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Adoption of Good Agricultural Practices (GAP) by Vegetable Farmers for Safe Food: An Empirical Study on Dinajpur District

Md. Rubayet Al Ferdous Noman[1,a,*], Shahana Yeasmin[2,b]

[1]*Department of Agricultural Extension, Faculty of Agriculture, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh*
[2]*Cotton Development Board, Ministry of Agriculture, Govt. of the People's Republic of Bangladesh*
[*]*Corresponding author*

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ABSTRACT

In order to produce safe and healthy food and agricultural products, Good Agricultural Practices (GAPs) are a set of guidelines that should be followed during the production process on farms as well as during post-production, all the while considering the sustainability of the economy, society, and environment. Therefore, the research focus was to determine the extent of awareness and adoption of Good Agricultural Practices (GAPs). A mixed method was followed during conducting the study. A sample of 120 vegetable farmers were selected by following simple random sampling technique and by following proper sampling formula. Data were collected by a pre-tested interview schedule during 01 January to 31 May 2024 by face-to-face interview method. Descriptive statistics as well as inferential statistics like Pearson Product Moment Correlation Coefficient analysis were followed. Findings reveals that more than half of the respondents (56.7%) had medium awareness level on GAP while majority (65.0%) of the vegetable farmers had low level of adoption of Good Agricultural Practices in vegetable cultivation. Factors such as area under cultivation, experience, training received, market perception, environmental orientation, and extension contact demonstrated a positive and significant relationship, underscoring the importance of these elements in enhancing GAP adoption among farmers. The most important constraint is increased difficulty in management of pest and disease incidence having mean score of 2.7. More intensive training, motivational activities and capacity building programs are required for the farmers to enhancing awareness, skill on GAP ultimately increase the adoption.

[a] *sonetrubayet@hstu.ac.bd* *https://orcid.org/0009-0002-7818-7015* | [b] *shahanayeasmincdb@gmail.com* *https://orcid.org/0009-0006-4414-8201*

Introduction

The agricultural sector in Bangladesh is gradually transitioning from subsistence to commercial agriculture to meet the increasing demand for food driven by population growth. This shift has led to a higher use of high-yielding and hybrid crop varieties alongside extensive application of chemical fertilizers and pesticides. Sometimes, organic fertilizers containing harmful heavy metals or chemicals are also used, posing risks to human health. Good Agricultural Practices (GAPs) address these environmental, economic, and social sustainability issues by promoting safe and quality food and non-food agricultural products, such as vegetables.

The rising demand for quality and safety in vegetables has spurred the development of common principles and standards for cultivation, commonly referred to as GAP (Guddanti, 2015). Ensuring safe food requires adherence to GAP from production through harvest and post-harvest processes like packaging and transportation (Hobbs, 2003). Adoption of GAP can boost farm income by 6.2% while reducing synthetic fertilizer use by 31% for crops like rice, lentil, tomato, and ginger, as observed in Nepal (Bairagi et al., 2019) and farmers adopting cropping practices like soil water retention, knowledge, and cow dung availability (Sunny et al., 2022)) livestock integration, soil fertility, and integrated pest management reduced agrochemical use by over 40%, motivated mainly by soil health improvement, safety, and farm image benefits (Kharel et al., 2023)). Many developed countries, including Denmark, Australia, and the United States, have long implemented GAP packages focusing on integrated pest and nutrient management (Waage, 1998; Zalucki et al., 2009; Remac, 2018). In Turkey, GAP serves as an alternative to organic farming (Akkaya et al., 2005). Similarly, several Asian countries such as Nepal, India, Indonesia, Malaysia, the Philippines, and Thailand have adopted GAP particularly in vegetable farming, emphasizing integrated pest and soil fertility management (Ntshangase et al., 2018). Research by Laosutsan et al. (2019) identified income as the most influential factor in GAP adoption among Thai vegetable farmers, recommending compulsory GAP certification by exporters and government agencies to boost adoption. Household labor constraints, land ownership, and expectations of market opportunities influenced GAP adoption and dis-adoption in rice farming, with improved

pest and nutrient management persisting even after GAP abandonment (Srisopaporn et al., 2015). High GAP adoption in the Davao banana industry, attributed to corporate farms serving export markets Banzon et al., 2013). Program participation and knowledge precursors to adoption were significantly affected by chili production experience (Athipanyakul and Pak-Uthai, 2012)

GAP is applicable across various farming systems of different scales, improving sustainability through integrated pest, weed, and disease management, soil and water conservation, and fertilizer management (Ntshangase et al., 2018). Widespread unawareness of GAP standards among vegetable growers, with production costs, market exclusivity, training, government support, and labor access as key determinants for GAP use. Behavioral intentions to adopt GAP were influenced by attitudes, subjective norms, and perceived behavioral control (Cherotich, 12021). GAP awareness and positive attitudes, but limited adoption due to lack of information, technical knowledge, inputs, capital, labor, and suitable field conditions. Awareness of GAP certification and understanding its benefits significantly affected adoption (Thenuwara and Malknthi (2020)). Overall, GAP promotes increased productivity and improved quality (Dudeja and Singh, 2018).

