IDENTIFICATION OF THE GAPS BETWEEN FARMERS' PRACTICES AND GOOD AGRICULTURAL PRACTICES IN CROP HUSBANDRY

A Thesis

By

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Student Id: MS-200821

A Thesis (Course No. AERD-6104) Submitted to Agrotechnology Discipline in Partial Fulfillment of the Requirement for the Degree of

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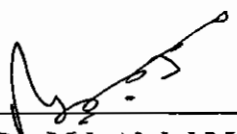

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ABSTRACT

Good agricultural practices (GAP) are important for producing good quality food minimizing health risk and improving situations relating economy, environmental sustainability and workers health. The study was conducted at Dumuria upazila of Khulna to identify the gaps between farmers' practices and GAP. Most of the farmers (63%) had medium knowledge on the practices under GAP and 82% of the farmers had highly favorable attitude towards GAP. Farmers did occasional practice regarding planting materials (93%) and the gaps were identified in 'record of planting materials if obtained from another farm' (100%), 'record of seed quality' (96.50%) and 'record of fertilizers and chemicals used' (94.75%). Most of the farmers' (91%) practices regarding fertilizers and soil additives were often, gaps were identified in 'record keeping of the source, product name, date, quantity obtained' (96.50%), 'to minimize the risk of heavy metal contamination' (94.50%), 'application of fertilizers and soil additives based upon soil analysis' (93.50%), 'assessment of the chemical and biological risks related to fertilizers and soil additives' (92%). The farmers did the practices related to water (irrigation) often (80%) and gaps were identified in 'where water testing is required, frequency of testing' (96%). The respondents (92%) did the practices under 'chemicals' often and gaps were identified in 'record of chemicals' (99.50%), 'record of application for each crop' (99.50%), 'records of chemicals in storage' (93.50%), 'harvesting as per the pre harvest interval period mentioned on the label' (89.50%), 'IPM'(70.75%). In case of harvesting and handling produce 97% farmers did the practices often and gaps were identified in 'shatter proof lights in packing house' (100%), 'applying specific test on produce if required' (99.75%), 'construction of sewage, waste disposal and drainage systems to minimize contamination' (99.50%), 'training workers in personal hygiene' (96%), 'calibrating measuring devices for ensuring correct measurement' (95.25%), 'availability of toilets and hand washing facilities to workers maintaining hygiene' (92.25%). Farmers had severe problem against practicing GAP (94%); 'not being able to understand the necessity of GAP' ranked 1st followed by 'unavailability of information of GAP' and 'lack of Govt. policy' ranked 2nd and 3rd. Farmers age had significant negative correlation with 'chemicals' and 'harvesting and handling produce related practices', farm size had significant negative correlation with 'fertilizers and soil additives' related practices, 'knowledge on GAP' had significant positive correlation with 'chemicals' and 'harvesting and handling produce'.

Key words: GAP, knowledge on GAP, planting materials, fertilizers and soil additives, water, chemicals, harvesting and handling produce.

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CHAPTER I

INTRODUCTION

1.1 General Background

Food safety is gaining increasing importance day by day because of its significance both from health and trade perspectives. The production of safe food is essential for protecting consumers from the hazards of food borne illnesses and is important both in the domestic food business as well as for increasing competitiveness in export markets. Hazards may occur at different stages of the food chain starting right from the primary production, e.g. residues above permitted levels, microbial contaminants and heavy metals. So, it is important to address food safety right from food production at farm level (FAO, 2016).

Good agricultural practices (GAP) are a collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economic, social and environmental sustainability (FAO, 2016). The concept of Good Agricultural Practices has evolved out of, and expands on, such production recommendations. Consumers and hence the food industry and the development community are every day more concerned that food – more and more of which comes through processing and supermarket chains - is safe to eat. They also increasingly care that commodities are produced in ways that are in harmony with the environment and social values (e.g., at least the minimal needs of farm workers are met, international agreements on child labor are respected, etc.) (Poisot et. al., 2007).

Good Agricultural Practices is important because it reinforces responsible farming methods from site selection and land preparation to harvesting and handling. According to the Food and Agriculture Organization of the United Nations (FAO, 2010), GAP applies available knowledge to address environmental, economic, and social sustainability for on-farm production and post-production processes, resulting in safe and healthy agricultural products.

To meet the consumer demand GAP certification was introduced. GAP certification is a process done by an independent certifying body to guarantee that production processes or products of farms meet GAP standards. It is a system which marks the produce of a farm as GAP certified. Here, GAP certified food will ensure the food was produced in a farm where good agricultural practices were applied. The purpose of the GAP program is to provide

consumers with confidence that they are purchasing fresh fruits, vegetables and tree nuts that have been handled in a manner to reduce the risk of microbial contamination.

There are many GAP certification systems around the world. Every system has their own standards considering the local situation, availability of resources etc. GLOBALG.A.P. is one of them. Some other GAP certification program includes CanadaGAP in Canada, NZGAP in New Zealand, PhilGAP in Philippines, SALM in Malaysia etc. Different countries have their own set of standards for GAP while maintaining the critical criteria for food safety. Many countries have their standard equivalent to GLOBALG.A.P.

The GAP process embraces actions, technologies and systems that are accepted as most effective for optimal management of soil and water, and for crop and livestock production, from the point of view of microbiological and chemical safety, with the added dimensions of environmental, economic and social sustainability. The details of a GAP protocol for a commodity in a given production environment cannot be generalized and prescriptive from a central information source like FAO, but must be adapted locally (taking into consideration local conditions and market requirements, if any) while based on general underlying principles or norms (Poisot et. al., 2007).

Assuring food safety is one of the most important challenges in Bangladesh. With a view to assure the availability of safe food through proper practice of scientific procedures through coordination of food production, import, processing, storage, supply, marketing and sales related activities, establishment of an efficient and effective authority by repealing related existing acts and reframing act the Food Safety Act, 2013 of Bangladesh has been enacted.

In Bangladesh certification of produce at national level on the basis of GAP hasn't started yet. But different experimental GAP project was done in different areas of the country like GAP training program in Narsingdi under AFACI-GAP project (BARC Annual Report, 2018). Formulation of "Good Agricultural Practices (GAP) Policy 2020" is one of the major steps reaching towards it.

To implement GAP, first of all it is needed to understand the present situation of farmers' practices at their farm. Realizing the present situation helps to measure the effort needed in different sector to implement GAP. For this identifying the gap between farmers' practices and GAP is an important step. Identifying the gap will help to prioritize practices that will reduce the gap and will result in good quality food production.

1.2 Statement of the Problems

In view of the above background and facts, the present study was undertaken with the title "Identification of the gaps between farmers' practices and good agricultural practices (GAP)". The study aimed at providing information regarding the following queries

i. What is the extent of practice used by the farmers in implementing GAP?
ii. What are the gaps in implementing GAP by the farmers?
iii. What are the problems regarding GAP?
iv. What are the relationships between the selected characteristics of the respondents with their extent of practicing GAP?

1.3 Objectives of the Study

Considering the facts this study was conducted to identify the gaps between farmers' practices and good agricultural practices (GAP) in crop husbandry. The specific objectives of the study were

i. To determine the extent of application of GAP (Good Agricultural Practices) and identification of the gaps in implementing GAP

ii. To determine the extent of problems against implementing GAP

iii. To explore the relationships between the selected characteristics and practicing extent of GAP by the farmers

1.4 Scope of the Study

The present study was designed to know the extent of application of GAP, identify the gaps between farmers' practices and GAP and to find relationships between farmers' characteristics and practicing extent of GAP. The scopes of the study are as follows

i. The study was conducted in one upazila named Dumuria of Khulna district. The findings may also be applicable to other areas of Bangladesh where socio-cultural, psychological and economic situation do not differ much than those of the study area.
ii. The study will help to formulate extension program to improve farmers' practices in identified gap area.

iii. According to the relationships between farmers' characteristics and practicing extent of GAP by the farmers, more specified plans can be undertaken to select adequate and proper technologies to improve the condition of applying GAP.

1.5 Assumptions of the Study

An assumption is the supposition that an apparent fact or principles is true in the light of available evidence (Goode, 1945). The following assumptions were in the mind of the researchers while conducting the study

i. The respondents were involved in the sample were capable of furnishing proper responses of the questions contained in the interview schedule.

ii. The interviews were well adjusted to the social and cultural environment of the study area.

iii. The views and opinions furnished by the respondents were representative of the whole populations of the study.

iv. The responses furnished by the respondents were reliable and truly expressed.

v. The interviews were able to rate the responses with adequate precision.

vi. Identified problems in the area included all the sustainability criteria considered by the researchers.

1.6 Limitations

i. The study was conducted in Dumuria upazila under Khulna District. Thus the finding may not represent the real scenario of whole country due to the wide spread variation in nature and one social system to other.

ii. Only few characteristics were taken into consideration for investigation in this study.

iii. The interview schedule was prepared in English but was translated into mother tongue while interviewing data.

1.7 Definition of the Terms

Certain key terms were used throughout this study which are defined here for clarity of understanding.

GAP: GAP (Good Agricultural Practices) are a "collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economic, social and environmental sustainability.

Farmers: A person who owns or manages a farm.

Age: Age of the farmers refers to the period of time in years from his birth to the time of interview.

Educational qualification: Educational qualification refers to the ability of an individual to read and write or having formal education received up to certain standard of full schooling years.

Family size: It referred to actual number of permanent members in a subject's family who lived in a fixed dwelling unit and ate from the same cooking arrangement.

Farming experience: It referred to the actual number of days that an individuals are involved with agricultural work which measured by the number of years from his/her involvement with agricultural work to the time of interview. In case of SAAOs farming experience referred to the job experience and it is also measured by the number of years from his/her involvement with the job to the time of interview.

Farm size: Farm size refers to the respondents' area of ownership and area under cultivation in hectare.

Monthly family income: Family income referred to the total earnings of all the family members of a respondent from agriculture/job, business, service and other accessible sources.

Training received: It referred to the total number of training and total days that a respondent received in his entire life from different organizations under different training programs.

Organizational participation: Organizational participation of an individual referred to his/her participation in various organizations as ordinary member, executive committee member and executive committee officer.

Cosmopolitanism: It referred to an individual's exposure outside his own social environment, his exposure to the nearest village, own union, own upazila, other upazilas, districts or places of social and agricultural important.

Extension media contact: It referred to an individual's exposure to or contact with different communication media and sources and personalities being used for discrimination of new technologies among the farmers.

Knowledge on GAP: It refers to the theoretical or practical understanding of farmers about the practices that are considered to be good agricultural practices.

Attitude: It treats the positive or negative reaction of a respondent towards implementing GAP and outcome of GAP.

Problem: It denotes different sorts of problems that are acting as obstacles in implementing GAP by the farmers.

CHAPTER II

REVIEW OF LITERATURE

This chapter deals with the review of past researches related to this investigation. In spite of sincere effort adequate numbers of direct related literatures were not readily available for this study. Literatures were arranged in section wise. However, the literatures of available studies have been briefly discussed in this chapter

2.1 Reviews on Good Agricultural Practices (GAP)

2.1.1 Definition of GAP

FAO (2016) defined GAP as a collection of principles to apply for on-farm production and postproduction processes, resulting in safe and healthy food and non-food agriculture products, while taking into account economic, social and environmental sustainability.

