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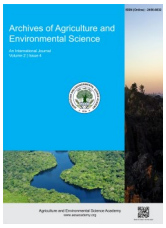

ORIGINAL RESEARCH ARTICLE

Good agricultural practices in mandarin (*Citrus reticulata* Blanco); Perception and factors affecting awareness among farmers in Gulmi, Nepal

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ABSTRACT

Citrus, in general, and mandarin, in particular, has long been one of Nepal's most important fruit crops. However, in recent years, a lack of good cultivation procedures and negligence has resulted in a significant reduction in its productivity. The declining situation cannot be controlled without the transfer of science-based knowledge and skills where Good Agricultural Practices have been linked to higher output. A study was carried out in 2020 to assess the perception of farmers towards Good Agricultural Practices and factors affecting awareness of GAP among mandarin growers. Altogether 100 households from Dhurkot and Chhatrakot Rural Municipalities, and Resunga Municipality from Gulmi district, were purposively chosen for the study in the command area of the PMAMP PIU Citrus Zone, and sampling was carried out using a simple random sampling technique. Data were collected with the use of a semi-structured questionnaire, entered, and analyzed using SPSS and STATA software. The farmers were categorized into GAP aware and unaware based on the criteria made by the focus group discussion carried out with the leading farmers, mandarin experts, and government agriculture officers. The findings revealed that 39% of the total respondents knew about GAP for mandarin. The entire respondents agreed that GAP-produced fruit has a nicer appearance and better quality and fruits meet national and international standards and enhance exportability of fruits, however, 61.5% of respondents didn't agree that GAP helps in providing subsidies from governmental organizations. The output of the binary logit model suggested that an increase in participation in training and contact with extension agents has a significant effect on awareness of GAP. Participatory GAP training, regular extension services to smallholding farmers could be beneficial for mandarin farmers leading to commercialization.

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INTRODUCTION

Nepal is rich in agro-ecological diversity and has a climate that is ideal for growing fruits, particularly mandarins where fruits have been significant for a country's economy because they contribute roughly 7% of the overall AGDP (MOAD, 2016). Mandarin (*Citrus reticulata* Blanco) is the most important fruit in Nepal, ranking first in the total fruit business (APP, 1995). It is a high-value fruit crop that is commercially feasible and profitable and grown primarily in the country's mid-hills (Rokaya *et al.*, 2016). Nepal has a total citrus growing area of 65.3 percent and a production of 67.2 percent, both the area and production of mandarin are increasing, however, the area increase is bigger than the output increase (Pandey *et al.*, 2017). Gulmi, in the

western hills of Nepal, is one of the leading districts for mandarin cultivation. The Gulmi district has the potential for excellent mandarin farming due to its climate conditions and location. Even though mandarin farming has been practiced for a long time, orchard management remains a challenge. The low or non-adoption of GAP is becoming one of the most pressing concerns confronting most parts of Nepal. Rogers (1995) explains that awareness and knowledge of new technology is the first step towards adoption so this study evaluated different factors influencing GAP awareness which will give directions and guidelines to concerned institutions, organizations, and stakeholders to focus on factors that would increase GAP awareness. In Nepal, the bulk of citrus orchards is either mismanaged or neglected. A lack of awareness and adoption of orchard management approaches is one of the fundamental causes of poor fruit tree growth and development, as well as the presence of significant diseases and insect pests that ultimately lead to the production of inferior quality fruits (FAO, 2011). NARDF (2010) reported a citrus decline to spread throughout Nepal and severely affecting many orchards.