Safe food production is increasingly important for protecting human health and ensuring economic competitiveness in the global market. Food safety issues arise from indiscriminate pesticide use, chemical residues, heavy metals, and microorganisms throughout the food chain. Thus, adopting GAP at all production stages is crucial for safe food provision. In Bangladesh, especially within the proposed study areas, adopting GAP can ensure safe, high-quality vegetable production, sustainable environmental and social benefits, increased incomes, economic momentum, and enhanced food and nutrition security.

Despite these advantages, poor implementation of GAP along the vegetable production chain remains a challenge. When carefully applied, GAP enables farmers to produce highly nutritious, high-quality vegetables with better market access. Effective GAP implementation has shown significant reductions in contamination risks in vegetable production. A clear understanding of the current adoption status of GAP is essential. Hence, the study aims:

i) To determine the extent of awareness on Good Agricultural Practices (GAPs) in vegetable cultivation among the farmers.

ii) To assess the extent of adoption of Good Agricultural Practices (GAPs) by the vegetable farmers.

iii) To explore the relationship of the selected characteristics of the vegetable farmers on the adoption of Good Agricultural Practices (GAPs).

iv) To identify the confronted constraints of the vegetable farmers while implementing the Good Agricultural Practices (GAPs) in their field.

Methodology

A mixed-method approach, combining quantitative and qualitative methods was adopted for the study, which includes farmers' surveys, key informant interviews, and in-depth interviews (Kharel et al., 2023).

Locale of the Study

The proposed research study was conducted at the two upazilas namely Birol and Birganj under Dinajpur district as in these areas a plenty of vegetables are cultivated which is not only fulfil the local market demand but also export in the abroad. The proposed study areas are given in the Figure 1.

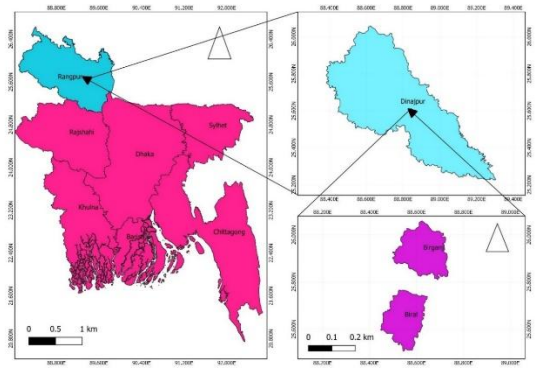

Figure 1. Map of the proposed study areas (prepared by using QGIS software)

Description of the Study Areas

Dinajpur is a district in the Rangpur Division of northern Bangladesh. It is the largest district among all sixteen northern districts of Bangladesh. Total area 3437.98 km^2, located in between 25°10' and 26°04' north latitudes and in between 88°23' and 89°18' east longitudes. Dinajpur experiences a hot, wet and humid tropical climate. Under the Koppen climate classification, Dinajpur has a tropical wet and dry climate. The district has a distinct monsoonal season, with an annual average temperature of 25 °C (77 °F) and monthly means varying between 18 °C (64 °F) in January and 29 °C (84 °F) in August. The economy of Dinajpur mainly depends upon agriculture-based production. There is a well-known proverb about Dinajpur – 'paddy piled up high, sheds full of cows, ponds brimming with fish' [*gola bhora dhan, goyal bhora goru, pukur bhora mach*]. People in this district are much happier than those in other districts, everything grows easily, it's a peaceful place. It grows a plenty of vegetables and seasonal fruits. Crops and grown in the district include rice, wheat, maize, potato, brinjal, and tomato.

Population and Sampling

Vegetable farmers of the proposed study areas was the population of the study. An appropriate sample and reserve list was determined to avoid the uncertainty related with the availability of samples during data collection. Considering the study is intending to have statistically significant and comparable set of results for the study areas, sample size for the research was calculated using the following formula (Kothari, 2004):

$$n = \frac{Z2PQN}{(n-1)e2 + z2pq}$$

Where,

n= Sample size

Z= 1 the value of the standard normal variable at the chosen (95 percent) confidence level (1.96)

P= Probability (assume 0.5)

Q = Remaining from probability (1-P)

N = Total population

e = the level of precision (5 percent)

By using the above formula, the sample size of 120 vegetable farmers was found from a population list of 175. From each selected upazila Birol and Birganj, 60 farmers were selected by following simple random sampling techniques, respectively. Beside this, a reserved list of 12 farmers was prepared who were supposed to be interviewed only when a respondent in the original sample list was unavailable during data collection.

