ID: 592

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

Rubayet Noman[1], Shahana Yeasmin[2]
[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

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.

Key Words: GAP, Adoption, Vegetable farmer and Safe food

Introduction

In Bangladesh, agricultural sector is gradually changing from subsistence agriculture to commercial agriculture. In view of producing more food as well as increasing crops production for growing population, high yielding and hybrid varieties of crops are being used with excessive chemical fertilizers and pesticides. Sometimes organic fertilizer that contained heavy metals or chemicals harmful to human health are also used. Good Agricultural Practices (GAPs) addresses the environmental, economic and social sustainability issues for safe and quality food and non-food agricultural products like vegetables.

The demand for quality and safety in vegetables has led to the development and promotion of common principle and standards for cultivation, often referred to as Good Agricultural Practices (GAP) (Guddanti, 2015). Considering the availability of safe food, it is very important to follow Good Agricultural Practices (GAP) from the beginning of production, harvest and post-harvest processing, such as collection from field, packaging, transportation etc. to ensure safe food. The GAP is a set of principles that apply to the farm production and post-production processes to produce safe and healthy food and non-food agriculture products, considering economic, social, and environmental sustainability (Hobbs, 2003). Adoption of GAP could increase farm income by 6.2% and decrease the use of synthetic fertilizers by 31% for rice, lentil, tomato, and ginger in Nepal (Bairagi et al., 2019). Many developed countries, such as Denmark, Australia, and the United States have adopted the GAP package for integrated pest and nutrient management for decades (Waage ,1998; Zalucki et al., 2009; Remac, 2018). In Turkey, GAP has been implemented as an alternative to organic farming (Akkaya et al., 2005). Also in several Asian countries such as Nepal, India, Indonesia, Malaysia, Philippines, and Thailand, the GAP system has been implemented particularly in vegetable farming, focusing more on integrated pest and soil fertility management. GAP use is practical in wide categories of farming system of different scales through improved sustainability by integrated pest, weed and disease management, soil and water conservation, and fertilizer management (Ntshangase et al., 2018). Good Agricultural Practices are desirable increased productivity and improved quality (Dudeja and Singh, 2018).

Safe food is becoming increasingly important in terms of human health and economic aspects. Safe food production is urgent because of the competition in the global export market, as well as protecting people from food bound illness. Indiscriminate use of pesticides and chemical, presence of heavy metals, infection s of microorganism etc. from the early stages of production to various stages of food chain made food unsafe. That is why, considering the availability of safe food, it is very important to adopt Good Agricultural Practices (GAPs) from the beginning of production, harvest, and post-harvest processing such as collection from field, packaging,

transportation etc. to ensure safe food. In Bangladesh especially in the proposed study areas if the adoption of GAPs is ensured, then the vegetable produce will be safe, improved and of good quality, sustainable environment and social acceptance will be increased with income growth and economic momentum, and food and nutrition security will be ensured.

Therefore, it is really very necessary to adopt GAP for the production of vegetable for ensuring the quality of vegetable to export. Good Agricultural Practices (GAP) minimize food safety risk. However, its poor implementation along the vegetable production chain is a challenge. GAP, if carefully implemented ensures that farmers can obtain highly nutritional, good quality vegetables with higher market access. Well-managed GAPs have proven to be effective in the reduction of risks of vegetable contamination in agricultural production.

Therefore, it is necessary to have a clear understanding of the present status of the adoption of Good Agricultural Practices. The main purpose of the study is to have an understanding of the adoption of Good Agricultural Practices by the vegetable farmers in vegetable cultivation.

The proposed research study is designed by considering the following framed out specific objectives:

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.

