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Research Article

Adoption status of good agricultural practices among vegetable growers in the Arghakhanchi district of Nepal

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ABSTRACT

The vegetable sector substantially contributes to the Nepalese economy and offers instant income, nutrition, and food security. The unsystematic use of agrochemicals for commercialising production has posed a threat to the sustainability of the vegetable sector in recent decades. The usage of agrochemicals in commercial vegetable production may be reduced by implementing Good Agriculture Practices (GAP). This study aims to find out the knowledge, application, and perception of farmers towards Good Agricultural Practices (GAP) along with the adoption index in the Arghakhanchi district of Nepal from February 2023 to June 2023. Altogether 125 households from Sandhikharka Municipality and Chhatradev Rural Municipality were chosen using stratified random sampling technique. Focus group discussion (FGD), Key Informant Interview (KII), and preliminary field visits were carried out to gather primary data, and a variety of literatures were reviewed to gather secondary data. The results showed that 38.4% of households (HHs) were aware of the GAP. The higher adopters were 15.48% HHs with a mean adoption value of 19.57. About15.4% HHs were low adopters with an adoption value of 9.45 and 70.73% of HHs were medium adopters with an adoption value of 14.92 out of 29. The low level of GAP application was found in the harvesting method with the lowest mean score of 0.136, however, storage duration had the highest average score of 0.992. Farmers ranked insect pest damage as the most severe problem with an index value of 0.79, while weather as the least severe problem with an index value of 0.33 in rank I, and V respectively. All respondents gave their perception of GAP with 75.2% agree, 12.8% neither agree nor disagree and 12% strongly agree that GAP helps them to increase their productivity.

Keywords: GAP, Adoption, Production, Application, Perception

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INTRODUCTION

Nepalese people are mostly involved in agriculture, reaching up to 2/3rd of the total population, contributing 24.90% to our country's overall Gross Domestic Product (GDP). Among these vegetables contribute 16.9% to Agriculture Gross Domestic Product (AGDP)

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(MoALD, 2020). Horticultural products make up a significant portion of Nepal's agricultural business, among other various agricultural products, horticultural products contribute 7.11 of the overall GDP in total and vegetables are grown on 284,121 hectares which is a major portion of cultivated land (MoALD, 2020). With an average yield of 12.61 t/ha, the production is 19,898 tons (MoALD, 2020).

The Food and Agriculture Organization (FAO) (FAOSTAT, 2019) of the United Nations defines 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 considering economic, social, and environmental considerations. In 2018, the concept of Good Agricultural Practices (GAP) was introduced in Nepal to address the issues of food safety, trade, and sustainability. It has also identified barriers to wider adoption of GAP, broadly categorized into production, extension, regulation and standards, and markets and finance.

The five key pathways of GAP are (i) Technical capacity building, (ii) Awareness creation, (iii) Soil fertility management strategies, (iv) Extension programs, and (v) Market development for institutionalizing GAP in Nepal, based on the learning from global evidence. In simple language economic viability, environmental sustainability, social acceptability, food safety, and quality are the four major pillars of GAP (FAO, 2023). Because of the increasing demand for safe products with the certification, the government of Nepal has recently endorsed Nepal GAP Implementation Directives.

Even though the production and productivity of vegetables have increased in past decades and farmers are more drawn to growing vegetables because of greater financial returns than cereals, the present productivity is still not satisfactory. The reason behind this can be the adoption of faulty cultivation practices by farmers. The dilemma of the farmers for the adoption of suitable variety for seasonal and off-seasonal farming is also quite a problem in the area.

Despite the government's efforts and technical and financial support from bilateral and international aid agencies, agricultural productivity in Nepal has not increased substantially since the green revolution; even though there have been ongoing efforts from Government of Nepal and civil society organizations, agriculture growth has remained stagnant at an average rate of 3% over the past few decades (Kharel *et al*., 2022). Realizing the limitations of conventional farming and the importance of GAP, this study aimed to promote sustainable technology among vegetable farmers of Nepal through a learning-by-doing approach. Moreover, to date, there is no scientific evidence found on the effect of GAP on vegetable production in the Arghakhanchi district.