Measurement Technique of the Variables

The personal and socio-economic characteristics was selected by reviewing the relevant documents related to the present study and proper statistical techniques was followed to measure them.

Adoption of improved vegetable cultivation practices by the vegetable farmers was the focus issue of this research study. It was measured by using five-point rating scale. The respondents were requested to make response on their adoption of GAP related to vegetable cultivation. The score of the five-point rating scale against each of the GAP was given as follows:

Extent of adoption	Score assigned
Regularly (≥ 4 times in last 4 years)	4
Frequently (3 times in last 4 years)	3
Occasionally (2 times in last 4 years)	2
Rarely (1 times in last 4 years)	1
Not at all (0 times in last 4 years)	0

Based on the possible score range the respondents of the study was categorized as 'Low adoption', 'Medium adoption' and 'High adoption'. Similar measurement technique (AS) was followed by (Mou, 2015).

$$\text{AS} = \frac{\text{Score obtained by the vegetable farmers}}{\text{Maximum possible score}} \times 100$$

Awareness of GAP in vegetable cultivation will be operationalized as the information available to the vegetable growers about GAP in vegetable cultivation. To determine awareness, an audit checklist will be developed with reference to FAO, bgGAP recommendations, which captured farmers' awareness and compliance to GAP standards.

Awareness was measured through rating on a 3- point rating scale ranging from 2 for 'fully aware', 1 for 'partially aware', and 0 for 'not aware' developed by (Cherotich and Kaur, 2021). The respondents was categorized into the following three categories as none, partial, and full based on their observed score. Awareness score (AWS) was calculated by using the following formula:

$$\text{AWS} = \frac{\text{Score obtained by the farmers}}{\text{Maximum possible score}} \times 100$$

Confronted constraints of the vegetable farmers while implementing the GAP in their field level was measured by asking the question to the sampled farmer. In this regard, farmers were asked to assess how difficult it was for them to adopt good agricultural practices on a three-point scale of most serious, serious and least serious, with weights 3, 2 and 1 was assigned to each response.

Data Collection Techniques

Both quantitative and qualitative techniques was used for this research study. The flow chart of the data collection technique was followed as given below:

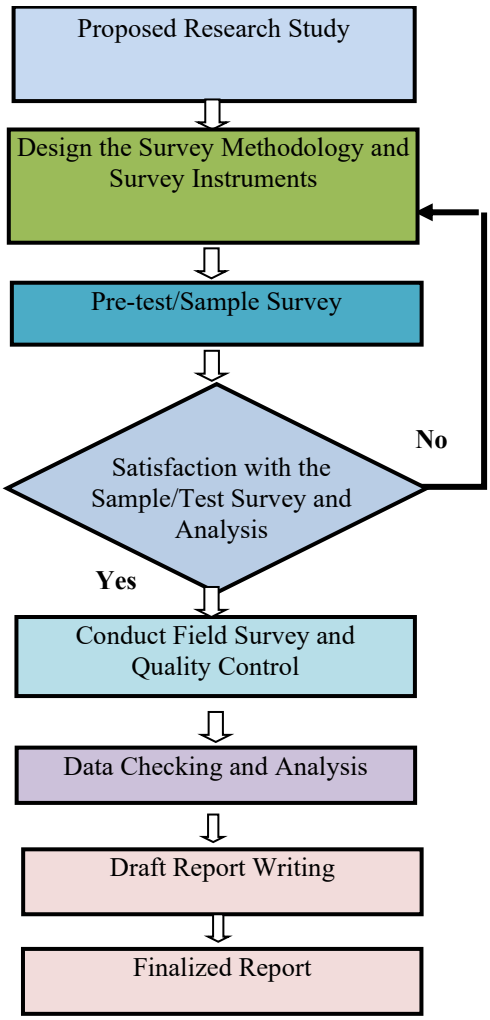

Figure 2. Flow chart for data collection

Preparation of Data Collection Tools and Statistics Employed for Data Analysis

The interview schedule and checklist were developed on various aspects of the objectives considered in the present study. An interview schedule was prepared to collect quantitative data, while a checklist was prepared used in eliciting qualitative data through Focus Group Discussions (FGDs). Experts was employed to improve the content validity of the interview schedule and checklists for qualitative data collection. The variables considered under each objective were put in the SPSS to test the reliability of the questions and they all gave a value above 0.775 meaning that the data collected was consistent. Prior to the actual conduct of research, both the interview schedule and the checklist was pre-tested in similar socio-economic condition. After data collection, the data was input concerned SPSS 25.0 version data analyzing software. Then the normality of the data was tested and if any outlier present was removed. Different types of statistical techniques like frequency, percentage, mean, standard deviation, ranking, coefficient of correlation, was used for data analysis.

