PRODUCTION HYGIENE AND TRAINING INFLUENCES ON RURAL SMALL-SCALE ORGANIC FARMER PRACTICES: SOUTH AFRICA

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OPSOMMING

Produksie van goeie gehalte voedselprodukte is van kritieke belang in die verbetering van toegang tot die mark en voedselsekuriteit. Boerderypraktyke beïnvloed die gehalte van die finale produk, wat op sy beurt sukses in die mark bepaal. Dit is dus belangrik dat boere voedsel van goeie higiëniese gehalte produseer as hulle van plan is om suksesvol mee te ding in die organiese vars produkte mark. Die doel van die studie was om die belang van sosio-ekonomiese faktore soos ouderdom, geslag, vlak van opvoeding en opleiding vir die higiëniese boerderypraktyke van kleinskaalse organiese boere in Umbumbulu , KwaZulu-Natal te bepaal. Vraelyste is deur 73 ongesertifiseerde organiese boere in Umbumbulu, KwaZulu-Natal voltooi. Die vraelys het die higiëniese boererypraktyke, soos weerspieël deur die was van hande, skoene en implemente bepaal. Die data-analise het beskrywende statistiek soos die Chi - kwadraat toets en 'n logistieke regressie model betrek. Die resultate het aangedui dat die meerderheid van die boere (60 %) vroulik was , waarvan die meeste (73 %) bo die ouderdom van 40 was. Die logistieke regressie het aangedui dat sosio-ekonomiese faktore soos onderwys, opleiding en boerdery-inkomste 'n beduidende invloed het op die higiëniese praktyke wat kleinboere beoefen. Hierdie studie het getoon dat geslag geen invloed op die praktyke van die eTholeni kleinboere gehad het nie. Boere wat reeds inkomste uit boerdery–aktiwiteite ontvang het, en diegene wat opleiding in higiëniese boerderypraktyke ontvang het, het meer waarskynlik hande en toerusting gewas voordat hulle in die landerye sou gaan in vergelyking met diegene wat geen opleiding gekry het nie. Hierdie resultate dui daarop dat opleiding, opvoeding en boerderyondervinding belangrike en doeltreffende instrumente is in die implementering van goeie higiëniese praktyke in kleinskaalse boerdery. Dit word dus aanbeveel dat die landboubeleid aangepas moet word om vir die opleiding van kleinboere voorsiening te maak – nie net vir voedselsekuriteitsdoeleindes nie, maar ook met die doel om toegang tot die vars produkte mark te kry.

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INTRODUCTION

In the improvement of small farming enterprises and household food security, agricultural produce must meet high microbiological food standards to safeguard the well-being of

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consumers (Soon & Baines, 2012; Arias *et al*., 2013:6-7). Questions of hygiene and subsequent microbial quality in the rural small-scale farming sector of South Africa are even more crucial, given the policy drive to develop small-scale farming as a measure for reinforcement of household food security and reduction of poverty (Matshe, 2009; Statistics South Africa, 2012:6 -7).

In view of the frequently reported foodborne disease outbreaks caused by contaminated fresh produce (Berger *et al*., 2010; European Food Safety Authority Panel on Biological Hazards, 2013), consumers have a preference for foods that meet requisite hygienic standards to reduce the risk of foodborne illnesses (Martins *et al*., 2012). Markets therefore impose stringent standards for produce hygiene. For organic produce these include documentation of hygiene practices, recording of training activities, and identification of potential hygiene hazards (Global Good Agricultural Practices, 2013a, b).

Correct crop production and crop management practices are important throughout the crop production stages, including crop irrigation, soil management, manure handling and composting and post-harvest processing. Thamaga-Chitja and Mabaya (2014: 1-22) explain that quality is an important market access driver often bewildering smallholder farmers. In seeking to produce good quality vegetables that meet market preferences and quality requirements it is therefore crucial for farmers to practice good production hygiene.