Review of Literature

Kharel et al. (2023) revealed that farmers were adopting different GAP, such as cropping practices, livestock integration, soil fertility management practices, and integrated pest management practices. Upon adopting these practices, farmers reduced agrochemicals' use by more than 40%. The critical incentives for surveyed farmers to adopt GAP were soil health improvement, farmers' safety, and reduction in the use of agrochemicals while improving the farm's image. Sunny et al. (2022) revealed that farmers' age, land typology, soil water retention, knowledge, and availability of cow dung significantly influenced Boro rice farmers' adoption decisions of recommended fertilizer doses. Chaudhary (2022) revealed that more than one half (57.50%) of the farmers were having medium adoption of good agricultural practices. Cherotich (2021) reported that a majority of the vegetable growers were unaware of GAP standards for vegetable production, with many deviating from the expected standards in their vegetable production activities. Most of the vegetable growers identified production costs, market exclusivity, training, government support, and access to labor as the key determinants to the use of GAP in their activities. It is also revealed that behavioural intention to adopt GAP by vegetable growers is predicted by attitude, subjective norms, and perceived behavioural control. Nagadevi (2021) explored that overall adoption index of GAP in vegetable cultivation was found to be medium (73.21). The adoption score on components of GAP viz. land preparation and soil management (79.56) and harvesting and post-harvest handling (81.05) was high, while that on seed quality parameters, sowing and intercultural operations, nutrient management and plant protection measures were medium. The component that had lowest level of adoption score was irrigation management and drainage (54.04). Thenuwara and Malknthi (2020) explored that most vegetable farmers in the Galle district have a general level of awareness on GAP and a positive attitude towards the GAP programme. However, most farmers do not adopt the GAP, and some farmers lack the required amount of information, technical know-how, inputs, capital, labour and require field conditions to practice GAP, even though thy wish to practice it. According to the results, awareness of GAP, GAP certification, and the awareness of the importance and benefits of GAP were the significant factors affecting the adoption of GAP by vegetable farmers. Joshi et al. (2020) revealed that GAP related to soil management and fertilization (87.4%) and harvesting and on-farm processing (94.2%) is adopted at a low level. Laosutsan et al. (2019) identified and investigated the factors influencing the adoption of good agricultural practices (GAP) and revealed that the income variable is the most influential factor in the GAP adoption by participating vegetable farmers. They also found that effectively increase the GAP adoption rate among the Thai vegetable growers, the exporters and relevant government agencies could make GAP certification compulsory. Pandit et al. (2017) revealed that awareness and the adoption of the critical GAPs in basmati production system was at lowest ebb, whereas the benefits of adoption were well understood by the farmers. Awareness level of farmers about Good Agricultural Practices in basmati rice was found to be 58.33%, whereas adoption was only 27.41% which is even less than half of awareness level. Srisopaporn et al. (2015) revealed that adoption and dis-adoption are highly related to household labour constraints, land ownership, and initial high expectations regarding the market opportunities of the GAP produced rice. They found several encouraging differences between non-adopters and first-time adopters, indicating better pest and nutrient management. Although they observed an important rate of dis-adoption, they also determined that farmers are maintaining those better practices even after abandoning the program. Banzon et al. (2013) revealed that a high level of GAP adoption in the Davao banana industry primarily because of the predominance of corporate farms in

the area that cater to the export markets. Athipanyakul and Pak-Uthai (2012) revealed that significant effect on program participation and farmer's knowledge that was the precursor of adoption. Farmers' experience in chili production significantly affected adoption. Age was a negative determinant of adoption. Adoption of knowledge-intensive technologies such as GAP needs an effective approach such as the participatory research program, which can improve farmers' knowledge and encourage them to adopt innovative technologies

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.