Several technologies have been developed as a consequence of research to assist mandarin growers in overcoming their issues. Improved varieties, spacing, recommended fertilizer and manure doses, irrigation methods, weeding, mulching, insect management, disease control, harvesting, and post-harvest technology are only a few of them, although not all have been adopted by farmers. While some farmers are fast to adopt new technologies and put them into practice, others are more hesitant. Farmers' propensity to adopt new technology is influenced by their knowledge, awareness, effective communication methods, socioeconomic circumstances, and extension contact (Rogers, 1995). There are no sufficient studies conducted to find out the awareness level of GAP. The gap between farmers' practices and good agricultural practices was observed in this study to ascertain the following questions: Whether the farmers are aware of GAP or not? What is the perception of farmers towards GAP? What are the factors affecting the awareness of farmers about GAP?

The Food and Agriculture Organization of the United Nations (FAO) defines Good Agriculture Practices as a "collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products, while taking economic, social, and environmental sustainability into account" (FAO, 2016). FAO has developed a scheme and training manual on GAP for fruits and vegetables which has categorized the requirements in the form of five modules, namely food safety, environmental management, product quality, and worker health, safety, and welfare, and the fifth module is on general requirements that need to be met by a farm in addition to the four modules. It has categorized the criteria/requirements as “critical”, “major” or “minor” based on their importance (FAO, 2016). “Critical” requirements- these are required to maintain the integrity of the product and failing to adhere to these may result in a serious food safety incident resulting from a breach in food safety and product integrity. “Major” requirements- these are mandatory and must be followed. “Minor” requirements- these are important but may not be essential depending upon the product category. The planting material should be free from visible signs of pests and diseases. Quality propagation materials should be used of reliable sources (Government/ registered private nurseries/ agricultural institutions/ accredited tissue culture laboratories) (FAO, 2016). Chemical and biological risks related to fertilizers should be assessed and if any significant hazard is identified, the measure should be taken to minimize the risk of contamination of the produce (FAO, 2016). Based on the type of soil the depth of the pit should be 3 feet to 1 meter. During pit filling 25-30 kg well-decomposed FYM, 20-30 gm lime should be added along with the soil (Acharya *et al.*, 2015). Harvesting requires technical knowledge along with skills. Harvested produce shouldn’t be kept directly in the soil, equipment and materials that are exposed to produce should be made from material that will not contaminate the product and is easy to clean (FAO, 2016). A waste management procedure should be documented and followed, which includes identification of waste products generated during production, harvesting and handling procedure, using practices to minimize waste generation, reuse, recycle waste and dispose of waste (FAO, 2016). Documents and records of all the practices should be kept for a minimum period of two years and out-of-date documents should be discarded (FAO, 2016). During the production, harvesting, and post-harvesting stages, a plan should be kept on practices that are crucial to managing produce quality (FAO, 2011). Workers’ health, safety, and welfare should be addressed. Mechanical, chemical, biological, electrical, solar radiation, noise, stress, and fatigue are some hazards encountered by workers (FAO, 2016). The knowledge of good agricultural practices, safe use of chemicals, operation and handling of the tools and equipment, and safety requirements should be provided to farmers through training (MOAD, 2016). In Nepal, the government has established GAP technical committee in 2011 under the ministry of agriculture development. Under GAP technical committee, a technical sub-committee has been established in three departments Department of Agriculture, the Department of Livestock Services, and the Department of Food Technology and Quality Control. In 2014, the GAP steering committee has been established in MOAD with the representation of various related ministries, private sectors, farmers’ representatives, and UNFAO (G.C, 2015). Along with this, “Nepal Good Agriculture Practices (Nepal GAP) Implementation Directorate 2015” has been drafted and is under discussion for approval (G.C, 2015). The implementation of GAP contributes to sustainable Agriculture and Rural Development. In October 2018 Nepal has approved Nepal GAP Implementation Directive based on the Agriculture Development Strategy (ADS), Nepal Agro Business Policy, 2016, and GAP developed for SAARC countries by FAO (MOALD, 2018). However, different guidelines for fruit have not been made yet.

