoral Characteristics

A firm's specific economic sector plays a significant role in its receptivity to certain organizational practices, strategies, and standards. The degree of certain innovation may vary across different economic sectors. For example, 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 and its 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 Descriptive Statistics

The study comprises of secondary data from various sources. All data about GlobalGAP coverage is taken from GlobalGAP Headquarters, Cologne, Germany. These data include number of certified producers and number of hectares certified under the standard, information about certification bodies as well as benchmarking data. We have a panel of five years 2008 to 2012. For GlobalGAP coverage in crop subsector, the panel is only three years 2010 to 2012[7]. Data on common language is taken from CEPII. Data on cellular mobile phone subscriptions, internet subscriptions, GDP per capita and arable land per country are borrowed from World Development Indicators of the World Bank. The study borrows information on governance indicators form Kaufman et al. (2013). The data presents value of various indicators ranging -2.5 to 2.5. We consider Regularity Quality as a relevant governance indicator taking its 3 quintile. FAO data on agricultural value and area harvested is included. Trade data, fruits and vegetables (HS07, HS08) imports in million USD by EU6 is taken from ITC database. Fruits and vegetables share (% of arable land) is the area under fruits and vegetables over the total arable land per country. This variable shows the relative size of fruits and vegetable subsector in agriculture sector. Agricultural value added (% of GDP) is the share of net value of agriculture production over total GDP of the country. Agricultural sector openness is the share of value of agriculture exports on total value of agriculture production. It signifies how much export oriented agriculture sector of a country is. We hypothesize that these variables are likely to impact GlobalGAP diffusion positively. Finally the data on ISO membership is taken from ISO website.

In Table 1, we present the descriptive statistics of variables used in the analysis. The sample is divided by the country's GlobalGAP adoption status. Certified countries are those which have at least one producer adopting the GlobalGAP standard. Mean number of certified producers for all agricultural commodities is 477. For subsector crops, mean value for certified producers is 486 and mean value for land coverage is around 17943.59. The number of certified producers in agriculture is slightly lower than that in crops subsector this is due to the fact that the countries where GlobalGAP exits only in livestock and aquaculture have relatively fewer certified producers, lowering the overall mean value for agriculture sector.

[7] GlobalGAP data disaggregated to subsector i.e. crops, livestock, aquaculture, and individual products i.e. apple, banana, potato etc. is not available before 2010.

Table 1 - Descriptive Statistics

Variables	Non-certified		Certified		Differences
	Mean	SD	Mean	SD	
GlobalGAP producers in agriculture			477.78	1371.73	
GlobalGAP producers of crops			486.95	1361.77	
GlobalGAP hectares of crops			17943.59	37191.1	
GlobalGAP domestic auditor			0.33	0.47	
GAP benchmarked producers (%)			3.49	13.12	
Language commonality with EU6	0.28	0.45	0.32	0.47	0.04
Regularity quality (3 quintiles)	1.62	0.78	2.18	0.72	1.03***
Internet subscriptions per 100 people	22.44	24.57	38.82	27.06	16.38***
GDP per capita (current 1000 USD)	9.59	17.54	13.67	18.04	4.08***
F&V share (% of arable land)	47.85	105.38	17.93	28.78	-29.92***
Agricultural value added (% of GDP)	17.66	15.26	11.01	9.78	-6.66***
Agricultural sector openness	4.05	18.78	0.91	1.26	-3.14***
F&V imports in million USD by EU6	4.38	17.59	233.36	396.04	228.98***

Table 1 also draws interesting differences between certified and non-certified countries with the certified countries having better governance, infrastructure, and income status. This reflects that higher the economic development of a country the more likely is that the country would adopt GlobalGAP standards. We also tested for the important of agriculture sector in these countries and find that agriculture holds much higher importance in non-certified countries. For example, share of fruits and vegetables as percentage of arable land, agricultural openness and agricultural value added as percentage of GDP are much higher in non-certified countries. This might be surprising at first glance, but we argue that it shows GlobalGAP diffusion is primarily taking place in countries that are economically better placed with relatively smaller role played by agriculture in economic development. Hence, descriptively our data supports the main claim of the paper: country level characteristics are crucial for diffusion of private food standards[8].