Results and Discussion

Selected Characteristics of the Respondents

Age

The age group of the vegetable farmers of the study areas included in the present study is given in Figure 3. It could be observed that more than half (58.3%) of the farmers fall under middle aged group of 36 to 50 years followed by exactly one-fourths of the respondents (25.0%) belonging to young aged category and only 16.7% of the vegetable farmers belong to the old aged category of above 50 years.

This indicates that all the age groups of the farmers were engaged in vegetable cultivation in the study areas. The results are found to be in tune with the natural trend of majority of the farmers under young to middle aged category as young are getting engaged in agricultural entrepreneurships.

Education

Educational qualification is regarded as an instrument of change and transformation of society. Education can be seen in the emancipation of women from the patriarchal society.

Findings presented in the Figure 4 show that majority (41.7%) of the farmers fall under secondary education category followed by one-third of the respondents (30.8%) belonging to higher secondary category, 16.7% of the vegetable farmers belong to the primary education category and only 10.8% are educated above higher secondary.

Area Under Vegetable Cultivation

The analysed data in Figure 5 shows the distribution of vegetable farmers based on the area under vegetable cultivation. The categorization as made with five categories of landholding size (hectare) under vegetable cultivation. It is evident from Figure 5 that just more than half (54.2%) of the vegetable farmers fell under the group of land holdings 0.2 to 1.0 ha. whereas 30% of the farmers fell under the group of landholdings 1.01 to 3.0 ha, 12.5% fell under large land holding while only a negligible portion of the farmers i.e. 1.7% equally fell under landless and marginal landholding categories respectively.

Experience in Vegetable Cultivation

The vegetable farmers were grouped into three categories based on their experience in vegetable cultivation as given in Figure 6. The findings revealed that the average experience of the selected farmers in vegetable cultivation is about 6 years. The majority of the farmers (54%) had more than six years of experience in vegetable cultivation. Exactly one-fourths (25%) of the respondents had experience of 5-6 years while only 21% had experience of up to 4 years. The probable reason of the findings might be that the major crops cultivated in the study areas are vegetable.

Training Received

The expertise of an individual is enhanced by training and improves their skills, knowledge, and even attitude. Based on training received on, the vegetable farmers have been categorized as shown in Table 1.

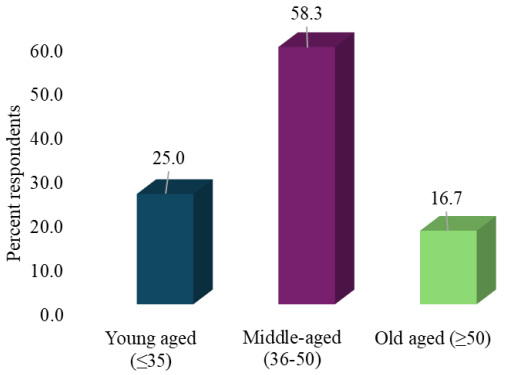

Figure 3. Distribution of the respondents according to their age

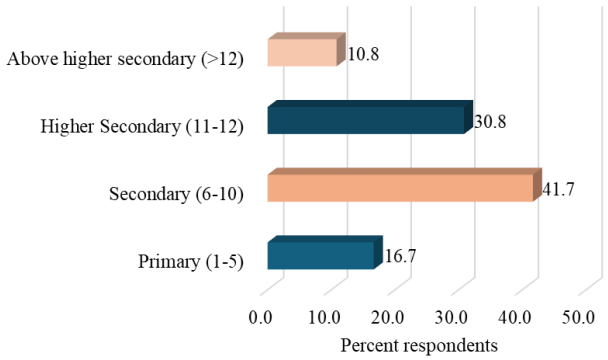

Figure 4. Distribution of the respondents according to their education

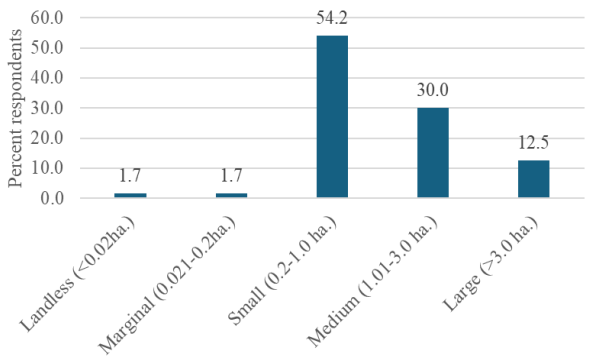

Figure 5. Distribution of the respondents according to their area under vegetable cultivation

