FERTILIZER USE GAP BETWEEN RECOMMENDED AND FARMER'S PRACTICES IN RICE PRODUCTION

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JUNE, 2018

ACKNOWLEDGEMENT

All praises are due to Almighty Allah, the Great, Gracious and Merciful, Whose blessings enabled the author to complete this research work successfully. Guidance, help and co-operation have been received from several persons or authority during the tenure of the study, the author is grateful to them all who made a contribution to this research work. Although it is not possible to mention all by names it will be an act of ungratefulness if some names are not mentioned here for their immense contribution in the accomplishment of this study.

In particular, the author takes the opportunity to express his deepest sense of gratitude to his honorable Supervisor ***Prof. Dr. Md. Rafiquel Islam****, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka for his continuous inspiration, valuable suggestions, constructive criticism, constant guidance and intensive supervision through the period of the study and preparation of this thesis without his intense co-operation this work would not have been possible.*

The author deems proud privilege to extend his extreme gratefulness and best regards to his venerable Co-supervisor ***Asso. Prof. Dr. Muhammad Humayun Kabir,*** *Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka for his keen interest, valuable advice, creative suggestions, co-operation and encouragement to bring this thesis up to its present standard.*

The author would like to express his deepest respect and boundless gratitude especially to, ***Asso. Prof. Dr. Muhammad Humayun Kabir****, Chairman, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka for his active help and moral support in pursuing the study.*

The author deeply acknowledges the cooperation and sincere help of Upazila Agriculture Officer, Kendua. The author also expresses his heartfelt gratitude to the respondents of the study area who patiently provided the information during the interview with the author.

The author expresses his grateful thanks to all staff and employees of the Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka for their co-operation and encouragement to prepare this thesis.

The author also expresses heartfelt and sincere appreciations to all other departmental teachers of Sher-e-Bangla Agricultural University for their help and encouragement. Last but not least, the author expresses his deepest sense of gratitude, indebtedness and profound respect to his beloved parents, uncle, sisters, relatives and friends for their blessings, encouragement and moral support in all phases of this academic pursuit from beginning to the end.

The Author

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LIST OF ABBREVIATION AND GLOSSARY

Abbreviations	Full word
Ag. Ext. Ed	Agricultural Extension Education
Ag. Ext. and Info. Sys.	Agricultural Extension and Information System
ANOVA	Analysis of Variance
B	Multiple Regression
BBS	Bangladesh Bureau of Statistics
DAE	Department of Agriculture Extension
DAP	Diammonium Phosphate
et al.	All Others
FAO	Food And Agriculture Organization
GDP	Gross Domestic Product
GOB	Government of Bangladesh
MoP	Muriate of potash
NAV	Net Asset Value
NGOs	Non-Government Organizations
OLS	Ordinary Least Squares
SAAO	Sub Assistant Agriculture Officer
SPSS	Statistical Package for Social Science
TSP	Triple supper phosphate
WYTEP	Women and Youth Training and Extension Project
ZnSO4	Zinc Sulphate

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ABSTRACT

The objectives of the study were to assess the extent of fertilizer use gap between recommended and farmer's practices in rice production and to explore the contribution of the selected characteristics of the farmers to their fertilizer use gap between recommended and farmer's practices. The study was conducted in two villages of the Ashujia union of Kendua upazila under Netrokona district. Data for this study were collected from 103 farmers by using an interview schedule from 2 January, 2019 to 5 February, 2019. Descriptive statistics and stepwise multiple regression were used for analysis of the data. These five variables combined explained 36.8 percent of the total variation to the fertilizer use gap between recommended and farmer's practices. Training on fertilizer application alone contribute 21.8 percent where time spent (6.9%), extension contact (5.0%), and farming experience (3.1%) had rest of variation to the fertilizer use gap between recommended and farmer's practices in rice production. Training and Time spent in farming on fertilizer application of the farmers had influenced in decreasing the fertilizer use gap between recommended and farmer’s practices. Extension contact and Farming experience had negative significant effect to the fertilizer use gap between the recommended and farmer’s practices. Farmers should gain more farming experience, training and extension contact that should encourage the farmers in farming on fertilizer application that could help the farmers to make more fertilizer use gap between the recommended and farmer’s dose practices.

