Asian Research Journal of Agriculture

5(1): 1-15, 2017; Article no.ARJA.33146
ISSN: 2456-561X

Farm Level Strategic Response to Pesticide Regulations and Its Impact on Performance of Small Scale Vegetable Farmers in Tanzania

A. D. Funga[1*], M. Chacha[1] and B. Tiisekwa[2]

[1]School of Life Sciences and Bio Engineering, Nelson Mandela African Institute of Science and Technology, Arusha, Tanzania.
[2]Department of Food Technology, Nutrition and Consumer Sciences, College of Agriculture, Sokoine University of Agriculture, Morogoro, Tanzania.

Authors' contributions

This work was carried out in collaboration between all authors. Authors ADF and BT designed the study and wrote the protocol. Author ADF managed the analyses of the study and wrote the first draft of the manuscript. Author MC reviewed the experimental design and all drafts of the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/ARJA/2017/33146
Editor(s):
(1) Afroz Alam, Department of Bioscience & Biotechnology, Banasthali University, Rajasthan, India.
Reviewers:
(1) Vjollca Vladi, Food Safety and Veterinary Institute, Albania.
(2) Isabel Bertolaccini, Universidad Nacional del Litoral, Argentina.
Complete Peer review History: http://www.sciencedomain.org/review-history/19403

Original Research Article

Received 31st March 2017
Accepted 7th May 2017
Published 8th June 2017

ABSTRACT

Aims: To analyze the impact of different farm-level strategic response to pesticide regulations on farm performance of small scale vegetable farmers.
Study Design: A cross-section survey of 167 small scale farmers was carried out to estimate the impact of pesticide regulations on farm performance. A structured interview was used to obtain descriptive information in the field.
Place and Duration of Study: Data collection for the study took place between January and April 2016 in the selected small scale vegetable farms in Mvomero and Kilosa districts in Morogoro region, Tanzania.
Methodology: The Hirschman's framework was used to examine the strategic options through which small scale vegetable farmers respond to the private and public pesticide standards focusing on whether the strategy is loyalty, voice, exit and neglect. The logistic regression was used to

**Corresponding author: E-mail: fungaa@nm-aist.ac.tz;*

estimate the impact of loyalty and exit strategies on the income and pesticide expenditure of small scale vegetable farmers. The instrument variable was used to account for endogeneity problem in regression function of pesticide use.

Results: About, 80% of the small scale vegetable farmers responded to pesticide regulations through "loyalty and exit" while 20% of the farmers deployed "neglect" option with no voice response. The regression results revealed that the loyalty and exit strategies are significantly but positively and negatively associated with pesticide expenditure and income of small scale vegetable farmers respectively. The small scale vegetable farmers who opted for loyalty and exit strategies not only have an increased amount spent on pesticides but also earn less income from vegetable production than those with a neglect strategic response.

Conclusion: The loyalty and exit strategies showed no desired impact on farm performance in terms of pesticide expenditure and income for small scale farmers. In an effort to build capacity, the small scale farmers should focus on strategies that exhibit loyalty and voice behavior.

Keywords: Pesticides; food safety standards; Hirschman's framework; farm performance; small scale farmers; Tanzania.

1. INTRODUCTION

Food safety is becoming an important factor for farmer's participation in high value market. Farmers are facing continuing challenges to grow safe, healthy crops through the responsible agronomic practices [1]. There is a growing pressure from consumers, retailers and legislations that have placed new demands on vegetable farmers whereby they are gradually required to use production systems that ensure the least use of pesticides. The requirements of private and public pesticide regulations appear to be a major challenge for small scale farmers since compliance measures has a significant influence on the production processes [2]. Responses to public pesticide regulations may induce changes in the structure and operating modes of supply chains thus affecting the participation of vulnerable groups such as small scale farmers.

Vegetable production in Tanzania is dominated by the small scale farmers who produce for both domestic and export markets. As the primarily producers and supplier of vegetable crops, small scale farmers are directly affected by pesticide regulations since the requirements associated with the standard, both public and private, in most cases require a shift in production practices [3]. This shift often requires both technical and financial resources that small scale farmers in Tanzania clearly lack. The pesticide Maximum Residue Limits (MRLs) set by public and private standards can decrease pesticide uses but can also result in increases in cost to effectively manage pest and disease [4]. The ban of some pesticides can further increase the expenditure on pesticide if the alternative method of plant protection is relatively expensive and not readily available.

Several studies extensively analyzed the implication of food safety standards on farm performance [5-9]. However, in literature very little in is known on the processes and strategies through which the small scale farmers respond to what they perceive to be dissatisfying standards. Furthermore, the extent at which the farm performance of uncertified small scale farmers is affected due to different strategic options remains unknown. Given the scarcity of an adequate amount of literature to analyze the response of small scale to emerging food safety standards in resource poor settings, we adapt the modified Hirschman's conceptual framework [10] to analyze the strategic options adopted by small scale farmers in response to market requirement of pesticide regulations. According to this framework, farmers can respond to pesticide regulations through Neglect, exit, voice and loyalty strategies [11].

Relevance to food safety standards in horticultural sector, "exit" option arises when small scale farmers ceases their participation in high value market or choosing not to comply with the standard in a particular market and change markets segments if alternative markets are available [12,13]. The "voice" strategy occurs when small scale farmers are trying to improve conditions through discussing problems with the government or private standards authorities, taking collective action in setting standards, suggesting solutions and seeking help from an outside agency like the International Plant Protection Convention (IPPC) and World Trade Organization (WTO) [12,14]. The "loyalty" option

is regarded as a response strategy that reflects a passive and optimistic anticipation of improvement by practicing good and necessary actions required to comply with standards [15]. The "neglect" response refers to passively allowing conditions to deteriorate through reduced interest or effort for acquiring improvement in business process and farming activities [16].

Voice and loyalty are considered to be constructive responses, in that they are oriented towards improvement in the capacity to penetrate in high value markets, while exit and neglect are sometimes viewed as a destructive option [17]. The exit strategy is not always considered as a loose option but rather can be a market orientation, which in turn may be a sound strategy to maintain competitiveness [18]. Among high growth sector, such as horticultural sector; exit is viewed often as the ultimate goal of building a profitable venture [19]. Proactive exit may contribute to the development and implementation of new ideas and to the creation of new opportunities that may result into the competiveness of a farm [18,20,21]. Thus, at a farm level, it is expected that voice, loyalty and exit strategies may provide constructive benefits on the farm performance compared with destructive effect of neglect option.