MATERIALS AND METHODS

The research was conducted in the command area of the PMAMP, PIU Citrus Zone, Gulmi during May/June 2020. The study areas were Dhurkot and Chhatrakot Rural Municipalities and Resunga Municipality which were selected purposively. A list of mandarin growing farmers provided by the Citrus zone, PMAMP Gulmi was used to randomly select the respondents. The scheduled interview using a semi-structured questionnaire was employed with 100 mandarin growers. To validate data and information obtained from the scheduled interview and to obtain additional qualitative information three Focus Group Discussion (FGD) were employed with progressive mandarin farmers, government agricultural officers, members of the zone management committee, and other mandarin experts in Dhurkot and Chhatrakot rural municipalities and Resunga municipality respectively using FGD checklist. The secondary data related to mandarin production was obtained from reports of different institutes and organizations such as Agribusiness Promotion and Marketing Development Directorate, Ministry of Agriculture and Livestock Development, Food and Agriculture Organization, Central Bureau of Statistics, Fruit Development Directorate, etc. Statistical Package for the Social Sciences (SPSS) was used to code and tabulate both primary and secondary data obtained from the field survey and other methods. SPSS, Stata, and MS-Excel were used to conduct the analysis. The inferential statistical tools like the index of agreement, t-test, and binary logit model were used along with descriptive statistics. Before running the regression, diagnostic tests were run to check out the possibility of multicollinearity in the independent variable.

Conceptual framework

Poor orchard management practices led to yield reduction, and orchard decline in the long run due to disease and pest infestations, nutritional disorders, and poor-sized plant and fruit. The research intervention to understand farmers' perception of GAP could find the way for control recommendations for intervention for increasing production, income, and maintaining good orchard health as shown in the figure below (Figure 1). The study mainly focused on the factors affecting awareness of GAP on mandarin orange production. The study also examined different standard requirements for GAP adoption by mandarin farmers and the effect of GAP on mandarin growers. Along with this, the major problems in production and post-production were identified.

Index of agreement

The farmer's perception of GAP was analyzed by using different variables. Strongly agree, agree, neither agree nor disagree, disagree and strongly disagree were used to analyze perception. Perception towards GAP was analyzed by using an index of agreement. The frequency of agreement was calculated by the summation of frequency of response of scale as strongly agree and agree and frequency of disagreement was calculated by the summation of frequency of response of scale as neither agree nor disagree, disagree and strongly disagree. Index of the agreement was calculated by using the formula:

Index of agreement= (Frequency of agreement- Frequency of disagreement)/ n
Where n= total sample size

The value of the index of agreement may range from -1 to 1. When the value of the index of agreement is greater than 0.5 then the variable is considered to have positive perception whereas when the index of agreement is less than 0.5 then the variable is considered to have a negative perception.

