Asian Journal of Agricultural and Horticultural Research

8(3): 29-36, 2021; Article no.AJAHR.70665
ISSN: 2581-4478

Factors Affecting the Adoption Level of Good Agricultural Practices by Cucurbit Farmers in Anuradhapura District, Sri Lanka

A. M. K. R. Bandara[1*], A. A. M. Jayarathne[1] and A. I. Y. Lankapura[1]

[1]Department of Agricultural Systems, Faculty of Agriculture, Rajarata University of Sri Lanka, Sri Lanka.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAHR/2021/v8i330118
Editor(s):
(1) Dr. Paola A. Deligios, University of Sassari, Italy.
Reviewers:
(1) Alex Muremi Fulano, University of Nairobi, Kenya.
(2) Seyed Shahabeddin Nourbakhsh, New Mexico State University, United States.
Complete Peer review History: https://www.sdiarticle4.com/review-history/70665

Original Research Article

Received 12 May 2021
Accepted 24 July 2021
Published 30 July 2021

ABSTRACT

Aims: The primary focus of this empirical study was to investigate the factors influencing the level of GAP adoption for cucurbit vegetable in the Anuradhapura district of Sri Lanka.
Study Design: Three-stage purposive and proportionate sampling
Place and Duration of Study: The study was carried out in the Anuradhapura district, North Central Province of Sri Lanka in 2018.
Methodology: Primary and secondary data were used in the study. The primary data were collected mainly through a field survey using a structured and pre-tested questionnaire. The total sample size was 120. Key informant interviews (KII), and a focus group discussion (FGD) were conducted to triangulate data and information obtained from the questionnaire survey and to obtain additional qualitative information. Descriptive analytical techniques, analysis of variance (ANOVA) test, and the General Linear Model (GLM) were employed for the data analysis.
Results: Results revealed that 40% of respondents are moderate level GAP adopters, whilst about 68% practiced more than half of the recommended GAPs. The results of ANOVA revealed that farmers who adopted a higher proportion of GAPs earned a higher farming income, than those who practiced a moderate or low proportion of GAPs. Similarly, when compared to moderate and poor

**Corresponding author: Email: amkrb@yahoo.com, bandara@agri.rjt.ac.lk;*

level GAP adopters, the average cost of production of higher-level adopters decreased significantly ($p < 0.05$). The results of the regression analysis revealed that farmer awareness of GAPs, farmer education level, farming experience, farming income, and cost of cultivation have a significant ($p < 0.05$) effect on the level of GAP adoption by cucurbit farmers.

Conclusion: Awareness of GAPs, farmer education level, farming experience, and farming income significantly affect the adoption level of GAPs. Policy priority should be given to planning for a long-term farmer awareness program on GAPs through proper training and extension programs.

Keywords: Adoption level; analysis of variance; cucurbit vegetable; general linear model; good agricultural practices.

1. INTRODUCTION

Vegetables belonging to the family Cucurbitaceae play a significant role in the vegetable production system in Sri Lanka. The extent of cultivation and the production, as well as domestic consumption of these vegetables, are higher in Sri Lanka. Cucumber (*Cucumis sativus*), bitter gourd (*Momordica charantia*), snake gourd (*Trichosanthes cucumerina*), ridge gourd (*Luffa acutangula*), and pumpkin (*Cucurbita maxima*) are the most commonly cultivated cucurbit vegetables [1]. Commercial-scale cucurbit farming applies higher levels of agrochemicals, which affects the quality and safety of vegetable products [2]. The increased use of agrochemicals in agriculture harms the environment and impedes agro-product trading [1]. The concept of Good Agricultural Practices (GAP) has evolved to ensure safe and healthy agricultural products in the context of a rapidly changing and globalizing food economy.