Based on this framework, the present study tries to characterize the strategies on which small scale vegetable farmers have opted internally due to increasing market pressure from pesticide regulations focusing on whether the strategy is loyalty, voice, exit and neglect. Further, we explore the impact of loyalty and exit strategies on income and pesticide use performance based on data from a survey of 167 small scale vegetable farmers in Morogoro region. This paper extends the literature on the implication of food safety standards on the competitiveness of small scale firms. The paper proceeds as follows: the study methodology is the next section which describes the survey design, data collection and empirical analysis. Afterward results of the study are presented and discussed. The last section concludes with a summary of the main results of the study and policy implication.

2. METHODOLOGY

2.1 Survey and Data

Data collection for the study took place between January and April 2016 in Morogoro region, Tanzania. The study was carried out in selected small scale vegetable farms in Mvomero and Kilosa districts. These are one of the agro-ecological areas where small scale farmers are highly involved in vegetable production. According to Tanzania Agriculture Sample Census, 2012, tomato is the single most dominant produced and leading consumed vegetable crop in Tanzania and hence served as a reference crop in this study. Morogoro region tops the list of five leading regions with the largest planted area of tomatoes by 2442 hectare (9.2%) of tomato planted area in Tanzania [22]. Furthermore, Morogoro is one of the regions with the highest percentage of households reporting to have commercialization of crops.

A cross-section survey of 167 small scale vegetable farmers in the main tomatoes producing area of Morogoro was carried out. We focus our analysis here on small scale farmers with less than 10 acre and who represent majority of all tomatoes produced for both domestic and export markets. Purposive sampling technique was used in the selection of the study villages because that is where vegetables are highly grown and easily accessible. We randomly selected eight villages located in Mvomero and Kilosa districts where vegetables are highly grown and farmers have been previously supported by government or private lead programs for capacity building in adoption of Good Agricultural Practices (GAPs). Within these villages, small scale farmers were chosen randomly among the farmers who produce tomatoes, farmers who use pesticides and were willing to participate in the study. The information from village leaders and agricultural extension officers was used to generate a list of study participants. Systematic interviews with key informants were used to complement the questionnaire results. Pesticides vendors in the study area served as sources of information on the type of pesticides sold. The information from small scale farmers was obtained through a structured interview, to provide descriptive information on farmers' demography, farm characteristics, and strategic options taken in response to pesticides related standards.

2.2 Analytical Model

A major objective of the loyalty, voice and exit strategies in vegetable production is that dealing with the market standard requirement to maintain a profitable business. In the case of pesticide regulations, one of the important motivations for

farmers to adopt loyalty strategies is the expected benefit placed on reduced expenditure of pesticides [23] and improves quality and safety criteria required to penetrate into the high value market. As a result, farmers will be able to sell higher volumes to the high value market and through quality increases that might be able to further increase their incomes. Exit strategies such as shifting to less safety demanding market is one of the most appropriate commercial strategies that triggers high vegetable production which can further increase farmer's income [24]. We therefore expect the loyalty and exit strategies to have a desired outcome on farm performance in terms of pesticide use and income. Small scale vegetable farm sector in Tanzania is characterized by poor availability of resource and thus farmers prefer to control plant diseases and pest attack by using low cost cultural methods than pesticides which are rather expensive. We assume that farmers try to minimize the cost of pesticide application using cultural methods. In this case the pesticides cost per acre is considered to be a good proxy indicator for pesticide use performance. The instrumental variable (IV) and standard least squares (OLS) linear regression models were used for estimation of pesticide use and income of small scale farmers respectively. In each model the latent variable for selection of loyalty and exit strategies takes binary values; "1" if a farmer responded to pesticide regulations by exit and loyalty strategies and "0" if farmers choose Neglect option. Table 1 gives the description of variables included in the regression models for estimation of pesticide use and income.

In the pesticide use regression analysis, the instrumental variables approach was used because the farmer's decision toward choosing loyalty and exit strategies might be subject to bias resulting from unobserved factors influencing not only the farmers' willingness and ability to choose loyalty and exit strategies, but also their pesticide use. Pesticides use is more likely to be endogenous because its use is a response to an observable pest attack or plant diseases. Furthermore, some factors that drive farmers to adopt a particular strategy for control of pest and plant diseases also lead farmers to decide to apply certain amount of pesticides [25, 26]. In this situation, instrument variable was carried out to take into account of endogeneity and selection bias [27,28]. The first and second stage of the pesticide use regression model is represented by equation 1 and 2 respectively. In equation 1, the factors influencing the selection of loyalty and exit strategies (access to extension services, training on GAPs, income and technical support from agricultural advisors) were analyzed. Pesticide use of small scale farmers was estimated in equation 2 which contains the instruments, the predicted value of selection of loyalty and exit strategies obtained from equation 1, and the control variables thought to affect pesticides cost per acre (age and education of farmer; access to credit and farm production assets; number of vegetable crops grown, vegetable growing area size, pesticides application rate, awareness to food safety standards and membership to famer's association) [29-33].

$$^{*}\mathrm{Z}_{i} = \beta_i x_i + \mu_i \quad (1)$$

$$\mathrm{A}_{i} = \alpha \mathrm{Y}_{i} + \gamma \mathrm{Z}_{i} + \ell_{i} \quad (2)$$

Where $^{*}Z_i$ represents the latent variable for selection of loyalty and exit strategies, x_i stands for non-stochastic vector of observed control variables for farmers' selection of loyalty and exit strategies, and μ_i stands for stochastic error terms for selection of loyalty and exit strategies. A_i denotes the pesticide use of a small scale farmer, Y_i is a vector of exogenous variables thought to affect pesticide use, Z_i is the predicted value for selection of loyalty and exit strategies from equation of the model, and ℓ_i is the error term associated with pesticide use.