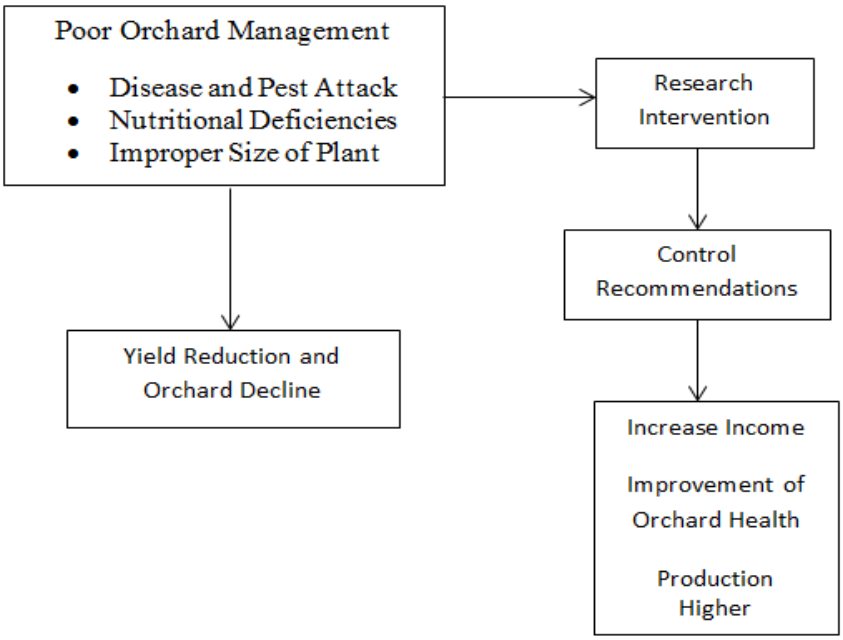

Figure 1. *Conceptual framework.*

Table 1. Description of variables used in a binary logit regression model.

Variable	Type	Description	Value
Dependent variable			
Awareness of GAP (Y)	Dummy	Farmer is aware or unaware of GAP	1if aware, 0 if unaware
Independent variables			
Sex(X_1)	Dummy	Sex of the respondent	1if male, 0 if female
Age(X_2)	Continuous	Age of the respondent	Years
Education(X_3)	Continuous	Education status of respondent	Years
Household size(X_4)	Continuous	Household size of respondent	Persons
Type of agriculture(X_5)	Dummy	Type of agriculture carried by respondent	1=if commercial, 0=if subsistence
Farm size(X_6)	Continuous	Total farm size of the respondent	Ha
Experience of mandarin farming(X_7)	Continuous	Experience of mandarin farming of respondent	Years
Contact with extension agents(X_8)	Dummy	Contact of respondent with extension agents	1=if Yes, 0=if No
Participation in training related to GAP(X_9)	Dummy	Whether the respondent attended GAP related training	1=if attended, 0=if not attended

Logit model

The binary logit regression model was used for the analysis of factors affecting awareness of GAP among mandarin growers. GAP awareness among mandarin growers is regarded as the function of sex, age, education, household size, type of agriculture, farm size, the experience of mandarin farming, contact with extension agents, participation in training related to GAP. Table 1 presents the description of variables used in the binary logit regression model

RESULTS AND DISCUSSION

Socio-economic and demographic characteristics

GAP was found to be known to 39% of respondents and approximately 89.7% learned about it from technicians or extension agents, while 10.3% learned about it through social media/the internet. Similarly, Joshi *et al.* (2019), also found that 16.5% of the respondents have heard about GAP from the technicians, 2.9% from social media, 1% from TV, and 1% from the newspaper which is similar to our findings. The average age of GAP-aware respondents was 49.74 years, while the average age of GAP unaware respondents was 45.26 years, with the difference in age being statistically significant at the 5% level, and their average years of experience were 22.49 and 23.69 years, respectively (Table 2). The difference in mandarin production experience was found to be statistically non-significant. The average household size for GAP-aware and unaware respondents was 6.26 and 6.28, respectively which is higher than the national average family size of 4.88 in hilly regions of Nepal (CBS, 2012). The average number of male and female HH of GAP aware and unaware respondents was 3.33, 2.92, and 3.34, 2.93, respectively. Table 2 shows that the difference in household size and male and female members of HH was found to be statistically non-significant. The average number of economically active members was found to be 4.15 and 3.69 for GAP aware and unaware respondents respectively. The difference between economically active members was found to be statistically non-significant (Table 2). The average landholding was 0.88 ha for GAP-aware respondents and 0.58 ha for GAP unaware respondents, with mandarin cultivated on 0.52 ha and 0.26 ha of HH land, respectively. The difference in total landholding and land cultivated with mandarin was found to be statistically significant at the 1% level (Table 2). For GAP-aware and unaware respondents, the average productivity was 8.81 and 5.41 Mt ha^{-1}, with an average price of NRs.53.54 and NRs.49.67, respectively. The productivity of GAP-aware respondents was discovered to be 8.81mt/ha, which is less than the national level productivity of 10mt/ha (MOALD, 2018). The difference in productivity and price of mandarin between aware and unaware respondents was found to be statistically significant at a 5% level (Table 2). According to Verma *et al.* (2020), GAP adopters could earn roughly a third more than non-adopters. Farmers were able to get attractive pricing thanks to GAP during the pre-harvest and post-harvest stages, as well as branding and market connections that support our findings.