GAPs are practices adapted in the agricultural production system for environmental, economic, and social sustainability [3] focusing on safe and high-quality food and non-food agricultural products [4]. The risks of food safety hazards can be reduced by following GAPs. This certification is based on the principles of risk prevention, risk analysis, and sustainable agriculture through the use of integrated pest management (IPM) and integrated crop management (ICM) to continuously improve farming systems [5]. Therefore, the GAP standards have the potential to broaden the inclusion of small-scale producers in the pursuit of social, economic, and environmental benefits [6]. The GAP includes a set of production standards: crop rotation, intercropping, IPM methods, minimum tillage, mulches, cover crops, composts, chemical storage, recording, and worker safety and health, which optimize the use of farming inputs or resources in a sustainable manner [7]. Therefore, the enforcement of GAP has become more important in recent days in Sri Lanka, as increasing risk is prevailing in the country for some non-communicable diseases like CKDu (Chronic Kidney Disease of Unknown Etiology).

In 2016, the Sri Lankan government launched a GAP program for vegetables in response to international food safety and quality concerns, as well as rising demand for certified safe products [2]. The goal of the GAP program is to reduce agrochemical use, while increasing commodity production and marketing standards. The program was initially implemented in areas such as the North Central Province, the North West Province, and the Southern Province, where most commercial-scale farmers are available and use a high level of agrochemicals [8]. However, GAP adoption by vegetable farmers is relatively low [2]. Further, adoption of the recommended full GAP package is low among cucurbits farmers.

Since the GAPs have been recognized as a type of innovation in the literature, it is reasonable to consider GAP adoption in the context of agricultural innovation adoption. Research [9] has revealed that adopting new agricultural practices is a complex and time-consuming process with various determinants. The knowledge and willingness to learn are critical determinants, especially for knowledge-intensive technologies [9]. The GAP concept is associated with critical production decision factors [10] thus, producers with more knowledge may increase the likelihood of technology adoption. Few researchers including Senanayake and Rathnayaka [11] have studied GAP adoption in the agriculture sector of Sri Lanka. However, there is no evidence in the literature on available studies about the adoption of vegetable farmers for GAP, particularly cucurbit-producing farmers. This suggests that there is a need to investigate the factors that lead to cucurbit vegetable farmers adopting GAP. Therefore, the primary focus of this empirical study was to investigate the factors influencing the level of GAP adoption for cucurbit vegetable in the Anuradhapura

district of Sri Lanka. The findings of this study can help policymakers and stakeholders develop strategies for more rapid and efficient adoption of GAPs.

2. METHODOLOGY

2.1 Study Area and Sampling

The study was carried out in the Anuradhapura district, North Central Province of Sri Lanka. Farmers who cultivate cucurbit vegetables in the Anuradhapura district were the target population. The cucurbit vegetables considered for the study were Bitter Gourd (*Momordica charantia*), Snake Gourd (*Trichosanthes cucumerina*), and Ridged Gourd (*Luffa acutangula*).

Three-stage purposive and proportionate sampling methods were used to draw a sample from the target population. The sampling frame was a farmer list obtained from the divisional offices of the Department of Agriculture (DOA). At the first stage of sampling, four Divisional Secretariat (DS) divisions were purposely selected covering 50% of the total cucurbit farmer population in the Anuradhapura district. The selected DS divisions are *Thambuththegama, Galenbidunuwewa, Rambewa,* and *Medawachchiya.* At the second stage, Agrarian Service divisions (ASD) covering half of the farmer population within each DS division were purposefully selected. At the final stage, farmers were randomly selected from each ASD in proportion to the farmer population in selected ASDs. The total sample size was 120, selected in proportion to the farmer population of the above-selected ASDs (Table 1).

Table 1. Sample distribution of the cucurbit vegetable farmers

DS division	ASD
Medawachchiya	*Medawachchiya (15)*
	Poonewa (20)
Rambewa	*Rambewa (22)*
Galenbidunuwewa	*Galenbidunuwewa (21)*
	Siwalakulama (14)
Thambuththegama	*Thambuththegama (28)*
Total	120