2.1.2 Benefits of GAP

Sabir et. al. (2010) said that the advantages of adopting GAP are development of basic infrastructure at the field level, build up the culture of following good agricultural practices by the farmers, uniform approach across farms regardless of their sizes, increased awareness among the farmers, traceability through complete integration of food chain i.e. from farm to fork, the produce must be traceable for its origin including all inputs, improvement in the environment as well as soil fertility, worker safety and welfare, reputation in the international market as a producer of good quality and safe produce

Nirmala (2016) found that farm women benefited from GAP interventions in understanding the basic importance of soil fertility management, crop production practices, post-harvest technologies, and animal production practices. It was evident from significant differences in knowledge levels between beneficiaries and non-beneficiaries that reflected from high mean scores. This change is however necessary to improve profitability and sustainability of small farms and its development.

Athipanyakul and Pak-Uthai (2012) found that GAP implemented treatment effect model of chili production which showed better production and well maintenance increased the adoption of GAP in chili cultivation by the farmers.

Junming et al. (2009) found in their research that implementing GAP practices improved quality of milk by increasing protein and fat content and decreasing presence of stomatocyte.

Senthilkumar et. al. (2018) found that compared to the farmers' own practices, average yield increases of 1 t paddy ha^{-1} in 2013 and 2.7 t ha^{-1} in 2014 were achieved when following GAP in Tanzania.

Islam et. al. (2012) found that between GAP practiced field and conventional field, GAP practiced field showed increased production of tomato. The price of tomato of GAP adopted field was also higher because the quality of the tomatoes was greater in size, appearance and color.

2.1.3 Risk of not adopting GAP

Parmar and Vardhini (2016) found that although the soil testing has become mandatory to know the soil health condition nearly about 62% of the farmers have not done the testing of their soil. Nearly about 90% farmer didn't know the physical, chemical nature and also about nutrients present in the soil.

Sagheer et. al. (2009) found that their research analysis brought out a compelling need for "sensitive and responsive" action by developing country governments while competing globally maintaining food standards. Food industries in developing countries tend to detour while complying with standards, owing to costs involved in setting up systems and procedures. While a strong surveillance mechanism is the high point of a good compliant system this has to be preceded by supporting measures such as linking of domestic and international markets, consolidation of institutional structures, strengthening of legal/regulatory systems, etc.

Akkaya et. al. (2005) said that GAP is of utmost importance in protecting consumer health. It requires ensuring safety throughout the food chain. It must be compulsory and transparent and operate not only from the table but also upstream to include suppliers (e.g. fertilizers, plant protection).

de Quadros Rodrigues et. al. (2014) found in their research in a lettuce farm that *E. coli O157* was detected in irrigation water and in rinse water samples, *Salmonella spp.* was detected in one out of nine manure samples applied as organic fertilizer and generic *E. coli* was frequently present in numbers exceeding 10 cfu/g in manure, manured soil, and lettuce samples or more than 1 cfu/100 ml in water.

Sing et. al. (2019) said that although food is necessary for our body, if it is contaminated with pathogenic microbes or their toxins or environmental contaminants, it can play a role in the transmission/onset of diseases. A food hazard refers to any agent present in the food that causes adverse health consequences for consumers. Hazards may be introduced into the food at any time during harvesting, formulation and processing, packaging and labeling, transportation, storage, preparation, and serving. The contamination of food by pathogenic microbes or chemical toxicants is a significant problem, as it can prompt an extensive variety of health issues. To ensure food safety, hazard analysis is required, which involves evaluation of risks related to all parts of food production.

Patino et. al. (2020) found in their research that at least one pesticide is present in 63% of the samples evaluated ($n = 100$, including fruits and vegetables), and in 41% of these, pesticides exceeded the maximum residue limit. Heavy metals were also found in 45% of the samples, with cadmium (38%) and lead (14%) being the most frequent. The pathogenic microorganisms *Escherichia coli* O157:H7, *Listeria monocytogenes*, *Salmonella*, and *Campylobacter sp.* were also detected. Factors concerning integrated crop management, contaminated inputs with chemicals and microorganisms, and the lack of hygiene in the postharvest stage favor the presence of pesticide residues, heavy metals, and the appearance of pathogenic microorganisms.

Gilden et. al. (2010) said that the presence of pesticide residues is a concern for consumers because pesticides are known to have potential harmful effects to other non-targeted organisms than pests and diseases. The major concerns are their toxic effects such as interfering with the reproductive systems and foetal development as well as their capacity to cause cancer and asthma.

Mahmood et. al. (2016) said that pesticides benefit the crops; however, they also impose a serious negative impact on the environment. Excessive use of pesticides may lead to the destruction of biodiversity. Many birds, aquatic organisms and animals are under the threat of harmful pesticides for their survival. Pesticides are a concern for sustainability of environment and global stability.

Rani et. al. (2021) said that pesticides are very toxic in nature and pose acute risks on the human health and the environment. They negatively affected the agricultural workers and trigger social conflicts when employed extensively and without safety measures. Further, they also have adverse effects on the neighboring communities.

Yekti and Suryaningsih (2021) said that the level of dependence of farmers on chemical fertilizers and pesticides on rice plants can lead to soil nutrient degradation and pest resistance. Also, excessive use of chemicals in rice can leave a residue in the production of rice, thus affecting the food security of rice.

2.1.4 Initiative to follow GAP

Sabir et. al. (2010) said that in India, Bureau of Indian Standards (BIS) has taken initiatives to develop its own standards to be followed by institutions and companies, etc. The draft Indian Standard Good Agricultural Practices – IndiaGAP (Part 1- Crop Base) takes into account not only the quality and quantity of the crop obtained from a unit area but also the care and attention gone into integrating pre-harvest practices like soil & water management, nutrient management and pest management, harvesting, post harvest handling and other logistics.

2.1.5 Other concepts related to GAP

Banzon et. al. (2013) found that the results of their study indicate a high level of GAP adoption in the Davao banana industry because of the number of corporate farms in the area that cater to the export market. The operations of these farms are aligned with GLOBALGAP but not with the Philippine GAP (PhilGAP).

Banzon et. al. (2013) found that for smaller farms that do not have the capability to comply with GAP requirements on their own, the initiatives and support of government and nongovernment entities serve as the most important driver.

Schmidt and Rodrick (2003) said that public concerns have arisen regarding high-profile food-borne illness outbreaks due to contamination of food with certain pathogens (e.g., *Salmonella*, *Escherihia coli* 0157:H7, Listeria monocytogenes and others) which have serious acute impact and potential chronic long-term complications in the ever-increasing high-risk population segment(e.g., elderly, children, immune compromised).

Keikotlhaile and Spanoghe (2011) said that the use of pesticides have increased because they have rapid action, decrease toxins produced by food infecting organisms and are less labour intensive than other pest control methods. However, the use of pesticides during production often leads to the presence of pesticide residues in fruits and vegetables after harvest.

Singh and Ryan (2015) said that while soil health can be affected by limited nutrient input from fertilizers, application of amounts of fertilizer nutrients above the crop's needs for

optimum growth can be equally detrimental to soils and reduce economic profitability. Low or unbalanced fertilization leads to depletion of soil nutrients and degradation due to lower soil organic matter (SOM) contents from lower root biomass associated with reduced crop yields, and indirectly reduced soil structure which promotes soil erosion.

Singh and Ryan (2015) said that where the supply of nutrients in the soil is adequate, crops are more likely to grow well and produce large amounts of biomass. Fertilizers are needed in those cases where nutrients in the soil are lacking and cannot produce healthy crops and sufficient biomass.

Dewi et. al. (2022) found that a high level of knowledge does not mean that farmers will apply this knowledge in practice: this is particularly relevant to wearing gloves and masks, using tools to remove blockages, never clearing blocked nozzles by blowing into them, and disposing of empty containers properly. Nevertheless, in some cases high levels of knowledge do result in high levels of application. Cases of pesticide exposure affecting human health by causing symptoms such as dizziness, nausea, and vomiting confirm that GAP for pesticide usage are not being implemented properly by some farmers.

Arsanti and Böhme (2018) said that farmers generally have a positive perspective in implementing GAP, even although it is complicated in some cases. The positive impact from farmers arises from improved productivity and higher returns.

Campbell (2005) said that EurepGAP can be argued to be a new form of social authority. Its constituent partners are not publicly controlled but privately owned and it is not a form of state or supra-state regulation. Rather, it is an alliance of food retailers, NGOs, producer organisations, consumer groups, agri-industry and the science community – ordered at the European level.

Dhivya et. al. (2021) said that rethinking of the availability and applicability of similar systems in the food chains of developing countries could turnaround the business model linking the stakeholders of a value chain whereas bringing about economic impacts.