In the income regression model the dependent variable is measured as the total income per acre obtained from the sale of vegetable. Among the control variables we include a dummy variable for selection of loyalty and exit strategies, which we expect to result in higher incomes for farmers. According to our model specification the control variables that may affect income derived from vegetable sale include sex, access to credit, extension services and pesticides application cost. The income regression model is represented by equation 3.

$$y_i = \beta_i x_i + \mu_i \quad (3)$$

Where y_i is the income of small scale farmer, β_i represents coefficient, x_i stands for independent variables and μ_i stands for stochastic error terms.

Table 1. Description of variables used in regression models

Variable	Description	Type
Age	Farmer's age (years)	Continuous
Sex	1, if farmer is a male; 0, otherwise	Dummy
Education	Farmer education level; none, primary school and high school	Categorical
Farm size	Size of vegetable growing area (acre)	Continuous
Assets	1, if farmer own farm production assets;0, if otherwise	Dummy
Association	1, if farmer is member in a farmers' association; 0, if otherwise	Dummy
Pestcost	Pesticide costs per acre of vegetable production (Tanzania shillings)	Continuous
Strategies	1, if farmer choose loyalty and exit strategies; 0, if choose Neglect option	Dummy
Credit	1, if farmer is receiving credit from Government /NGOs; 0, if otherwise	Dummy
Training	1, if farmer is receiving training on GAP from Government /NGOs; 0, if otherwise	Dummy
Extserv	1, if farmer is receiving extension services from agricultural advisors; 0, if otherwise	Dummy
Technsupport	1, if farmer is receiving technical support on GAP from Government /NGOs; 0, if otherwise	Dummy
Income	Seasonal total income obtained from vegetable sale (Tanzania shillings)	Continuous
Awareness	1, if farmer know about food safety standards; 0, if otherwise	Dummy
Numbercrops	The number of vegetable crops grown by a farmer per season	Continuous
Numberpestcd	The frequency of pesticide application by a farmer per growing season	Continuous

Table 2. Descriptive values in demography and farm characteristics

Variable	Frequency	Percentage
a) Age (years)		
17 - 39	99	59.3
40 - 60	61	36.5
>60	7	4.2
b) Sex		
Female	49	29.3
Male	118	70.7
c) Education level		
Not completed any school	31	18.6
Completed primary	93	55.7
Completed high school	43	25.7
d) Awareness of pesticide residue standards	66	39.5
e) Access to factors of production	109	65.3
f) Adopted any agricultural and food safety standards scheme for vegetable production	24	14.4
g) Adopted loyalty and exit strategies	134	80.2
h) Integration in value addition chain		
Selling to export	2	1.2
Selling to domestic agro processing	12	7.2
i) External support		
Credit	14	8.38
Technical support	56	33.53
Training on GAP	77	46.11
Extension services from agriculture advisors	71	42.51
Members in farmers' association	71	42.51

Source: Field survey, 2016

3. RESULTS AND DISCUSSION

3.1 Descriptive Analysis

Demographic values for all 167 small scale vegetable farmers and farm characteristics are presented in Table 2. Most of the small scale vegetable farmers are male (71%). It is also indicated that about 71% of the small scale vegetable farmers have completed primary and high school education. About 59% of the farmers are young (17 -39 years), while 41% are over 39 years old. In fact, only a very small percentage of small scale vegetable farmers are integrated in the vegetable value added processes namely 1% in the case of export market and 7% selling direct to domestic agro-processing industry. Farmers were asked also about their profile on external assistance from private and public organizations and the details are provided in Table 2. It was realized that a very small part of the small scale vegetable farmers (8%) are receiving credit from financial organizations. With regard to technical assistance, only 34% of the small scale vegetable indicated that they were receiving technical support from public and private organizations. Interestingly about 46% and 43% of the small scale vegetable farmers were receiving training on GAPs and extension services respectively.

Furthermore, in the surveyed area, 43% of the small scale vegetable farmers are members of the farmer's association. It has to be noted, however, that 80% of the small scale farmers in the surveyed area adopted various strategies aimed at gaining competitiveness in response to pesticides standards related pressures. Although agricultural and food safety standards schemes appear to be an emerging concept in the surveyed area, only 14% of the small scale vegetables farmers have joined these scheme including Global GAP. Finally about 65% of the small scale vegetable farmers in the sample have access to various factors of production dedicated to vegetable farming. Table 3 shows further that, in the surveyed area tomato is the most dominant vegetable grown by 75% of the small scale farmers. The farm performance for small scale vegetable farmers in Morogoro region is presented in Table 4. The average vegetable growing area in the sample is 1 acre. In the surveyed area small scale vegetable farmers spent 241000 Tanzanian shillings per acre on pesticides; while the average total income from selling of vegetable was recorded as 2480000 Tanzanian shillings per acre for a growing season.

Table 3. Vegetable crops grown by small scale farmers in Morogoro

Crops	Number of farmers	Percentages
Tomato	138	75
Cabbage	14	8
Watermelon	10	5
Cucumber	6	3

Source: Field survey, 2016

3.2 Strategic Response on Pesticide Regulations

In an attempt to characterize strategic response on pesticides regulations, this study focused on loyalty, voice, exit and neglect as the main alternative strategic options available to small scale vegetable farmers.

3.2.1 Loyalty

Due to the heavy reliance on niche markets, lack of specialist skills, low cash flow and small asset base of the small scale farmers, the loyalty option is considered as the implicit most likely strategic response on pesticide standards. This can be achieved through service improvements, process enhancements and quality initiatives that are deployed by farmers to encourage loyalty primarily by removing preliminary obstacles. As indicated in Table 5, small scale vegetable farmers have been since then working to transform their operations through the adoption of a variety of different loyalty strategies in response to pesticide regulations in order to achieve the needed outcomes.

Table 4. Farm performance for small scale vegetable farmers in Morogoro

Variable	Mean
Vegetable growing area (acre)	0.95
Number of pesticides per season	2
Per acre pesticide application cost per growing season (Tanzanian shillings)	241000
Total income derived from vegetable sale per acre (Tanzanian shillings)	2480000

Source: Field survey, 2016

3.2.1.1 Adoption of good agricultural practices

Adoption of GAP has a potential to help reduce the risk of non-compliance with pesticide regulations and guidelines regarding permitted pesticides and maximum levels of pesticides in food products [34]. In the surveyed area as shown in Table 5, about 46% small scale vegetable farmers adopted some safe pesticide management practices in an effort to reduce the risk of pesticides residues in vegetable harvest. They are taking some stances in applying GAP before and during spraying of pesticides in farm. The small scale vegetable farmers are reading label instructions for the mixing, loading and handling of the specific pesticide being used, using personal protection equipment during mixing and spraying; while observing re-entry and postharvest interval. For some small scale farmers, adopting GAPs is part of providing a pesticide-residue free vegetable produce and are planning to implement GAPs protocol in their farming activities. According to the survey, around 8% of the small scale vegetable farmers were in the process of joining GlobalGAP scheme in their farming activities. Good pesticide management practices appear to be so strongly linked with good performance that might further strengthen competitiveness [35,36].