About 74.4% male and 25.6% female were aware of GAP and 62.3% male and 37.7% female were unaware of GAP, however, the difference was statistically non-significant (Table 3). Similarly, among the aware respondents, 53.8% were Brahmin, 38.5% were Chhetri, 5.1% were Janajati, 2.6% were Dalit and among unaware 32.8% were Brahmin, 45.9% were Chhetri, 11.5% were Janajati and 9.8% were Dalit. However, the difference was statistically non-significant. The major ethnic groups in the Gulmi district are Brahmin, Chhetri, followed by Janjatis and Dalits (CBS, 2012) similar to our findings. Among the aware respondents, 17.9% were literate, 7.7% attained primary level education, 17.9% attained lower secondary level education, 38.5% attained SLC level education, 12.8% attained +2/ certificate, 5.2% attained university-level education and among unaware respondents 9.8% were illiterate, 32.8% were literate, 1.6% attained primary level education, 21.3% attained lower secondary level education, 24.6% attained SLC level education, 9.8% attained +2/certificate level education and the difference in education status was found to be statistically significant at 5% level. The population of Gulmi district is 326,766 with a male-female ratio of 90, the literacy rate is 63%, and ethnicity composition of 28.47% Brahmin, 23.14% of Chhetri, 9.46% of Kami, 3.37% of sarki, 3.20% of Damai (AKC, 2019) which supports our findings.

Table 2. Distribution of the socio-economic and demographic characteristics (continuous variable) of the sampled household with farmer's category.

Variables	Overall (n=100)	Farmers' category		Mean difference	t- value
		GAP aware (n=39)	GAP unaware (n=61)		
Age	47.01(11.27)	49.74(11.21)	45.26(11.05)	4.48	1.97** (p=0.052)
Experience of mandarin production	23.22(12.75)	22.49(12.85)	23.69(12.76)	-1.20	-0.46ns (p=0.649)
HH size	6.27(2.41)	6.26(2.44)	6.28(2.4)	-0.022	-0.05ns (p=0.964)
Male members of HH	3.34(1.31)	3.33(1.18)	3.34(1.40)	-0.011	-0.04ns (p=0.968)
Female members of HH	2.93(1.39)	2.92(1.49)	2.93(1.33)	-0.011	-0.04ns (p=0.968)
Economically active members	3.87(1.80)	4.15(1.81)	3.69(1.78)	0.47	1.26ns (p=0.209)
Total land holding (ha)	0.69(0.53)	0.88(0.59)	0.58(0.44)	0.30	2.91*** (p=0.004)
Total operational land (ha)	0.36(0.32)	0.52(0.39)	0.26(0.23)	0.26	3.73*** (p=0.000)
Productivity (Mt/ha)	6.74(6.79)	8.81(6.79)	5.41(6.52)	3.39	2.50** (p=0.014)
Price/kg	51.18(8.3)	53.54(8.85)	49.67(7.63)	3.87	2.25** (p=0.028)

Notes: Figures in parenthesis indicate standard deviation; p-values are the result of t-test, ***, ** indicates 1%, 5% level of significance respectively.

Table 3. Distribution of the socio-economic and demographic characteristics (categorical variable) of the sample households with farmer's category.

