Research Article:

FACTORS AFFECTING THE ADOPTION OF GOOD AGRICULTURAL PRACTICES (GAP) AMONG SMALLHOLDER VEGETABLE FARMERS IN SURKHET DISTRICT, NEPAL

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ABSTRACT

A study was conducted in 2022 within Birendranagar municipality of Surkhet District of Nepal to identify the factors affecting the adoption of Good Agricultural Practices (GAP) among smallholder vegetable farmers. Employing a random sampling approach, 115 smallholder vegetable farming households were selected. Primary data were gathered through semi-structured questionnaires administered to household heads. The collected data was analyzed using a binary probit model. The findings revealed formal education, farming experience, training program, agricultural extension services, membership in agricultural cooperatives, annual household income, agricultural subsidies, and reliance on farming as the primary source of income were found significantly influencing the adoption of GAP. Thus, it is essential to provide smallholder vegetable farmers with regular extension services and trainings on GAP to promote its adoption. Further, agricultural cooperatives should be strengthened, subsidies should be made accessible to smallholder farmers and households that rely solely on agriculture for their livelihood should be prioritized to promote efficient adoption of GAP.

Key words: Cooperatives, extension, subsidy, training

INTRODUCTION

In the fiscal year 2022/23, vegetables contributed 13.43% to the agricultural Gross Domestic Product (GDP) in Nepal, highlighting their significance as a major component of the country's economy (MoALD, 2023). The vegetable farming subsector in Nepal offers significant opportunities for self-employment along the food value chain, involving diverse actors such as input suppliers, farmers, traders, transporters, processors, and supporting agencies (Niraula et al., 2023). This subsector contributes to income generation, poverty reduction, food and nutritional security, and improved livelihoods (Shrestha et al., 2022). Smallholder farmers, who dominate Nepalese agriculture, typically cultivate small plots of land, with the majority measuring less than 0.5 hectares (14.8 kattha) (Mishra et al., 2021; Mishra et al., 2023; Niraula et al., 2023). In vegetable farming, smallholders commonly adopt integrated cropping systems, cultivating a variety of vegetable crops on a single farm (Shrestha et al., 2016).

The sustainability of the vegetable subsector in Nepal faces several critical challenges that need to be addressed to ensure long-term growth and safety. One key issue is the inadequate use of protective clothing during chemical applications (FAO, 2016c). This not only endangers farmers' health but also contributes to environmental degradation. According to the FAO (2018),

poor pesticide management is a critical issue in many developing countries, including Nepal. Another major challenge is the gender wage gap in agriculture. This gender inequality restricts women's participation in the economy, reducing agricultural efficiency (Adhikari & Thapa, 2023). ADB (2019) highlights this wage disparity as a significant barrier to inclusive agricultural development in Nepal. Site selection is also a critical area as many vegetable farmers fail to consider factors such as crop rotation, chemical use, and pest and disease history. This lack of planning leads to recurrent pest problems and poor growing conditions, ultimately reducing crop yields and quality (FAO, 2016c). Unsafe water sources for irrigation are another common issue. Many farms in Nepal rely on untreated water, highlighting the urgent need for safer irrigation practices (CBS, 2021). In many areas, farmers use water contaminated by industrial discharge, household waste, or agricultural runoff, which introduces harmful substances into the soil and crops. This practice compromises both consumer health and soil fertility, limiting long-term productivity (FAO, 2016c).

Additionally, farmers frequently ignore recommended waiting periods between chemical application and harvest, leading to excessive pesticide residues in vegetables. This not only threatens food safety but also disqualifies produce from meeting export standards, limiting market access (FAO, 2016c). Unhygienic harvesting methods and inadequate postharvest management further exacerbate these issues. Farmers often use poorly maintained tools, which leads to contamination and a reduced shelf life for vegetables (Adhikari & GC, 2021). The lack of proper storage facilities also contributes to significant postharvest losses, with up to 20-50% of produce wasted annually (Khatiwada et al., 2022). This not only affects farmer incomes but also threatens food security.

Nepal introduced the Good Agricultural Practices (GAP) scheme to address these issues. In 2018, the Government of Nepal officially endorsed the Nepal Good Agricultural Practices (NepalGAP) implementation directive (Kharel et al., 2022). The Food and Agriculture Organization of the United Nations (FAO) defines Good Agricultural Practices (GAP) as a "collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agriculture products, while taking into account economic, social and environmental sustainability" (FAO, 2016a). FAO has highlighted four pillars of GAP: (i) economic viability, (ii) environmental sustainability, and (iii) social acceptability, which leads to (iv) food safety and quality (FAO, 2003).