3.2.1.2 Land management and general hygiene practices

Small scale vegetable farmers have implemented strategies to better improve hygienic conditions for quality and safety factors. As shown in Table 5, about 53% of the small scale vegetable farmers are applying an array of basic cultural controls of pests and plant diseases such as carrying out sanitation practices in the field, crop rotation, intercropping, resistant varieties use or respecting specific planting time schedules in order to lower risk of pests, plant disease and pesticides contamination of vegetable produces. These approaches have been found as a measure to reduce pesticide use [37-39]. Some of the small scale vegetable farmers are adopting proper pesticide application concept through the use of correct types of pesticide, pesticide dose and concentration, right on application time and appropriate application method. Small scale vegetable farmers are motivated for collecting and storing pesticide container properly after use. However, this approach needs to be strengthened by enhancing farmer's decision-making process toward the proper operation and safety practices.

3.2.1.3 Vertical coordination through specification contracting

Local vegetable traders and wholesalers often do not have a formal contract with the small scale vegetable farmers. However, the small scale vegetable farmers have developed strategies to integrate production and retail marketing in the form of direct retail marketing or specification contracting. In the surveyed area as reflected in Table 5, about 27% of the small scale vegetable farmers had informal contracts with middlemen who supplies to domestic processor or supermarkets. Supermarkets also obtain vegetable produce supplies direct from organized small scale farmers. These retail traders such as supermarket buyers are demanding safer vegetables produced in accordance with good agricultural practices. However, these buyers are lacking with own codes of practice that could manage their relationships with small scale vegetable farmers, with detailed provisions for farmer record on land management, agronomic practices, pesticide use and disposal, hygiene and safety. Contracts arrangement is particularly important in situation of quality management and has been used to provide incentives to motivate quality performance [40,41]. In most cases, small scale farmers can gain access to essential inputs, technical advice and information relating to pesticide standards and hygiene requirements [23]. Small scale farmers are using these standards for food safety and 'quality' as strategic tool to gain competitiveness in the effort to build capacity for compliance with standards [42]. Farmer's participation in supermarket channels has been also found to induce gain in average household income [43,44].

3.2.1.4 Integration in information system with pesticide vendors

The access of extension and information services to farmers in poor resource setting is a common problem in Tanzania [45]. Among the 167 small scale farmers, only 71 (43%) farmers had access to extension services. Therefore, for most of the farmers, the pesticide vendors are indeed the primary source of information among the parties involved in pesticides supply chain. With this inadequacy of governmental extension services, the information sources for small scale farmers regarding the correct use of pesticides are rather limited. Table 5 shows further that, about 22% of the small scale vegetable farmers in the surveyed area have entered into business relationship with pesticides vendors necessary for obtaining information related to pesticide

application. The existing literature suggests that small scale farmers may gain knowledge by learning from pesticide vendors [46,47].

3.2.1.5 Join initiatives on good agricultural practices

In an effort to gain competitiveness on the practical application of GAPs in vegetable production, farmers are joining various initiatives on good agricultural practices supported by government or non-Governmental organizations (NGOs). This strategy takes a form of collective action through which both public and private sectors are involved in capacity building by providing training and awareness focusing on the practical application of GAPs in vegetable production. Certain governmental agencies and NGOs are taking a leading drive to influence best practices through training, promotion of integrated pest management, and, in some location an organic production of vegetables. For instance, the Tanzania Horticultural association (TAHA) through a GlobalGAP National Technical Working Group is working with farmers to meet international standards requirement. The Food and Agriculture Organization (FAO) in partnership with the Government of Tanzania and the horticultural industry have committed resilient efforts to create awareness on GlobalGAP for the small scale fruits and vegetable producers. Furthermore, the United states Agency for International Development based Tanzania agriculture productivity program (USAID-TAPP) developed clusters of commercial farms, small scale for fruits and vegetables farmers in Arusha, Kilimanjaro, Lushoto, Morogoro, the Coastal strip and Zanzibar as a platform to facilitate GAP adoption. In the surveyed area as shown in Table 5, about 38% of the small scale vegetable farmers have joined public and private programs designed for awareness raising and training in good agricultural and pest management practices. The public private partnerships can play a key role in creating linkages that can satisfy market demands for food safety, while retaining smallholders in the supply chain [48-50].

3.2.1.6 Formation of farmers group for identification and certification

In the case of small scale farmers with an average on one acre of farm size, the loyalty strategy at the individual level seems to be difficult due to the fixed costs of compliance. The only option is that farmers organize themselves within farmer's organizations so as to comply collectively with the standards. In the surveyed area as shown in Table 5, about 39% of the small scale vegetable farmers have joined farmers' group so as to seek for identification and further certification by agricultural and food safety standards scheme such as GLOBALGAP and Kilimohai. Through farmers' groups, the small scale vegetable farmers can attain economies of scale to reduce the training, monitoring and coordination costs, and further hire own technical staff to monitor members' compliance with pesticide standards and hygiene requirements and; implement traceability system [51]. The farmers' group is a crucial factor in making markets work for the poor farmers [52].

3.2.2 Exit

Not all the small scale vegetable farmers have been willing or able to transform their operations however, some of the small scale vegetable farmers in the study area exited from some of the high value vegetable market in response to evolving pesticides standards' pressures through refocusing on alternative markets with lower pesticide residue standards. This implies that the small scale farmers with poor resources can switch to less quality demanding customers, or exiting export markets completely [15,53]. A small scale farmer may choose to switch to different market for which the requirement for risk management measures is less costly. Such a strategy may be employed if compliance would impacts and resources could be better spent elsewhere, or if there are profitable alternative markets that have less demanding standards. In other cases, market re-orientation may be a very practical strategy to maintain competitiveness.