FERTILIZER USE GAP BETWEEN RECOMMENDED AND FARMER'S PRACTICES IN RICE PRODUCTION

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REGISTRATION NO.: 11-04399

A Thesis
Submitted to the Faculty of Agriculture,
Sher-e-Bangla Agricultural University, Dhaka,
In Patial Fulfillment of the Requirements for the degree of

MASTER OF SCIENCE (MS)
IN
AGRICULTURAL EXTENSION
SEMESTER: JANUARY-JUNE, 2018

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CERTIFICATE

This is to certify that the thesis entitled **"FERTILIZER USE GAP BETWEEN RECOMMENDED AND FARMER'S PRACTICES IN RICE PRODUCTION"** submitted to the faculty of agriculture, Sher-e-Bangla Agricultural University, Dhaka-1207, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE in AGRICULTURAL EXTENSION**, embodies the result of a piece of bona fide research work carried out by **ABU EFTIKAR MOHAMMAD SIDDIQUE**, Registration No. **11-04399** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been available during the course of this investigation has duly been acknowledged.

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DADICATED TO

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BELOVED PARENTS AND

SUPERVISOR AND CO-SUPERVISOR

CHAPTER I
INTRODUCTION

1.1 Background of the Study

Bangladesh is the fifth most populous country in Asia and the 18th in the world which has successfully attained self-sufficiency in food despite the decline in per capita land and increase in population. The country has opted for an agricultural development policy that gradually moved farmers away from the traditional and rather static agriculture dependent on native soil fertility to a dynamic judicious fertilizer dependent farming. In the last three decades, food grain production as considerably increased due to substantial intensification of cropping, introduction of high yielding varieties (HYVs), and expansion of irrigated area and use of chemical fertilizers. However, this has also led to widespread soil fertility depletion caused by fertilizer nutrient imbalance and serious nutrient gap between plant use and fertilizer application and mining out scarce native soil nutrients to support increases in yields of food crops.

The use of chemical fertilizers mainly for N, P, K and S has been increasing steadily but they are not applied in balanced proportion. Continuously cropped areas were observed to have problems of decline in organic matter and those associated with imbalance use of fertilizers were found, aside for its impacts on P and K fertilization, to have emerging deficiencies of micronutrients like Zn, B, Mn, Mo. Bangladesh adopted a strategy for balanced fertilization to promote soil building to support sustainable land use system and ensure stable supply of food grains from existing agricultural lands. In this context and as a further response to economic recession, as well as to conserve and improve soil fertility, the concept of integrated nutrient management (INM) system has been adopted.

In the recent years, intensive crop cultivation using high yield varieties of crop with imbalanced fertilization has led to mining out scarce native soil nutrients to support plant growth and production, the dominant soil ecological processes that severely affected the fertility status and production capacity of the major soils in Bangladesh. Available data indicated that the fertility of most of our soils has been deteriorated over the years

(Karim, *et al*., 1994 and Ali *et al*., 1997), which is responsible for national yield stagnation and in some cases, even declining crop yields (Cassman, *et al*., 1997).

The use of chemical fertilizers mainly for NPKS has been increasing steadily but they are not applied in balanced proportion. For example, in 1996- 421:71:454:44 million tons of NPKS, respectively, were removed in grain and straw while in the same year 507:119:114:13 million tons were added in the form of inorganic fertilizers. Considering, the recovery percentage of the added nutrients the gap was about 244:47:400:41 million tons of NPKS (Islam *et al*., 1998). Moreover, emerging deficiency of micronutrients like Zn, B, Mn and Mo has been reported in some parts of the country particularly northwestern region. It is now well known that S and Zn deficiencies particularly in wet land rice soils in many parts of the country have been induced by imbalanced fertilization. Deficiencies of Ca and Mg are also prevalent in calcareous soils. On the other hand, organic matter content of most of the Bangladesh soils is very low where the majority fall below the critical level (1.5 percent). The organic matter content of Bangladesh soils in continuously cropped areas from 1967 to 1995 has been depleted by 5 to 36 percent (Ali *et al*., 1997). One natural reason is that organic matter decomposition in soils with tropical climate, like Bangladesh, is high.

