Determinants of Awareness of Good Agricultural Practices (GAP) among Vegetable Growers in Nakuru, Kenya

ABSTRACT

Good Agricultural Practices (GAP) towards ensuring vegetable safety and quality is a novel concept among Kenyan vegetable growers with its implementation low due to lack of awareness. To bridge this gap, this study sought to determine the socio-economic characteristics that affect GAP awareness among vegetable farmers in Nakuru, Kenya. Simple random sampling was used to select 100 vegetable growers. Logistic regression was used for analysis and the findings reveal that gender, level of education, leased land, income and training significantly influenced awareness. Emphasis on awareness creation among female vegetable growers and capacity building through training on GAP standards is suggested as a way forward in order to increase implementation.

Key words: Adoption, Awareness, Determinants, Good Agricultural Practices, Safety

INTRODUCTION

New agricultural practices need prior awareness for their successful adoption, but various conditions and factors may affect this. Socioeconomic characteristics such as age, sex, education, access to information, family size, norms of the farm family, extension, and training have been shown to greatly influence information and knowledge of new technologies and new practices (David & Asamoah 2011; Bernier *et al.* 2015).

Good Agricultural Practices (GAP) concept is emerging issue given a dynamic and globalized food economy. Good Agricultural Practices (GAP) decreases risks food contamination risks thus ensuring food safety and quality. Its implementation along the vegetable production chain however is still a major challenge.

Vegetables are highly perishable and vulnerable to contamination from high and uncontrolled use of pesticides, chemicals and fertilizers hence rendering it unsafe for consumption. Literature has exposed widespread chemical usage among Kenyan farmers, and that few farms adhere to the standards advocated by Good Agricultural Practices (Ndwiga & Kiruki 2018).

Contamination risks can be reduced by the adoption of pre-farm-gate standards as put forward by the Good Agricultural Practices (GAP) program, which is a voluntary codified system of standards that addresses the production process until the produce leaves the farm. KenyaGAP is a country-specific body benchmarked against GLOBALGAP standards for fruit, vegetables, and flowers. KenyaGAP is voluntary, but certification is restricted to large and small-scale farmers who are members of the Fresh Produce Exporters Association of Kenya (FPEAK) (Carey 2008). KenyaGAP has brought increased awareness of plant protection products (IIED and NRI 2008) and improved produce quality (UNCTAD 2008); however, many small-scale farmers who have no membership with FPEAK have not benefitted from the standards (RSA 2015).

Nakuru County is one of the leading producers of vegetables in Kenya (Francesco & Hanne, 2019). However, its productive potential is not fully exploited due to different factors that influence successful production, especially issues of vegetable quality and safety. Adopting GAP is one way of ascertaining that quality standards are met, but its knowledge and awareness within the County is low (Cherotich & Kaur 2021). This study, therefore, sought to establish the determinants of awareness of GAP among the vegetable growers of Nakuru County, Kenya.

MATERIAL AND METHODS

The study was carried out in Nakuru County in Kenya. An interview schedule was developed and used to explore the determinants of GAP awareness among vegetable growers. The tool captured the respondent's general information such as age, gender, level of education, experience in vegetable production, size of the farm, annual income, and training on GAP. The next part of the schedule had an audit checklist developed following FAO recommendations (Poisot *et al*. 2004). The checklist had 151 statements which were classified into 13 sections: (i) site history (ii) planting material (iii)water usage (iv) fertilizers, manures, bio-solids, and nutrition (v) chemicals (plant protection or other agrochemicals) (vi) integrated pest management (IPM) (vii) soils and substrates (vii) harvesting and handling (ix) animal and pest control (x) worker health and safety (xi) storage and transport (xii) waste management (xiii) training. Descriptive statistics such as frequencies, percentages and also inferential statistics using logistic regression were carried out to establish vegetable growers' socioeconomic characteristics, their awareness, and compliance to GAP by use of the statistical package SPSS (version 26). Awareness was measured through rating on a 3- point rating scale ranging from 2 for 'fully aware', 1 for 'partially aware', and 0 for 'not aware'.