Historically disadvantaged, South African, small-scale farmers, are entering value chains for the first time and are unfamiliar with food quality and safety standards (Louw *et al*., 2007; Thamaga-Chitja & Hendriks, 2008). Little attention however is paid to capacitating such farmers in product quality and safety standards. Traditionally, smallholder farmer support in South Africa is focused on improving physical assets of farmers such as in the Comprehensive Agricultural Support Programme'(CASP) (Mkhabela & Materechera, 2013) with weaker support for improving skills and capacity of farmers to improve farmers knowledge. Thamaga-Chitja and Hendriks (2008), together with Louw *et al.* (2007) agree that poor education and poor knowledge of farming including farming practices can be a constraint for improvement and limit successful market access. Such constraints undermine the potential of farming activities to contribute to household food security, including household income.

Conforming to good hygiene practices can be a challenge for small-scale farmers, particularly in the developing world (Thamaga-Chitja & Mabaya, 2014:1-22). Poor access to reliable and safe water resources (Gemmell & Schmidt, 2012, Mdluli *et al*., 2013), inadequate information and expertise, and lack of financial assistance (Thamaga-Chitja & Hendriks, 2008) are obstacles encountered by these farmers. Such obstacles may compromise hygiene practices because (a) farmers lack knowledge around the importance of pre- and post-harvest hygiene in the farming environment (Agwu & Edun, 2007); and (b) essential resources required for crop production by the farmer, such as irrigation water may already be contaminated with pathogens (Buck *et al.,* 2003; Olaimat & Holley, 2012; Gemmell & Schmidt, 2013).

Sources of contamination

Everything in the farming environment that is in contact with the crops has the potential to be a source of contamination (Beuchat, 2006). Hence, pre-harvest practices (seed handling, fertilization and irrigation) and post-harvest practices (processing, packaging and distribution) should receive attention to attempt to curb microbial contamination (Beuchat, 2006; Buck *et al.,* 2003). During pre-harvest one possible source of contamination is the soil. For example, an area where livestock previously grazed is likely to be contaminated with enteric pathogens (Buck *et al.,* 2003). Other potential contamination sources include incorrect seed storage (contamination by rodents) and insects and snails that can spread pathogenic bacteria as they move from plant to plant (Berger *et al.*, 2010). In addition, manure that has not been properly composted may also be a source of contamination as it can contain potential pathogens (Berger *et al.*, 2010; Buck *et al.*, 2003). Proper composting of manure is thus essential to eliminate potential pathogens (Unc and Goss, 2004; Wang *et al*., 2004).

The absence of pesticides, bactericides and the extensive use of animal manure predispose organic agriculture to microbial contamination, if proper hygiene and production practices are not implemented (Unc and Goss, 2004). The initial premise of this study is that there is a set of general production and hygiene practices that small-scale farmers employ. Washing of hands, boots and farming equipment with a detergent may prevent infield soil and plant contamination hence the paper is focused on 'hygienic practices'. The extent to which training in production hygiene influenced hygienic farming practices was investigated in this study. In this instance, the phrase "hygienic farming practices" is used as a proxy for the washing of hands, boots and farming equipment before entering the field.

RESEARCH METHODS

Study site and sampling procedures

The study took place at the uMbumbulu Agri-Hub headquarters at the eTholeni village in uMbumbulu, KwaZulu-Natal (29°59'27.9"S, 30° 42'28"E). The uMbumbulu Agri-Hub supplies vegetables under the "organically produced" and not "certified organic" label as their produce is yet to be certified as organic. For this study, 73 farmers were purposively sampled. The uMbumbulu area where the farmers are located is a rural area with access to the large metropolitan city of Durban.

Questionnaire

A face-to-face questionnaire available in English and isiZulu was administered in the study. The interviews were performed by first language isiZulu speakers, the same language spoken by the farmers. Factors that could influence farmer hygiene practices were explored in the questionnaire. The questionnaire contained close-ended questions relating to socio-economic variables and the hygiene practices of the farmers.

Data analysis

Questionnaire data were coded using coding sheets. The coding sheets assigned numerical values to the answers, which had been captured on the spread sheets and analysed using the IBM SPSS 21 and STATA 11 statistical packages. The Chi-square test evaluated the significance of relationships between hygiene practices and relevant nominal or categorical socio-economic variables.