The adoption of Good Agricultural Practices (GAP) in Nepal can significantly benefit farmers, agricultural labors and consumers. GAP promotes fairness and reduce inequalities, ensuring agricultural sustainability. GAP provides sustainable approaches that guide farmers in the efficient use of natural resources and agricultural inputs, improving soil fertility, protecting biodiversity, and building resilience against agricultural externalities, ensuring agricultural sustainability. It would also increase access to national and international markets for safe agricultural products, promoting the welfare of both farmers and consumers. Additionally, GAP adoption would reduce foodborne diseases, and ensure overall food safety and well-being across the agricultural value chain (Kharel et al., 2022).

The Agriculture Development Strategy (ADS) of Nepal (2015-2035) has emphasized the adoption of Good Agricultural Practices (GAP) as a key program to boost productivity (MoAD, 2016). However, the adoption of GAP remains at a low to medium level (Adhikari & Thapa, 2023; Nepal et al., 2023). To enhance the adoption of GAP and support farming communities, this study aims to identify the factors affecting their adoption among smallholder vegetable farmers.

MATERIALS AND METHODS

Study area

The study was conducted in Birendranagar Municipality of Surkhet district, Nepal, where farmers grow a variety of vegetables, including cabbage, cauliflower, tomato, potato, radish, bitter gourd, snake gourd, beans, onions, and other seasonal vegetable crops. Vegetable farming serves as a livelihood recovery strategy for returnee migrants, smallholder farmers, and other vulnerable community members in this area. Although there is considerable awareness about Good Agricultural Practices (GAP) among the farming community, the actual extent of their adoption remains unclear. Preliminary insights from Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) indicate that the adoption level is below satisfactory. This study aims to identify ways to enhance the adoption of GAP, ultimately benefiting farming communities in this area and in similar contexts. The GAP framework outlined by FAO (2016b) serves as the basis for this research.

Data collection and Sampling procedure

In this study, a multistage sampling technique was employed to select the district, municipality and farm households in 2022. In the first stage, Surkhet district was purposively selected as it is a major vegetable producing district in western Nepal. In the second stage, Birendranagar municipality was purposively selected due to its accessibility to improved farming practices among vegetable farming households within the district and its potential for rapid expansion. In the third stage, small farm households (less than 0.5 ha) that were either adopters or non-adopters of GAP were purposively chosen, as they constitute the majority of farming households. Primary data was collected from the principal decision maker (head) of each farm household using a semi-structured questionnaire. Additionally, one Key Informant Interview (KII) was conducted with progressive farmers, government officials from the agriculture section and members of agricultural cooperatives. Furthermore, one Focus Group Discussion (FGD) with farmers was conducted to complement the results from the household interviews.

Empirical model

Descriptive analysis was done using IBM SPSS Statistics 25. Probit model was employed using Stata/SE 12.1 in order to determine the factors affecting the adoption of GAP among smallholder vegetable farmers. With a small sample size (115 households), the probit model can provide more stable estimates and smoother marginal effects, making it suitable for understanding how changes in independent variables impact the probability of GAP adoption. Additionally, many similar studies on adoption behavior have successfully applied the probit model, supporting its use for consistency and comparability (Greene, 2018). The model was applied separately to each of the GAP. This model was used to identify the determinants (regressors) on the probability of adoption of GAP (regressand). The likelihood of smallholder farmers' adoption of GAP is a non-linear function of regressors. The probit model used is of the form Pr (Y = 1) = (X_i) where Pr (Y = 1) represents the probability of adoption of GAP with the change in X variable. A positive estimated coefficient implies an increase in likelihood of adoption of GAP. Relation between probability values and explanatory variables is established with probit model. It ensures the probability value between 0 and 1.

Nguyen et al. (2023) used probit model to study the adoption of GAP. Let us suppose Y_i is the binary response of the smallholder farmers, $Y_i = 1$, if smallholder farmer adopt GAP, and $Y_i = 0$ if the smallholder farmer don't adopt.

If $Y_i = 1$; Pr ($Y_i = 1$) = P_i

If $Y_i = 0$; Pr ($Y_i = 0$) = 1-P_i

Where P_i = E (Y = 1/X) represents the conditional mean of Y given certain values of X.

Model specification

The probit model specified in this study to analyze factors affecting the adoption of GAP among smallholder vegetable farmers was expressed as follows.