Variables	Overall (n=100)	Farmers' category		Chi-square Value
		GAP aware (n=39)	GAP unaware (n=61)	
Gender of respondents				
Male	67	29(74.4)	38(62.3)	1.566ns(df=1,p=0.211)
Female	33	10(25.6)	23(37.7)	
Ethnicity				
Brahmin	41	21(53.8)	20(32.8)	5.742ns(df=3,p=0.125)
Chhetri	43	15(38.5)	28(45.9)	
Janajati	9	2(5.1)	7(11.5)	
Dalit	7	1(2.6)	6(9.8)	
Education status				
Illiterate	6	0(0)	6(9.8)	
Literate	27	7(17.9)	20(32.8)	12.936**(df=6,p=0.044)
Primary	4	3(7.7)	1(1.6)	
Lower secondary	20	7(17.9)	13(21.3)	
SLC	30	15(38.5)	15(24.6)	
+2/ certificate	11	5(12.8)	6(9.8)	
University	2	2(5.2)	0(0)	

Note: Figures in the parenthesis indicate percent, ** indicates 5% level of significance.

Perception of farmers toward GAP

The perception of respondents toward GAP was analyzed by using an index of agreement. Farmer's perception toward GAP was found to be positive, except for the statement that GAP aids in obtaining government subsidies. As shown in Table 4, approximately 61.5% of respondents disagreed with the statement (index=0.23). The majority of respondents agreed that GAP-produced mandarin has a nicer appearance and higher quality, and that fruit produced using GAP meets national and international standards and adoption of GAP enhances exportability of fruits. GAP was perceived as a time-consuming approach by the majority (89.7%) of respondents (index=0.79). It was reported that even a single mandarin tree can take an entire day to manage. Joshi *et al.* (2019), also found that the majority (83.3%) of respondents agreed that GAP is a time-consuming procedure, which is similar to the finding. The majority (84.6%) of respondents (index=0.69) agreed that GAP increases farmer income and GAP is effective in reducing pest and disease infestation (index=0.69) as shown in Table 4. The financial conditions of adopting farmers would be improved as a result of decreased production costs, partly due to better use of herbicides and pesticides, and higher prices commanded by GAP crops compared to non-GAP (i.e., conventional) vegetables (Laosutsan *et al.*, 2019) which supports our findings. Farmers perceived that GAP component technologies all offer relative advantages and observable benefits (Oo and Usami, 2020).

Factors affecting awareness of GAP

GAP awareness is influenced by a variety of factors, including socio-demographic and extension-related factors. Gender, education level, training, landholding size, contact with extension agents had a significant association with adoption (Belbase *et al.*, 2020). The study looked at the impact of such independent variables on GAP awareness. Before running the regression,

Table 4. Perception of respondents toward GAP (n=39).

GAP statements	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)	Index of agreement
Produced fruit have nicer appearance and better quality	76.9	23.1	0.0	0.0	0.0	1
Is time consuming	35.9	53.8	10.3	0.0	0.0	0.79
Increases farmers' income	23.1	61.5	12.8	2.6	0.0	0.69
Efficient in reducing pest and disease	48.7	35.9	15.4	0.0	0.0	0.69
Helps to get subsidy	10.3	28.2	53.8	7.7	0.0	0.23
Fruit meets national and international standards	43.6	56.4	0.0	0.0	0.0	1
Enhances exportability of fruits	43.6	56.4	0.0	0.0	0.0	1

Table 5. Major determinants of awareness of GAP among mandarin growers.

Determinants	GAP aware(1=Yes) dy/dx	Odd ratio	Z	p>|z|
Sex (1=Male, 0=Female)	0.117(0.191)	1.734(1.631)	0.59	0.541
Age (Years)	0.004(0.009)	1.022(0.039)	0.56	0.577
Education (Years)	0.011(0.022)	1.051(0.107)	0.49	0.624
Household Size(persons)	-0.018(0.036)	0.920(0.153)	-0.50	0.615
Type of agriculture (1=commercial, 0=subsistence	0.169(0.178)	2.242(2.029)	0.89	0.341
Farm size(ha)	-0.015(0.154)	0.932(0.652)	-0.10	0.920
Experience of mandarin farming (years)	-0.002(0.007)	0.993(0.031)	-0.22	0.827
Contact with extension agents (1=yes, 0=no)	0.416***(0.147)	9.512(11.129)	1.93	0.005
Participation in GAP related training (1=attended, 0=not attended)	0.765***(0.108)	57.892(67.355)	3.49	0.000
Summary Statistics				
Number of observations	100			
LR Chi^2	74.76***			
Log likelihood	-29.49			
Pseudo R^2	0.5590			