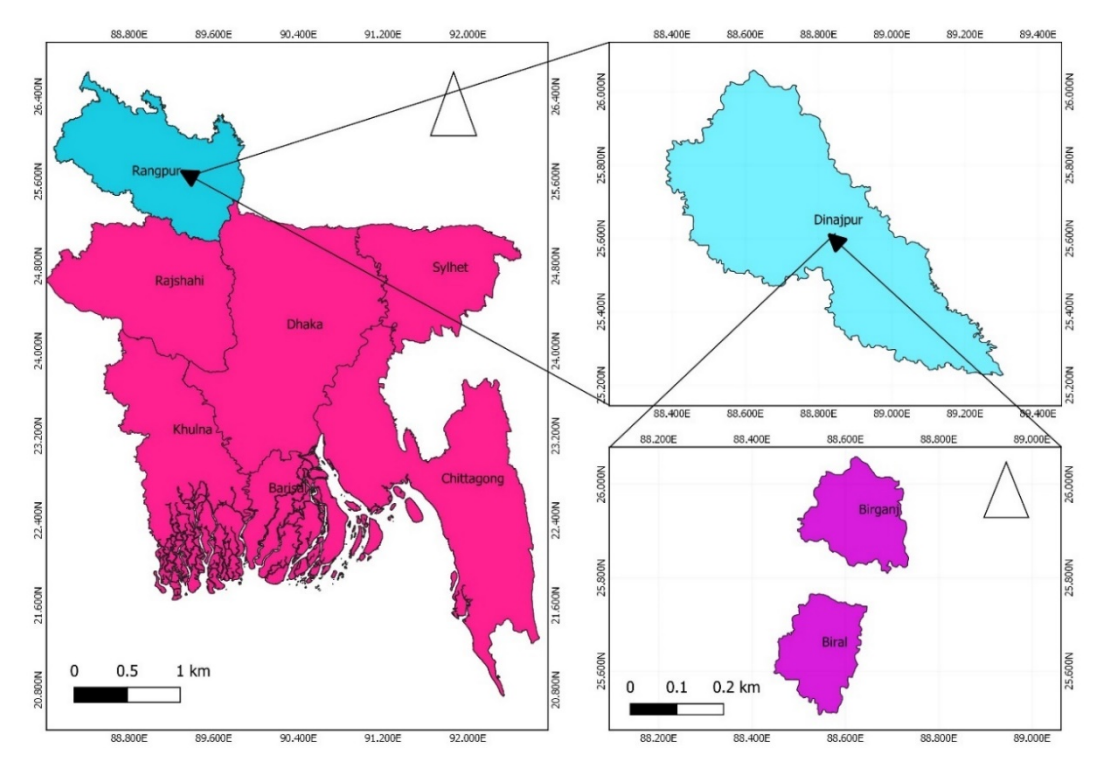

Figure 1. Map of the proposed study areas (prepared by using QGIS software)

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, 60 from each selected upazila Birol and Birganj was 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 was 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 was followed by (Mou, 2015).

Adoption score= Score obtained by the vegetable farmers/Maximum possible score× 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 was calculated by using the following formula:

Awareness score= Score obtained by the farmers/Maximum possible score× 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:

Preparation and administration of data collection tools

Data collection tool is a device which is used to collect the data. The interview schedule and checklist was 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. Reliability of the tools was also tested by Cronbach's alpha. Prior to the actual conduct of research, both the interview schedule and the checklist was pre-tested in similar socio-economic condition.

Statistical method employed for data analysis

Statistical analysis of quantitative data is an important aspect of research work, as it facilitates the condensation and interpretation of collected data in simple form helps in predicting future trends, helps in establishing relationship between different variables and provides sound base of policy formulation. 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. Data was analyzed in the light of the objectives set forth for the proposed study. Different types of statistical techniques like frequency, percentage, mean, standard deviation, ranking,

coefficient of correlation, was used for data analysis. The qualitative information and quantitative data analysis was performed separately, and their findings was synthesized for triangulation.

Data analysis plan

The collected data was analyzed using computer software like SPSS 25.0 version. The primary unit of analysis of the study was individuals, with results summarized for the study areas.