2.2 Conceptual Framework of the Study

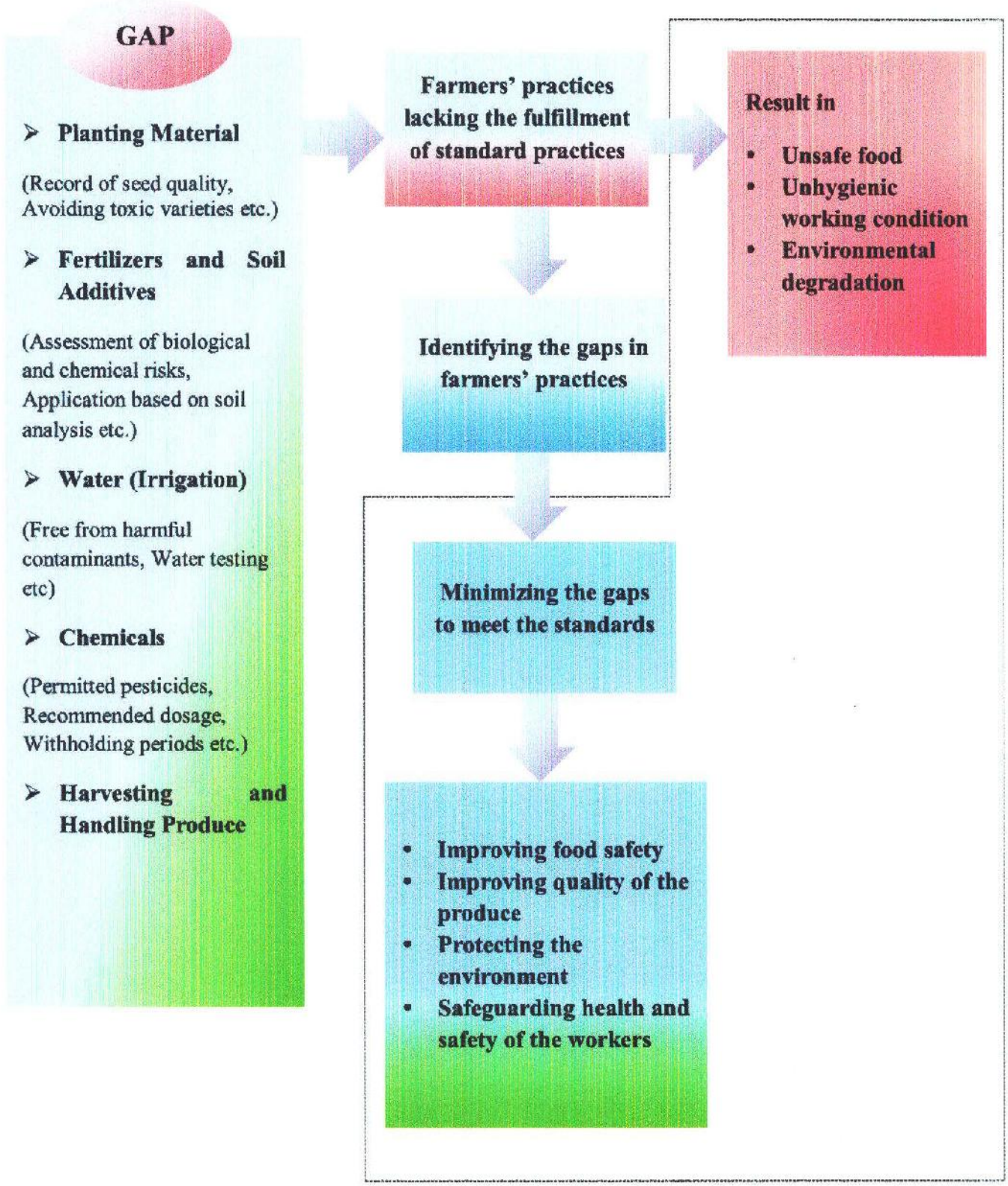

Figure 1: Conceptual Framework

Figure 1 showed the conceptual framework of the study and there under GAP there are different criteria like planting material, fertilizers and soil additives, water (irrigation) etc. under which different practices are classified. The frame work showed that if farmers' practices lack the fulfillment of GAP it will result in unsafe food, unhygienic working condition, environmental degradation. So, identifying the gaps in farmers practices will help to minimize the gaps to meet the standards and will improve food safety, quality of produce, protect the environment and safeguard the health of the workers. The boxes on Figure 1 which are in the dotted box are not directly related to the study.

CHAPTER III

METHODOLOGY

The methods and procedures followed to conduct the present study have been described in this part.

3.1. Research Design

An ex-post facto explanatory cross-sectional research design was used for the study. The study was quasi-experimental in nature and tried to predict the relationship of the selected characteristics of the farmers with their extent of practicing good agricultural practices.

3.2. Locale of the Study

The study was conducted at different villages of Dumuria upazila under Khulna district. The distinct features of the study area is that the people of the area mainly depend on farming for their livelihood, farmers of Dumuria upazila were active in crop cultivation (both grain crops and vegetables) and fish culture but they were more active in vegetable cultivation. The study area was near the Khulna University and well developed communication system exists in the area. The total area of Dumuria upazila was 454.23 sq. km. A map Dumuria upazila shown in Figure 2.

Figure 2: Dumuria upazila of Khulna district

3.3. Population and Sampling Technique

All the farmers who were involved in crop cultivation of the study area under Dumuria upazila were considered as the population of the study. Out of them one hundred farmers were selected purposively as sample of the study.

3.4 Preparation of Interview Schedule

An interview schedule was prepared for collecting valid and reliable information from the farmers. The interview schedule was designed according to the objectives of the study. Before final data collection, the interview schedule was pretested with 5 farmers of Dumuria upazila for checking suitability of the statements added in it. After pretesting, correction and rearrangements were added in the interview schedule according to the directions of the supervisor of the researcher. The final interview schedule was then prepared and made necessary number of copies for the study. The English version of the interview schedule has been added in Appendix A.

3.5 Method and Time of Data Collection

Data were collected and checked properly after preparing the final interview schedule. Data were collected using face to face interviews by the researcher herself using the interview schedule. To get valid and relevant information the researchers made all possible efforts to explain the purpose of study to the respondents. While starting the interview with any respondents, the researcher took all possible care to establish rapport with them so that the respondents would not feel any hesitation to furnish proper answers. Besides the views of some key informants were taken to enrich and validate some information collected through interview schedule. The local people of the area helped and co-operated the researchers in data collection. Data was collected from the respondents during January 24 to February 6, 2022.

3.6. Selection of the Study Variables

In a survey research, selection and measurement of variables is a vital task. It is essential to delineate the problem and decide variables where relationships are involved, because relations are fundamental stuff out of which all sciences are built. In all relationship two kinds of variables are identified, one is the independent variable other is the dependent variable. An independent variable is that factor manipulated by the experimenter in his attempts to ascertain its relationship to an observed phenomenon. A dependent variable, on

the other hand, is that factor which appears, disappears or varies as the experimenter introduces, removes or modifies the independent variables (Townsend, 1953).

Table 3.1 Selected characteristics of respondents

Selected characteristics of farmers	GAPs related
i. Age	i. Planting materials
ii. Educational qualification	ii. Fertilizers and soil additives
iii. Family size	iii. Water (Irrigation)
iv. Farming experience	iv. Chemicals (plant protection products or other agro and non-agrochemicals
v. Farm size	
vi. Family income	v. Harvesting and handling produce
vii. Training received	vi. Problem regarding GAP
viii. Organizational participation	vii. Knowledge on GAP
ix. Cosmopolitanism	Attitude towards GAP
x. Extension media contact	

For this study GAP related practice criteria i to v (Table 3.1) and the standard practices (Appendix A) listed under them were taken from "A Scheme and Training Manual on Good Agricultural Practices (GAP) for Fruits and Vegetables" published by FAO in 2016 (FAO, 2016) under the criteria of 'Food Safety Module (FSM)' to measure the extent of practice and identify the gaps in practicing GAP.

3.7 Data Processing and Analysis

After collection of data, all the information contained in the interview schedule was edited. All personal characteristics were categorized and arranged in simple tables for interpretation and discussion. Local units were converted into standard units and qualitative data were converted into quantitative ones by means of suitable scoring whenever necessary. Data analysis was done by using a micro-computer with SPSS and MS Excel. Simple statistics like frequency counts, percentage, range, mean and standard deviations were used in the interpretation of descriptive data. A five points Liker type scale was used to measure the attitude of respondents towards GAP. Spearman rank correlation was used in order to explore

the relationships between the concerned variables, throughout the analysis. At least five percent (0.05) level of significance was used as basis of rejecting a null hypothesis.

3.8. Measurement of Socioeconomic Characteristics of Farmers

3.8.1 Age

The age of the respondents were measured in terms of actual years from his/her birth to the time of interview. However, based on available information of respondents, one score was assigned for each and every complete year of respondent's age. The minimum and maximum score is unknown. Based on age, the respondents were categorized into following categories as shown in Table 3.2

Table 3.2 Categories of respondents according to their age

Categories	Score
Young	≤35
Middle	36-55
old	>55

3.8.2 Educational qualification

Educational qualification of a respondent was measured in terms of year schooling. A score of score zero (0) was assigned to the respondents who cannot read and write means illiterate. If a respondent receive education outside of the school, his/her education equivalence score was determined corresponding to the level of his formal education. A score of "one" was assigned for every completed schooling year. The minimum can be "0" and maximum score is unknown. Educational qualification belongs to item number 2 in the interview schedule (Appendix A). Based on educational qualification, the respondents were categorized into following categories as shown in Table 3.3

Table 3.3 Categories of respondents according to their educational qualification

Categories	Score
Illiterate	0
Can sign only	0.5
Primary	1-5
Secondary	6-10
Higher secondary	11-12
Undergraduate	13-16
Postgraduate	>16

3.8.3 Family size

Family size was determined by the total number of family members of a respondent including himself/herself and the others dependents. Score of a farmer on family size was counted by the actual number of their family members. Family size belongs to item number 3 in the interview schedule (Appendix A). On basis of family size, respondents were classified into following categories as shown in Table 3.5.

Table 3.4 Categories of respondents according to their family size

Categories	Number of family members
Small	≤4
Medium	5-6
Large	>6

3.8.4 Farming experience

The experience in farming of a respondent was measured by the length covered from his/her starting year in farming to the interview on the basis of his/her statement number 4 in the interview schedule (Appendix A). The minimum and maximum score is unknown. On the basis of the farming experience they are classified into following categories as shown in Table 3.5.

Table 3.5 Categories of respondents according to their farming experience

Categories	Score
Low	≤10
Medium	11-20
High	>20

3.8.5 Farm size

Farm size refers to the total area of land owned by a respondent including homestead area. It also includes the land obtained from others on share cropping/borga or taken from others on lease. The area was being estimated in terms of full of benefits to the farmers. The farm size was calculated using following formula:

FS = A1+A2+1/2 (A3+A4) +A5

Where, FS= Farm size

A1= Homestead

A2= Own land under cultivation

A3= Land given to others on borga

A4= Land taken from others on borga

A5= Land taken from others on lease

A6= Others

The farm size was recorded in local unit and then it was converted to hectare. Farm size belongs to item number 7 in the interview schedule (Appendix A). On the basis of farm size, farmers were classified into five categories which are shown in Table 3.6.

Table 3.6 Categories of respondents according to their farm size

Categories	Score (ha)
Landless	≤0.02
Marginal	0.02-0.2
Small	0.21-1.0
Medium	1-3
Large	>3

Source: BBS (2016)

3.8.6 Monthly family income

Family income (monthly) of a farmer was estimated by considering total earning in the last year from different sources viz. agriculture, business, service and others. Family income is included in the interview schedule as item number 8 of the interview schedule (Appendix A). The minimum and maximum score is unknown.

Table 3.7 Categories of respondents according to their monthly family income

Categories	Taka (BDT)
Low	<15000
Medium	15000-25000
High	>25000

3.8.7 Training received

Training score of the respondent was measured depending on the number of training he/she had received. For computing training score, (1) was given receiving on the training only. Respondents who have received one or two or three training, were assigned a score of 1, 2, 3 respectively. The score 0 was assigned if they do not take any training. Training received is included in the interview schedule as item No.9 (appendix A). The respondents were classified into following categories in the Table 3.8.

Table 3.8 Categories of respondents according to their training received

Categories	Score
Low	≤2
Medium	3-5
High	>5

3.8.8 Organizational participation

Organizational participation of a respondent was measured on the basis of his/her involvement and the nature of participation in different organizations of the study area during the time of interview. List of different organizations are shown in item number 10 in the interview schedule (Appendix A). The score '0'was assigned for no participation, "1" for ordinary member, "2" for executive committee member and "3" for executive committee officer. The summation of score obtained by a respondent was the score of his/her organizational participation, farmers are classified into following categories as shown in Table 3.9.

Table 3.9 Categories of respondents according to their organizational participation

Categories	Score
Low	≤8
Medium	9-16
High	>16

3.8.9 Cosmopolitanism

The cosmopolitanism score of a respondent was measured to determine the extent of his/her cosmopolitanism on the basis of his/her frequencies of visits to the places outside of his/her own social system. It was determined by counting the number of visits made in five different places which indicate the extent of visit as frequently, occasionally, rarely and not at all and the scores were 3, 2, 1 and 0 respectively. The score could range from 0 to 15 where "0" meaning no cosmopolitanism and "15" meaning very high cosmopolitanism. Cosmopolitanism of the respondents is shown in item number 11 of the interview schedule (Appendix A).