Note: Figures in parenthesis indicate a standard error, *** indicates a 1% level of significance, and dy/dx is the marginal effect after logit.

diagnostic tests were run to check out the possibility of multicollinearity in the independent variable. The average VIF was found to be 1.59, and none of the variables had a value greater than 1.8, indicating that there is no multicollinearity among the independent variables in the model. Table 5 shows the results of a binary logit regression model used to identify the most important factors influencing farmers' knowledge of GAP. Nine independent variables namely sex, age, education, household size, type of agriculture, farm size, experience in mandarin farming, contact with extension agents, and participation in GAP related training were used for regression analysis using the logit model, of which two variables namely contact with extension agents, and participation in GAP related training were statistically significant. This result was similar to Ashraf *et al.* (2015) findings, however, contradict the findings of Anarvat (2015) indicating a positive and significant relationship between mandarin growing area and level of awareness, and contradict with (Meena *et al.*, 2017) which showed that age and mandarin are statistically significant with awareness-adoption. At the 1% level of significance, the model's Chi-square value (χ^2) of 74.76 and the log-likelihood ratio of -29.49 indicate that all variables in the model significantly influence the probability of GAP adoption. The pseudo R^2 value of 0.5590 indicates that tabulated variables govern approximately 55.9 percent of the decision to adopt GAP, implying that the model fits the given data 55.9 percent of the time. Contact with extension agents had a significant effect on GAP knowledge among the independent variables at a 1% level of significance. This suggests that mandarin producers with higher extension contact had a higher level of awareness, as supported by the finding of (Kumar *et al.*, 2017). This could be attributed to the experts' knowledge being disseminated to local farmers, as well as their good influence and attitude. The findings revealed that for every unit increase in contact with extension agents, the likelihood of being aware of GAP rises by 41.6%. Farmer's frequency of contact with personal localite sources of information had a positive and significant impact on adopting the recommended technology (Dhital and Joshi, 2016) which supports our findings. GAPs in agricultural production

should be improved by regular contact with extension personnel (Oo and Usami, 2020). Similarly, participation in training had a significant effect on GAP knowledge at a 1% level of significance. The findings revealed that increasing training participation by one unit increases the likelihood of being aware of GAP by 76.5%. Training, according to Barakoti (2000), is an effective strategy for increasing farmer awareness of innovation technologies. Better extension services and training in advanced manufacturing technology are required for the greater adoption of innovations (Kunwar *et al*., 2015; Atreya and Manandhar, 2016) which supports our findings.

Conclusion

Farmers' awareness may be affected by a variety of causes and circumstances. The study's findings implied that a strong emphasis on training and regular contact with extension agents has a significant impact on GAP awareness. Findings also revealed that the majority of respondents perceived GAP-produced fruits have a nicer appearance and better quality and those fruits produced using GAP, meet national and international standards and improve fruit exportability. GAP-related programs must be prioritized by the government so that farmers can receive greater benefits. By providing training and other educational activities, municipal and provincial governments can help agriculture technicians, farmer groups, agricultural cooperatives, and other stakeholders get a solid understanding of GAP. However, the majority disagreed that GAP aids in the provision of subsidies from governmental organizations. Farmers could be persuaded to embrace the GAP if they are made aware of the potential benefits. Similarly, guaranteeing a higher price for GAP products can encourage farmers to follow GAP guidelines. For most Nepalese farmers, Good Agricultural Practice (GAP) is a new concept, and most are unaware of it. Extension initiatives must be carried out in this environment to raise awareness of the GAP.

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Conflict of interest

No conflict of interest with the present work

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