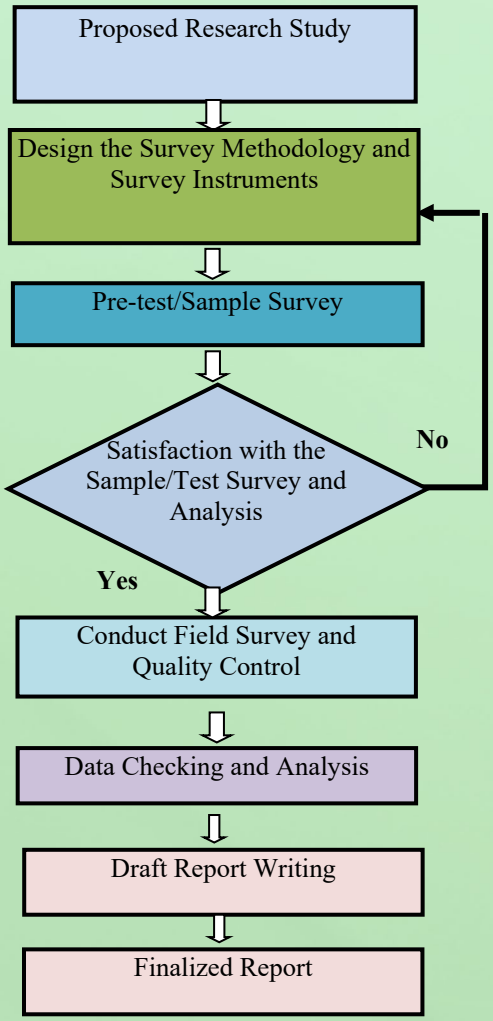

Figure 2. Flow chart for data collection

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.

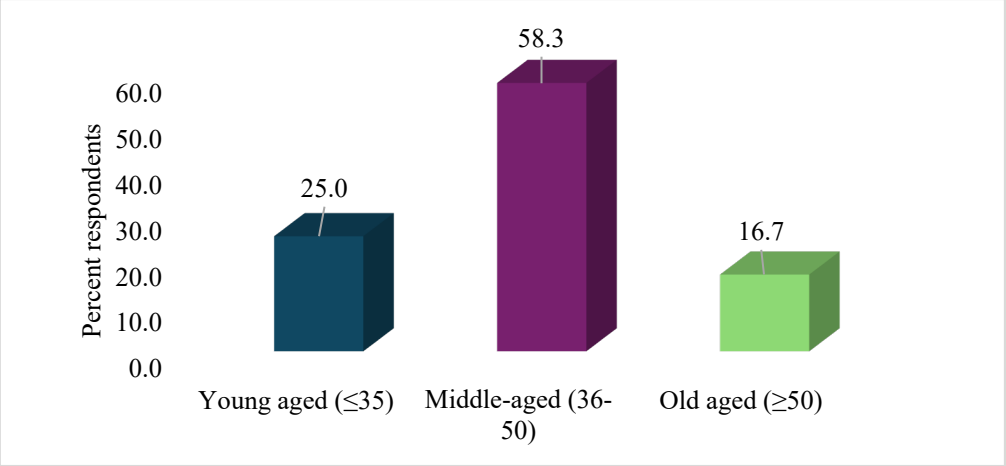

Figure 3. Distribution of the respondents according to their age

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.

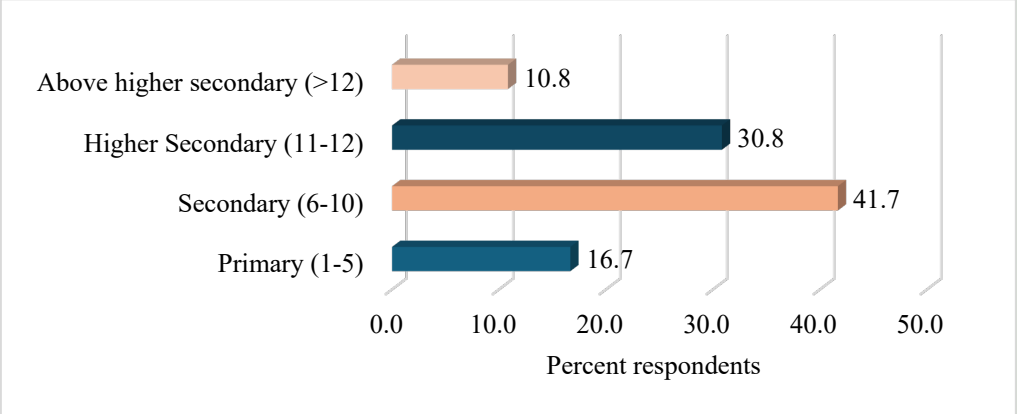

Figure 4. Distribution of the respondents according to their education

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.