RESULTS AND DISCUSSION

The socioeconomic characteristics of the vegetable growers were studied using eight socioeconomic characteristics and the results presented in Table 1. According to the results, majority of the farmers (61 %) were middle-aged, 77 percent were male, and that slightly less than half of them (48 %) had attained secondary and tertiary level. Cherotich and Kaur (2021), Mohammad *et al*. (2020) and Singh *et al*. (2017) established in their studies that the majority of farmers fell into the middle age groups, while Mohammad *et al*. (2020) and Adebayo (2012) reported that most of the small scale farmers possess higher education level.

Sixty one percent had low experience in vegetable growing, and almost all (97%) were marginal farmers. 53 percent of the farmers had medium to high income from vegetable farming, and half (50%) of the them had received prior training on improved vegetable production practices. Higher income from vegetable cultivation among farmers was reported by Samra and Kataria (2014).

Table 1: Smallholder vegetable growers' socioeconomic characteristics n=100

Variable	Category	*f (%)*
Age (years)	Young (18-30)	26(26.0)
	Middle (31-50)	61(61.0)
	Old (>50)	13(13.0)
Gender	Male	77(77.0)
	Female	23(23.0)
Education	Illiterate	1(1.0)
	Primary	16(16.0)
	Middle	11(11.0)
	Matric	24(24.0)
	Secondary	37(37.0)
	Graduate	11(11.0)
	Post Graduate	-
Vegetable growing experience	Low (< 10 years)	61(61.0)
	Medium (10-20 years)	36(36.0)
	High (> 20 years)	3(3.0)
Operational Land	Marginal (<2.5)	97(97.0)
	Small (2.5-5)	3(3.0)
	Semi-medium (5-10)	-
	Medium (10 -25)	-
	Large (>25)	-
Land leased	Marginal (<2.5)	99(99.0)
	Small (2.5-5)	-
	Semi-medium (5-10)	1(1.0)
	Medium (10 -25)	-
	Large (>25)	-0
Annual income	Low (< 200,000Kshs)	47(47.0)
	Medium (200,000-500,000Kshs)	20(20.0)
	High (>600,000Kshs)	33(33.0)
Training in GAP	Yes	50(50.0)

* Source: Field survey, 2020

GAP awareness among vegetable growers

GAP awareness results are presented in Table 2. The awareness score of the vegetable growers ranged from 45 to 96 on a possible range of 0 to 151. Fifty eight percent of vegetable growers in Nakuru had partial awareness GAP standards to be followed during site selection similar to those by Cherotich and Kaur (2021) in their study on GAP awareness among vegetable growers in Punjab; and those by Waghmod *et al.* (2020) in their study on GAP adoption among mango farmers. 84% of the growers were unaware of the protocols followed when selecting planting materials, while almost all the respondents (92%) were unaware of the protocols that guide the use and conservation of water. Cherotich and Kaur (2021) and Rochelle *et al*. (2014) reported on use of unverified water by farmers. Water conservation is not a priority for most farmers as most make decisions based on personal judgments arising from practical experience (Luquet *et al*.2005; Knox *et al.* 2012; Arati *et al*.2020). A study by Rehman (2013) however showed that most farmers had an awareness of different water management practices.

The results further revealed that more than two-thirds of the respondents (64%) were not aware of GAP protocols for fertilizer, manures, bio-solids, and nutrition. 57 percent of the vegetable growers had no knowledge of the standards to be adhered to while using chemicals. The results echo those by Reeves and Schafer (2003) and Sandesh *et al*. (2021) and Cherotich and Kaur (2021).

The awareness level among the vegetable growers on IPM GAP standards was high (91%), while 88 percent of the respondents were not aware of the protocols concerning soils and substrates. There was partial awareness of GAP standards for harvesting and handling vegetables among 88 percent of the vegetable growers. Mixed findings were noted for awareness of standards followed in animal and pest control, where 38 percent of the respondents had partial knowledge and another 38 percent were completely unaware of the standards. Similar observations were made by Waghmod *et al*. (2020) and Cherotich and Kaur (2021).