$Pr(Y = 1) = f(b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + b_7 X_7 + b_8 X_8 + b_9 X_9 + b_{10} X_{10})$

Where, $Pr(Y = 1)$ = Probability of adoption of GAP

X_1 = Gender (dummy); X_2= Age (continuous); X_3 = Education (continuous); X_4= Farming experience (continuous); X_5 = Training (dummy); X_6 = Regular contact (dummy); X_7 = Membership (dummy); X_8= Subsidy (dummy); X_9= Income (continuous); X_{10}= Source of income (dummy)

b_0 = Regression coefficient

$b_1, b_2 \ldots\ldots\ldots\ldots b_{10}$ = Probit coefficient

The description of the variables is presented in Table 1.

Table 1. Description of the dependent and independent variables used in the study

Variable	Description
Dependent variable	
GAP	GAP for this study includes following;
Use of dress (GAP1)	=1 if proper dress to spray chemicals is used in farm, 0 otherwise
Equal wages (GAP2)	=1 if farm provide equal wages to male and female labors for similar work, 0 otherwise
Site history (GAP3)	=1 if farm adopt site selection after evaluating previous crop, chemical spray status and disease, pest and weed infestation condition in past for farming, 0 otherwise
Safe water (GAP4)	=1 if farm use safe water for irrigation, 0 otherwise
Harvesting after safe period (GAP5)	=1 if farm harvest produce, after safe period of chemical application, 0 otherwise
Hygienic harvesting (GAP6)	=1 if farm adopt hygienic and proper equipment for harvesting, 0 otherwise
Storage (GAP7)	=1 if farm adopt proper storage facilities to reduce contamination and postharvest loss, 0 otherwise
Independent variable	
Gender	Gender of the respondent (1= male, 0=female)
Age	Age of the respondent (year)
Education	Formal education of the respondent (year)
Farming experience	Farming experience of the respondent (year)
Training	= 1 if respondent have received training on GAP, 0 otherwise
Regular contact	=1 if respondent have regular contact with extension worker, 0 otherwise
Membership	=1 if respondent is member in agricultural cooperatives, 0 otherwise
Subsidy	= 1 if respondent has access to agricultural subsidy, 0 otherwise
Income	Annual income of the household (NPR)
Source of income	=1 if household receive income from agriculture only, 0 otherwise

RESULTS AND DISCUSSION

Descriptive statistics of the variables used in the study

The descriptive statistics of the variables used in this study are presented in Table 2. The results indicate that 70% of the farms adopted the use of proper dress for spraying chemicals, 38% adopted the practice of equal labor wages for males and females performing similar work, and 20% considered site history and management practices for farming. Additionally, 76% of the farms used safe water for irrigation, 75% practiced harvesting after a safe period following chemical application, 69% used hygienic and proper equipment for harvesting, and 41% had proper storage facilities to reduce contamination and postharvest loss.

Among the sample farm households, 52% were headed by males. The respondents had an average age of 42.85 years and an average of 7.95 years of formal schooling. On average, respondents had 11.15 years of farming experience and an annual household income of NPR 547304.35. Additionally, 37% of the respondents had received training related to GAP, 72% participated in agricultural cooperatives, and 39% had regular contact with extension workers. Similarly, 46% of the respondents had access to agricultural subsidies, and for 45% of the farm households, agriculture was their only source of income.

Table 2. Descriptive statistics of the dependent and independent variables used in the study

Variable	Mean	Standard Deviation
Dependent variable		
GAP		
Use of dress (GAP1)	0.70	0.458
Equal wages (GAP2)	0.38	0.488
Site history (GAP3)	0.20	0.402
Safe water (GAP4)	0.76	0.431
Harvesting after safe period (GAP5)	0.75	0.436
Hygienic harvesting (GAP6)	0.69	0.466
Storage (GAP7)	0.41	0.494
Independent variable		
Gender	0.52	0.502
Age	42.85	14.357
Education	7.95	5.876
Farming experience	11.15	9.067
Training	0.37	0.486
Regular contact	0.39	0.490
Membership	0.72	0.450
Subsidy	0.46	0.501
Income	547304.35	735482.08
Source of income	0.45	0.500

Source: Field survey, 2022

Factors affecting the adoption of GAP

Table 3 shows the results of a binary probit regression analysis used to identify the factors affecting the adoption of GAP. Several variables significantly affected the adoption of GAP, as discussed below;

Education of the respondent

The results revealed that the respondent's education positively affected the adoption of hygienic and proper equipment for harvesting, as well as the adoption of proper storage facilities to reduce contamination and postharvest loss on the farm. With better education, farmers can access more information on good agricultural practices and develop positive attitude in adopting new technologies. Fakkhong and Suwanmaneepong (2017) reported a significant influence of education on the adoption of GAP among rice farmers.