4.1.3 Area under vegetable cultivation

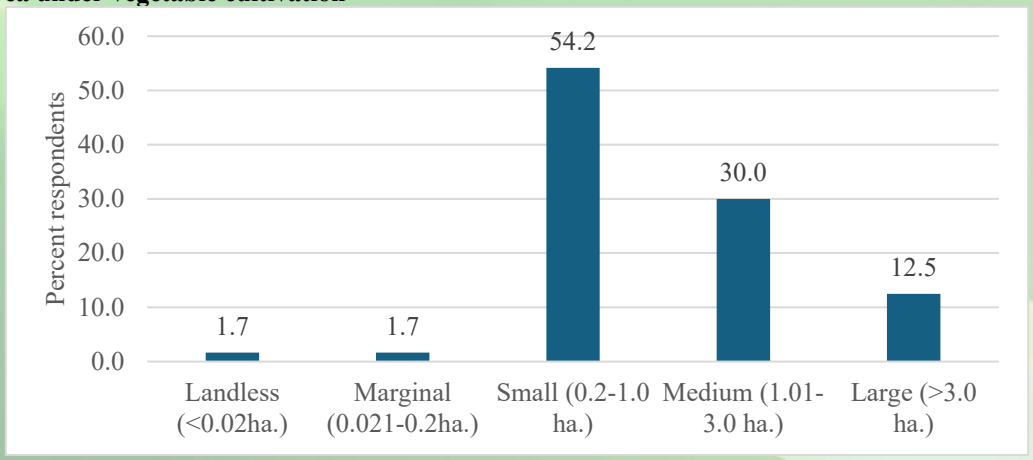

Figure 5. Distribution of the respondents according to their area under vegetable cultivation

The analyzed 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.

4.1.4 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 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.

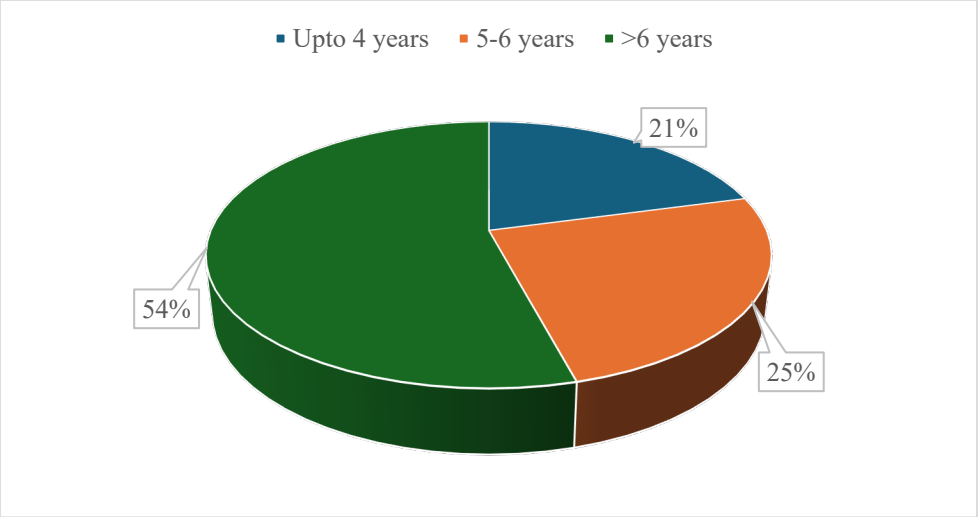

Figure 6. Distribution of the respondents according to their experience in vegetable cultivation

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.

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

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 vey 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.

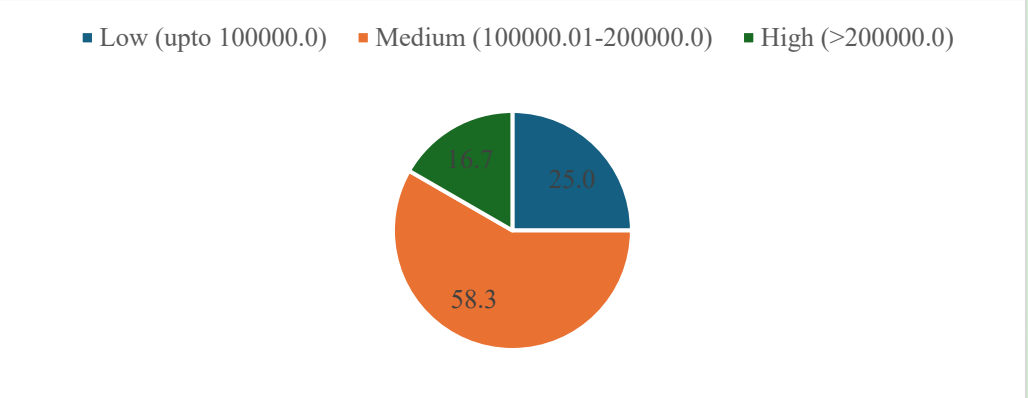

Figure 7. Distribution of the respondents according to their annual income

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.