Table 2. Recommended GAPs for bitter gourd, snake gourd, and ridged gourd

Criteria	GAPs
Selection of seeds	1. Selection of quality seeds
	2. Keep seeds in sealed containers and store them in a cool and dry place
Soil & soil conservation	3. Soil test once per 2 year
	4. Application of decomposed rice straw
	5. Application of cow dung & cattle manure
	6. Hedging and ditching
	7. Minimum tillage
Use of fertilizers	8. Apply the required level of fertilizers at the right time
	9. Keep fertilizers in a dry, clean & sheltered place
	10. Do not use empty/used fertilizer bags for harvested vegetables
Use of pesticides	11. Only purchase and use registered pesticides
	12. Do not apply pesticides during strong winds & heavy rain
	13. Do not recycle or re-use pesticide containers for another usage
Pest & Disease Management	14. Adopting crop rotation and intercropping
	15. Adopt physical control measures
	16. Use biopesticides/synthetic pesticides
	17. Integrated pest management (IPM)
Irrigation	18. Irrigate field early in the morning, late in the evening
	19. Adopt micro irrigation method
Harvesting	20. Harvest at the right stage of maturity
	21. Harvest during the coolest part of the day-either early morning or late afternoon
Record keeping	22. Records of farm activities

2.2 Data Collection

Primary and secondary data were used in the study. The primary data were collected mainly through a field survey using a structured and pre-tested questionnaire. The questionnaire consisted of four (04) sections covering information on socio-demographics, agriculture, GAPs, and respondents' perspectives on the constraints and opportunities for GAP adoption. The study took into account 22 GAPs recommended by the Department of Agriculture Sri Lanka [2] for cucurbit vegetables (Table 2). Key informant interviews (KII), and a focus group discussion (FGD) were conducted to triangulate data and information obtained from the questionnaire survey and to obtain additional qualitative information. Secondary data were mainly collected from publications of the Department of Agriculture and the Department of Census and Statistics, Sri Lanka.

2.3 Data Analysis

The collected data were summarized using descriptive statistics such as mean, percentage, standard deviation, and graphical methods. The level of GAP adoption (LADOPT) was calculated by adapting the procedure used by previous studies [12] [13], which generates values ranging from 0% to 100% depending on the number of practices adopted by each farmer (Eq. 01). Farmers were divided into three groups based on their GAP adoption level: good, moderate, and poor. The analysis of variance (ANOVA) test was used to compare the cost of production and agricultural income among the three adoption categories.

$$\text{LADOPT} = \frac{\text{No. of GAP practices adopted by the farmer}}{\text{No. of GAP practices recommended for cucurbit farming}} * 100 \quad (Eq.01)$$

The General Linear Model (GLM) [14] [15] was used to assess the factors influencing adoption level for GAPs (Eq.02). Hence, the level of adoption for GAP (LADOPT) was used as the dependent variable in the model and Farmers' gender, age, education level, farming experience, the extent of cultivation, farming income, cost of production, and awareness of GAPs are among the independent variables (Table 3). The theoretical model used for the study is given in the following equation (Eq.02).

$$Y_i = \beta_0 + \beta_1 x_1 \ldots + \beta_n x_n + \varepsilon_i \quad (Eq.02)$$

Where;

Y_i = Level of GAP adoption (LADOPT)

β_0 = Coefficient of the intercept

β_n = Partial regression coefficients

x_n = Independent variables

ε_i = Error term

3. RESULTS AND DISCUSSION

3.1 Socio-demographic Characteristics

The majority of respondents (82%) were male, indicating that men are more involved in cucurbit farming in the study area. The age of the respondents ranged from 27 to 66, with a mean of 46. Education of farmers revealed that 40% had formal schooling up to grade 05, 30% up to G.C.E (O/L), and 10% up to G.C.E (A/L), while the remaining 20% had no formal education.

The farmers in the study sample had an average of 16 years of farming experience, ranging from nine (09) to 40 years. The average land size owned by a farmer is 1.86 acres of cultivated land, varying from 0.5 to 10 acres. The majority of the respondents belonged to the small (≤ 0.5 acres) and moderate (0.5–5.0 acres) scale farmers.

3.2 The Level of GAP Adoption

Based on the number of GAPs practices used, respondents were classified as good (> 75% of GAPs), moderate (50 –75%), or poor (< 50%) GAP adopters. Results revealed that only 28% are good adopters, 40% of respondents are moderate level adopters, while 32% are poor adopters. However, about 68% of the respondents practiced more than half of the recommended GAPs.