Three primary plant nutrient nitrogen, phosphorus and potassium arc being supplied from urea, triple super phosphate and muriate of potash to the soils of Bangladesh for more than two decades. The addition of other nutrients to the soils not recognized earlier. Sulfur and Zinc, being a limiting factor for crop productions were added later in the list of fertilizer elements. The proportion of different nutrients used as fertilizer in soil is not at all balanced. Nitrogen alone was comprises about 75 percent of the total nutrients use in the country. Use of phosphorus and potassium is limited to about 12 and 6 percent. Others including S and Zn constitute about 7 percent. Such disproportion use of fertilizer appears to

be highly deleterious to soil productivity. Under such situation the Liebig ' s "Law of the Minimum" will operate in Bangladesh agriculture, which states that if one of the nutritive

elements is deficient or lacking, plant will be poor even when all the other elements are abundant (Karim et al., 1989).

Considering above situations Soil Resource Development Institute (SRD1) in collaboration with the Department of Agricultural Extension (DAL). Bangladesh .Agricultural Research Institute (BARI), Bangladesh Rice Research Institute (BRRI) and Bangladesh Agricultural Research Council (BARC) prepared the Land and Soil Resource utilization Guide popularly known as "Upazila Nirdeshika " for every Upazila. This guide is now available for proper utilization of location specific land, soil and water resources for successful crop production. This also provides location specific soil nutrient status along with fertilizer recommendation.

1.2 Statement of the Problem

Environmental pollution is the act of introducing into the environment some extraneous substances or energy that may result in unfavorable change. The pollution can cause among others health problem, economic problem and ecological problem. Farming and the environment have always been closely interlinked in Bangladesh. We depend on the environment, as the resources of land, water, sunlight and biological organisms for any farming enterprise. The environment of the world is slowly degrading due to the industrial and agricultural emissions and the people are very anxious about the degradation as this may cause serious damage to lives on the earth. It has been found in different countries of the world that in addition to the beneficial effect, the improved agricultural practices have tremendous relevance to environmental pollution. The improved technologies including fertilizer and pesticide create some problem in the soil and environments (Bouwman, 1990).

To get higher yield, many farmers use fertilizers on HYV crops heavily. A typical crop response to the fertilizer application indicates that the rate of utilization decreases in the heavily fertilized land. Evidences show that only 30 - 40 per cent
of the fertilizer used in the crop land is utilized by the plant, the rest 60 - 70 per cent fertilizers remain unutilized in the land. Consequently, these fertilizers are converted to

other forms such as NH_3, NO_3, NO_2, etc. and cause serious environmental pollution. Excess nitrogen application results lodging of the crops.

There is increased incidence of plant diseases and pest attacks with excessive nitrogen application. Heavy use of nitrogen fertilizer is known to be inimical to the activity of symbiotic nitrogen fixing organisms. Pesticides create numerous hazards or problems to the human health and environment and perhaps as many as 25 million agricultural workers are poisoned each year by the pesticide and some 20,000 deaths can be directly attributed to agro-chemical use. The dynamics and desired change inherent in the development programme are always associated with environmental hazards and risks. It is, therefore, necessary to identify such hazards and risks at an early stage of development and adopt necessary steps to reduce them. Assessment of any technology from the points of view of its efficiency and environmental friendliness is therefore important.

In view of the foregoing discussion, the researcher undertook a study entitled "fertilizer use gap between recommended and farmer's practices in rice production". The main purpose of the study was to have an understanding on the fertilizer use gap between recommended and farmer's dose practices in rice production and about some selected factors contributing in the fertilizer application practices. For conducting the research in a planned and appropriate way, the researcher put forwarded the following questions:

i. What are the characteristics of the farmers?
ii. What is the extent of fertilizer use gap between recommended and farmer's dose practices?
iii. Is there any contribution of selected characteristics of the farmers to the fertilizer use gap?