Table 3.10 Categories of respondents according to their cosmopolitanism

Categories	Score
Low	≤5
Medium	6-10
High	>10

3.8.10 Extension media contact

Extension media contact of a respondent was determined as his/her degree of exposure with different extension media and persons that acted as information sources to motivate him/her and to broaden his outlook to new practices. The score could range from 0 to 96 where "0" meaning no extension media exposure and "96" meaning very high extension media exposure. The respondents were classified into following categories according to extension media exposure as shown in Table 3.11.

Table 3.11 Categories of respondents according to their extension media contact

Categories	Score
No	0
Rare	1-24
Occasional	25-48
Often	49-72
Regular	>72

3.8.11 Knowledge on GAP

Knowledge on Good Agricultural Practices (GAP) of the farmers indicate their practical knowledge on GAPs. To determine knowledge of GAPs of farmers 10 questions were asked to each farmer. The questions covered different aspects on GAP. Each question was assigned

3.9 Measurement of dependent variable (GAP related)

All the practice criteria (planting materials, fertilizers and soil additives, water, chemicals, harvesting and handling produce; number 15-19 of the interview schedule (Appendix A) were scored as Table 3.14.

Table 3.14 Score of Extent of Practice

Extent of practice	Score
Regularly	4
Often	3
Occasionally	2
Rarely	1
Not at all	0

3.9.1 Planting Materials

Planting materials related practices were listed in No.15 of the interview schedule (appendix A). The score could range from 0 to 24. The categories of respondents according to their scores of planting materials related practices are given below

Table 3.15 Categories of respondents according to their practice related to planting materials

Categories	Score
No use	0
Rare	≤6
Occasional	7-12
Often	13-18
Regularly	>18

3.9.2 Fertilizers and Soil Additives

Fertilizers and soil additives related practices were listed in number 16 of the interview schedule (appendix A). The score could range from 0 to 40. The categories of respondents according to their score of fertilizers and soil additives related practices are given in Table 3.16.

Table 3.16 Categories of respondents according to their practice related to fertilizers and soil additives

Categories	Score
No use	0
Rare	≤10
Occasional	11-20
Often	21-30
Regularly	>30

3.9.3 Water (Irrigation)

Water (irrigation) related practices were listed in number 17 of the interview schedule (Appendix A). The score could range from 0 to 24. The categories of respondents according to their score of water (irrigation) related practices are given below

Table 3.17 Categories of respondents according to their practice related to water (irrigation)

Categories	Score
No use	0
Rare	≤6
Occasional	7-12
Often	13-18
Regularly	>18

3.9.4 Chemicals (Plant protection products or other agro and non-agrochemicals)

Chemicals (plant protection products or other agro and non-agrochemicals) related practices were listed in number 18 of the interview schedule (Appendix A). The score could range from 0 to 76. The categories of respondents according to their score of related practices are given in Table 3.18

Table 3.18 Categories of respondents according to their practice related to chemicals (plant protection products or other agro and non-agrochemicals)

Categories	Score
No use	0
Rare	≤19
Occasional	20-38
Often	39-57
Regularly	>57

3.9.5 Harvesting and handling produce

Harvesting and handling produce related practices were listed in number 19 of the interview schedule (Appendix A). The score could range from 0 to 104. The categories of respondents according to their score of harvesting and handling produce related practices are given in Table 3.19

Table 3.19 Categories of respondents according to their practice related to harvesting and handling produce

Categories	Score
No use	0
Rare	≤26
Occasional	27-52
Often	53-78
Regularly	>78

3.9.6 Problems regarding GAP

Problems against GAP were listed on number 20 in the interview schedule (Appendix A). The severity magnitude of the problems were scored as Table 3.20

Table 3.20 Score of problem

Severity magnitude	Score
Highly severe	3
Severe	2
Less severe	1
Not at all	0

Table 3.21 Categories of respondents according to their problems regarding GAP

Categories	Score
Less severe	≤10
Severe	11-20
Highly severe	>20

3.10 Practice Index of GAPs

The extent of practicing a GAP was determined based on practice index. The practice score was determined by using the following formula,

PS= N1×4+N2×3+N3×2+N4×1+N5×0

Where,

PS= Practice score

N1= Number of respondents did the practice regularly

N2= Number of respondents did the practice often

N3= Number of respondents did the practice occasionally

N4= Number of respondents did the practice rarely

N5= Number of respondents did the practice not at all

The possible range of practice score was 0 to 400.

For example, among 100 respondents 55, 17, 11, 9 and 8 respondents indicate the extent of a practice as regularly, often, occasional, rarely and not at all respectively. Thus the PS for that practice is

$$PS = 55\times4+17\times3+11\times2+9\times1+8\times0$$

$$= 220+51+22+9+0 = 302$$

After determination of PS, the practice index was determined by following formula

$$(\%)\ \text{Practice Index} = \frac{\text{observed practice score}}{\text{possible highest practice score}} \times 100$$

3.11 Measurement of Gaps in implementing GAP

Practice index 100 means the full application of the practice. So, for measuring the gaps practice index of each practice was deducted from 100.

Gaps (%) = 100 – Practice index

3.12 Problem Severity Index (PSI)

The severity of a problem was determined based on problem severity index (PSI). The PSI was determined by using the following formula,

PSS= N1×3+N2×2+N3×1+N4×0

Where,

PSS= Problem severity score

N1= Number of respondents who marked the problem as highly severe

N2= Number of respondents who marked the problem as severe

N3= Number of respondents who marked the problem as less severe

N4= Number of respondents did not mark the problem at all

The possible range of problem severity score (PSS) was 0 to 180.

For example, among 100 respondents 64, 17, 11 and 8 respondents indicate the extent of problem regarding problem number as highly severe, severe, less severe and not at all respectively. Thus the PSS for that problem is

$$PSS = 64\times3+17\times2+11\times1+8\times0$$

$$= 192+34+11+0 = 237$$

After determination of PSS, the severity index of the problem was determined by following formula

$$(\%)\ \text{Severity index of the problem} = \frac{\text{observed problem score}}{\text{possible highest problem score}} \times 100$$

3.11 Rank

The rank of a problem was determined based on the (%) severity of the problem. The problem which obtained highest (%) severity hold the first rank and then the second highest (%) severity hold the second rank and so on.

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this chapter is to describe the findings of the study. The study was done to identify the gap between farmers' practices and good agricultural practices in crop husbandry. In accordance with the objectives, presentations of the findings has been made in this chapter in the following sections

i. Measuring the extent of application of GAP (Good Agricultural Practices) and identification of the gaps in implementing GAP
ii. Identification of problems regarding implementing GAP
iii. Relationships between the selected characteristics and practicing extent of GAP by the farmers

4.1 Measuring the Extent of Application of GAP (Good Agricultural Practices) and Identification of the Gaps in Implementing GAP

4.1.1 Knowledge on GAP

Data presented in Table 4.1 showed that 63% of the respondents had good knowledge on GAPs. 20% and 17% had excellent and low knowledge. The knowledge score ranged from 6 to 16 with a mean of 11.64 and standard deviation 2.16.

Table 4.1 Distribution of respondents on the basis of knowledge on GAP

Categories	Score	N=100	Mean ± SD ($\bar{x} \pm \sigma$)	Range	
		%		Min.	Max.
Low	<10	17.0	11.64±2.16	6.00	16.00
Good	10-13	63.0			
Excellent	>13	20.0			

Here farmers knowledge is mainly on the practices under GAP. No farmers were aware of the literal term named "GAP". Respondents medium knowledge cannot guarantee higher practice of GAP. Respondents knowledge level indicates that there is much gap of information in farmers level. It may be due to less information from extension personnel and low level of extension media contact. Training can significantly increase the knowledge of farmers on GAP.

Shaw et. al. (2015) found that growers positively changed their knowledge and opinions on key food safety principles and regulations, which provides evidence that Extension programming is an effective method to educate small growers.

4.1.2 Attitude towards GAP

Results of Table 4.2 indicate that most of the respondents (82%) had highly favorable attitude towards GAPs. Eighteen percent of the respondents had favorable attitude. The score ranged from 46 to 60 with a mean of 51.45 and standard deviation 2.35.

Table 4.2 Distribution of respondents on the basis of attitude towards GAP

Categories	Score	N=100	Mean ± SD ($\bar{x} \pm \sigma$)	Range	
		%		Min.	Max.
Less favorable	12-24	0	51.45±2.35	46.00	60.00
Moderately favorable	25-36	0			
Favorable	37-48	18.0			
Highly favorable	49-60	82.0			

Respondents' highly favorable attitude towards GAP indicates that they are able to understand basic quality points of GAP. They understood that related practices of GAP are beneficial for farm practice, health and will result in increased profit.

GAP training program in Narsingdi under AFACI-GAP project found farmers positive and favorable interest towards GAP (BARC, 2018).

4.1.3 Planting materials

Table 4.3 showed that highest portion of the respondents (93%) did occasional level of practice related to planting materials followed by 5% and 2% had often and rare level of practice. There was no respondent who did the practices regularly. The score ranged from 4 to 16 with a mean of 10.30 and standard deviation of 2.15.

Table 4.3 Distribution of respondents on the basis of planting materials

Categories	Score	N=100	Mean ± SD ($\bar{x} \pm \sigma$)	Range	
		%		Min.	Max.
Rare	≤6	2.0	10.30±2.15	4.00	16.00
Occasional	7-12	93.0			
Often	13-18	5.0			
Regular	>18	0			

Most of the respondents practice was occasional and no one did the practices regularly that means their practice related to planting materials were not so good.

Table 4.4 Planting Materials Index

Serial	Statement	Practice Score	Practice Index (%)	Rank	Gap (%)
i.	Record of fertilizers and chemicals used	21	5.25	4th	94.75
ii.	Record of seed quality	14	3.50	5th	96.50
iii.	Checking visible signs of pest and diseases	395	98.75	2nd	1.25
iv.	Seed treatment by approved additives/pesticides	206	51.50	3rd	48.50
v.	Avoiding cultivation of toxic variety	400	100	1st	0
vi.	Record of planting materials if obtained from another farm	0	0	6th	100

From Table 4.4 highest 100% gap was identified in 'record of planting materials if obtained from another farm' (practice 0%, ranked 6th). That means farmers did not practice it at all. 'Record of seed quality' had 96.50% gap (practice 3.50%, ranked 5th). In case of 'Record of fertilizers and chemicals used' 94.75% gap was identified (practice 5.25%, ranked 4th). Formal record keeping was not done often but farmers keep rough record for benefit cost analysis.

Table 4.4 showed that avoiding cultivation of toxic materials ranked 1st (100%) in adopting planting materials related GAPs. 'Checking visible signs of pest and diseases' and 'Seed treatment by approved additives/pesticides' hold the 2nd (98.75%) and 3rd (51.50%) rank.

Parmar and Vardhini (2016) found that farmers didn't know the botanical name and variety name. They were also not sure that the seed chosen for cultivation were physically free from pest, disease, weeds and foreign and inert matter.