This study further examined differences in income and production cost among different GAP adopter categories. The results of the analysis of variance test (ANOVA) revealed that the average farming income and cost of production significantly ($p < 0.05$) different (Fig. 1). Farmers who adopted a higher proportion of GAPs earned a higher farming income, than those who practiced a moderate or low proportion of GAPs.

Table 3. Description of variables in the empirical model

Variables	Description	Units of measurement	
X1	Age of the farmer	Years	
X2	Gender of the farmer	Male = 1, Female = 0	
X3	Education level of the farmer	No formal education = 1 Up to O/L=3	Up to grade 05 =2 Up to A/L = 4
X4	Vegetable farming experience	Years	
X5	Cultivated extent	Acres (ac)	
X6	Time spend on cultivation	Fulltime = 1, Part time = 0	
X7	Awareness on GAPs	Aware= 1, Not ware = 0	
X8	Cost of cultivation	Rupees (LKR) per acre	
X9	Income from cultivation	Rupees (LKR) per acre	
X10	Input availability	High = 3, Moderate = 2, Low = 1	

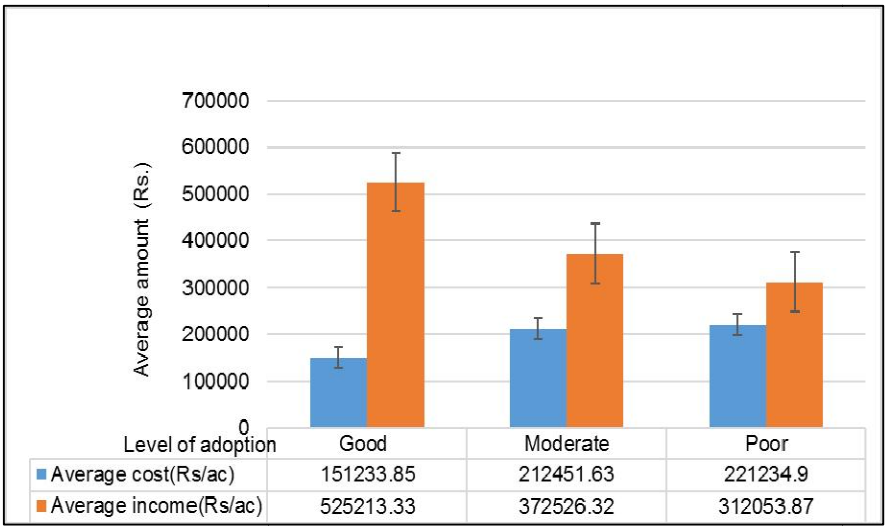

Fig. 1. Average farming income and production costs based on GAP adoption level

Similarly, when compared to moderate and poor level GAP adopters, the average cost of production of higher-level adopters decreased significantly ($p < 0.05$). This is mainly due to the lower agrochemical costs associated with GAP adoption. These results are consistent with Senanayake and Rathnayake's [11] findings on GAP adoption for potato farming in Badulla district, Sri Lanka.

3.3 Factors Affecting the Level of GAP Adoption

The results of the regression analysis revealed that farmer awareness of GAPs, farmer education level, farming experience, farming income, and cost of cultivation have a significant ($p < 0.05$) effect on the level of GAP adoption by cucurbit farmers (Table 04). These five factors accounted for 50% ($R2 = 0.51$) of the total variation in GAP adoption level.

The results revealed that the most important factor influencing cucurbit farmers' level of GAP adoption is their awareness. A farmer having awareness of GAPs uses 34% ($\beta = 34.16$) of more GAPs compared to those who are unaware, while other factors held constant. Studies [11] [13] have also reported that awareness has a positive effect on GAP adoption. According to Bernier et al. [16], adoption of any agricultural technology necessitates prior awareness, and farmers who rely heavily on traditional agricultural practices are more likely to be unaware of new agricultural technology. The farmers' awareness can be increased through the extension programs and training [17] [18], social networking [13], and project participation [9].