1.3 Objectives of the Study

The focal point of the research work was to explore the extent of fertilizer use gap between recommended and farmer's practices. This is why the following objectives were structured out in order to provide an appropriate track to the research work:

i) To describe the following selected characteristics of the farmers

a. Age
b. Education
c. Farming experience
d. Annual family income
e. Farm size
f. Knowledge on fertilizer use
g. Extension contact
h. Training on fertilizer application
i. Time spent in farming
j. Distance from farmers home to fertilizer store

ii) To assess the extent of fertilizer use gap between recommended and farmer's practices in major cropping pattern

iii) To explore the contribution of the selected characteristics of the farmers to the fertilizer use gap between recommended and farmer's dose practices.

1.4 Scope of the Study

The main focus of the study was to determine the fertilizer use gap between recommended and farmer's dose practices. The findings of the study would be specifically applicable to Kendua upazila in Netrokona district. In the light of increased degradation of natural resources due to intensive cultivation and injudicious use, their sustainable management holds the key for ensuring sustainable food production. Due to lack of awareness among the farmers, there are wide spread problems related to the use of chemical fertilizers, mismanagement of surface water and over exploitation of ground water. The over use of chemical fertilizers in most parts of Bangladesh for nutrient management in farming in the last few decades led to several problems affecting soil health, nutrient flow and natural environment. There is a need for promoting, among

others, balanced use of fertilizers for increasing productivity of crops and for better absorption of nutrients from the applied fertilizers. But there is no systematic study was undertaken so far for evaluating the effectiveness of these efforts/programmes on crop productivity, extent of soil testing for nutrient deficiency and adoption of recommended doses of fertilizers by farmers based on the soil tests. Therefore, the present study on the fertilizer use gap between recommended and farmer's dose practices for sustaining the soil productivity of Netrokona district in Bangladesh.

1.5 Justification of the Study

The study expects to provide useful and important information to the farmers of Bangladesh those are using the fertilizers gap in their major farming system. The findings of the study are also expected to be helpful to the farmers and traders for taking appropriate decision regarding further expansion of commercial farming.

The Government, policy makers, planners and other concerned agencies will get help to formulate development policies regarding more effective major crops farming in the country by using the information of the study. The results of this study will provide some basic information to policy maker, production economics specialists, and extension workers, enable them to formulate policies regarding effective production plan of major crops farming. The study will also provide information to the researchers, who are interested in conducting studies in future.

1.6 Assumptions of the Study

An assumption is the supposition that an apparent fact or principle is true in the light of available evidence (Goode and Hatt, 1952). The researcher had the following assumptions in his mind while undertaking this study:

i. The respondents included in the sample of the study were able to provide their opinions and were competent enough to satisfy the queries.
ii. The information furnished by the respondents was reliable.
iii. The fertilizer use gap between recommended and farmer's dose practices for major farming system included in the study were known to the respondents.

iv. The collected data from the respondents were free from bias.

v. Views and opinions furnished by the respondents included in the sample were the representative views and opinions of the whole population of the area concerned.

vi. The findings of the study would be useful for planning and execution of the programs in connection with diffusion of fertilizer use gap between recommended and farmer's practices.

vii. The selected characteristics and fertilizer use gap between recommended and farmer's dose in major farming of the study were normally and independently allotted with respective means and standard deviation.

1.7 Limitations of the Study

Considering the time, money and other necessary resources available to make the study manageable and meaningful, it was necessary to consider the following limitations:

i. The study was confined to only in Ashujia union of Kendua upazila in Netrakona district. This union is consisted of eleven villages. Among the eleven villages, only nine villages were selected purposefully for this study.

ii. There were many farmers under fertilizer use gap between recommended and farmer's practices in the study area, but only the farmers who were involved in major farming were considered for this study.

iii. Characteristics of the farmers were many and varied but only ten (10) characteristics were selected for investigation in this study.

iv. During data collection the researcher had to depend on data furnished by the respondents. As none of the farmers kept records of their farming activities, they furnished information to the different questions by recall.

v. Conceptually, extent of fertilizer use gap between recommended dose and farmer's dose practices were determined from their statements.

vi. Fertilizer use gap between recommended and farmer's practices could be measured in various ways. However in this study this was measured by using a rating scale.

vii. The present study highlights a new dimension of research in the field of

agricultural extension in Bangladesh and so the researcher could not provide sufficient evidence in equipping his study report with relevant literature reviews.