There is enormous potential to produce vegetables on a large scale in the Arghakhanchi district and a lot of farmers are directly involved in it making it a major source of their family's source of income. However, farmers are still ignorant of effective agricultural production techniques even with the provision of required agricultural and technical inputs. Previous research has shown that education level and policies made by the governmental sector are of major importance for the adoption of GAP among farmers (Poisot *et al.*, 2007). The knowledge of the GAP and, detailed study of factors affecting its adoption in farmers

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could boost vegetable production exponentially because of the improvement in the inter cultural practices. This study aims to identify the existing differences between farmers' practices and recommended Good Agricultural Practices. As research shows, the first step in adopting modern technology is to become familiar with it (Rogers & Albritton, 1995). This study analyzed GAP awareness among vegetable producers as well as the adoption rate of GAP by farmers. It will provide guidance to organizations and institutes, focusing on factors that might raise GAP awareness. This study will determine the perception of farmers toward GAP. It can also serve as a basis of feedback for the formulation and implementation of plans and programs that may prove to be effective for the concerned stakeholders within the district.

METHODOLOGY

Study site description

The selection of the site was based on the area coverage of vegetables and number of vegetables growing farmers, the production of vegetables, and access to road facilities in the Arghakhanchi district. This district is situated in middle hill of Lumbini Pradesh which has a total area of 1,193 km2. The altitudes vary from 305 to 2,515 masl and have latitudes of 27’45” N-28’6” N and longitudes of 80’45” E-83’23” E. There is enormous potential for vegetable cultivation and production. The study was conducted in the Sandhikharka Municipality and the Chhatradev Rural Municipality. These areas were prioritized also because of the major focus from PMAMP and AKC; and suggestions from the officials.

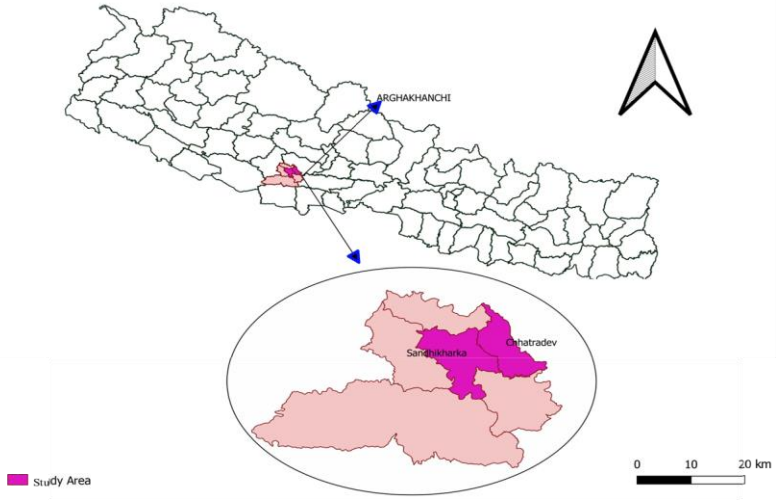

Figure 1: Map of Nepal with site of research
Source: National Geoportal, Nepal (Qgis version 3.16)

Sample size and sampling techniques

A verified database of 536 registered vegetable growers from the AKC and PMAMP zone in Arghakhanchi district was used as the sampling frame. Farmers producing year-round vegetables on at least two ropani of land were selected. Using stratified random sampling without replacement, 187 eligible farmers were identified in two municipalities selected based on data from PMAMP Vegetable Zone, Arghakhanchi . Further wards were selected based on density of commercial farmers. Applying Raosoft’s sample size formula (5%

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margin of error, 95% confidence level), a sample size of 125 farmers was chosen, distributed across Chhatradev and Sandhikharka.