Table 4. Results of the regression analysis

Variable	Coefficient	Probability value
Age of the farmer	-0.20867	0.3180
Gender of the farmer	5.07345	0.2538
Education level of the farmer	3.5936*	0.0489
Vegetable farming experience	0.36587*	0.0340
Extent of cultivation	-1.97913	0.1204
Time spend on cultivation	2.27567	0.4870
Awareness on GAPs	34.16410*	<0.0001
Cost per acre	-0.00005871*	0.0096
Income per acre	0.00014454*	0.0086
Input availability	2.89595	0.2300

Results show that the level of farmer's education has a positive impact on the adoption of GAPs for cucurbits. Studies [11] [19] [20] [21] [22] have found that educated farmers are more likely to adopt environmentally-friendly farming practices such as GAPs. Rajendran et al. [7] reported that education allows farmers to be more open to new ideas and demonstrate greater learning ability, enabling them to comprehend complex information and manage intensive sustainable agricultural practices. Therefore, formal education is recognized as an important tool in governing farmers' adoption of GAPs.

Results also show that the farming experience [11] significantly (p =0.034) affects the level of GAP adoption by cucurbits farmers. Experienced farmers are typically skilled at assessing risks and managing farming practices [23]. Farmers who have been involved in agricultural activities for a long period may have a better understanding of the impact of poor farming practices on productivity and farm sustainability, compelling them to use more GAPs.

The study findings are consistent with the literature, which indicates that the level of GAP adoption was influenced positively by farming income and negatively by cultivation costs [11]. Higher-income from GAP vegetables allows for better harvesting and post-harvesting, transportation and storage, and more efficient management practices [24] [25] [26] [27]. In addition to farming income, researches [9] [13] have shown that total family income positively influences GAP adoption. Krasuaythong [9] reported that rich farmers are more likely to adopt environmental management practices, as they are more willing to experiment with new technologies, and income from off-farm activities reduces the risk of adopting such practices [28] [29] [30]. Therefore, external supports, enhancing farmers' economy such as sponsorships and public-private partnerships are identified as critical for assisting resource-limited and financially constrained farmers in adopting GAPs.

4. CONCLUSIONS AND RECOMMENDATIONS

The study found that cucurbit vegetable farmers in Anuradhapura district have a moderate GAP adoption level. Higher-level GAP adopters earn significantly higher farming income and have significantly lower production costs compared to the lower level GAPs adopters. Awareness of GAPs, farmer education level, farming experience, the income of farmers have a significant effect on adoption for GAPs. Further, the cost of cultivation is significantly less for GAP adopted cucurbit farmers. Policy priority should be given to planning for a long-term farmer awareness program on GAPs through proper training and extension programs.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ariyaratne I, Weeraratne WA, Ranatunge RK. Identification of a new mosaic virus disease of snake gourd in Sri Lanka. Annals of the Sri Lanka Department of Agriculture. 2005;7:13-21.
2. Department of agriculture Sri Lanka. Good agricultural practices for bitter gourd, luffa,