1.8 Definition of Important Terms

Different terms used throughout the study are defined and interpreted below for clarity of understanding:

Practice: Practice is the actual application or use of an idea, belief, or method, as opposed to theories relating to it "the principles and practice of teaching". It's the synonyms of application, exercise, use, operation, implementation, execution, enactment, action, doing more.

Age: Age of a respondent was defined as the period of time in actual years from his birth to the time of interviewing.

Education: Empirically it was defined to the development of desirable changes in knowledge, skill and attitudes in an individual through reading, writing, working, observation and other selected activities. However, in this study, it was measured on the basis of classes passed from a formal educational institution by the farmers.

Farming Experience: Experience as a general concept comprises of knowledge or skill of something or some event gained through involvement in or exposure to that thing or event. Experience refers to the nature of the events someone or something has undergone. Experience is what is happening to use all the time-as long we exist. However, in this study, it was considered as the year of starting from first major farming till the year of data collection.

Knowledge: Knowledge can refer to a theoretical or practical understanding of a subject. It can be implicit (as with practical skill or expertise) or explicit (as with the theoretical understanding of a subject); it can be more or less formal or systematic. It is a familiarity, awareness, or understanding of someone or something, such as facts, information,

descriptions, or skills, which is acquired through experience or education by perceiving, discovering, or learning.

Extension contact: It refers to the extent of contact with various communication media by the farmers in receiving agricultural information.

Training exposure: Training exposure referred to organized instruction aimed at improving knowledge, skill and attitude of respondents that they can perform his/her functions more effectively. Training experience referred to number of days the respondents received training in different aspects of agriculture.

Respondents: Randomly selected people considered to be representable of the population are known as respondents. They are the people from whom a social research worker usually gets most data required for his research. In this study the respondents were the village level farmers.

Assumption: An assumption is "the supposition that an apparent fact or principle is true in the light of the available evidence" (Goode and Halt, 1952).

Hypothesis: Defined by Goode and Halt (1952), a proposition this can be put to "a test to determine its validity". It may be true or false, it may seem contrary to or in accord with common sense. However, it leads to an empirical test.

Null hypothesis: The hypothesis which we pick for statistical test is null hypothesis (H_0). In this study the null hypothesis is stated that there is no relationship between the concerned variables.

Research methodology: Research methodology is the description, explanation and justification of various methods of conducting research. It may be understood as a science of studying how research is done scientifically. In it we study the various steps that are generally adopted by a researcher in studying the research problem along with the logic behind them.

Statistical test: A body of rules which help to take decision regarding acceptation or rejection of the hypothesis is defined as test. In this study if a null hypothesis is rejected it is assumed that there is a relationship between the variables.

Variable: A general indication in statistical research of characteristic that occurs in a number of individuals, objects, groups etc. and that can take on various values, for example the age of an individual.

CHAPTER II
REVIEW OF LITERATURE

In this chapter, review of literature related to the fertilizer use gap between recommended and farmer's practices and some other improved technologies, information collected on this aspect from various sources such as journals, articles, organization's reports etc. were presented into four sections:

Section 1: Extent of use of fertilizer technology or practice
Section 2: Fertilizer use gap scenario of Bangladesh
Section 3: Relationship between the selected characteristics of the farmers and fertilizer use gap practices
Section 4: Conceptual framework of the study

2.1 Extent of use of fertilizer technology or practice

The improved technologies can be adopted effectively in favorable areas but the adoption was likely to be limited in unfavorable areas. Ramaswamy *el al.* (1992) conducted a study on modern rice varieties grown with fertilizer and observed similar results. Abedin *el al*. (1999) examined the fertilizer supply and the fertilizing behavior of farmers in Boro season. They found that fertilizer use grew at a significant rate during the study period. The ratio of land under higher yielding varieties to total Boro cultivated land was also a significant factor. Irrigation cost was significant in all the cases. These results implied that an increase in farm size, a decrease in fertilizer prices and increase in irrigation intensity can increase the level of fertilizer utilization.