[8] These differences in the observables among certified and non-certified countries are all tested for their significance and we find them all statistically different. Again, assuming non normal distribution of the dummied we use Willcox ranksum test for the difference. For the others we use t-test.

5 Methodology

The magnitude of GlobalGAP diffusion can be expressed by three indicators: (a) number of GlobalGAP certificates issued; (b) number of producers accepted under GlobalGAP certification process; (c) hectares harvested under GlobalGAP certification. Since, certification can be obtained either as individual or as a group of producers; using number certification might not reflect the exact penetration of GlobalGAP as group certification does not account for the exact number of certified producers within the group. With this respect number of producer accepted under GlobalGAP certification is a better measure of GlobalGAP diffusion. We further argue that landholding size differs among the producers; therefore landholding by the certified producer could be the most appropriate among the three measures of diffusion. However, landholding is valid only to capture diffusion in crop subsector, not for aquaculture and livestock. In our analysis of GlobalGAP diffusion we therefore follow a two tier approach. In the first tier we measure diffusion in entire agriculture sector using number of certified producers as dependent variable. In the second tier we restrict our analysis only to crop subsector and use number of certified producers as well as hectares of area harvested under GlobalGAP as dependent variables.

We consider a five year panel for 170 FAO member states[9]. Since, there are number of countries that have not adopted GlobalGAP, simple OLS estimates of diffusion are likely to biased as the impact for those who have not participated is not observed in case they would have participated. We also believe that adoption of GlobalGAP is not entirely random and our analysis is contended with issue of selection bias. To tackle such selection problems we use Heckman two step approach. We first estimate GlobalGAP adoption 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 measures (non-zero) on the observables and the IMR. Thus in the second stage includes only those countries who adopted GlobalGAP. Significance of IMR would imply presence of selection bias in the data. In the first stage, the selection equation should include an exclusion variable that can explain GlobalGAP adoption. The variable we use as exclusion restriction is the

[9] 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.

ISO membership status of a country. It is a categorical variable showing four categories for ISO membership: 1 for a member body, 2 for a correspondent member, 3 for a subscriber member and 4 for a non-member. In this way, the ISO membership category of a country indicates its inclination towards standardization. Our exclusion variable shows significance at 10 % level. The ISO membership status, however, does not influence the magnitude of GlobalGAP certification, hence serves as an appropriate instrument.

Decisions on random or fixed effect models to be applied are taken on the basis of Hausman test under the null hypothesis that random effects model is consistent as the unobserved heterogeneity is uncorrelated with the regressors (Greene, 2012, p. 421). In case of rejection only the fixed-effect model is considered unbiased and consistent. The fixed effect estimator, however, omits the coefficients of time invariant variables. One solution for this is to use the Mundlak approach (Mundlak, 1978) which proposes approximating the country specific effects as a function of the mean of time-variant variables.

Notably, diffusion of GlobalGAP is highly skewed (see appendix 1) across countries whether it is taken in terms of producers or hectares. So we used log of the nonzero positive values in the second stage regression. We also normalized with total arable land of the country to capturer varying country size[10].

6 Regression Results

Table 2 and 3 report the estimation results of GlobalGAP diffusion. Table 2 provides the estimation of GlobalGAP diffusion in entire agriculture sector using log of normalized number of certified producers as dependent variable. Table 3 presents the case of diffusion in subsector crops taking log of normalized number of certified producers as well as log of normalized hectares of area harvested under GlobalGAP as dependent variables. As discussed in the previous section we estimates the coefficients using random effect and fixed effect settings. Among

[10] Number of GlobalGAP certified producer could be best normalized by the total number of agricultural producers in a country. However, there is no data available on this. Neumayer and Perkins, 2005 normalized ISO certificates by population to make the counts comparable across different-sized countries. However, we think total arable land per country is more relevant in our case to normalize the number of GlobalGAP certified producers as it represent the size of agriculture sector.

repressors we have two time invariant variables namely common language and GlobalGAP domestic auditor. Therefore we additionally used Mundlak approach to have an approximated fixed effect without omitting these important variables.