Data collection

A preliminary field visit was conducted to gather demographic, socio-cultural, topographical, and farming information, aiding in schedule preparation and sampling framework design. A semi-structured interview schedule was developed to collect data on socio-economic characteristics, production practices, land holdings, income, and adoption of Good Agricultural Practices (GAP) in the study area. The interview schedule was pre-tested with vegetable growers outside the study area in Arghakhanchi district, leading to necessary adjustments. The field survey involved both open and closed-ended questions, collecting qualitative and quantitative data from a stratified random sample. A Focus Group Discussion (FGD) was held to verify data, involving diverse local farmers to discuss farming practices, production factors, and GAP knowledge. Key Informant Interviews (KII) with progressive farmers and officials provided insights into the current state of vegetable production and the effectiveness of training and subsidies.

Data Analysis

With the help of MS Excel 2015 and SPSS Version 25 tools, Descriptive analysis was done using mean frequency, percentage, etc. As per necessity, graphs, Tables, and Pie Charts were used that sufficiently extrapolate the prevailing status of the farming system, mechanical equipment used, etc.

Chi-square or test of independence

The chi-square test was applied to determine whether two variables were independent or associated with each other. This test was used to analyze the association between knowledge of GAP and the other variables and the adoption of GAP.

$$X^{2=} \quad \Sigma \frac{(oij-eij)2}{eij} \qquad \text{…….(1)}$$

Where, X^2= chi square,
O_{ij} = Observed frequency of each ij^{th} term
e_{ij}= Expected frequency of each ij^{th} term
i=1, 2, 3……r
j= 1, 2, 3……k

This was tested at a 0.05 level of probability for different degrees of freedom. (Poudel *et al*,. 2022) used chi-square test for a comparative study of major diseases of major summer vegetables and their management practices in Syangja, Nepal.

Awareness of GAP among farmers

The knowledge of GAP among farmers was divided into two categories viz. farmers having some idea of GAP and farmers who have not heard about it before.

Perception of farmers toward GAP

The farmers' perception of GAP was analyzed on a scale of strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree. They were simply described based on the

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maximum obtained value.

Level of GAP adoption

The GAP application scores achieved by the respondents on each practice are calculated on average score. Furthermore, the level of application of GAP is classified into 2 categories namely low application level and high application level. A score higher than 60% was considered a higher application level and others were low application level as practiced in previous researches on GAP. (Suharni *et al*., 2017) used the differentiation of the Level of Application of GAP to rank different practices in Shallot farming in Bantul Regency. The adopters of GAP technology were classified under three categories as either low, medium adopter or high adopter by using the Adoption Index (AI). The adoption index was calculated from the adoption scores. Based on the AI, the respondents were grouped into three categories i.e., low (less than mean minus SD), medium adopters (mean minus SD to mean plus SD), and high adopters (mean plus SD). The degree to which an innovation is adopted by the farmer is the adoption index.

Adoption Index was calculated (Dongol, 1979).

$$\text{Adoption Index (AI)} = \text{TAS/MOS} \times 100 \quad \text{……..(2)}$$

Where,

AI: Adoption Index

TAS: Total adoption score obtained by an individual farmer.

MSO: Maximum score one can obtain.

Dhital & Joshi (2016) used the adoption index to determine the factors affecting the adoption of recommended cauliflower production technology in Nepal.

Ranking of problems related to vegetable production

Five-point scaling technique was used to measure the relative severity of production problems. Farmers' perception of the importance given to the different production constraints was analyzed by using a 5-point scale of constraint indicating major factor or problem (1 or 6) to minor factor or problem (0.2 or 1).The index of importance was computed by using the formula (Miẏa, 1993).

$$I_{imp} = \sum S_i f_i / N \quad \text{……..(3)}$$

Where,

I_{imp} (index of importance) = "0<I<1" or "1<I>6"