Close to three-quarters of the vegetable growers were not aware of GAP standards to be followed to ensure worker health and safety, and more than half of the respondents were partially aware of the standards followed for storage and transport of harvested vegetables. There was almost a complete lack of knowledge on waste management standards as revealed by the majority of the vegetable growers (92%) lack of awareness. 71 percent of the vegetable growers also lacked awareness of GAP standards followed for worker or employee training. These findings are confirmed by Jackson *et al.* (2007), Rochelle *et al*. (2014) and Cherotich and Kaur (2021).

Table 2: Distribution of vegetable growers' according to awareness of GAP n=100

GAP standards	Awareness Level	*f (%)*
Site History	none	28(28.0)
	partial	58(58.0)
	High	14(14.0)
Planting Material	none	84(84.0)
	partial	13(13.0)
	High	3(3.0)
Water Usage and Conservation	none	92(92.0)
	partial	6(6.0)
	High	2(2.0)
Fertilizer, Manures, Bio-Solids and Nutrition	none	64(64.0)
	partial	22(22.0)
	High	14(14.0)
Chemicals (plant protection and other agrochemicals)	none	57(57.0)
	partial	29(29.0)
	High	14(14.0)
Integrated Pest Management	none	3 (3.0)
	partial	6(6.0)
	High	91 (91.0)
Soils and Substrates	none	88(88.0)
	partial	5(5.0)
	High	7(7.0)
Harvesting and handling vegetables	none	2(2.0)
	partial	88(88.0)
	High	10(10.0)
Animal and pest control	none	38(38.0)

	partial	38(38.0)
	High	24(24.0)
Worker health and safety	none	73(73.0)
	partial	25(25.0)
	High	2(2.0)
Storage and transport	none	23(23.0)
	partial	67(67.0)
	High	10(10.0)
Waste management	none	92(92.0)
	partial	-
	High	8(8.0)
Training	none	71(71.0)
	partial	20(20.0)
	High	9(9.0)

* Source: Field survey, 2020

Determinants of awareness to Good Agricultural Practices (GAP)

A logistic regression was performed to ascertain the effects of age, gender, education level, vegetable growing experience, operational land, and land leased, income and training on the likelihood that the vegetable growers will be aware of GAP procedures and standards among the vegetable growers. The logistic regression was not statistically significant for awareness to site history protocols χ^2 (9) = 16.525, p>.005. The model explained 38.7% (Nagelkerke R^2) of the variance in GAP awareness and correctly classified 90.3% of cases. Male vegetable growers were 3.778 times more likely to be aware of site history GAP protocols than female ones. The logistic regression was statistically significant for awareness of planting materials protocols $\chi 2$ (9) = 23.157, p<.005. The model explained 36.2% (Nagelkerke R^2) of the variance in GAP awareness and correctly classified 85.0% of cases. Male vegetable growers were 8.542 times more likely to be aware of planting material GAP protocols than female ones. Increase in education levels and size of land leased statistically significantly influenced awareness to the GAP standards.

The logistic regression was statistically significant for awareness of water usage standards χ^2 (9) = 20.528, p<.005. The model explained 65.0% (Nagelkerke R^2) of the variance in GAP awareness and correctly classified 96% of cases. In addition, the logistic regression was statistically significant for awareness of fertilizer standards χ^2 (9) = 27.787, p<.005. The model explained 41.5% (Nagelkerke R^2) of the variance in GAP awareness and correctly classified 87% of cases. Increase in size of land leased and decrease in annual income among those who earned below Ksh 400,000 statistically significantly influenced awareness to the GAP standards.

The logistic regression was not statistically significant for awareness of chemical standards χ^2 (9) = 12.830, p>.005. The model explained 16.8% (Nagelkerke R^2) of the variance in GAP awareness and correctly classified 78% of cases. Increase in size of land leased statistically significantly influenced awareness to the GAP standards. Awareness of soil standards was significant χ^2 (9) = 19.951, p<.005. The model explained 36.2.0% (Nagelkerke R^2) of the variance in GAP awareness and correctly classified 89.0% of cases. Increase in education level had a significant influence on awareness to the GAP protocols.