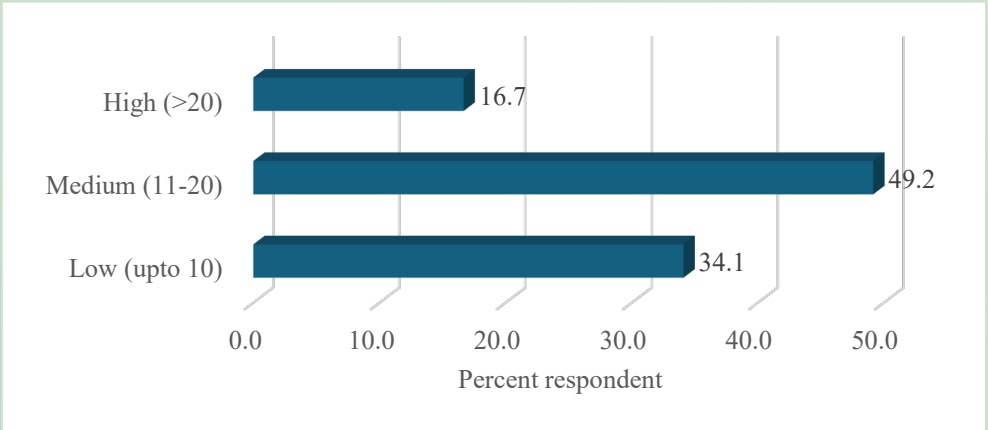

Figure 8. Distribution of the respondents according to their market perception

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.

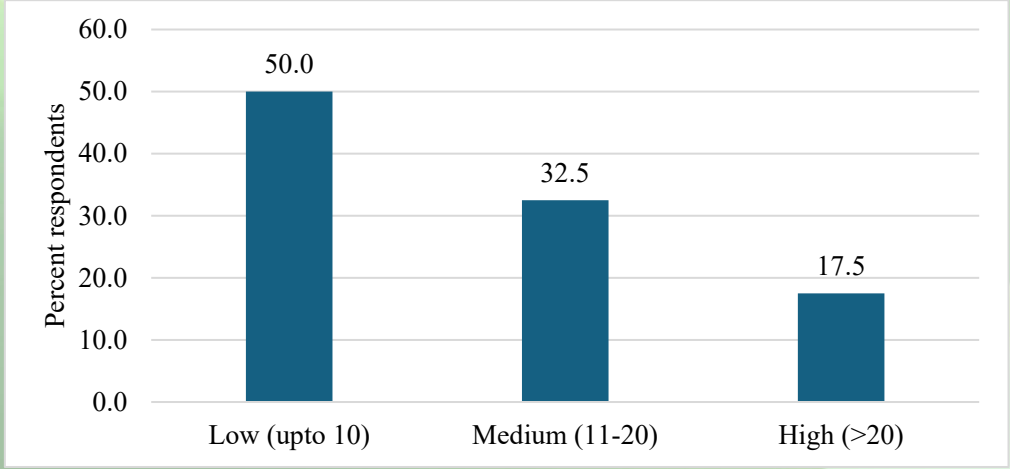

Figure 9. Distribution of the respondents according to their market perception

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.