$\sum$ = summation

S_i= i^{th} scale value

F_i= frequency of i^{th} importance given by the respondents

N = total number of respondents

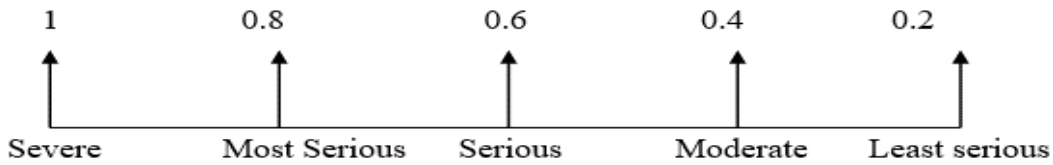

Figure 2: Scale of rating

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RESULTS AND DISCUSSION

Socioeconomic and demographic profile of respondents

Out of 125 respondents, a significant majority, constituting 76.0% were from Sandhikharka Municipality while about 24.0% were from Chhatradev Rural Municipality. This was mostly due to easy access of farmers to AKC, and other government policies, and training. The male respondents contributed a major portion of the research i.e., 80.0% and female respondents were 19.2%. Greater involvement of male farmers was found in vegetable farming in the study area (Table 1). This study showed that male were more involved in vegetable farming and aware of GAP. This result is in line with the findings of (Dorji *et al*., 2016)

Among the total respondents, 78.4% were of Brahmin / Chhetri ethnicity, 11.2% were Janajati / Adhibasi, 8.8% were Dalit and 1.6% belonged to other ethnicities. Concerning education, the majority of the respondent were of SLC level 36.0% and minority was Illiterate with only 4%. The Literate, Primary, Secondary, +2 level, and bachelor and above consist of 11.2%, 11.2%, 16%, 12.8%, and 8.8% respectively, and was found highly significant among the aware and unaware population (Table 1). High percentage of literate people indicated that people were aware of GAP, (Joshi *et al*., n.d.) reported similar field observation in terms of literate percentage.

Table 1: Socio-economic profile of respondents

Profile Characters	Categories	GAP Awareness		Overall (N=125)	Chi-square	P-value
		Unaware (n= 77)	Aware (n= 48)			
Palika	Sandhikharka	52(54.7)	43(45.3)	95(76.0)	7.882***	0.005
	Chhatradev	25(83.3)	5(16.7)	30(24.0)		
Gender	Male	61(60.4)	40(39.6)	101(80.8)	0.322	0.570
	Female	16(66.7)	8(33.3)	24(19.2)		
Ethnicity	Brahmin/Chhetri	61(62.2)	37(37.8)	98(78.4)	1.915	0.590
	Janajati/Adhibasi	10(71.4)	4(28.6)	14(11.2)		
	Dalit	5(45.5)	6(54.5)	11(8.8)		
	Other	1(50)	1(50)	2(1.6)		
Education Status	Illiterate	5(100)	0(0)	5(4)	20.011***	0.003
	Literate	14(100)	0(0)	14(11.2)		
	Primary	11(78.6)	3(21.4)	14(11.2)		
	Lower Secondary	12(60)	8(40)	20(16)		
	SLC	24(53.3)	21(46.7)	45(36.0)		
	+2	6(37.5)	10(62.5)	16(12.8)		
	Bachelor and above	5(45.5)	6(54.5)	11(8.8)		

Notes: Figures in parentheses indicate percentage (%). ** indicates significance at 5% level.
Source: Field Survey, 2023

Level of application of GAP

Awareness and knowledge of new technologies is the first step toward its adoption (Roger, 2000). The average score of GAP application was 0.510(51%). The low level of GAP application was found on storage, precooling, rhizobium application, tillage operation method, harvesting method, time of harvesting, use of gloves, method, and time of FYM

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application, crop rotation, modern irrigation method, soil testing and disease, pest, and weed management. The Storage duration has the highest average score with 0.992 followed by Source of seed resources, Crop rotation with legumes, Equipment and Mechanization, Spacing, Poly tunnel, Gap filling, Chemical Dose, Seed treatment, Bio pesticides uses, Mulching, and Micronutrient Application (Table 2).These areas are crucial for maintaining crop quality and ensuring efficient post-harvest processing, which could affect both yield and marketability.