4.1 Fertilizers and Soil Additives

Data presented in Table 4.5 most of the respondents (91%) did the practice often and 9% did the practice occasional. The score of data ranged from 17 to 30 with a mean of 23.30 and standard deviation 2.31. There was no respondent who did the practices regularly.

Table 4.5 Distribution of respondents on the basis of fertilizers and soil additives

Categories	Score	N=100	Mean ± SD ($\bar{x} \pm \sigma$)	Range	
		%		Min.	Max.
Rare	≤10	0	23.30±2.31	17.00	30.00
Occasional	11-20	9.0			
Often	21-30	91.0			
Regular	>30	0			

Respondents did these practices often. As higher production of crops significantly depends on efficient application of fertilizers and soil additives, farmers may have followed these practices more often for better production.

Table 4.6 Fertilizers and soil additives index

Sl	Statement	Practice Score	Practice Index (%)	Rank	Gap (%)
i.	Assessment of the chemical and biological risks related to fertilizers and soil additives	32	8.0	7th	92
ii.	If significant hazards identified, measures taken to minimize the risk of contamination to produce	385	96.25	3rd	3.75
iii.	Application of fertilizers and soil additives based upon soil analysis	26	6.5	8th	93.50
iv.	To minimize the risk of heavy metal contamination to produce	22	5.5	9th	94.50
v.	Recommended application practices at appropriate stage of crop growth	379	94.75	4th	5.25
vi.	Avoiding untreated organic materials in case of significant risk of contaminating produce is identified, record for treated organic materials	388	97	2nd	3
vii.	Avoiding untreated human sewage	371	92.75	5th	7.25
viii.	Handling of fertilizers and soil additives to minimize the risk of contamination to production sites and water sources	358	89.50	6th	10.50
ix.	The source, product name, date, quantity obtained	14	3.50	10th	96.50
x.	Separate storage of organic and inorganic fertilizers from harvested farm produce	389	97.25	1st	2.75

From Table 4.6 highest 96.50% gap was identified in the practice of record keeping of 'The source, product name, date, quantity obtained' (practice 3.50%, ranked 10th) followed by 'To

minimize the risk of heavy metal contamination to produce' had 94.50% gap (practice 5.50%, ranked 9th), 'Application of fertilizers and soil additives based upon soil analysis' had 93.50% gap (practice 6.50%, ranked 8th), 'Assessment of the chemical and biological risks related to fertilizers and soil additives' had 92% gap (practice 8%, ranked 7th). These practices were less practiced by the respondents. Record keeping of 'The source, product name, date, quantity obtained' can be practiced easily as most of the farmers were literate. Though this practice was less practiced but most of the farmers keeps rough record of information for benefit and cost analysis.

Table 4.6 showed that 'Separate storage of organic and inorganic fertilizers from harvested farm produce' ranked 1st in practicing. 'Avoiding untreated organic materials in case of significant risk of contaminating produce is identified, record for treated organic materials' and 'If significant hazards identified, measures taken to minimize the risk of contamination to produce' hold the 2nd and 3rd rank.

Parmar and Vardhini (2016) found that although the soil testing has become mandatory to know the soil health condition nearly about 62% of the farmers have not done the testing of their soil. Nearly about 90% farmer didn't know the physical, chemical nature and also about nutrients present in the soil.

4.1. Water (Irrigation)

From Table 4.7 it is found that highest portion of the respondents (80%) did the practices often with a mean of 17.40 and standard deviation 1.68

Table 4.7 Distribution of respondents on the basis of water (irrigation)

Categories	Score	N=100	Mean ± SD ($\bar{x} \pm \sigma$)	Range	
		%		Min.	Max.
Rare	≤6	0	17.40±1.68	12.00	22.00
Occasional	7-12	2.0			
Often	13-18	80.0			
Regular	>18	18.0			

Respondents did these practices more often and there were also respondents who did these practices on regular basis. Farmers were more sincere in case of water (irrigation) because irrigation water can affect soil status by increasing soil salinity, metal contamination etc. Low

quality irrigation water is also harmful for crop production. Most of the farmers used ground water for irrigation and in case of high metal concentration they stored the water for some days before using it for irrigation. Storing of water helps in sedimentation of metal contents.

Table 4.8 Water (irrigation) index

Sl	Statement	Practice Score	Practice Index (%)	Rank	Gap (%)
i.	Free from harmful contaminants	383	95.75	2nd	4.25
ii.	Assessment of the source of water	233	58.25	5th	41.75
iii.	Where water testing is required, frequency of testing	28	4.0	6th	96
iv.	In case of identification significant risk, use of safe alternative water source or treated water	380	95.0	3rd	5
v.	Avoiding untreated sewage water, treated water maintaining regulations	400	100	1st	0
vi.	Maintaining irrigation equipment as per manufacturers guidelines	322	80.50	4th	19.50

From Table 4.8 highest 96% gap was identified in 'Where water testing is required, frequency of testing' (practice 4%, ranked 6th). Respondents who used river water or other sources of water they knew about water testing but they were not much interested in doing so. The one who did rarely, most of them were involved in fish culture in the same field.

Table 4.8 showed that 'avoiding untreated sewage water, treated water maintaining regulations' ranked 1st (100%), 'free from harmful contaminants' ranked 2nd (95.75%), 'in case of identification significant risk, use of safe alternative water source or treated water' ranked 3rd (95%).

Parmar and Vardhini (2016) found that no farmer has tested or analysed the water for its quality like salt concentration, sodium absorbing rate, presence of bicarbonates, boron etc. Water was also not analysed to check the presence of heavy metals and pesticides in the water supplied to the crops.

4.2 Chemicals (Plant protection products or other agro and non-agrochemicals)

Data presented in Table 4.9 showed that 92% of the respondents did the practices often. Data ranged from 42 to 64 with a mean of 51.26 and standard deviation 5.

Table 4.9 Distribution of respondents on the basis of chemicals (plant protection products or other agro and non-agrochemicals)

Characteristics	Categories	Score	N=100	Mean ± SD ($\bar{x} \pm \sigma$)	Range	
			%		Min.	Max.
Chemicals (plant protection products or other agro and non-agrochemicals	Rare	≤19	0	51.26±5.00	42.00	64.00
	Occasional	20-38	0			
	Often	39-57	92.0			
	Regular	>57	8.0			

Respondents did these practices more often and there were also respondents who did these practices on regular basis. Farmers were more sincere in case of chemicals handling and applying because it is needed for proper outcome of chemicals in case of management of pest, insect, parasites and diseases.

Table 4.10 Chemicals (plant protection products or other agro and non-agrochemicals index

Sl	Statement	Practice Score	Practice Index (%)	Rank	Gap (%)
i.	Pesticides permitted under country's regulations	400	100	1st =	0
ii.	Pesticides purchased from registered/licensed suppliers	400	100	1st =	0
iii.	Mixing of two or more chemicals unless recommended by technically competent personnel	385	96.25	5th	3.75
iv.	Application of dosage recommended by competent authorities	369	92.25	6th	7.75
v.	Disposal of surplus chemicals to avoid contamination	266	66.50	13th	33.50
vi.	Withholding periods for the interval between chemical application	368	92.0	7th	8
vii.	Harvesting as per the pre harvest interval period mentioned on the label	42	10.50	15th	89.50
viii.	Maintaining equipment for applying and checking for effective operation	352	88.0	9th	12
ix.	Washing equipment after use and disposal of water to avoid contamination to produce	295	73.75	12th	26.25
x.	Well storage of chemicals	392	98.0	3rd	2
xi.	Disposal of empty chemical containers	315	78.75	10th	21.25

Table 4.10 continued....

Sl	Statement	Practice Score	Practice Index (%)	Rank	Gap (%)
xii.	Storage of liquid chemicals above powder	313	78.25	11th	21.75
xiii.	Storing chemicals in original container/replaced container with legible label, dosage, withholding period	393	98.25	2nd	1.75
xiv.	Disposal of obsolete or expired chemicals	390	97.50	4th	2.50
xv.	Record of chemicals (chemicals used, supplier, date and quantity obtained, date of manufacture/expiry)	2	0.50	17th=	99.50
xvi.	Record of application for each crop (reason, dosage, date, name of operator)	2	0.50	17th=	99.50
xvii.	Records of chemicals in storage	26	6.50	16th	93.50
xviii.	Handling of non-agro chemicals to avoid risk of food safety	357	89.25	8th	10.75
xix.	IPM	117	29.25	14th	70.75

From Table 4.10 highest 99.50% gap was identified both in 'Record of chemicals (chemicals used, supplier, date and quantity obtained, date of manufacture/expiry)' and 'Record of application for each crop (reason, dosage, date, name of operator) (practice 0.50%, ranked 17th), 'Records of chemicals in storage' had 93.50% gap (practice 6.50%, ranked 16th), 'Harvesting as per the pre harvest interval period mentioned on the label' had 89.50% gap (practice 10.50%, ranked 15th), 'IPM' recorded 70.75% gap (practice 29.25%, ranked 14th). In case of record keeping practices, it can be done by the farmers. They do not practice it because they don't mark it as necessary but they keep rough record for benefit cost analysis. Though farmers know about the directions and necessity of 'Harvesting as per the pre harvest interval period mentioned on the label', they do not practice as much as needed but it very important to minimize the health risk related to chemical residues. For keeping out insect, pest they apply chemicals more often even before harvesting.

Table 4.10 showed that 'pesticides permitted under country's regulations' and 'pesticides purchased from registered/licensed suppliers' both ranked 1st (100%), 'storing chemicals in original container/replaced container with legible label, dosage, withholding period' ranked 2nd, 'well storage of chemicals' ranked 3rd .

Parmar and Vardhini (2016) found that most of the farmers were using the chemical pesticides for the crop protection. Only about 10% if farmers are using the bio-pesticides or Bio-control methods for the eradication of the pests. No farmer knew the use of smallest effective dosage on the basis of crop protection protocol.

4. Harvesting and handling produce

From Table 4.11 data showed that 97% of the respondents did the practices often with a mean of 66.60 and standard deviation 5.96. Data score ranged from 46 to 75. But there was no respondent who did the practice regularly.

Table 4.11 Distribution of respondents on the basis of harvesting and handling produce

Characteristics	Categories	Score	N=100	Mean ± SD ($\bar{x} \pm \sigma$)	Range	
			%		Min.	Max.
Harvesting and Handling Produce	Rare	≤26	0	66.60±5.96	46.00	75.00
	Occasional	27-52	3.0			
	Often	53-78	97.0			
	Regular	>78	0			

Though most of the farmers did the practices often but there was no farmer who was regular in the practices. That means farmers need more training, information and initiative from extension personnel to develop their harvesting and handling produce related practices.