The logistic regression model was used to investigate how training in the presence of other socio-economic variables influence farmer hygiene practices. Washing of hands, boots and equipment was used as a proxy for hygiene practices. Farmers with good hygiene practice were defined as 'those who washed both their hands, boots and equipment prior to entering the field'. The hygiene variable takes the value 1 for households practicing good hygiene, and 0 otherwise. The explanatory variables were farmer socio-economic factors: gender, age, education level, incomes and access to training. The model is specified below:

$$L_i = \ln [P_i/(1-P_i)] = â_0 + â_1X_{1i} + â_2X_{2i} + ... + â_kX_{ki} + u_i ;$$

where: i = 1, 2, ………n are the farmers; L is the logit; ln = natural logarithm; P_i = the probability of a farmer practicing good hygiene; $(1-P_i)$ = the probability of a farmer not practicing good hygiene; X_{1i} …….X_{ki} are the farmer attributes; u_i is the random error term; and â's are the parameters to be estimated.

RESULTS AND DISCUSSION

Demographic and socio-economic characteristics

The majority (60%) of the farmers were female, while 40% were male. This is in line with literature indicating that women are the main participants in smallholder farming in South Africa (Aliber & Hart, 2009; Modi, 2003). Twenty-seven per cent (27%) of the respondents were below 40 years of age, while 73% of the respondents were ≥40. This demonstrates that the youth is rejecting farming, to possibly target higher paying opportunities instead. Data analysis also showed that most of the farmers were literate. Only 12% of the farmers had no formal education, while 37% had a primary school education and 51% a secondary school education. The most common sources of respondent income were: farming (63%), social grants (37%) and pensions (29%). Farming provided income for 60% of the participants with 78% of those farmers receiving revenues between R150–R250 per week. As evidence of income growth, more farmers were joining the Agri-Hub to be trained to supply markets with fresh leafy vegetables.

Only 45% of the 73 respondents supplying the uMbumbulu Agri-Hub had received training on a number of crop production practices and skills; these included composting, hygiene practices and soil management. According to uMbumbulu Agri-Hub policy, farmers who have attended at least two or more workshops were eligible to supply the uMbumbulu Agri-Hub and were thus registered in the farmer database.

Influence of gender, age and education level and farmer training on hygiene farming practices

The Chi-square test of independence was used to analyse relationships between hygiene practices and gender, age, education level and training.

The p-value from the Chi-square test indicated that the relationship between gender and hygiene practices was statistically insignificant at 10% significance level. The hygiene practices employed by the eTholeni small-scale farmers were therefore not influenced by gender.

The p-value from the Chi-square test reported the relationship between age and education level as significant, with significance levels ranging between 5% and 10%. This result suggested that groups over 40 years were more likely to practice good hygiene. This was in line with common farmer traits associated with age suggested by Burton (2006). Thus farmers over 40 years often employed hygienic practices as a result of farming experience (Burton, 2006).

The data also suggested that farmers who possess primary and high school education employ better farming practices compared to those who have received no formal education. School education and onsite training however are expected to yield different results (Serin *et al.*, 2009), the skills acquired through formal edu -cation may assist farmers in problem solving.

It is clear from the significance levels that training has a powerful influence on practice. Information in Table 1 suggests that trained members of the Agri-Hub employed good hygienic practices. The relationship existing between hygiene practices and training that is significant at 1%, the highest level of significance proves this. These findings suggest farmer behavioural changes following training leading to better farming practices. These results are consistent with results from studies in Taiwan and Portugal (Ko, 2010; Martins *et al.*, 2012).

The differences between trained and untrained farmers were similar to the findings of Yang *et al.* (2008). In this study, Chinese farmers prior to training had limited knowledge of the natural enemies of their produce. After training, farmers were significantly more knowledgeable about the natural enemies ($p<1\%$, 5% and 10%) compared to farmers who were not trained, thereby confirming the relationships between knowledge and training (Yang *et al.*, 2008).

The logistic regression model was established to investigate how farmer training influences the probability of farmers employing good hygiene practices. This analysis was conducted in the presence of other socio-economic factors including gender, education level and age. The results of the logistic regression model are presented in Table 2.

Information in Table 2 indicates that in the presence of other socio-economic variables, gender and age were statistically insignificant at 10% and therefore did not significantly influence farmer hygiene practices. Higher farmer education levels positively influence hygienic practices. Farmers with primary or no education were found to be less likely to practice good hygiene compared to those with secondary education. Farmers with a primary education had a 35% less chance of implementing good hygiene compared to those with secondary education. Similarly, farmers with no education had a 43% less probability of implementing good hygiene compared to those with secondary education.