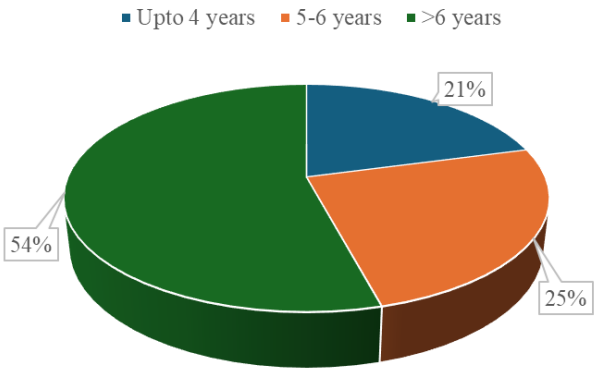

Figure 6. Distribution of the respondents according to their experience in vegetable cultivation

Table 1. Distribution of the respondents according to their training received

Categories (Days)	Percent respondents
Low (1-2 days)	79.2
Medium (3-4 days)	12.5
High (>4 days)	8.3
Total	100.0

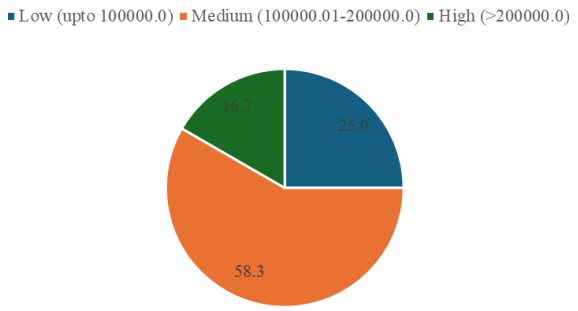

Figure 7. Distribution of the respondents according to their annual income

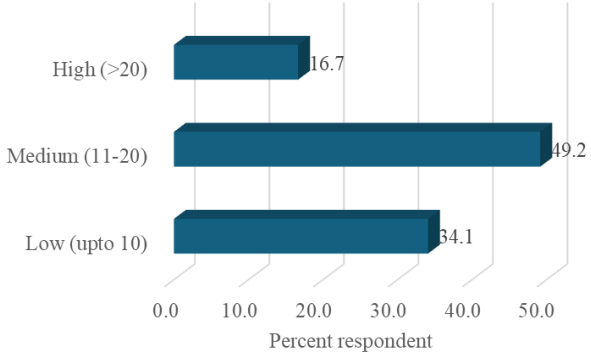

Figure 8. Distribution of the respondents according to their market perception

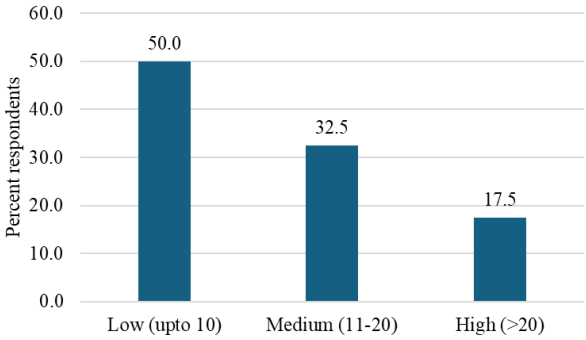

Figure 9. Distribution of the respondents according to their market perception

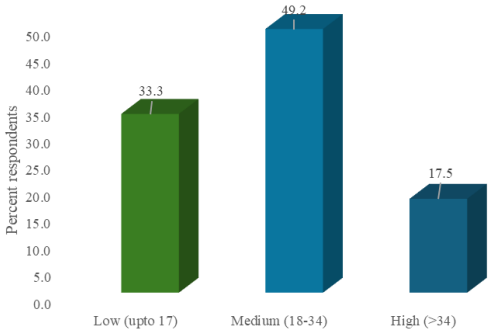

Figure 10. Distribution of the respondents according to their extension contact

More than three-fourths (79.2%) of the vegetable farmers were fell under low training received category followed by only 12.5 percent fell under the training received category of 3 to 4 days while only a very negligible portion of the farmers i.e. 8.3% fell under high training received category i.e. more than four days.