Table 4.12 Harvesting and handling produce Index

Sl	Statement	Practice Score	Practice Index (%)	Rank	Gap (%)
i.	Harvested produce not placing directly on the soil, or on the floor of the handling, packing or storage areas	202	50.50	20th	49.50
ii.	Using of equipment, containers and materials that will not contaminate produce and easy to clean	369	92.25	6th	7.75
iii.	Avoiding containers used for chemicals and other dangerous substances	394	98.50	2nd	1.50
iv.	Maintaining equipment and containers to minimize contamination and keeping them separately away from chemicals, fertilizers, soil additives	363	90.75	7th	9.25
v.	Checking of containers and equipment for soundness and cleanliness	332	83.0	14th	17
vi.	Calibrating measuring devices for ensuring correct measurement	19	4.75	22nd	95.25
vii.	Buildings and structures used for growing, packing, handling and storage of produce constructed and maintained to minimize the risk of contaminating produce	219	54.75	18th	45.25
viii.	Grease, oil, fuel and farm machinery segregated from handling, packing and storage areas	360	90	8th	10
ix.	Construction of sewage, waste disposal and drainage systems to minimize contamination	2	0.50	24th	99.50
x.	Shatter proof lights in packing house	.0	0	26th	100

Table 4.12 continued....

Sl	Statement	Practice Score	Practice Index (%)	Rank	Gap (%)
xi.	Storing separately the equipment and tools that may be sources of physical hazards	344	86.0	12th	14
xii.	Cleaning and sanitizing equipment, tools and containers	286	71.50	15th	28.50
xiii.	Appropriate cleaning and sanitizing chemicals	253	63.25	17th	36.75
xiv.	Keeping household and farm animals out of the production site	398	99.50	1st	0.50
xv.	Taking measures to prevent the presence of pests around handling, packing and storage areas	341	85.25	13th	14.75
xvi.	Maintaining baits and traps to minimize the risk of contamination	350	87.50	10th	12.50
xvii.	Training workers in personal hygiene	16	4.0	23rd	96
xviii.	Availability of toilets and hand washing facilities to workers and maintaining hygienic condition	31	7.75	21st	92.25
xix.	Disposing sewage minimizing direct and indirect contamination	269	67.25	16th	32.75
xx.	Quality of water applied to edible parts of produce equivalent to drinking water	217	54.25	19th	45.75
xxi.	Chemicals applied for post harvest maintaining regulations	356	89	9th	11
xxii.	Applying specific test on produce if required	1	0.25	25th	99.75
xxiii.	Storing goods separately avoiding contamination	380	95.0	4th	5
xxiv.	Storing in cool places, avoiding overloading and covering to reduce moisture loss	379	94.75	5th	5.25
xxv.	Avoiding placing containers filled with produce in direct contact with soil (if there is significant risk)	348	87.0	11th	13
xxvi.	Keeping vehicles clean and in good condition for transporting	390	97.50	3rd	2.50

From Table 4.12 highest 100% gap was identified in 'Shatter proof lights in packing house' (practice 0%, ranked 26th) followed by 'Applying specific test on produce if required' had 99.75% gap (practice 0.25%, ranked 25th), 'Construction of sewage, waste disposal and drainage systems to minimize contamination' had 99.50% gap (practice 0.50%, ranked 24th), 'Training workers in personal hygiene' had 96% gap (practice 4%, ranked 23rd), 'Calibrating measuring devices for ensuring correct measurement' had 95.25% gap (practice 4.75%, ranked 22nd), 'Availability of toilets and hand washing facilities to workers and maintaining hygienic condition' had 92.25% gap (practice 7.75%, ranked 21st). Respondents were not aware of shatter proof lights and their packing houses were also not well made. Construction of sewage, waste disposal and drainage systems to minimize contamination can also be done easily by the farmers by taking proper initiative. 'Training workers in personal hygiene' and 'Availability of toilets and hand washing facilities to workers and maintaining hygienic

condition' are critical points for ensuring food safety. More intensive care needed in this sector.

Data presented in the Table 4.12 showed that 'Keeping household and farm animals out of the production site' ranked 1st, followed by 'Avoiding containers used for chemicals and other dangerous substances', 'Keeping vehicles clean and in good condition for transporting', 'Storing goods separately avoiding contamination', 'Storing in cool places, avoiding overloading and covering to reduce moisture loss' ranked 2nd, 3rd, 4th and 5th respectively. Though these practices were high, more care needed to fulfill the standard.

Parmar and Vardhini (2016) found in their research that no farmer had ever gone for residue analysis when chemical pesticides were used for crop protection.

4.2 Identification of Problems regarding GAP

Data presented in the table 4.13 showed that most of the respondents (94%) had severe problem against practicing GAPs followed by 6% had highly severe problem

Table 4.13 Distribution of respondents on the basis of Problems against GAP

Categories	Score	N=100	Mean ± SD ($\bar{x} \pm \sigma$)	Range	
		%		Min.	Max.
Less severe	≤10	0	17.49±1.95	12.00	22.00
Severe	11-20	94.0			
Highly severe	>20	6.0			

Most of the farmers faced severe level of problems that means same scale of initiative can be taken to reduce the problems against GAP.

Table 4.14 Problems regarding GAP Index

Sl	Statement	Score	Index (%)	Rank
i.	Unavailability of information of GAP	290	96.67	2nd
ii.	Costly processes	191	63.77	5th
iii.	Lack of clean water for irrigation and other farm practices	79	26.33	9th
iv.	Not being able to understand the necessity of GAP	281	98.67	1st
v.	Shortage of land to build necessary infrastructures	69	23.0	10th
vi.	Low possibility of getting adequate price of products	88	29.33	8th
vii.	Less information from extension personnel	204	68.0	4th
viii.	Lack of Govt. policy	268	89.33	3rd
ix.	Adequate research is not conducted	91	30.33	7th
x.	Illiteracy among the farmers	175	58.33	6th

From Table 4.14 it is found that in case of problem against GAPs 'Not being able to understand the necessity of GAP' ranked 1st followed by 'Unavailability of information of GAP' ranked 2nd, 'Lack of Govt. policy' ranked 3rd, 'Less information from extension personnel' ranked 4th, 'Costly processes' ranked 5th.

Many respondents knew the proper form of a lot of practices but they didn't adopt them because they found it unnecessary. To persuade the farmers, the necessity of implementing GAPs for food safety, economic development and environmental sustainability need to be made clear before the farmers. Unavailability of information of GAP is also a major problem. More extension work needs to be done in this sector. Lack of govt. policy is one of the major problems implementing GAPs. Government need to start GAP certification system and set standard and regulations in farm practices to ensure food safety.

4.3 Relationships between the selected characteristics and practicing extent of GAP by the farmers

4.3.1 Selected characteristics of farmers

The selected characteristics include age, educational qualification, family size, farming experience, farm size, monthly family income, training received, organizational participation, cosmopolitanism and extension media contact of an individual. On the basis of selected characteristics distribution of respondents is shown in Table 4.15.

Table 4.15 Distribution of respondents according to their personal characteristics

Characteristics	Categories	Score	N=100		Mean ± SD	Range	
				%	($\bar{x} \pm \sigma$)	Min.	Max.
Age (years)	Young	≤35		26.0	45.52±12.10	23.00	70.00
	Middle	36-55		52.0			
	Old	>55		22.0			
Educational Qualifications (schooling years)	Illiterate	0		0	5.97±4.16	0.50	17.0
	Can sign only	0.5		22.0			
	Primary	1-5		29.0			
	Secondary	6-10		34.0			
	Higher secondary	11-12		13.0			
	Undergraduate	13-16		1.0			
	Postgraduate	>16		1.0			
Family Size (number of members)	Small	≤4		38.0	5.15±1.81	2	12
	Medium	5-6		46.0			
	Large	>6		16.0			

Table 4.15 continued....

Characteristics	Categories	Score	N=100		Mean ± SD ($\bar{x} \pm \sigma$)	Range	
				%		Min.	Max.
Farming Experience (years)	Low	≤10		21.0	20.56±10.37	5.00	55.00
	Medium	11-20		35.0			
	High	>20		44.0			
Farm size (ha.)	Landless	≤0.02		0	0.64±0.78	.06	5.06
	Marginal	0.02-0.2		26.0			
	Small	0.21-1.0		56.0			
	Medium	1-3		15.0			
	Large	>3		3.0			
Income (BDT/month)	Low	<15000		45.0	20540±17005.59	9000	100000
	Medium	15000-25000		32.0			
	High	>25000		23.0			
Training received	Yes			46.0			
	No			54.0			
Training Participation (number)	Low	≤6	28	60.9	2.35±0.97	1.00	5.00
	Medium	7-12	18	39.1			
	High	>12	0	0			
Organizational involvement	Yes		44	44.0			
	No		56	56.0			
Organizational Participation (score)	Low	≤6	44	100	1.11±0.39	1.00	3.00
	Medium	7-12	0	0			
	High	>12	0	0			
Cosmopolitanism (score)	Low	≤5		58.0	4.68±2.02	2	11
	Medium	6-10		40.0			
	High	>10		2.0			
Extension media contact (score)	No	0		0	40.77±9.82	23	66
	Rare	1-24		3.0			
	Occasional	25-48		66.0			
	Often	49-72		31.0			
	Regular	>72		0			

Table 4.15 showed that highest proportion (52%) of the respondents was middle aged. Young farmers were 26% and old farmers were 22%. The age of the farmers ranged from 23 to 70 years with a mean of 45.52 years and standard deviation 12.10.

Middle aged respondents were more involved in farming. Young and old people were less involved. The reason behind young people being less interested in farming can be the insecurity of not earning expected amount.

Das et al. (2019) found middle aged farmers (60.0%) were highly involved in farming followed by young aged (20.0%) and old aged farmers (20.0%).

Most of the respondents (34%) belong to secondary level of education compared to 29%, 22%, 13%, 1% and 1% of the respondents belong to primary, can sign only, higher secondary, undergraduate and postgraduate level of education. The score ranged from 0.5 to more than 16 with a mean of 5.97 and standard deviation of 4.16.

The mean of educational qualification 5.97 means the respondents' educational qualification was very low. 22% of them can sign only which means they are illiterate. Respondents having higher level of education were also very low. As they do not have well institutional literacy it increases the possibility of low practices of GAP.

Das et al. (2019) found major proportion (55.0%) of respondents had secondary level of education while (24.2%) farmers had primary level of education, (11.7%) of respondent had higher secondary level of education.

Most of the farmers had medium family (46%). About 38% of the farmers had small family and only 16% of the farmers had large family. The number of family members ranged from 2 to 12 with a mean 5.15 and standard deviation 1.81.

Farmers' family size is also low with a mean 5.15. Large family is very low. This means number of joint family is decreasing in rural area or children number is low in nuclear family.

Das et al. (2019) found maximum numbers (56.7%) of families in selected areas were medium in size followed by small size (21.7%) and large size (21.7%) family.

Data presented in the Table 4.1 shows that maximum farmers had high farming experience (44%). About 35% of the farmers had medium farming experience. Only 21% of the farmers had low farming experience. Farming experience of the farmers ranged from 5 to 55 years with a mean 20.56 years and standard deviation 10.37.

High farm experience indicates respondents are well aware of the classical farm practices and they are involved in farming for a long time. High farm experience also helps the farmer to understand the cause and effect of different practices.

Das et al. (2019) found majority of respondents (72.5%) had high farming experience.

Most of the farmers' farm size was small (56%). The farm size of the respondents ranged from 0.06 ha to 5.06 ha with a mean of 0.64 ha and standard deviation 0.78.