This indicates that only slightly over half of the recommended practices are being adopted, suggesting room for substantial improvement in several critical areas. Almost 98% of the soil in Nepal is deficient in organic matter (Tripathi, 1999) due to higher application of chemical pesticides. Percentage of the respondents who conduct soil test and applied chemical dose are in line with the findings of (Joshi *et al.,* 2020). Weed management by the respondents shows similar observation with the results of (Adhikari *et al*., 2023)

Table 2: Level of Application of GAP

Technology Components	Maximum Score	Average Score	Percentage (%)	Criteria
Site Selection	1	0.408	40.8	Low
Soil Test	1	0.52	52	Low
Time of FYM application	1	0.448	44.8	Low
Method of FYM application	1	0.344	34.4	Low
Source of Seed Resources	1	0.976	97.6	High
Seed Treatment	1	0.736	73.6	High
Spacing	1	0.824	82.4	High
Micronutrient Application	1	0.64	64	High
Rhizobium Application	1	0.064	6.4	Low
Tillage Operation Method	1	0.088	8.8	High
Equipment and Mechanization	1	0.824	82.4	High
Polytunnels	1	0.808	80.8	High
Modern Irrigation Method	1	0.48	48	Low
Mulching	1	0.64	64	High
Crop rotation with Legume	1	0.936	93.6	High
Storage	1	0	0	Null
Gap Filling	1	0.768	76.8	High
Timing of Planting	1	0.368	36.8	Low
Chemical Dose	1	0.736	73.6	High
Biopesticides	1	0.656	65.6	High
Disease Management	1	0.48	48	Low
Pest Management	1	0.5392	53.92	Low
Weed Management	1	0.5552	55.52	Low
Harvesting Method	1	0.136	13.6	Low
Use of Gloves	1	0.224	22.4	Low
Precooling	1	0.008	0.8	Low
Storage duration	1	0.992	99.2	High
Crop rotation	1	0.448	44.8	Low
Harvesting Time	1	0.152	15.2	Low

Source: Field Survey, 2023

Adoption Index

The average total GAP points obtained by the respondent farmers is 14.798 out of 29. The 19 Higher Adopters have an average GAP point of 19.579, that of 19 Low Adopters is 9.453 and

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the Medium Adopters have an average GAP point of 14.922 (Table 3). This lower adoption score represents limited adoption of GAP, potentially due to barriers like resource limitations, lack of awareness, or insufficient access to training. The gap between High, Medium, and Low Adopters suggests that targeted training, resources, and support are needed, particularly for Low Adopters, to encourage broader and more effective GAP adoption. A study conducted by (Pandit *et al*., 2017) shows similar result with the low level of GAP application in overall.

Table 3: Adoption Level and Index Value

Adoption Level	Frequency	Mean
Low Adopter	19	9.453(1.806)
Medium Adopters	87	14.922(1.787)
Higher Adopters	19	19.579(1.617)
Total	125	14.798(3.310)

Note: Figures in the parentheses indicate Standard Deviation
Source: Field Survey, 2023

Perceptions of farmers on different management practices

Perceptions of the different practices were considered by the respondents in the form scale. The practices discussed were Mulching, Tunnel, Post-harvest techniques, Drip Irrigation, and GAP. The respondents with high satisfaction ranked them as strongly agree and with lowest satisfaction, they ranked the practices as Strongly Disagree.

Out of the survey farmers, 80.8% gave their perception on mulching, tunnel, and post-harvest techniques while, 48 % gave on drip irrigation and all gave their perception on GAP. The majority agree on GAP with 75.2%, mulching with 52.5% and Tunnel with 51.5%. In case of Post-harvest techniques, the majority i.e. 47.5% neither agree nor disagree on its positive impact on productivity. This result agrees with the finding of (Olayemi *et al*., 2020).