Farming experience of the respondent

The results revealed that the respondents' farming experience negatively affected the adoption of equal wages for male and female labor performing similar work and the adoption of an overview of site history and management for farming practices. Longer farming experience appears to make farming communities resistant to adopting new practices, as they tend to rely heavily on traditional methods (Yu & Luo, 2021). Pongvinyoo and Yamao (2014) reported a similar finding, noting that farming experience negatively influenced the perception and understanding of GAP among coffee growers.

However, a positive influence of farming experience was observed in the adoption of hygienic and proper equipment for harvesting produce on the farm. In contrast to the resistance observed in other areas, farmers with more experience are more inclined to adopt GAP because their familiarity with agricultural practices enables them to understand and incorporate new techniques more effectively (Janthong & Sakkatat, 2018; Krasachat, 2023; Krasachat & Yaisawarng, 2021). Suwanmaneepong et al. (2016) reported a significant influence of farming experience on the adoption of GAP among fruit farmers. Janthong and Sakkatat (2018) also reported experience in corn farming affected the adoption of GAP among farmers.

Participation in training

The results revealed that participation in training positively affected the adoption of proper dress for spraying chemicals, equal wages for male and female labor performing similar work, an overview of site history and management for farming practices, the use of safe water for irrigation, and proper storage facilities to reduce contamination and postharvest loss. GAP is a relatively new concept for farming communities, and their widespread adoption is achievable primarily through training for farmers and stakeholders. Suwanmaneepong et al. (2016) reported a significant influence of training participation on the adoption of GAP among fruit farmers. Nguyen et al. (2020) also reported training played a crucial role in promoting the adoption of Good Animal Husbandry Practices in pig production, significantly enhancing the implementation of various GAP standards.

Regular contact with extension worker

The results revealed that regular contact with extension workers positively affected the adoption of proper dress for spraying chemicals, the use of safe water for irrigation, and harvesting produce after the safe period following chemical application. Extension workers are equipped with extensive knowledge of good agricultural practices. They serve as key facilitators of these practices within local communities by ensuring timely dissemination of information, building farmers' confidence, and fostering adoption through interventions like experience sharing (Kilonzo-Nthenge et al., 2018). Pongvinyoo and Yamao (2014) similarly reported a significant

influence of extension services on the adoption of GAP among coffee farmers.

Involvement in agricultural cooperatives

The results revealed that involvement in agricultural cooperatives positively influenced the adoption of proper dress for spraying chemicals, equal wages for male and female labor performing similar work, an overview of site history and management for farming practices, the use of safe water for irrigation, harvesting produce after the safe period following chemical application, and proper storage facilities to reduce contamination and postharvest loss. Agricultural cooperatives play a crucial role in promoting improved farming practices within local communities. I/NGOs and government institutions closely collaborate with agricultural cooperatives (using a group-based extension approach) to disseminate information, providing cooperative members with greater access to agricultural knowledge (Niraula et al., 2023).

Moreover, Mishra and Bhatta (2021) reported that agricultural cooperatives support their members by pooling inputs and equipment, offering credit without collateral in some cases or using monthly deposit sums as security, building capacity, and ensuring marketing facilities. These functions collectively promote the development and adoption of good agricultural practices (GAP). Similarly, Fakkhong and Suwanmaneepong (2017) reported a significant influence of involvement in agricultural cooperatives on the adoption of GAP among rice farmers. Srisopaporn et al. (2015) also reported adoption of GAP among rice farmers is influenced by cooperative membership.

Income of farm household

The results revealed that the annual income of farm households negatively affected the adoption of equal wages for male and female labor performing similar work. In the Nepalese context, the wage gap between male and female labor has remained significant. In the study area, male laborers typically earn NPR 140-150 per hour, while female laborers earn NPR 90-100 per hour. Farm households with higher annual incomes tend to focus more on off-farm activities and property acquisition, which reduces their emphasis on adopting GAP on the farm. These households, often considered power groups within the community, perpetuate discriminatory practices. Despite female laborers being dominant in numbers, they receive less recognition and fewer economic benefits compared to their male counterparts.