Annual Income

In a society individual levels of status determine by different factors, among them money is the most powerful, influential, and potential component. It is well known that the higher is the income of a family, the greater control over the society by the family. Family annual income is an important variable for explaining the economic characteristics of vegetable farmers.

Findings presented in the Figure 7 shows that more than half (58.3%) of the vegetable farmers fall under medium income category followed by exactly one-fourths of the respondents (25.0%) belonging to low-income category, 16.7% of the vegetable farmers belong to the high-income category. The average annual income of the farmers was about 183000.30 taka.

Market Perception

The result in Figure 8 showed that the distribution of the vegetable farmers based on their market perception. It could be observed that about half (49.2%) of the farmers had medium level of market perception followed by just more than one-third (34.1%) of the respondent had low market perception and only 16.7 percent of the vegetable farmers had high level of market perception.

The possible reason for this finding might be that the vegetable farmers are more concerned about the market opportunities available for vegetables and the possibility to get remunerative price for GAP vegetables.

Environmental Orientation

It could be inferred from the result in Figure 9 that exactly half (50.0%) of the respondents had low level of environmental orientation followed by 32.5% of them had medium and only 17.5 percent of the respondent had a low level of environmental orientation.

The probable reason for such finding might be that the higher educational level of the farmers which contributed towards achieving high environmental orientation among vegetable farmer.

Extension Contact

The findings in Figure 10 showed that just about half (49.2%) of the vegetable farmers had medium extension contact followed by exactly one-third (33.3%) had low level and only 17.5% had high level of extension contact.

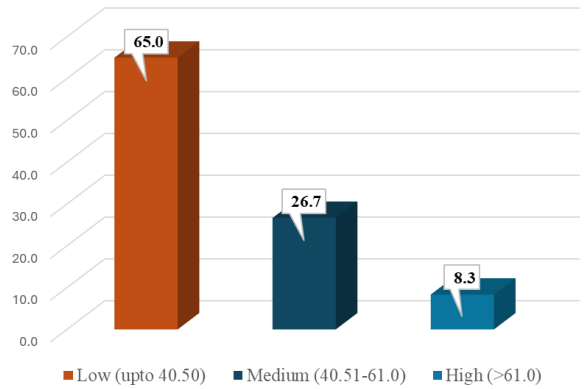

Figure 11. Distribution of the respondents according to their extension contact

The possible reason behind this finding might be that selected respondents from the study areas are the beneficiaries of CIG group members of DAE and majority of the farmers had frequent contact and interaction with the officials of different public and private level extension organizations like DAE, Ministry of Agriculture, Bangladesh.

Awareness on Good Agricultural Practices (GAP) on Vegetable Cultivation

The extent of awareness of vegetable farmers on various Good Agricultural Practices in vegetable cultivation is discussed below. Table 2 reveals that the distribution of the vegetable farmers based on their awareness level on GAP.

It could be inferred that more than half of the respondents (56.7%) had medium awareness level on GAP, 26.7% had low level of awareness and only 16.6% of them had high level of awareness on Good Agricultural Practices (GAP). Pandit et al. (2017) revealed low awareness (58.33) of GAP in basmati rice production, despite farmers' recognition of its benefits.

Component Wise Awareness Level on GAP Among Vegetable Farmers

The findings of Table 3 shows component-wise awareness level on GAP among vegetable farmers. It could be observed that GAP components like pest and disease management gained high range of awareness score. Awareness score of GAP component land and soil preparation (55.2), nutrient management (52.3), harvesting and post-harvest handling (60.1) were found to be medium level.

Good agricultural practices awareness score on the practices like seed/seedling quality parameters (48.8), sowing/transplanting parameters (49.1) and irrigation management (40.5) were found to be low.

The findings means that the vegetable farmers of the study areas had not a fairly well awareness about Good Agricultural Practices, therefore, it could be inferred that they are not fully aware about all the aspects of GAP.

Adoption level of Good Agricultural Practices (GAP)

The findings revealed in Figure 11 indicated that majority (65.0%) of the vegetable farmers had low level of adoption of Good Agricultural Practices in vegetable cultivation while 26.7% of the study respondent had medium and only a negligible portion of the respondents had low level of adoption. Slightly different result was reflected in the study of Chaudhary (2022) who reported that 57.50% of farmers had medium-level adoption of GAP. Similar findings were reported by Pandit et al. (2017) who revealed lower adoption (27.41%) of GAP in basmati rice production, despite farmers' recognition of its benefits. Since the Good Agricultural Practices (GAPs) are very new in our country perspective therefore, farmers are not yet used to these practices. As well as farmers of our country producing various types of agricultural products in commercial basis so, they use plethora of chemical fertilizers with the intention of high productivity and it is really very difficult to convince them for adopting GAPs. Most of the farmers of the study areas are producing various agicultural products particularly vegetables in commercial basis and GAPs are disseminating in these areas in a pilot basis. As a result, the adoption of GAPs among vegetables farmers in the considering areas of the study are under low level.