In the study area as shown in Table 5, about 44% of small scale vegetable farmers who were positioned to grow fresh vegetable for the high value market are now focusing on the community spot markets. On the other hand, about 37% of the small scale farmers who were formally selling directly to relatively high quality demanding domestic retailers such as supermarket and agro-food processing is now concentrating on the less quality demanding community spot markets. In the literature [54] a similar finding has shown the smallholder farmers exit from export market due to difficulty to maintain certification with GlobalGAP. The finding of this study adds to the growing concerns that implementation of pesticide standards may lead, even in the short run, to the exclusion of the small scale farmers from high value markets while reinforcing them to produce for low value domestic market [55].

Table 5. Strategic response on pesticide standards within small scale vegetable farmers

Strategies	Frequency	Percentage
Loyalty		
Adoption of good agricultural practices	77	46.1
Vertical coordination through specification contracting	45	26.9
Integration in information with pesticide vendors	37	22.2
Join initiatives on good agricultural practices supported by government or NGOs	50	29.9
Formation of farmers group for identification and certification by food safety standards scheme	65	38.9
Establishment for land management, pesticides disposal and general hygiene practices in vegetable farming	89	53.3
Exit		
Focus on the local community market to avoid pesticide residue issues	73	43.7
Withdraw from high value markets where they cannot meet or guarantee pesticide residue standards	61	36.5

Source: Field survey, 2016

3.2.3 Voice

Generally, our findings revealed that there was no evidence of voice strategies opted by the small scale farmers in the surveyed area. The small scale horticultural sector in Tanzania as a whole is fragmented and weakly positioned in the issue of bargaining power or supporting complaints on the regulations [56]. While this could partly be a reflection of the structure of domestic market, which are concentrated in commodities for which food safety and agricultural health measures are of lesser importance, it likely also reflects their limited capacity to participate in the standards setting and implementation process. The resource poor small scale vegetable farmers are more likely to have exit options available and hence this may decrease their tendency of voice behavior. On the other hand, voice activity is expensive for them, so they are more likely to exhibit exit response [24].

3.2.4 Neglect

Small scale farmers who are frustrated about the pesticide standards barrier to participate in the high value fresh vegetable market were easily developed tendency of inactivity related to their efforts of gaining competitiveness [57] and consequently they have kept farming activities subject to deterioration [58]. It was revealed that, in the surveyed area about 20% of the small scale vegetable farmers did not engage in exit, voice or loyalty strategies in response to public and private pesticides regulations.

3.3 Impact of Loyalty and Exit Strategies on Farm Performance

In the analysis of the effect of these strategies on farm performance we divided the sample into two groups according to the type of strategic response. Group I: loyalty and exit strategies and Group II: Neglect strategy. We analyzed the impact of these strategies on two important performance indicators i.e. the income obtained from the vegetable production and pesticide expenditure.

3.3.1 Impact of loyalty and exit strategies on pesticide use

In the pesticide use model we present results from both estimation approaches for comparison, however, for the interpretation we rely on the instrumental variable (IV) estimates. As shown in Table 6 the results of over-identification tests support the choice of the instruments, as do both the Sargan and Basmann chi-square values ($p = .1081$, $p = .1231$) suggest a valid instrument. The results from the regression analysis on pesticide use revealed a significant and substantial effect of these strategies on expenditure of pesticides. All other factors held constant, the small scale vegetable farmers who opted for loyalty and exit strategies have an increased amount spent on pesticides than those with neglect strategies. This might be due to some factors associated with the type of strategy itself. Firstly, although small scale farmers opted for good agricultural practices which promote the use of alternative plant disease and pest control strategies such as cultural methods and integrated pest

management (IPM), the small scale vegetable farmers rarely kept to this alternative because of the risks associated with the possible outbreak and rapid spread of pests. For example, the outbreak of dangerous "tomato leaf miner"(Tuta absoluta) in the Northern zone and Morogoro region during 2015/2016 season posed a great threat to tomato growers which encouraged them to spend more on a variety of pesticides in an effort to combat the outbreak.

Secondly, informal contracts with a vegetable traders or middleman buyers also indirectly promote the use of chemical control by insisting on buying spotlessness vegetable produce which implicitly triggers pesticides use on control of pests and plant diseases. Thirdly, integration of farmers and pesticide vendors in the supply chain has triggered more radical changes on pesticides expenditure. This is because given the sporadic occurrence of plant diseases and pest threat, integration of farmers and pesticide vendors might have increased access to chemical pesticides resulting to more pesticides application on vegetables.

The study shows that the small scale vegetable farmers who responded by loyalty strategies were most likely to spend more on pesticides. This suggests that loyalty strategies cannot always prompt small scale farmers to change their pesticide expenditure practices [59]. Loyalty strategies may offer much higher performance at the firm with the loyalty program than neglect strategy, but this does not necessarily imply that loyalty programs are effective [60].

Another important factor that positively influences the amount of pesticide use is the access to vegetable production assets. Accessibility to assets including land, machinery, telephones increases the amount of pesticide expenditure by 79645 Tanzanian shillings per acre. The farmer's age has a significant influence on the amount of pesticide use. An increase in age by 1 year decreases the amount of pesticide use by 3755 Tanzanian shillings per acre. Another important factor that negatively influences the amount of pesticide expenditure is farmer's education level. An increase in farmer's education level decreases the amount of pesticide use by 75761 Tanzanian shillings per acre. The farm size has a significant influence on the amount of pesticide expenditure. Surprisingly, an increase in farm size by 1 acre decreases the expenditure on pesticide by 122376 Tanzanian shillings per

Table 6. Regression results on the pesticide use function [total cost (Tanzania shillings/acre)]