Awareness to crop handling and harvesting standards was statistically significant χ^2 (9) = 21.321, p<.005. The model explained 27.6% (Nagelkerke R^2) of the variance in GAP awareness and correctly classified 76% of cases. Decrease in size of land leased statistically significantly influenced awareness to the GAP standards. The logistic regression was statistically significant for awareness of storage standards χ^2 (9) = 19.012, p<.005. The model explained 26.2.0% (Nagelkerke R^2) of the variance in GAP awareness and correctly classified 83% of cases. Decrease in size of land leased statistically significantly influenced awareness to the GAP standards.

The logistic regression was statistically significant for awareness of waste management standards χ^2 (9) = 17.484, p<.005. The model explained 37.5% (Nagelkerke R^2) of the variance in GAP awareness and correctly classified 96% of cases. Increase in size of operational land statistically significantly influenced awareness to the GAP standards.

Table 3: Binary logistic regression of socio- economic factors influencing vegetable growers' awareness of GAP.

Variable	**Site history GAP awareness**				**Planting material GAP awareness**				**Water usage GAP awareness**				**Fertilizer GAP awareness**			
	β	Wald	p value	Exp β	β	Wald	p value	Exp β	β	Wald	p value	Exp β	β	Wald	p value	Exp β
Age	-.131	1.448	.229	.877	-.029	.392	.531	.972	-.046	.152	.697	.955	.011	.056	.813	1.011
Gender (1)	1.329	.715	.398	3.778	2.145	2.827	.093	8.542	18.416	.000	.998	9951	2.019	2.424	.119	7.529
Level of Education	.836	3.239	.072	2.307	.833	4.807	.028*	2.300	.422	.190	.663	1.525	.689	3.660	.056	1.992
Vegetable growing experience	1.238	.928	.335	3.448	.226	.069	.793	1.253	1.677	.531	.466	5.351	-.450	.265	.606	.638
Operational land	-22.235	.000	.999	.000	2.607	2.558	.110	13.556	9.674	.000	1.00	15906	2.597	2.509	.113	13.419
Land leased	.969	3.735	.053	2.635	.775	4.464	.035*	2.170	15.441	.000	.996	50790	.856	5.063	.024*	2.353
Annual income (1)	-1.626	1.675	.196	.197	-1.019	.866	.239	.361	-.646	.116	.733	.524	-2.132	4.978	.026*	.119
income (2)	1.187	1.305	.253	3.726	.913	1.171	.279	2.491	-18.00	.000	.998	.000	.416	.262	.609	1.515
Training in GAP	.188	.040	.841	1.206	.616	.712	.399	1.851	.377	.059	.809	1.458	1.402	3.403	.065	4.063
Constant	39.69				-12.902				-72.69				-12.651			
Number of observations	100				100				100				100			
Chi-squared	16.525				23.157				20.528				27.787			
p value	.057				.006				.015				.001			
Nagelkerke R^2 (%)	38.7				36.2				65.0				41.5			
% Correctly classified	90.3				85.0				96				87			

Variable	**Chemical GAP awareness**				**IPM GAP awareness**				**Soil GAP awareness**				**Harvesting GAP awareness**			
	β	Wald	p value	Exp β	β	Wald	p value	Exp β	β	Wald	p value	Exp β	β	Wald	p value	Exp β
Age	.024	.840	.359	1.025	.078	.888	.346	1.081	-.042	.489	.484	.959	-.036	1.598	.206	.965
Gender (1)	.479	.572	.449	1.615	-18.318	.000	.998	.000	1.684	1.611	.204	5.390	1.108	3.452	.063	3.029
Level of Education	.240	1.417	.234	1.271	.358	.366	.545	1.431	.972	4.483	.034*	2.644	.317	2.464	.116	1.373
Vegetable growing experience	.009	.000	.986	1.009	-2.553	2.057	.151	.078	-.085	.007	.934	.919	.205	.132	.717	1.227
Operational land	1.350	.809	.368	3.858	18.488	.000	.999	10701	-21.929	.000	.999	.000	.333	.025	.874	1.395
Land leased	.656	6.084	.014*	1.927	-.078	.013	.910	.925	.724	3.183	.074	2.063	-.659	.6.342	.012*	.517
Annual income (1)	-.303	.273	.601	.739	.830	.377	.539	2.294	-1.743	2.906	.088	.175	-.107	.029	.864	.899
income (2)	.236	.129	.720	1.267	18.766	.000	1.000	.000	.569	.375	.540	1.767	-.045	.004	.952	.956
Training in GAP	.008	.000	.988	1.008	1.294	.902	.342	3.648	1.271	2.211	.137	3.566	-.317	.334	.563	.729
Constant	-6.532				-17.128				36.444				.141			
Number of observations	100				100				100				100			
Chi-squared	12.380				6.655				19.951				21.321			
p value	.193				.673				.018				.011			
Nagelkerke R^2 (%)	16.8				27.3				36.2				27.6			
% Correctly classified	78				97.0				89.0				76.0			