If the farm size is small farmers can't earn their expected amount even with trying their best. To help the situation of the farmers increasing the farm size is also important. Small farm size may help in adopting GAP but it will hinder the process in case of getting benefit from the farm. Because adopting GAP more or less increases the input cost. But if the farm is small then the input cost may not result in expected benefits.

Das et al. (2019) found more than half (54.2%) of the respondents had small farm size and only a few portion of respondents (2.5%) had large farm size.

Data presented in table 4.1 showed that highest portion of the respondents (45%) had low income, 32% had medium income and 23% had high income with a mean and standard deviation of 20540 and 17005.59 respectively. The minimum and maximum incomes were 9000 B.D.T and 100000 B.D.T.

The mean income of the respondents is very low (20540 BDT). Nowadays fulfilling the daily expenses of a family with that income is very difficult. As a result they are losing their interest in farming and looking for new ways of earning. On the other hand with low income farmers are more likely to avoid practices that will cost them or will delay the outcome of input (harvesting as per pre harvest interval period mentioned on the label.

Only 46% of the respondents received training. Among them 60.9% had low level of training and 39.1% had medium level of training. On the other hand only 44% of the respondents had organizational involvement and all of them had low level of participation.

Farmers involvement in training needs to be improved for better implementation of GAPs. Training helps to improve farmers view of perspective and abilities to do a operation more efficiently. The one who received training, most of them had low level of training. This is not sufficient for improving farm practices.

Most of the respondents (58%) low level of cosmopolitanism. 40% and 2% of them had medium and high level of cosmopolitanism respectively. The score ranged from 2 to 11 with a mean of 4.68 and standard deviation 2.02.

Higher level of cosmopolitanism helps to broaden the outlook of the farmers where low level of cosmopolitanism limits the farmers point of view. Low level of cosmopolitanism can also act as an agent for not adopting good quality practices in farm operations.

From Table 4.15 data showed that highest number of respondents (66%) had occasional level of extension media contact followed by 31% had often and 3% had rare level of extension media contact. The score ranged from 23 to 66 with a mean of 40.77 and standard deviation 9.82.

4.3.2 Measuring the relationship between the selected characteristics of the respondent and extent of practicing GAP

Table 4.16 Relationships between the selected characteristics of the respondent and extent of practicing GAP

Selected Characteristics	Coefficient of Correlation				
	Planting Materials	Fertilizers and soil additives	Water (Irrigation)	Chemicals	Harvesting and Handling Produce
Age	0.063	0.043	-0.006	-0.263**	-0.202*
Educational Qualification	-0.013	0.089	0.118	-0.107	-0.026
Family size	-0.134	0.064	0.086	-0.069	-0.305
Farming experience	0.081	0.118	0.043	-0.109	-0.112
Farm size	0.183	-0.262**	0.080	-0.142	-0.008
Family income	0.147	-0.286**	0.069	-0.073	0.039
Training received	-0.247	-0.023	-0.196	-0.244	-0.130
Organizational participation	0.054	-0.186	0.119	-0.081	-0.252
Cosmopolitanism	0.064	0.051	-0.153	0.120	-0.012
Extension media contact	-0.064	0.022	0.073	-0.050	-0.033
Knowledge on GAP	-0.037	0.064	-0.035	0.437**	0.422**
Attitude towards GAP	-0.001	0.055	0.085	-0.008	-0.081

From table 4.17 it is found that age had significant negative correlation with chemicals related practices at 1% level of significance and harvesting and handling produce related practices at 5% level of significance.

These means with the increase of age, extent of practice decreased. This may occur due to young peoples' higher interest in adopting good practices for better outcome, young peoples' high literacy rate, more extension media contact etc.

Table 4.17 showed that farm size had significant negative correlation with fertilizers and soil additives related practices at 1% level of significance. That means with the increase of farm

size, practicing fertilizers and soil additives related GAPs decreased. With the increase of farm size, needed fertilizers and soil additives also increases. As a result respondents' practice extent decreases. It may be caused due to increased amount of laborers, shortage of infrastructure related to practice, unwillingness of farmers to maintain every details in large scale.

Results of Table 4 show that 'knowledge on GAP' had significant positive correlation with 'chemicals' and 'harvesting and handling produce' at 1% level of significance. That means with the increase of "knowledge on GAP', practicing rate also increased among the respondents.

Here 'knowledge on GAP' is farmers' knowledge on the standard form of practices. If farmer is aware of the standard practices he is more or less likely to practice them in his farm for better production.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

Most of the farmers (63%) had good knowledge on the practices under GAP. About 82% of the farmers showed highly favorable attitude towards GAP. Most of the farmers practices regarding planting materials was occasional (93%). Highest 100% gap was identified in 'record of planting materials if obtained from another farm' (practice 0%, ranked 6th). That means farmers did not practice it at all. 'Record of seed quality' had 96.50% gap (practice 3.50%, ranked 5th). In case of 'Record of fertilizers and chemicals used' 94.75% gap was identified (practice 5.25%, ranked 4th).

Most of the farmers practices regarding fertilizers and soil additives were often (91%) and highest 96.50% gap was identified in the practice of record keeping of 'The source, product name, date, quantity obtained' (practice 3.50%, ranked 10th) followed by 'To minimize the risk of heavy metal contamination to produce' had 94.50% gap (practice 5.50%, ranked 9th), 'Application of fertilizers and soil additives based upon soil analysis' had 93.50% gap (practice 6.50%, ranked 8th), 'Assessment of the chemical and biological risks related to fertilizers and soil additives' had 92% gap (practice 8%, ranked 7th).

Highest portion of the farmers (80%) did the practices related to water (irrigation) often and highest 96% gap was identified in 'Where water testing is required, frequency of testing' (practice 4%, ranked 6th).

Most of the of the respondents (92%) did the practices under chemicals (Plant protection products or other agro and non-agrochemicals) often and highest 99.50% gap was identified both in 'Record of chemicals (chemicals used, supplier, date and quantity obtained, date of manufacture/expiry)' and 'Record of application for each crop (reason, dosage, date, name of operator) (practice 0.50%, ranked 17th), 'Records of chemicals in storage' had 93.50% gap (practice 6.50%, ranked 16th), 'Harvesting as per the pre harvest interval period mentioned on the label' had 89.50% gap (practice 10.50%, ranked 15th), 'IPM' recorded 70.75% gap (practice 29.25%, ranked 14th).

In case of harvesting and handling produce about 97% of the farmers did the practices often and highest 100% gap was identified in 'Shatter proof lights in packing house' (practice 0%, ranked 26th) followed by 'Applying specific test on produce if required' had 99.75% gap

(practice 0.25%, ranked 25th), 'Construction of sewage, waste disposal and drainage systems to minimize contamination' had 99.50% gap (practice 0.50%, ranked 24th), 'Training workers in personal hygiene' had 96% gap (practice 4%, ranked 23rd), 'Calibrating measuring devices for ensuring correct measurement' had 95.25% gap (practice 4.75%, ranked 22nd), 'Availability of toilets and hand washing facilities to workers and maintaining hygienic condition' had 92.25% gap (practice 7.75%, ranked 21st).

Most of the respondents (94%) had severe problem regarding practicing GAPs followed by 6% had highly severe problem. In case of problem regarding GAPs 'Not being able to understand the necessity of GAP' ranked 1st followed by 'Unavailability of information of GAP' ranked 2nd, 'Lack of Govt. policy' ranked 3rd, 'Less information from extension personnel' ranked 4th, 'Costly processes' ranked 5th.

Highest proportion (52%) of the respondents was middle aged. Young farmers were 26% and old farmers were 22%. Most of the respondents (34%) belong to secondary level of education and the mean of educational qualification was 5.97. About 46% of the farmers had medium family, 44% of the farmers had high farming experience, 56% had small farm size, 45% of the farmers had low family income followed by 32% medium, 23% high income. 46% farmers received various training and among them 60.9% had low level of training. Most of the respondents (58%) low level of cosmopolitanism. 40% and 2% of them had medium and high level of cosmopolitanism respectively. Highest number of respondents (66%) had occasional level of extension media contact followed by 31% had often and 3% had rare level of extension media contact and the highest percentage (78.50%) obtained by using of mobile hold 1st rank. The 2nd, 3rd, 4th, and 5th rank hold by watching television, contact with neighbor, contact with relatives, and contact with friends.

Age had significant negative correlation with chemicals related practices at 1% level of significance and harvesting and handling produce related practices at 5% level of significance, farm size had significant negative correlation with fertilizers and soil additives related practices at 1% level of significance, 'knowledge on GAP' had significant positive correlation with 'chemicals' and 'harvesting and handling produce' at 1% level of significance.

5.2 Conclusions

Most of the farmers had medium knowledge on the practices under GAP and majority of the farmers showed highly favorable attitude towards GAP. Farmers' practices regarding planting materials were mostly occasional. Highest gap was identified under planting materials in 'record of planting materials if obtained from another farm' followed by 'record of seed quality' and 'record of fertilizers and chemicals used' practice. Farmers are not keeping records in details and they don't understand the necessity of record keeping. Most of the farmers practices regarding fertilizers and soil additives were often and highest gap was identified in record keeping of 'the source, product name, date, quantity obtained' followed by 'to minimize the risk of heavy metal contamination to produce', 'application of fertilizers and soil additives based upon soil analysis', 'assessment of the chemical and biological risks related to fertilizers and soil additives'. Highest portion of the farmers did the practices related to water (irrigation) often and highest gap was identified in 'where water testing is required, frequency of testing'. Majority of the respondents did the practices under chemicals (plant protection products or other agro and non-agrochemicals) often and highest gap was identified in 'record of chemicals (chemicals used, supplier, date and quantity obtained, date of manufacture/expiry)' and 'record of application for each crop (reason, dosage, date, name of operator) followed by 'records of chemicals in storage', 'harvesting as per the pre harvest interval period mentioned on the label' and 'IPM'. In case of harvesting and handling produce almost all of the farmers did the practices often and highest gap was identified in 'shatter proof lights in packing house' followed by 'applying specific test on produce if required', 'construction of sewage, waste disposal and drainage systems to minimize contamination', 'training workers in personal hygiene', 'calibrating measuring devices for ensuring correct measurement', 'availability of toilets and hand washing facilities to workers and maintaining hygienic condition'.

Majority of the respondents had severe problem regarding practicing GAP. In case of problem regarding GAP, most faced problem by the farmers was 'not being able to understand the necessity of GAP' followed by 'unavailability of information of GAP', 'lack of Govt. policy', 'less information from extension personnel' and 'costly processes'.

Highest portion of the respondents were middle aged. Most of the respondents belonged to secondary level of education. Most of the farmers had medium family and majority of them had high farming experience. More than half of the farmers had small farm size and most of

the farmers had low family income. Farmers having high family income were low. Nearly half of the farmers received various training and most of them had low level of training. Most of the respondents had low level of cosmopolitanism. Highest number of respondents had occasional level of extension media contact and highest connection with extension media contact was in 'mobile' followed by watching television, contact with neighbor, contact with relatives, and contact with friends.

Age had significant negative correlation with chemicals related practices and harvesting and handling produce related practices; farm size had significant negative correlation with fertilizers and soil additives related practices, 'knowledge on GAP' had significant positive correlation with 'chemicals' and 'harvesting and handling produce'.