Table 4: Perceptions of farmers on different management practices

Perception on	Mulching	Tunnel	Post-harvest techniques	Drip Irrigation	GAP
Given	101(80.8)	101(80.8)	101(80.8)	60(48)	125(100)
Unknown	24(19.2)	24(19.2)	24(19.2)	65(52)	0
Ranking					
Strongly agree	33(32.7)	34(33.7)	7(6.9)	5(8.3)	15(12)
Agree	53(52.5)	52(51.5)	46(45.5)	39(65)	94(75.2)
Neither Agree nor Disagree	14(13.9)	15(14.9)	48(47.5)	10(16.7)	16(12.8)
Disagree	1(1)	0	0	6(4.8)	0
Strongly Disagree	0	0	0	0	0

Notes: Figures in parentheses indicate percentage (%).
Source: Field Survey, 2023

This result clearly showed that farmers are satisfied with the GAP adoption. Majority of farmers' satisfaction with GAP revealed a widespread belief in the effectiveness of GAP for improving agricultural outcomes. Besides, farmers' neutrality towards post harvest

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techniques suggests uncertainty about its effectiveness or a potential lack of sufficient knowledge and support in this area. The data implies a need for targeted education and support, especially in areas where farmers showed lower engagement like drip irrigation. (Dorji et al., 2016) reported that the adoption of GAP by farmers leads to increased yield and income.

Production problem

The five major production problems were identified in the study area and farmers were asked to rank them based on the severity from most severe to least severe. Farmers ranked Insect Pest damage as the most severe problem with index value of 0.7904. The consecutive ranked problems were Unavailability of Inputs, Poor Infrastructure, Poor Technical Knowledge, and Weather respectively as rank II, III, IV and respectively. A similar result was found in a research conducted in Syangja district (Acharya *et al.,* 2022) where farmers ranked insect pest damage as major problem in production process. The result depicted that insect pest damage cause heavy losses in production.

Table 5: Ranking of Major Production Problems in commercial vegetable production

Problems	Most Severe 1	Highly Severe 0.8	Moderately Severe 0.6	Less Severe 0.4	Least Severe 0.2	Weight	Index	Rank
Unavailability of Inputs	38	28	35	17	7	89.6	0.7168	II
Insects Pest Damage	50	34	27	13	1	98.8	0.7904	I
Poor Technical Knowledge	11	11	32	60	11	65.2	0.5216	IV
Poor Infrastructure	20	43	26	22	14	81.6	0.6528	III
Weather	7	10	5	11	92	40.8	0.3264	V

Source: Field Survey, 2023

CONCLUSION

The study showed that because of the adoption of inappropriate management practices, Insect pest was the major problem among other production problems while the weather was the least production problem. Medium level of GAP adopters were more followed by low and high-level of adopters. A higher percentage of medium level of adopters of GAP revealed there is need of training regarding the GAP. The farmers had better practices among source of seed resources, seed treatment, spacing of plants, micronutrient application, method of tillage operation, equipment, and mechanization, polytunnels, mulching, crop rotation with legumes, gap filling, dose of chemicals used and biopesticides. These resulted from training, experience, and modern social media. The other practices like site selection, soil test, time, and method of FYM application, rhizobium application, modern irrigation method, storage, timing of planting, harvesting method, management of disease, pest and weed needed big improvements to make farmers full adoption of Good Agricultural Practices. The reason for the lack of adoption of these practices was the lack of investment and traditional way of farming. The majority of respondents gave responses on mulching, tunneling, and post-

harvest techniques, while the reverse was the case for drip irrigation.

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Authors' Contributions

Conceptualization: Anish Nepal, Methodology: Anish Nepal and Kapil Khanal, Software and validation: Anish Nepal and Kapil Khanal, Formal analysis and investigation: Anish Nepal, Nikita Parajuli, Resources: Anish Nepal, Data curation: Anish Nepal, Nikita Parajuli Writing-original draft preparation: Anish Nepal, Writing review, and editing: Anish Nepal, Nikita Parajuli, Kapil Khanal Supervision: Anish Nepal and Kapil Khanal. All authors have read and agreed to the publication version of the manuscript.

Conflicts of interest

The authors declare no conflict of interest.

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