Variable	IV		OLS	
	Coefficient	**Standard error**	**Coefficient**	**Standard error**
Strategies	346666*	135565	65714	45897
Age	-3755**	1653	-4140*	1508
Edu	-75761*	28087	-64172*	26722
Awareness	-45950	37763	-38646	34479
Association	-75602**	45226	-34731	35948
Farmsize	-122377*	32231	-86877*	25775
Numbercrops	26317	65787	-37300	52444
Assets	79645*	40151	69696**	37029
Numberpestcd	4708	14590	9628	13577
Applrate	-7554	12558	-3204	11068
Extserv			117814	40975
Training			11248*	38696
Technsupport			-57335	42197
_cons	357894*	163402	536344*	111215
Number of observation = 150			Number of observation = 150	
Wald chi2(10) = 35.41			F(13,136) = 3.81	
Prob> chi2 =.0001			Prob> F = .0000	
R-squared = .0366			R-squared = .2671	
Root MSE = 2.2e+05			Adj R-squared .1970	
Tests of over-identifying restrictions			Root MSE =2.0e+0	
Sargan (score) $chi^2(2)$ = 4.45016 (p = .1081)				
Basmann $chi^2(2)$ = 4.18875 (p = .1231)				

**Results is significant at a 5% significance level*

***Results is significant at a 10% significance level*

acre. All other included variables such as, awareness on food safety standards, the number of pesticides and crops, membership in farmer's association and the application rate do not have a significant influence on the pesticide expenditure by small scale vegetable farmers.

The farmers' association has been identified as a major determining factor for the adoption of standards by small scale producers [16,25,61]. The results of the analysis imply that the small scale vegetable farmers with membership in the farmers' association may have benefited by the improvement of their pests and plant disease management skills. This may result in lower expenditure on pesticides application. This indicates that even if the strategic options are currently not resulting into a desired effect in terms of pesticides expenditure for many small scale vegetable farmers, the benefit of farmer's association still offers a high potential for farmers' reduction of pesticides application. This will also build capacity of farmers in the near future, which in the medium to long-term is likely to become a requisite competitiveness factor in complying with pesticide standards.

3.3.2 Impact of loyalty and exit strategies on income

The results of the regression analysis on total income derived from vegetable production are presented in Table 7. In the total income regression, (F=.002) demonstrates that our model specification is significant and can provide better estimates of the income effect of loyalty and exit strategies. The results revealed that a combination of loyalty and exit strategies did not provide desired impact on the income of the small scale vegetable farmers. All other factors held constant, the small scale vegetable farmers who are transforming their farming activities and those re-orienting market due to requirement of pesticide regulations earn less income from vegetable production than those with neglect strategic response. This might be due to some factors: firstly, due to market pressure related to pesticide residue issue, some small scale vegetable farmers refrained from high value market to less demanding local market resulting into poor quality of produce and low market price that affected their income. Secondly, since some farmers are adopting cultural methods for pest and plant disease control methods instead of synthetic chemicals, their crop are more prone to pests/diseases outbreak that may result into low yield and income.

Table 7. Regression results on the income from vegetable production [Total income (Tanzania shillings/acre)]

Variable	Coefficient	Standard error
Sex	-1139146**	664479
Strategies	-2345310*	838482
Credt	2009453**	1048778
Extserv	1452922*	636089
Pestcost	4.51747*	1.918325
_cons	3544602*	846703.2
Number of obs	= 144	
F(5, 138)	= 4.01	
Prob> F	= .0020	
R-squared	= .1267	
Adj R-squared	= .0951	

**Results is significant at a 5% significance level*
***Results is significant at a 10% significance level*

Male headed farms had reduced income obtained from vegetable sales. This result is inconsistent with previous findings in sub-Saharan Africa where it has been identified that male generally has higher utilization of input than female, and that this difference favors productivity of men than female [62]. The expenditure on pesticide has a significantly positive impact on total income per acre. All other factors held constant, farmers spending more on pesticides earn relatively more from vegetable production by just 5 Tanzanian shillings per acre. The existing competitiveness in yield can also be improved with strengthening collective action tailored to the needs of small scale farmers. The results of this study confirm the great role of external support provided by government and private organizations to farmers with respect to the access to extension services and credit. The findings further revealed that small scale vegetable farmers receiving credit from governmental or private financial organizations have high income compared to the non-credit receiving respondents. This is partly because the small scale vegetable farmers receiving credit have a relatively better position in adoption of improved farming technologies [63]. According to our model estimates, access to extension services increases the net income of the small scale vegetable farmers by 1452922 Tanzanian shillings per acre. The small scale farmers may have benefited from extension services especially through the improvement of their management skills resulting in higher yields and enhanced income of small scale vegetable farmers. This suggests that tailored made extension programs that promote the adoption of good agricultural practices are needed to

improve the competitiveness of small scale farmers.

4. CONCLUSION AND POLICY IMPLICATION

The performance of vegetable production is perceived by small scale farmers to be deteriorating when their participation in the potential high value market of fresh vegetable become limited due to changes in demand of compliance to food safety standards. In the literature, the mechanism at which the small scale farmers respond to increasingly pressure of food safety requirement in a poor resource setting are poorly addressed. The present study demonstrates that about 20% of the small scale vegetable farmers responded to pesticide standards pressure through neglect strategy while 80% of the respondents adopted various loyalty and exit strategies, with no evidence of voice. The small scale vegetable farmers adopted loyalty strategy through introduction of pesticides management practices; land management, pesticides disposal and general hygiene practices; join initiatives on good pesticides handling supported by government or NGOs; formation of farmers group for identification and certification by food safety standards scheme; and strengthening of supply chain relation with vegetable buyers and pesticide suppliers. In addition to locus of this effort for compliance strategies, some farmers opted for market reorientation strategies through concentrating on relatively less strict markets as an exit strategy.

In this study it was revealed that the loyalty and exit approaches in the resource poor setting may not offer desired effect on farmers' competitiveness. The small scale vegetable farmers who have deployed loyalty and exit options spent more on pesticides and earn less than those with neglect strategies. In reality, it is prudent that these small scale farmers might adopt mixed strategic responses to emerging pesticides standards. In particular, voice is likely to be adopted alongside loyalty. In the context of Hirschman's conceptual framework, the most positive and potentially advantageous strategy combines voice, and loyalty behavior while limiting exit strategies. Other factors kept constant, a combination of voice and loyalty strategies is most likely to turn the challenges related to compliance with pesticides regulation into a competitive opportunity and hence provide broader economic spillovers.