The possible reason for such types of findings might be that in the study area, the Good Agricultural Practices are very new idea among the farmer's level. DAE, under the Ministry of Agriculture just started different awareness creation as well as GAP dissemination activities among the farmers. Farmers are gradually getting aware along with adopting different GAP components for cultivation of vegetables by considering environmental as well as in broad context sustainability issue of production of vegetables.

Component wise adoption level of GAP among vegetable farmers

The extent of adoption of Good Agricultural Practices among vegetable farmers was measured with adoption score values. Among the listed seven components of GAP, pest and disease management (61.5) gained highest range of adoption score. The probable reason might be that farmers were benefitted from the adoption of Good Agricultural Practices related to pest and disease management.

It was also found that adoption score for remaining practices viz. land and soil preparation (50.1), nutrient management (45.3) and harvesting and post-harvest handling (59.1) had gained medium level of adoption score. Whereas seed / seedling quality parameters (39.5), sowing/transplanting parameters (38.1) and irrigation management (36.5) gained low level of adoption among the vegetable farmers in the study areas.

Association Between Extent of Awareness and Extent of Adoption of Good Agricultural Practices by Vegetables Farmers

For more clarity about the extent of awareness and extent of adoption of GAP, an association between extent of awareness and extent of adoption of GAP situation of the vegetable farmers is presented in Table 5.

Analysis of data contained in Table 5 indicates that there were appreciable variations in the level of adoption of GAP by vegetable farmers according to the variations in their extent of awareness. Percentage of farmers with low adoption of GAP was the highest (75.8%) in the low awareness category compared to 78.4% in the medium category and 36.1 percent in the high adoption category.

Table 2. Distribution of the respondents according to their awareness score

Awareness categories (Score)	Number	Percent	Mean	SD
Low (up to 51.0)	32	26.7	61.28	10.22
Medium (52-71.0)	68	56.7		
High (>71.0)	20	16.6		
Total=	120	100.0		

Table 3. Component wise awareness level on GAP among vegetable farmers

Sl. #	Component wise awareness score	Awareness score
1.	Land and soil preparation	55.2 (Medium)
2.	Seed / seedling quality parameters	48.8 (Low)
3.	Sowing/transplanting parameters	49.1 (Low)
4.	Nutrient management	52.3 (Medium)
5.	Irrigation management	40.5 (Low)
6.	Pest and disease management	71.5 (High)
7.	Harvesting and post-harvest handling	60.1 (Medium)

Table 4. Component wise adoption level of GAP among vegetable farmers

Sl. #	Component wise adoption score	Adoption score
1.	Land and soil preparation	50.1 (Medium)
2.	Seed / seedling quality parameters	39.5 (Low)
3.	Sowing/transplanting parameters	38.1 (Low)
4.	Nutrient management	45.3 (Medium)
5.	Irrigation management	36.5 (Low)
6.	Pest and disease management	61.5 (High)
7.	Harvesting and post-harvest handling	59.1 (Medium)

Table 5. Awareness and adoption of Good Agricultural Practices by the vegetable farmers

Extent of awareness	Extent of adoption			Adoption Indices	χ^2-value
	Low (up to 40.50)	Medium (40.51-61.0)	High (>61.0)		
Low (up to 51.0)	75.8	21.2	3.0	127.3	82.54**
Medium (52-71.0)	78.4	9.8	11.8	133.3	
High (>71.0)	36.1	41.7	22.2	186.1	

** Significant at the 0.01 level of probability, df=4

Proportion of the farmers with high adoption was highest (22.2%) in the high awareness category, compared to 11.8% in the medium awareness category and only 3.0% in the low awareness category. These variations were statistically significant at 0.01 level of probability as indicated by the chi-square value of 82.54.

In view of the above findings the null hypothesis was rejected and it was concluded that there is a relationship between the awareness among the farmers and level of adoption of GAP. The adoption indices indicate that the adoption consistently increased from the low awareness category to the high awareness category. Hence, the relationship was positive. The finding indicates that awareness about GAP among the farmers helps to improve their adoption of different components of GAPs.

Relationship Between Selected Characteristics of the Respondents and Adoption of GAP

This section deals with the relationship between the nine selected characteristics of the respondents and adoption level of GAP by vegetable farmers. The relationships were computed by using the Pearson's product moment correlation co-efficient. The co-efficient of correlation (5% level) was used to test the null hypothesis and analysis is presented in Table 6 as follows.