Variable	Pest GAP awareness				Health and safety GAP awareness				Storage GAP awareness				Waste management GAP awareness				Training GAP awareness			
	β	Wald	p value	Exp β	β	Wald	p value	Exp β	β	Wald	p value	Exp β	β	Wald	p value	Exp β	β	Wald	p value	Exp β
Age	-.019	.531	.466	.981	.034	1.255	.263	1.035	-.007	.058	.809	.993	.063	1.558	.212	1.065	-.035	.535	.465	.966
Gender (1)	-.045	.006	.940	.956	-.018	.001	.981	.982	.819	1.771	.183	2.267	.743	.395	.530	2.103	1.458	1.647	.199	4.297
Level of Education	.196	1.127	.288	1.216	.147	.296	.586	1.158	.133	.391	.532	1.142	.875	2.754	.097	2.398	.398	1.835	.176	1.490
Vegetable growing experience	-.494	.936	.333	.610	-.106	.027	.870	.899	-.146	.066	.798	.864	.088	.005	.941	1.092	.610	.511	.475	1.841
Operational land	20.123	.000	.999	54886	-19.742	.000	.999	.000	.194	.007	.937	1.214	4.621	4.711	.030*	101.641	.952	.316	.574	2.591
Land leased	.691	6.188	.013*	1.996	.546	2.011	.156	1.727	-.803	8.160	.004*	.448	.608	1.637	.201	1.837	.256	.813	.367	1.291
Annual income (1)	-.174	.106	.745	.840	.557	.459	.498	1.745	-.321	.223	.637	.726	1.158	.891	.345	3.184	-.304	.167	.682	.737
income (2)	-.660	1.074	.300	.517	.166	.030	.860	1.180	-.431	.302	.583	.650	.907	.330	.566	2.478	.344	.153	.695	1.411
Training in GAP	-.596	1.447	.229	.551	-1.689	3.869	.049*	.185	.063	.012	.914	1.065	.891	.696	.404	2.439	1.416	3.612	.057	4.119
Constant	-39.128				35.519				1.236				-21.123				-7.400			
Number of observations	100				100				100				100				100			
Chi-square	15.292				13.593				19.012				17.484				12.254			
p value	.083				.138				.025				.042				.199			
Nagelkerke R^2 (%)	19.3				23.6				26.2				37.5				20.8			
% Correctly classified	69.0				87.0				83.0				96				87.0			

β is the model intercept coefficient; Wald is the Wald statistics, Exp (β) is odds ratio; * and **Significance at 0.05 and 0.001 probability level

CONCLUSION

The results show a slightly below-average awareness of Good Agricultural Practices (GAPs) among the vegetable growers. Gender, level of education, size of land leased, and reduction on income earned from vegetable production are important parameters that played a significant role in awareness. These are the factors which should be strengthened and guide any capacity building of GAP-related programs for the farmers to enhance both quality and quantity of the produce, income and environmental conservation. Motivation for GAP adoption by the farmers can be strengthened by focusing on the benefits they can achieve, especially on higher market access and premium price on their produce.

ACKNOWLEDGEMENT

This is an original research article that forms part of Doctoral research work of the author. The authors duly acknowledge Indian Council of Agricultural Research for financial assistance under the ICAR full-term doctoral fellowship scheme. The authors are also grateful for the cooperation and hospitality of the vegetable farmers in Nakuru County, Kenya.

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