Access to subsidy

The results revealed that access to agricultural subsidies positively affected the adoption of hygienic and proper equipment for harvesting. Smallholders are generally resource-poor farmers with limited ability to invest in their farms (Mishra, 2021). Agricultural subsidies motivate farmers to advance and innovate in their farming practices. These subsidies help minimize the economic burden on farmers and enhance their ability to adopt new technologies. Additionally, I/NGOs and government bodies provide subsidies ranging from 30% to 100% for the purchase of farm equipment. Kılıç et al. (2020) reported influential role of subsidies and support program on the adoption of GAP by farmers.

Source of income in farm household

The results revealed that farm households with agriculture as their sole income source were more likely to adopt proper dress for spraying chemicals and proper storage facilities to reduce contamination and postharvest loss. These households tend to adopt improved farming practices to maximize returns and improve their livelihoods. The long-term effects of chemicals on human health and high postharvest losses are major issues faced by farm households. As a result, they try to address these challenges by adopting proper dress and postharvest technologies.

Table 3. Probit model parameter estimates on factors affecting the adoption of GAP

Variable	GAP1	GAP2	GAP3	GAP4	GAP5	GAP6	GAP7
	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)
Gender	0.270	0.519	0.136	0.125	-0.012	-0.297	-0.189
	(0.497)	(0.331)	(0.307)	(0.361)	(0.306)	(0.531)	(0.307)
Age	-0.006	0.016	0.012	-0.003	-0.007	-0.018	-0.008
	(0.021)	(0.012)	(0.011)	(0.014)	(0.010)	(0.023)	(0.010)
Education	0.031	-0.029	-0.002	-0.001	0.011	0.081*	0.060**
	(0.057)	(0.031)	(0.282)	(0.037)	(0.027)	(0.045)	(0.027)
Farming experience	-0.008	-0.053***	-0.043**	0.001	0.007	0.414***	0.007
	(0.025)	(0.018)	(0.017)	(0.019)	(0.017)	(0.081)	(0.016)
Training	2.087***	1.132***	0.892***	1.129***	0.356	0.749	0.541*
	(0.478)	(0.299)	(0.278)	(0.324)	(0.281)	(0.538)	(0.279)
Regular contact	3.161***	0.377	0.220	1.566***	1.101***	0.038	0.375
	(0.765)	(0.305)	(0.289)	(0.375)	(0.311)	(0.508)	(0.298)
Membership	2.653***	0.666**	0.667**	1.359***	0.653**	-0.148	0.903***
	(0.640)	(0.324)	(0.307)	(0.371)	(0.291)	(0.521)	(0.304)
Log (Income)	0.524	-1.047**	0.137	-0.352	0.280	-0.614	0.401
	(0.720)	(0.464)	(0.393)	(0.490)	(0.437)	(0.803)	(0.410)
Subsidy	0.479	0.286	0.063	0.0487	-0.203	1.024*	-0.116
	(0.435)	(0.293)	(0.277)	(0.325)	(0.282)	(0.560)	(0.280)
Source of income	1.019*	-0.302	-0.154	0.263	0.111	0.238	0.515*
	(0.525)	(0.294)	(0.277)	(0.335)	(0.287)	(0.538)	(0.284)
Cons	-7.179	4.392	-1.961	-0.084	-2.122	-0.932	-3.624
	(4.202)	(2.560)	(2.217)	(2.728)	(2.480)	(4.515)	(2.317)
Summary statistics							
Number of observations	115	115	115	115	115	115	115
LRchi2 (10)	107.68	42.91	29.34	69.48	31.03	118.24	34.31
Prob>chi2	0.0000	0.0000	0.0011	0.0000	0.0006	0.0000	0.0002
PseudoR2	0.6773	0.2704	0.1853	0.4370	0.1995	0.7437	0.2155
Log likelihood	-25.66	-57.902	-64.515	-44.7594	-62.2668	-20.3773	-62.4495

Source: Field survey, 2022

Note: ***, ** and * indicate 1%, 5% and 10% level of significance, respectively. Value in the parentheses indicates standard error.

CONCLUSION

Results from the investigation to identify the factors affecting the adoption of Good Agricultural Practices (GAP), revealed that formal education and farming experience significantly affected the adoption of GAP among respondents. Regular contact with extension workers, training related to GAP, membership in agricultural cooperatives, and access to agricultural subsidies also significantly affected adoption. Additionally, annual household income and having agriculture as the only source of income were found to significantly affect the adoption of GAP. Therefore, regular extension services and appropriate training related to GAP should be provided to smallholder vegetable farmers to improve adoption. The capacity of agricultural

cooperatives should be strengthened to maximize adoption. Smallholder farmers should also have proper access to agricultural subsidies for better utilization of GAP. Farm households with agriculture as their sole income source should be prioritized to increase the uptake of GAP.

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