5.3 Recommendations

5.3.1 Recommendations for policy implication

i. Different extension program like group discussion, farmers training on GAP need to be emphasized to increase farmers knowledge on GAP

ii. GOs and NGOs should take necessary motivational program to motivate farmers to adopt GAP. A GAP certification system need to be introduced which will certify food produced by implementing GAP.

iii. More awareness needs to be created in case of following strict regulations regarding soil testing, metal contamination, handling chemicals, fertilizers and produce.

5.3.2 Recommendations for further study

i. This study was conducted in one upazila in Khulna District so it will not be able to show the overall situation across the country. Further research is recommended in other area of the country.

ii. The criteria selected for identifying gap in this study were limited. Further research should be done selecting criteria like 'Site History and Management', 'Genetically modified organism (GMO)', 'Traceability and recall', 'Training', 'Documents and Records', 'review of practices' etc. and other optional requirements.

iii. The practices of GAP selected for this study was under 'Food Safety Module' of GAP. More research should be done separately on or in combination with other modules like 'Environmental Management Module (EMM)', 'Worker Health, Safety and Welfare Module (WHSM)', 'Produce Quality Module (PQM)'.

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Appendix A

Agrotechnology Discipline

Life Science School

Khulna University, Khulna-9208

Title: Identification of the Gaps between Farmers' Practices and Good Agricultural Practices (GAP) in Crop Husbandry

(Interview Schedule)

(Please answer the following questions & put a tick mark (√) whenever applicable)

Sample no: ☐

1. Age of the respondent.....years

2. Educational qualification: .....years

3. Family size: Number of family members.....

4. Farming experience..... years

5. Address: .....

6. Cell Phone: .....

7. Farm size (ha): .....

Please Furnish information about your lands according to use

SL No.	Use of land	Area of land	
		Local unit	Hectare
A1	Homestead		
A2	Own land under cultivation		
A3	Land given to others on borga		
A4	Land taken from others on borga		
A5	Land taken from others on lease		
A6	Others		

FS= A1+A2+1/2(A3+A4) + A5 ± A6

8. **Monthly family income**:

Please mention information's about your family income (annual) from different sources:

SL No.	Sources of income	Amount of income (taka)
i.	Agriculture:	
	a. Fishing	
	b. Farming	
	c. Crop Cultivation	

SL No.	Sources of income	Amount of income (taka)
	d. Livestock	
ii.	Business	
iii.	Service	
iv.	Others	
v.	Total	

9. Training Received: Do you receive any agricultural training? a.Yes ( ) b. No ( )

Name of the training	Duration(Days)	Organized by

10.Are you involved in any organization? a. yes ( ) b. no ( )

Please mention the nature and number of your participation in the following organizations:

SL No:	Name of Organizations	Nature of Participation (with number)			
		Executive Committee Officer(3)	Executive Committee Member(2)	Ordinary Member(1)	Not involved (0)
i.	Farmers Cooperative Society				
ii.	School/Mardrashah Committee				
iii.	Mosque/Mandir/Church/ Pagoda Committee				
iv.	IPM/ICM Club				
v.	NGO conducted committee				
vi.	Union council				
vii.	Youth club				
viii.	Cricket/Football Club				

11. Cosmopolitanism

Please indicate the number of times you have visited the following places within the specified period:

SL No.	Place of visit	Nature of visit			
		Frequently (3)	Occasionally (2)	Rarely (l)	Not at all (0)
i.	Relative or other Known persons located outside of your own village	5-6 times/month	3-4 times/month	1-2 times/month	0 times/month
ii.	Union parishad office	8-10 times/month	5-6 times/month	2-3 times/month	0 times/month
iii.	Own upazila/ distric sadar	5-6 times/month	3-4 times/month	1-2 times/month	0 times/month
iv.	Other district upazila/ sadar	4 times/year	3 times/year	1-2 times/year	0 times/year
v.	Capital and other cities	3 times/year	2 times/year	1 times/year	0 times/year

12. Extension media contact:

Categories		Regularly (4)	Often (3)	Occasionally (2)	Rarely (1)	Not at all (0)
i. Mass media	1. Radio					
	2. Television					
	3. Poster					
	4. Leaflets					
	5. Newspaper					
	6. Exhibition/Agri-culture fair					
	7. Magazine					
	8. Online Agricultural Apps					
ii. Group Contact	9. Farmers field					
	10. School					
	11. 1PM/1CM club					
	12. Tours					
	13 .Lecture					
iii. Personal contacts	14. Office call (SAAO)					
	15. Office call(AEO/UAO)					
	16. Email					
	17. Personal letter					
	18. Mobile					
	19. Farm & home visit by SAAO					
iv. Opinion leader	20. Friends					
	21. Relatives					
	22. Neighbor					
	23. Dealer (pesticide)					
	24. Model farmer					

GAP related Information

13. Knowledge on GAP

Serial	Questions	Extent of right answer		
		Wrong (0)	Partial (1)	Right (2)
i.	Can you tell me two GAPs?			
ii.	Please, mention two reasons of withholding periods for the interval between chemical application and harvest?			
iii.	Can you tell me two reasons why using clean water for irrigation and other farm work is necessary?			
iv.	Please mention two usefulness of IPM			
v.	Please mention two reasons of applying chemicals and fertilizers according to particular dosage			
vi.	Can you tell me two harmful effects of placing harvested produce directly on the soil			
vii.	Please, mention two methods of storing agrochemicals carefully?			
viii.	Can you tell me two practices of IPM?			
ix.	Can you tell me the name of two permitted pesticides in Bangladesh?			
x.	Please, mention two activity how contamination can occur (insect and diseases dispersal)			

14. Attitude towards GAP

Serial	Statement	Degree of Agreement				
		Strongly agree (5)	Agree (4)	No opinion (3)	Disagree (2)	Strongly Disagree (1)
i. +	Production of good quality food is important for all of us					
ii. - *	It is not important to maintain cleanliness in the field					
iii. +	Fertilizers need to be applied according to recommended dosage					
iv. -	Good quality foods will not help in good health					
v. +	Chemicals (plant protection products or other agro and non-agro chemicals) should be applied according to recommended dosage					
vi. -	Using clean water is not so necessary for irrigation					
vii. +	Good quality food will result in good prices					
viii. -	It is not so important to use clean tools and equipment					
ix. +	Toilets and hand washing facilities for workers are needed					
x. -	It is not necessary to maintain the facilities for storage, mixing and loading of fertilizer/soil additives and composting of organic material to minimize the contamination to production sites and water					

	sources					
xi. +	Withholding periods for the interval between chemical application and harvest shall be maintained for efficiency and good quality food					
xii. -	Empty chemical containers (permitted for one time use) is safe to use					

*Reverse scoring method will be used in case of negative statement

15. Planting materials

Serial	Statement	Extent of Practice				
		Regularly (4)	Often (3)	Occasionally (2)	Rarely (1)	Not at all (0)
i.	Record of fertilizers and chemicals used					
ii.	Record of seed quality					
iii.	Checking visible signs of pest and diseases					
iv.	Seed treatment by approved additives/pesticides					
v.	Avoiding cultivation of toxic variety					
vi.	Record of planting materials if obtained from another farm					

16. Fertilizers and soil additives

Serial	Statement	Extent of Practice				
		Regularly (4)	Often (3)	Occasionally (2)	Rarely (1)	Not at all (0)
i.	Assessment of the chemical and biological risks related to fertilizers and soil additives					
ii.	If significant hazards identified, measures taken to minimize the risk of contamination to produce					
iii.	Application of fertilizers and soil additives based upon soil analysis					
iv.	To minimize the risk of heavy metal contamination to produce					
v.	Recommended application practices at appropriate stage of crop growth					
vi.	Avoiding untreated organic materials in case of significant risk of contaminating produce is identified, record for treated organic materials					
vii.	Avoiding untreated human sewage					
viii.	Handling of fertilizers and soil additives to minimize the risk of contamination to production sites and water sources					
ix.	The source, product name, date, quantity obtained					
x.	Separate storage of organic and inorganic fertilizers from harvested farm produce					

17. Water (Irrigation/Fertigation)

Serial	Statement	Extent of Practice				
		Regularly (4)	Often (3)	Occasionally (2)	Rarely (1)	Not at all (0)
i.	Free from harmful contaminants					
ii.	Assessment of the source of water					
iii.	Where water testing is required, frequency of testing					
iv.	In case of identification significant risk, use of safe alternative water source or treated water					
v.	Avoiding untreated sewage water, treated water maintaining regulations					
vi.	Maintaining irrigation equipment as per manufacturers guidelines					

18. Chemicals (Plant protection products or other agro and non-agrochemicals)

Serial	Statement	Extent of Practice				
		Regularly (4)	Often (3)	Occasionally (2)	Rarely (1)	Not at all (0)
i.	Pesticides permitted under country's regulations					
ii.	Pesticides purchased from registered/licensed suppliers					
iii.	Mixing of two or more chemicals unless recommended by technically competent personnel					
iv.	Application of dosage recommended by competent authorities					
v.	Disposal of surplus chemicals to avoid contamination					
vi.	Withholding periods for the interval between chemical application					
vii.	Harvesting as per the pre harvest interval period mentioned on the label					
viii.	Maintaining equipment for applying and checking for effective operation					
ix.	Washing equipment after use and disposal of water to avoid contamination to produce					
x.	Well storage of chemicals					
xi.	Disposal of empty chemical containers					
xii.	Storage of liquid chemicals above powder					
xiii.	Storing chemicals in original container/replaced container with legible label, dosage, withholding period					
xiv.	Disposal of obsolete or expired chemicals					

xv.	Record of chemicals (chemicals used, supplier,date and quantity obtained, date of manufacture/expiry)					
xvi.	Record of application for each crop (reason, dosage, date, name of operator)					
xvii.	Records of chemicals in storage					
xviii.	Handling of non-agro chemicals to avoid risk of food safety					
xix.	IPM					

19. Harvesting and handling produce

Serial	Statement	Extent of Practice				
		Regularly (4)	Often (3)	Occasionally (2)	Rarely (1)	Not at all (0)
i.	Harvested produce not placing directly on the soil, or on the floor of the handling, packing or storage areas					
ii.	Using of equipment, containers and materials that will not contaminate produce and easy to clean					
iii.	Avoiding containers used for chemicals and other dangerous substances					
iv.	Maintaining equipment and containers to minimize contamination and keeping them separately away from chemicals, fertilizers, soil additives					
v.	Checking of containers and equipment for soundness and cleanliness					
vi.	Calibrating measuring devices for ensuring correct measurement					
vii.	Buildings and structures used for growing, packing, handling and storage of produce constructed and maintained to minimize the risk of contaminating produce					
viii.	Grease, oil, fuel and farm machinery segregated from handling, packing and storage areas					
ix.	Construction of sewage, waste disposal and drainage systems to minimize contamination					
x.	Shatter proof lights in packing house					
xi.	Storing separately the equipment and tools that may be sources of physical hazards					
xii.	Cleaning and sanitizing equipment, tools and containers					
xiii.	Appropriate cleaning and sanitizing chemicals					
xiv.	Keeping household and farm animals out of the production site					