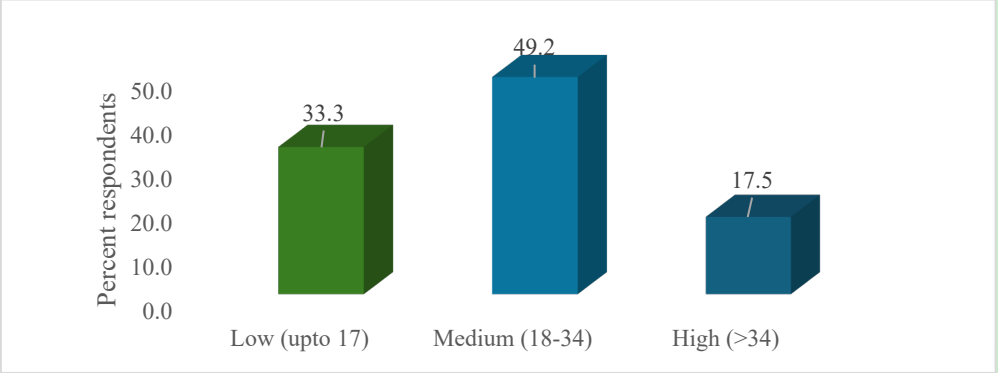

Figure 10. Distribution of the respondents according to their extension contact

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.

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		

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).

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.

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)

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.

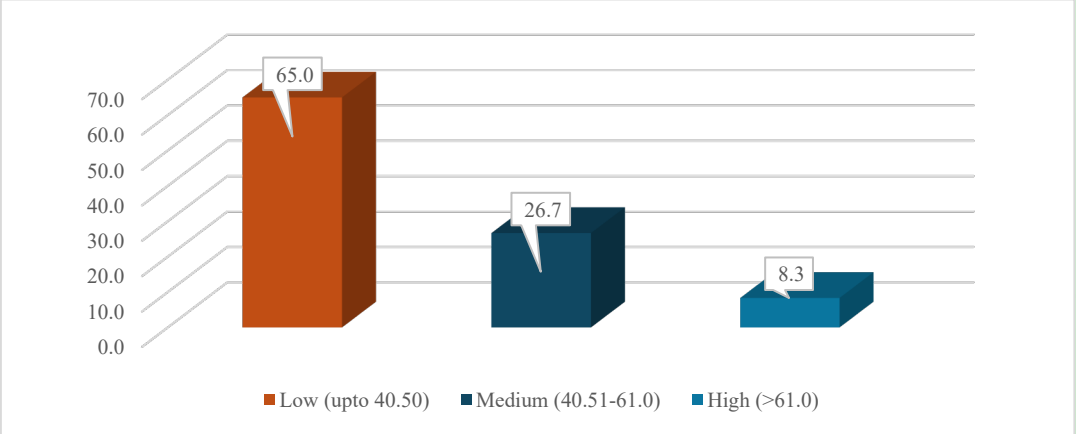

Figure 11. Distribution of the respondents according to their extension contact

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 form the adoption of Good Agricultural Practices related to pest and disease management.

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)

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.

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

Extent of awareness	Extent of adoption			Adoption Indices	χ2-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

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. 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.

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**

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 vegetablecultivation

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.

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

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.

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 findings reveal that a majority of vegetable farmers operate small landholdings and possess substantial experience in cultivation, yet face challenges with low training received, market perception, and environmental orientation, underscoring the need for enhanced support and education to improve their overall agricultural effectiveness. While 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.

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. 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.

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.

References

Akkaya F., Yalcin R., Ozkan B. 2005. Good agricultural practices (GAP) and its implementation in Turkey. Acta Horticulturae 699: 47–52. DOI: 10.17660/actahortic.2006.699.3.

Athipanyakul, T., & Pak-Uthai, W. (2012). Determinants of good agricultural practices (gap) adoption in the chili production system in Northeastern Thailand: A case of participatory approach. International Journal of Environmental and Rural Development, 3(2), 175-180.

Bairagi S., Mishra A.K., Giri A. 2019. Good agricultural practices, farm performance, and input usage by smallholders: Empirical evidence from Nepal. Ag-ribusiness 35(3): 471–491. DOI: 10.1002/agr.21577.

Banzon, A., Mojica, L. E., & Cielo, A. A. (2013). Adoption of good agricultural practices (GAP): How does the Philippines fare. Social Issue on Interdisciplinary Research and Development in ASEAN Universities, 2(1), 2-8.