Generally, the loyalty and exit strategies that were chosen by the small scale vegetable farmers in Morogoro region did not offer the desired effect on pesticide use and income of the small scale vegetable farmers. This suggest that as part of efforts to build capacity, the small scale farmers, technical assistance providers and policy makers should focus on strategies that are loyalty, while providing the greatest possible opportunity to apply voice. The collective voice action is necessary for enhancing small scale farmers' efficiency and this approach is more likely to generate quality gains. In so doing, small scale vegetable farmers should be able to turn the perceived threats associated with pesticide residue standards into opportunities for competitive gain. Capacity building should strive to maximize the strategic options available for small scale vegetable farmers and, more particularly, to enhance their ability to implement strategies which induce compliance and involve negotiation.

ACKNOWLEDGEMENTS

The authors thank Local community administration in Kilosa and Mvomero districts, the agricultural extension officers at the community field office, the study participants for their support and corporation in this research. We are further indebted by the staff of the Sokoine University of Agriculture Laboratory for Interdisciplinary Statistical Analysis (SUALISA) for the assistance with data analysis.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Okello JJ, Swinton SM. Compliance with international food safety standards in Kenya's green bean industry: Comparison of a small-and a large-scale farm producing for export. Review of Agricultural Economics. 2007;269-85.
2. Lee J, Gereffi G, Beauvais J. Global value chains and agrifood standards: Challenges and possibilities for smallholders in developing countries. Proceedings of the National Academy of Sciences. 2012; 109(31):12326-31.
3. Maertens M, Swinnen JF. Trade, standards, and poverty: Evidence from

Senegal. World development. 2009;37(1): 161-78.
4. Schreinemachers P, Schad I, Tipraqsa P, Williams PM, Neef A, Riwthong S, Sangchan W, Grovermann C. Can public GAP standards reduce agricultural pesticide use? The case of fruit and vegetable farming in northern Thailand. Agriculture and Human Values. 2012; 29(4):519-29.
5. Holzapfel S, Wollni M. Is GlobalGAP certification of small-scale farmers sustainable? Evidence from Thailand. Journal of Development Studies. 2014; 50(5):731-47.
6. Chiputwa B, Spielman DJ, Qaim M. Food standards, certification, and poverty among coffee farmers in Uganda. World Development. 2015;66:400-12.
7. Mitiku F, De Mey Y, Nyssen J, Maertens M. Do private sustainability standards contribute to poverty alleviation? A comparison of different coffee certification schemes in Ethiopia. Bioeconomics Working Paper Series: WP 2015/03; 2015.
8. Hansen H, Trifković N. Food standards are good–for middle-class farmers. World Development. 2014;56:226-42.
9. Schuster M, Maertens M. The impact of private food standards on developing countries' export performance: An analysis of asparagus firms in Peru. World Development. 2015;66:208-21.
10. Hirschman AO. Exit, voice, and loyalty: Responses to decline in firms, organizations, and states. Harvard University Press; 1970.
11. Vantilborgh T. Volunteers' reactions to psychological contract fulfillment in terms of exit, voice, loyalty, and neglect behavior. VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations. 2015;26(2):604-28.
12. Rusbult CE, Farrell D, Rogers G, Mainous AG. Impact of exchange variables on exit, voice, loyalty, and neglect: An integrative model of responses to declining job satisfaction. Academy of Management Journal. 1988;31(3):599-627.
13. Henson S, Jaffee S. A strategic perspective on the impact of food safety standards on developing countries. In Invited paper prepared for presentation at the International Association of Agricultural Economists Conference, Annual Meeting. 2006;12-18.
14. Henson S, Blandon J. The impact of food safety standards on an export-oriented supply chain: Case of the horticultural sector in Guatemala. International Food Economy Research Group, University of Guelph; 2007.
15. Okello JJ. Exit, voice and loyalty in Kenya's French bean industry: What lessons can we learn from smallholder farmers' past response to international food safety standards? African Journal of Food, Agriculture, Nutrition and Development. 2011;11:1.
16. Naus F, Van Iterson A, Roe R. Organizational cynicism: Extending the exit, voice, loyalty, and neglect model of employees' responses to adverse conditions in the workplace. Human Relations. 2007;60(5):683-718.
17. Rusbult CE, Zembrodt IM, Gunn LK. Exit, voice, loyalty, and neglect: Responses to dissatisfaction in romantic involvements. Journal of Personality and Social Psychology. 1982;43(6):1230.
18. Gofen A. Entrepreneurial exit response to dissatisfaction with public services. Public Administration. 2012;90(4):1088-106.
19. Wennberg K, DeTienne DR. What do we really mean when we talk about 'exit'? A critical review of research on entrepreneurial exit. International Small Business Journal. 2014;32(1):4-16.
20. Gaither M. Home schooling goes mainstream. Education Next. 2009;9:1.
21. Gofen A. Citizens' entrepreneurial role in public service provision. Public Management Review. 2015;17(3):404-24.
22. United Republic of Tanzania. National sample census 2007/2008 of agriculture small holder agriculture. Volume II: Crop sector – National Report, Prime Minister's Office, Dar es Salaam; 2012.
23. Kersting S, Wollni M. New institutional arrangements and standard adoption: Evidence from small-scale fruit and vegetable farmers in Thailand. Food Policy. 2012;37(4):452-62.
24. Henson S, Jaffee S. Understanding developing country strategic responses to the enhancement of food safety standards. The World Economy. 2008;31(4):548-68.
25. Asfaw S, Mithöfer D, Waibel H. EU food safety standards, pesticide use and farm-level productivity: The case of high-value crops in Kenya. Journal of Agricultural Economics. 2009;60(3):645-67.