snake gourd. Agriculture Publication Unit; 2016.
3. Tilman D, Cassman KG, Matson PA, Naylor R, Polasky S. Agricultural sustainability and intensive production practices. Nature. 2002;418(6898):671-7.
4. FAO. Development of a frame work for good agricultural practices, publishing management group, FAO Information Division, Rome; 2013.
5. Akkaya F, Yalcin R, Ozkan B. Good agricultural practices (GAP) and its implementation in Turkey. Ini International Symposium on Improving the Performance of Supply Chains in the Transitional Economies. 2005;699:47-52.
6. Amekawa Y. Reflections on the growing influence of good agricultural practices in the global south. Journal of Agricultural and Environmental Ethics. 2009;22(6): 531.
7. Rajendran N, Tey YS, Brindal M, Ahmad Sidique SF, Shamsudin MN, Radam A, Abdul Hadi AH. Factors influencing the adoption of bundled sustainable agricultural practices: A systematic literature review. International Food Research Journal. 2016;23(5).
8. Department of agriculture Sri Lanka. "Market based product plan vegetables and fruits". 2013-2015.
9. Krasuaythong T. Technologies adoption in vegetable production in Northern Thailand (Doctoral dissertation, Hannover: Gottfried Wilhelm Leibniz Universität Hannover); 2008.
10. Lutaladio N, Ortiz O, Caldiz D. Sustainable potato production. Guidelines for developing countries. Food and Agriculture Organization; 2009.
11. Senanayake SS, Rathnayaka RM. Analysis of factors affecting for adoption of good agricultural practices in potato cultivation in Badulla district, Sri Lanka. AGRIEAST. 2015;(10):1-5
12. Rathnayaka RM, Kithsiri KH, Gunathilaka RP. Assessing the adoption of Maximum Residue Level (MRL): in the tea small holding sector of Kandy district, Sri Lanka. Research Journal of Agriculture and Environmental Management. 2014;3(6):299-303.
13. Athipanyakul TH, Pak-Uthai WE. Determinants of good agricultural practices (gap) adoption in the chili production system in Northeastern Thailand: A case of participatory approach. International Journal of Environmental and Rural Development. 2012;3(2):175-80.
14. Myers RH, Myers RH. Classical and modern regression with applications. Belmont, CA: Duxbury press; 1990.
15. Miller J, Haden P. Statistical analysis with the general linear model. Creative Commons Attribution; 2006.
16. Bernier Q, Meinzen-Dick RS, Kristjanson PM, Haglund E, Kovarik C, Bryan E, Silvestri S. Gender and institutional aspects of climate-smart agricultural practices: Evidence from Kenya (Working Paper No. 79), Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS); 2015.
17. Coleman AL, Dimit RM, Lionberger HF, Miller PA, Wilkening EA, Bohlen JM. How farm people accept new ideas, Iowa State University, Iowa; 1955.
18. Joshi A, Kalauni D, Tiwari U. Application of Good Agricultural Practices (GAP) by the Banana Farmers of Chitwan, Nepal. bioRxiv; 2020.
19. Vanslembrouck I, Van Huylenbroeck G, Verbeke W. Determinants of the willingness of Belgian farmers to participate in agri-environmental measures. Journal of Agricultural Economics. 2002;53(3):489-511.
20. Marenya PP, Barrett CB. Household-level determinants of adoption of improved natural resources management practices among smallholder farmers in western Kenya. Food Policy. 2007;32:515–536.
21. Anley Y, Bogale A, Haile-Gabriel A. Adoption decision and use intensity of soil and water conservation measures by smallholder subsistence farmers in Dedo District, Western Ethiopia. Land Dégrad. Dev. 2007;18:289–302.
22. Haghjou M, Hayati B, Momeni Choleki D. Identification of factors affecting adoption of soil conservation practices by some rainfed farmers in Iran. J. Agric. Sci. Technol. 2014;16:957–967.
23. Thapa GB, Rattanasuteerakul K. Adoption and extent of organic vegetable farming in Mahasarakham province, Thailand. Applied Geography. 2011;31(1):201-209.
24. Laosutsan P, Shivakoti GP, Soni P. Factors influencing the adoption of good agricultural practices and export decision of Thailand's vegetable farmers. International Journal of the Commons. 2019;13(2).

25. Kramol P, Thong-ngam K, Gypmantasiri P, Davies WP. Challenges in developing pesticide-free and organic vegetable markets and farming systems for smallholder farmers in North Thailand. InI International Symposium on Improving the Performance of Supply Chains in the Transitional Economies. 2005;699:243-252.
26. Kara E, Ribaudo M, Johansson RC. On how environmental stringency influences adoption of best management practices in agriculture. Journal of Environmental Management. 2008;88(4):1530-7.
27. Tiwari KR, Sitaula BK, Nyborg IL, Paudel GS. Determinants of farmers' adoption of improved soil conservation technology in a middle mountain watershed of central Nepal. Environ. Manag. 2008;42:210–222.
28. Defrancesco E, Gatto P, Runge F, Trestini S. Factors affecting farmers' participation in agri-environmental measures: A northern Italian perspective. J. Agric. Econ. 2008;59:114–131.
29. Murphy G, Hynes S, Murphy E, O'Donoghue C. An investigation into the type of farmer who chose to participate in Rural Environment Protection Scheme (REPS) and the role of institutional change in influencing scheme effectiveness. Land Use Policy. 2014; 39:199–210.
30. Yuan Y, Liu Y, Hu Y, Chen X, Peng J. Identification of non-economic influencing factors affecting farmer's participation in the paddy landto-dry land program in Chicheng County, China. Sustainability. 2017;9:366.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/70665