The analysis also showed that farmers receiving most of their income from farming had 26% (significant at 5%) more likelihood of adopting good hygiene practices compared to those receiving little or no income from farming. Furthermore, farmers who had received training were 32% more likely to practice good hygiene compared to farmers who were not trained. This emphasises the importance of training and

TABLE 1: RELATIONSHIPS BETWEEN HYGIENE PRACTICES AND GENDER, AGE, LEVEL OF EDUCATION AND TRAINING

Hygiene practices prior to entering garden	p-value			
	Gender	Age	Level of education	Training
Washing of hands and boots	0,813	0,056*	0,067*	<0,0001***
Washing farming equipment	0,558	0,037**	0,012**	<0,0001***

*, ** and *** show significant relationships at 10%, 5% and 1% levels respectively

TABLE 2: FACTORS INFLUENCING FARMER'S HYGIENIC PRACTICE OF WASHING HANDS AND EQUIPMENT: LOGISTIC REGRESSION RESULTS

Variables	Coefficient		Marginal effects	
	Value	Std. Err.	Value	Std. Err.
Gender	0,6384	0,8168	0,0827	0,1041
Age	0,3567	1,1089	0,0462	0,1431
Education level				
Primary education	-2,7181**	1,3390	-0,3521**	0,1564
No education	-3,2924*	1,9662	-0,4265 *	0,2394
Main income source				
Remittances	-0,7316	1,0798	-0,0948	0,1383
Farm activities	2,0109**	0,9626	0,2605**	0,1119
Grant	0,9547	0,8841	0,1237	0,1119
Pension	-0,3596	0,9352	-0,0466	0,1207
Wages	-0,2504	0,9889	-0,0324	0,1278
Sale of produce	1,22912	0,8487	0,1592	0,1031
Food safety awareness	0,4372	0,9348	0,0566	0,1202
Training	2,4998**	1,1645	0,3238**	0,1347
Training from government	-1,0367	0,9796	-0,1343	0,1233
Pseudo R2 = 0,4191				
LR χ2 = 42,41***				

*, ** and *** show significant relationships at 10%, 5% and 1% levels respectively

equipping farmers with skills and knowledge enabling them to execute good farming practices.

The institution where training was received was insignificant; indicating that what is important is training and not the source. Age was expected to be significant and consistent with the Chi-square test; its insignificance in the logistic regression is difficult to explain but may be influenced by the presence of the other variables in the model.

The R^2 value was 0,42, implies the model explains 42% of the variation in the data. Although this R^2 value is relatively low, it is acceptable in cross-sectional data (Kuwornu & Owusu, 2012). The model as a whole was significant at 1% as indicated by the LR χ^2 value.

The uMbumbulu Agri-Hub was largely responsible for raising this awareness and suggesting farming practices to promote farmer hygiene practices and improve overall microbiological quality of fresh produce. Perhaps agricultural legislation and standardisation interventions by South African governmental departments of health and agriculture would be beneficial. Such interventions could highlight diseases associated with vegetable contamination and the importance of interventions by the department of water affairs for irrigation purposes. This is important in the context of the role of the smallholder farmer in future food security and in feeding the world in the future, given existing challenges such as climate change and water scarcity (Wegner & Zwart, 2011:3)

CONCLUSION

The present analysis suggests the education level and training of farmers have a considerable influence on small holder farmer hygiene practices. Training programmes are fundamental in equipping farmers, particularly small-scale farmers with knowledge that is necessary in the selection of methods and processes appropriate for their individual farming needs and for market access. The logistic regression indicated a number of socio-economic variables that significantly improve the likelihood of farmers washing hands, boots and equipment prior to entering the field and these are: income from previous farming activities, education and training on hygienic farming practices.

The study indicates that education and training are important and effective tools in implementing good farming hygienic practices such as sanitation of hands, boots and equipment in small-scale farming. The main recommendation arising from the study is that policies should advocate for small-scale farmer training in methods that could enhance new opportunities and thus improved household food security and income. This training should not be limited to subsistence farmers only but should also be aimed at preparing farmers to access produce markets. Farmer training in hygienic practices should aid farmers to meet the stringent market standards allowing for better access, the regular income from such activities support farming as a sustainable livelihood and bearer of food security.

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