Looking at Table 2 we find that presence of audit increases certified producers by more than 100%. The positive coefficient essentially indicates that having auditing facility in the country reduces compliance cost of certification by reducing transaction cost which in turn promotes spread of GlobalGAP. This is in line with the findings from other studies, such as, Hatanak et al. (2005); Barret et al. (2002). Language appears with positive and significant coefficient implying that cultural closeness and historical relation between EU and its importer countries promotes business activities and diffusion of GlobalGAP.

This result remains same in random effect and Mundlak estimation. Since, audit and language variables are time invariant in nature they are dropped in fixed effect model. For the other variables we additionally compare fixed effect model and observe positive and significant impacts of the share of fruits and vegetables production and their exports to the EU. GlobalGAP originally started with fruits and vegetables and significance of these variables indicates the importance of the fruit and vegetable sector in GlobalGAP diffusion. Furthermore, we tested for the importance of the infrastructure conditions. With this respect we find that internet coverage exerts significantly positive impact indicating that access to internet improves worldwide connectivity and spread of information which then promotes diffusion. However, its significance vanishes in fixed effect model. Other variables such as, governance indexes, agricultural openness, per capita GDP, share of agriculture in GDP and benchmarking mostly remain insignificant in all the panel models.

Table 1 - Estimation of GlobalGAP Diffusion in Agriculture Sector

Dependent variable	**Normalized no of certified producers**		
	Random effect	Fixed effect	Mundlak
GlobalGAP domestic auditor	1.763***		1.975***
	(0.183)		(0.110)
Language commonality with EU6	1.148***		1.141***
	(0.149)		(0.143)
Regularity quality (3 quantiles)	0.275	0.107	0.039
	(0.187)	(0.228)	(0.217)
Internet subscriptions per 100 people	0.024***	0.027***	0.024***
	(0.006)	(0.007)	(0.007)
GDP per capita (current 1000 USD)	-0.009	0.008	0.006
	(0.010)	(0.016)	(0.017)
F&V share (% of arable land)	0.057***	0.024	0.081***
	(0.008)	(0.029)	(0.028)
Agricultural value added (% of GDP)	0.015	-0.007	-0.009
	(0.018)	(0.047)	(0.044)
Agricultural sector openness	0.153	0.169	0.257
	(0.163)	(0.190)	(0.166)
F&V imports in million USD by EU6	0.001***	0.001**	0.001*
	(0.000)	(0.001)	(0.001)
GAP benchmarked producers (%)	-0.004	-0.005	-0.005
	(0.009)	(0.009)	(0.010)
IMR	0.074	0.099	0.101
	(0.156)	(0.182)	(0.141)
Constant	-14.852***	-13.067***	-16.621***
	(0.558)	(0.808)	(0.514)
Number of Observations	437	437	437
Number of countries	102	102	102
Hausman test RE vs FE	Prob>chi2 =0.00		

Note: Dependent variables are in log form. Robust Standard errors are reported in the parentheses after bootstrapping with 500 replications; *** p<0.01, ** p<0.05, * p<0.1; number of observation falls slightly due to missing values in data; dependent variable is normalized by size of total arable land

In Table 3 we restrict our analysis only to crop subsector and use number of certified producers and area harvested under GlobalGAP scheme as measures diffusion. The results remain more or less similar to that in Table 2, except that fruits and vegetables import appears with significant coefficient in hectares measure diffusion only in the random effect model. With hectares of and harvested under certification we additionally find that in random effect model governance index and country's income are having positively significant impact on GlobalGAP diffusion. This

shows that better governance and higher income of the countries promotes economic stability influencing the spread of certification.