Chaudhary, P. B. (2022). Awareness adoption and prospect of good agricultural practices in north Gujrat. PhD Thesis. Department of Agricultural Extension. Sardarkrushinagar Dantiwada Agrcultural University, Sardarkrushinagar.

Cherotich, C., & Kaur, M. (2021). Behavioural intentions of vegetable growers for adoption of Good Agricultural Practices (GAP) in Pubjab, India and Nakuru, Kenya. Ph.D. Thesis, Punjab Agricultural University, Ludhiana

Guddanti, N. (2015). Impact of good agricultural practices (GAP) on small farm development: knowledge and adoption levels of farm women of rain fed areas.

Hobbs J.E. 2003. Incentives for the adoption of good agricultural practices (GAPs). Background paper for the FAO Consultation on Good Agricultural Practices. Food and Agriculture Organization of the United Nations, 10–12 November 2003, Italy, 27 p. http://www.fao.org/23/ag854e/ag854e800.htm (accessed June 25, 2020).

Islam F. and Uddin, M.N. (2018). Good Agriculture Practices (GAP) standard and scheme in Bangladesh: Status, Challenges and Way forward. SAARC Agriculture Centre Dhaka, Bangladesh.

Joshi, A., Kalauni, D., & Tiwari, U. (2020). Application of good agricultural practices (GAP) by the banana farmers of Chitwan, Nepal. bioRxiv, 2020-06.

Kharel, M., Raut, N., & Dahal, B. M. (2023). An assessment of good agriculture practices for safe and sustainable vegetable production in mid-hills of Nepal. Journal of Agriculture and Food Research, 11, 100518.

Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.

Laosutsan, P., Shivakoti, G. P., & Soni, P. (2019). Factors influencing the adoption of good agricultural practices and export decision of Thailand's vegetable farmers. International Journal of the Commons, 13(2).

Mou M.M (2015). Adoption of Improved Vegetable Cultivation Practices by the Farmers in Selected Areas of Shajahanpur Upazila Under Bogra District. MS Thesis, Department of Agricultural Extension and Information System. Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka.

Nagadevi, G. (2021). Adoption of Good Agricultural Practices (GAP) among vegetable farmers of Palakkad District. MS Thesis. Department of Agricultural Extension, College of Agriculture, Vellanikkara.

Ntshangase, N. L., Muroyiwa, B., & Sibanda, M. (2018). Farmers' perceptions and factors influencing the adoption of no-till conservation agriculture by small-scale farmers in Zashuke, KwaZulu-Natal Province. Sustainability, 10(2), 555.

Pandit, U., Nain, M. S., Singh, R., Kumar, S. H. I. V., & Chahal, V. P. (2017). Adoption of Good Agricultural Practices (GAPs) in Basmati (Scented) rice: A study of prospects and retrospect. Indian Journal of Agricultural Sciences, 87(1), 36-41.

Remac M. 2018. Directive 2009/128/EC on the sustaina-ble use of pesticides. Study. European Implementa-tion Assessment. European Parliamentary Research Service, European Parliament, 192 p.

Srisopaporn, S., Jourdain, D., Perret, S. R., & Shivakoti, G. (2015). Adoption and continued participation in a public Good Agricultural Practices program: The case of rice farmers in the Central Plains of Thailand. Technological Forecasting and Social Change, 96, 242-253.

Sunny, F. A., Fu, L., Rahman, M. S., Karimanzira, T. T. P., & Zuhui, H. (2022). What influences Bangladeshi Boro rice farmers' adoption decisions of recommended fertilizer doses: A case study on Dinajpur district. Plos one, 17(6), e0269611.

Thenuwara, A. M., & Malknthi, S. H. P. (2020). Adoption of Good Agricultural Practices by Vegetable Farmers in Galle District in Sri Lanka. International Symposium on Agriculture and Environment 2020. University of Ruhuna, Sri Lanka

Waage J. 1998. The future development of IPM. Ento-mologia Sinica 5(3): 257–271. DOI: 10.1111/j.1744-7917.1998.tb00322.x.

Zalucki M.P., Adamson D., Furlong M.J. 2009. The fu-ture of IPM: whither or wither? Australian Journal of Entomology 48(2): 85–96. DOI: 10.1111/j.1440-6055.2009.00690.x.