26. Krishna VV, Qaim M. Consumer attitudes toward GM food and pesticide residues in India. Review of Agricultural Economics. 2008;233-51.
27. Hobbs JE. Incentives for the adoption of Good Agricultural Practices (GAPs). Food and Agriculture Organization; 2003.
28. Nikolaev V, Van Lent L. The endogeneity bias in the relation between cost-of-debt capital and corporate disclosure policy. European Accounting Review. 2005;14(4): 677-724.
29. Larcker DF, Rusticus TO. On the use of instrumental variables in accounting research. Journal of Accounting and Economics. 2010;49(3):186-205.
30. Ajayi OO. Pesticide use practices, productivity and farmers' health. Uni; 2000.
31. Kamara AB. The impact of market access on input use and agricultural productivity: Evidence from Machakos District, Kenya. Agrekon. 2004;43(2):202-16.
32. Fischer E, Qaim M. Smallholder farmers and collective action: What determines the intensity of participation? Journal of Agricultural Economics. 2014;65(3):683-702.
33. Rahman S. Farm-level pesticide use in Bangladesh: Determinants and awareness. Agriculture, Ecosystems & Environment. 2003;95(1):241-52.
34. Yorobe JM, Rejesus RM, Hammig MD. Insecticide use impacts of integrated pest management (IPM) farmer field schools: Evidence from onion farmers in the Philippines. Agricultural Systems. 2011; 104(7):580-7.
35. González-Rodríguez RM, Noguerol-Pato R, González-Barreiro C, Cancho-Grande B, Simal-Gándara J. Application of new fungicides under good agricultural practices and their effects on the volatile profile of white wines. Food Research International. 2011;44(1):397-403.
36. Mariano MJ, Villano R, Fleming E. Factors influencing farmers' adoption of modern rice technologies and good management practices in the Philippines. Agricultural Systems. 2012;110:41-53.
37. Bürger J, de Mol F, Gerowitt B. Influence of cropping system factors on pesticide use intensity–A multivariate analysis of on-farm data in North East Germany. European Journal of Agronomy. 2012;40: 54-63.
38. Ņečajeva J, Mintāle Z, Dudele I, Isoda-Krasovska A, Čūrišķe J, Rancāns K, Kauliņa I, Morozova O, Spuriņa L. Effects of crop rotation and field management methods on weed density and species composition in the southeastern part of Latvia. In Environment. Technology. Resources. Proceedings of the International Scientific and Practical Conference. 2015;2:235-240.
39. Urruty N, Deveaud T, Guyomard H, Boiffin J. Impacts of agricultural land use changes on pesticide use in French agriculture. European Journal of Agronomy. 2016;80: 113-23.
40. Barrett CB, Bachke ME, Bellemare MF, Michelson HC, Narayanan S, Walker TF. Smallholder participation in contract farming: Comparative evidence from five countries. World Development. 2012;40(4): 715-30.
41. Saenger C, Qaim M, Torero M, Viceisza A. Contract farming and smallholder incentives to produce high quality: Experimental evidence from the Vietnamese dairy sector. Agricultural Economics. 2013;44(3):297-308.
42. Jaffee S, Masakure O. Strategic use of private standards to enhance international competitiveness: Vegetable exports from Kenya and elsewhere. Food Policy. 2005; 30(3):316-33.
43. Rao EJ, Qaim M. Supermarkets, farm household income, and poverty: Insights from Kenya. World Development. 2011; 39(5):784-96.
44. Rao EJ, Brümmer B, Qaim M. Farmer participation in supermarket channels, production technology, and efficiency: the case of vegetables in Kenya. American Journal of Agricultural Economics. 2012; aas024.
45. TandiLwoga E, Stilwell C, Ngulube P. Access and use of agricultural information and knowledge in Tanzania. Library Review. 2011;60(5):383-95.
46. Jin S, Bluemling B, Mol AP. Information, trust and pesticide overuse: Interactions between retailers and cotton farmers in China. NJAS-Wageningen Journal of Life Sciences. 2015;72:23-32.
47. Lekei EE, Ngowi AV, London L. Farmers' knowledge, practices and injuries associated with pesticide exposure in rural farming villages in Tanzania. BMC public health. 2014;14(1):389.
48. Narrod C, Roy D, Okello J, Avendaño B, Rich K, Thorat A. Public–private partnerships and collective action in high

value fruit and vegetable supply chains. Food Policy. 2009;34(1):8-15.
49. Fischer E, Qaim M. Smallholder Farmers and Collective Action: What Determines the Intensity of Participation? Journal of Agricultural Economics. 2014;65(3):683-702.
50. Fuchs D, Kalfagianni A, Havinga T. Actors in private food governance: The legitimacy of retail standards and multistakeholder initiatives with civil society participation. Agriculture and Human Values. 2011; 28(3):353-67.
51. Belton B, Haque MM, Little DC. Certifying catfish in Vietnam and Bangladesh: Who will make the grade and will it matter? Food Policy. 2011;36(2):289-99.
52. Hellin J, Lundy M, Meijer M. Farmer organization, collective action and market access in Meso-America. Food Policy. 2009;34(1):16-22.
53. De Battisti AB, MacGregor J, Graffham A. Standard bearers: Horticultural exports and private standards in Africa. IIED; 2009.
54. Graffham A, Karehu E, MacGregor J. Fresh insights number 6-impact of EurepGAP on small-scale vegetable growers in Kenya; 2007.
55. Handschuch C, Wollni M, Villalobos P. Adoption of food safety and quality standards among Chilean raspberry producers–Do smallholders benefit? Food Policy. 2013;40:64-73.
56. Alphonce R, Alfnes F. Consumer willingness to pay for food safety in Tanzania: An incentive-aligned conjoint analysis. International Journal of Consumer Studies. 2012;36(4):394-400.
57. Mellahi K, Budhwar PS, Li B. A study of the relationship between exit, voice, loyalty and neglect and commitment in India. Human Relations. 2010;63(3):349-69.
58. Townsend J, Phillips JS, Elkins TJ. Employee retaliation: The neglected consequence of poor leader–member exchange relations. Journal of Occupational Health Psychology. 2000; 5(4):457.
59. Liu Y. The long-term impact of loyalty programs on consumer purchase behavior and loyalty. Journal of Marketing. 2007; 71(4):19-35.
60. Leenheer J, Van Heerde HJ, Bijmolt TH, Smidts A. Do loyalty programs really enhance behavioral loyalty? An empirical analysis accounting for self-selecting members. International Journal of Research in Marketing. 2007;24(1):31-47.
61. Markelova H, Meinzen-Dick R, Hellin J, Dohrn S. Collective action for smallholder market access. Food Policy. 2009;34(1): 1-7.
62. Peterman A, Behrman JA, Quisumbing AR. A review of empirical evidence on gender differences in nonland agricultural inputs, technology, and services in developing countries. In Gender in Agriculture. Springer Netherlands. 2014; 145-186.
63. Girabi F, Mwakaje AE. Impact of microfinance on smallholder farm productivity in Tanzania: The case of Iramba district. Asian Economic and Financial Review. 2013;3(2):227.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/19403