Table 2 - Estimation of GlobalGAP Diffusion in Crops Subsector

Dependent variable	**Normalized no of certified**			**Normalized hectareds of land**		
	Random	Fixed	Mundlak	Random	Fixed	Mundlak
GlobalGAP domestic auditor	2.056***		1.921***	3.566***		3.474***
	(0.259)		(0.165)	(0.257)		(0.189)
Language commonality with EU6	1.187***		1.432***	1.917***		2.258***
	(0.168)		(0.159)	(0.268)		(0.246)
Regularity quality (3 quantiles)	0.441	0.087	0.063	0.728*	-0.004	-0.116
	(0.300)	(0.307)	(0.329)	(0.394)	(0.246)	(0.327)
Internet subscriptions per 100 people	0.011	0.004	0.002	0.019	0.005	-0.001
	(0.009)	(0.012)	(0.012)	(0.022)	(0.029)	(0.032)
GDP per capita (current 1000 USD)	-0.022	-0.031	-0.035	-0.039**	-0.028	-0.037
	(0.019)	(0.038)	(0.035)	(0.020)	(0.043)	(0.041)
F&V share (% of arable land)	0.064***	0.101*	0.126***	0.059***	0.073	0.126**
	(0.007)	(0.052)	(0.033)	(0.009)	(0.145)	(0.060)
Agricultural value added (% of GDP)	0.010	0.028	0.027	-0.013	-0.025	-0.043
	(0.019)	(0.043)	(0.037)	(0.033)	(0.082)	(0.067)
Agricultural sector openness	0.125	0.246	0.290	0.042	0.194	0.288
	(0.179)	(0.331)	(0.338)	(0.242)	(0.494)	(0.517)
F&V imports in million USD by EU6	0.001***	0.002**	0.002**	0.002***	0.002	0.001
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
GAP benchmarked producers (%)	0.001	0.001	-0.000	0.001	0.005	0.002
	(0.010)	(0.019)	(0.018)	(0.009)	(0.014)	(0.013)
IMR	0.029	0.044	0.052	-0.047	-0.015	-0.059
	(0.100)	(0.155)	(0.102)	(0.120)	(0.176)	(0.118)
Constant	-14.60***	-13.26***	-17.45***	-13.51***	-9.70***	-17.50***
	(0.820)	(1.382)	(0.500)	(1.289)	(3.234)	(0.711)
Number of Observations	274	274	274	274	274	274
Number of countries	100	100	100	100	100	100
Hausman test RE vs FE	Prob>chi2 =0.02			Prob>chi2 =0.22		

Note: Dependent variables are in log form. Robust Standard errors are reported in the parentheses after bootstrapping with 500 replications; *** p<0.01, ** p<0.05, * p<0.1; number of observation falls slightly due to missing values in data; dependent variable is normalized by size of total arable land

7 Conclusion

Using five year panel for 170 countries our study analyzes the diffusion of GlobalGAP certification at country level. We argue that other than firm level factors which have been studied extensively by large number studies, macro factors also contribute to the spread of private food standard, such as GlobalGAP. However, studies in this front are still relatively scarce.

We measure diffusion at crop level and for entire agriculture sector using number of producers accepted under GlobalGAP certification and hectares harvested under GlobalGAP in crops. These variables are all normalized by size of arable land in the country. In estimation of diffusion model we face the problem of selection bias as impact of GlobalGAP for those countries who have not adopted it remains unobserved. To tackle this we use Heckman two part model in which in the first stage we estimate adoption of GlobalGAP using ISO membership by countries as instrument and then the second stage plugs in the IMR estimated from the first stage to control for the selection bias. The second stage uses only the truncated sample.

So far the spread of the standardization scheme has been highly skewed around the globe. We therefore hypothesize that factor, such as, geographic preconditions, network tie and historical relations of countries as well as various indicators for economic development and governance level prevailing in a country influence spread of GlobalGAP.

In our estimation, we find that domestic availability auditing encourages certification. This might be caused by lowering of compliance cost due locally available auditing system. Analyzing the role of transnational network ties in certification, it is found that countries connected through common language with the EU states are likely to adopt GlobalGAP. Common language facilitates mutual business activities among these states. In the same way, countries with high exports of fruits and vegetables to the EU states have higher diffusion. An implication of such network ties is that they reinforce retailer-supplier relations within networks. Consequently, it makes the inclusion of new entrants harder. We find a positive impact of fruits and vegetables sector on certification magnitude. Since GlobalGAP originally started with this sector this sector hold importance in spread of GlobalGAP. Our estimates show that higher share of fruit and vegetable as percentage of arable land.

Clearly, this study focuses only on country level diffusion process. To include farm level characteristics of each country it obviously beyond the scope of this study. There are available certain mechanisms for financial 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. This marks as a limitation of the current study. Further investigations, therefore, are needed to analyze the diffusion process of certification schemes in agrifood sector.

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Appendix 1

Distribution of GlobalGAP Certification across Countries