According to the computed correlation coefficients among the nine selected characteristics of the farmer's age, education, and annual income had no significant relationship with the adoption of GAP by the vegetable farmers. On the other hand, area under vegetable cultivation, experience in vegetable cultivation, training received, market perception and Environmental orientation and extension contact had positive significant relationship with adoption of GAP by the vegetable farmers.

Constraints Faced by the Farmers in Adoption of Good Agricultural Practices (Gaps) in Vegetable Cultivation

It is evident from the Table 7 that the most important constraint is increased difficulty in management of pest and disease incidence having mean score of 2.7. To counter this constraint promoting group action by the farmers is one of the ways. Various biological methods of control by the farmers as a group would enable them to eradicate the pests and diseases problem as a whole in the study areas. Farmers also have to follow stringent measures under GAP to control pests and diseases. The logistic support of an extension system and government policy for group action would be necessary for managing this constraint.

Table 6. Relationship between selected characteristics of the respondents and adoption of GAP

Focus Issue	Selected Characteristics	Pearson's Product Moment Correlation Coefficient (r) at 118 df
Adoption of GAP by the vegetable farmers	Age	0.086ns
	Education	0.038ns
	Area under vegetable cultivation	0.275**
	Experience in vegetable cultivation	0.474**
	Training received	0.290**
	Annual income	0.040ns
	Market perception	0.365**
	Environmental orientation	0.294**
	Extension contact	0.374**

Table 7. Item wise constraints faced by the farmers in adoption of Good Agricultural Practices (GAPs) in vegetable cultivation

Constraints	Mean score	RO
Lack of awareness of good agricultural practices	2.5	4th
Lack of knowledge in use of good agricultural practices	2.6	2.5nd
Lack of technical guidance	2.3	6th
Lack of market knowledge	2.4	5th
Lack of local market demand	2.2	7th
Lack of better pricing for GAP	2.6	2.5nd
Increase in cost of production of Good Agricultural Practices	2.0	9th
Decline in income during conversion of conventional farming to good agricultural practices	1.9	10th
Inadequate loan/credit facility	1.7	12th
Unavailability of bio inputs like fertilizers, plant protection chemicals, herbicides etc.	2.1	8th
Increased labour and land management requirements	1.8	11th
Increased difficulty in management of pest and disease incidence	2.7	1st

Lack of knowledge in use of good agricultural practices and Lack of better pricing for GAP having mean score of 2.6, respectively gained the second position in the constraint table and jointly ranked. The reason for this finding might be due to those farmers of the study area as just getting training on GAP for awareness creation on this issue as well as for adoption. Therefore, the knowledge level of the farmers in the study areas still have less awareness as well knowledge regarding GAP. While some of the progressive farmers started to adopt different components of GAP but still their product in the market are not treated especially therefore, they are not getting price fairly.

The last ranked constraint is inadequate loan/credit facility having mean value of 1.7. This finding could be due to that now various farmers are getting credit from different micro-credit organization as well as bank on agricultural practices. Therefore, farmers are not faced high extent of constraint in this regard.

Conclusions and Recommendation

In conclusion, the majority of respondents exhibit a medium level of awareness regarding Good Agricultural Practices (GAP), the varying awareness scores across specific components indicate opportunities for targeted educational initiatives to further enhance farmers' understanding and implementation of these practices. Factors such as area under cultivation, experience, training received, market perception, environmental orientation, and extension contact demonstrated a positive and significant relationship, underscoring the importance of these elements in enhancing GAP adoption among farmers. A significant majority of vegetable farmers have a low level of adoption of Good Agricultural Practices, with pest and disease management emerging as the most adopted component, highlighting the need for strategies to improve overall adoption across all GAP areas. The study highlights that a significant constraint for vegetable farmers lies in the lack of knowledge and better pricing for Good Agricultural Practices (GAP), so there is still a considerable gap in awareness, understanding and adoption of GAP.

Creating more awareness regarding GAP components among the farmers as well as ultimate consumers would be required which increase the demand for GAP products and thereby contribute to higher income to the farmers. More intensive training, motivational activities and capacity building programs are required for the farmers to enhancing awareness, skill on GAP ultimately increase the adoption. Similar research studies could be conducted in the other vegetable growing areas of the country for making the findings generalize as the current study was limited to only one district.

Declarations

Author Contribution Statement

RAFN: Data collection, contributed to the analyses and writing of the manuscript.

SY: Contributed to the conduct of the study and writing of the manuscript.

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Conflict of Interest

The authors declare no conflict of interest.

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