De (1999) studied the nature and causes of inter-district variations in yield of rice in West Bengal, lie reported that the yield of rice in West Bengal increased significantly during the study period. Chemical fertilizer and level of irrigation had a great impact on the level of yield. Inter-district variations in yield level were significantly affected by the differences in per acre consumption of chemical fertilizer and area under potential irrigation.

Hossain *el al.* (1992) conducted a research on socio-economic study of soybean in some selected areas of Bangladesh and reported that the farmers of Tangail area had used cowdung and ash in soybean to an amount of 632 kg/ha and 188 kg/ha respectively for high land elevation.

Khanain *et al.* (1993) conducted research on effect of Rhizobial inoculation and chemical fertilizers on the growth and yield of lentil at two AEZ of Bangladesh and found that the Rhizobium inoculation either alone or in presence of phosphate and potash fertilizers significantly increased nodulation and grain yield of the crop.

Jahangir (1906) found in an experiment conducted at IPSA, Gazipur that 0.5 ton organic compost with 120 kg N, 120 kg P, 100 kg KAO, 20 kg S, 1 kg B and 0.2 kg Mo application per hectare might be the optimum for profitable production of cauliflower line lPSA-1 in shallow red brown terrace soil of Bangladesh. Hossain *et al.* (1998) reported in their study entitled “Agioeconomic study on ginger production at farm level" in a selected area of Nilphamari district that ginger farmer applied cow dung u 9000 kg/ha. Oilcake 130 kg/ha and used Urea. TSP and MP as 105.6 kg/ha, 120 kg/ha and 76.6 kg/ha respectively on an average. The findings further revealed that 76. 61 and 70 percent farmers used cow dung, TSP and MP respectively.

Ranganatha *el al.* (1999) conducted a research on knowledge status of paddy farmers regarding organic farming practices at Karnataka in India and found that a majority of the farmers (53%) possessed medium level of knowledge, while 23 and 24 percent of them had high and low level of knowledge regarding organic farming practices respectively.

Jabbar (1979) showed in his study that only 37% of the recommended dose was applied to the fertilized area under Boro MYV, compared to 66% of Boro LYV. 76% for Jute.37% for T. Aman and 30% for Aus.

Quasem (1978) in an ease study concluded that (1) fertilizer use was mainly dependent on the crops grown and their productivity (2) farm size did not have much effect on the use of fertilizers even under unfavorable tenurial system because of crisis of land.

Karim (1973) showed that thirty eight percent of the farmers used urea only. 11 percent urea and phosphate and 5 percent urea, phosphate and potash.

Quayum *el al.* (1995) in their research entitled 'An economic investigation into Aus rice cultivation in some selected areas of Bangladesh'; found that for modern variety of Aus rice small farmers applied manure, Urea, TSP and MP @ 494 kg/ha, 141 kg/ha, 102 kg/ha and 99 kg/ha respectively, medium farmers used manure, Urea, TSP and MP (a 988 kg/ha.143 kg/ha, 93 kg/ha and 68 kg/ha respectively and average of the materials applied were 556 kg/ha, 110 kg/ha and 84 kg/ha respectively. Large farmers used Urea. TSP and MP @ 189, 148 and 86 kg/ha respectively.

Mondal (1995) reported that per hectare use of total fertilizer was 321.55, 310.55 and 472.17 kg respectively for small, medium and large farmers. Large farmers used significantly higher doses of fertilizer than their small and medium counterparts. But fertilizer doses of small and medium farmers did not differ significantly. Manure applied by small, medium and large farmers were 4930.49. 2490.38 and 3038.72 kg per hectare, respectively. As the small farmers possessed relatively more cattle per unit of land they used higher doses of manure compared with others. The study also showed that medium farm group was technically more efficient.

Hossain (1971) studied the extent of adoption of four recommended practices namely, recommended variety, line transplanting method, recommended dose of fertilizer, and plant protection measures in transplanted aman rice by the farmers in Gouripur Union of Mymensingh district. He observed that more than 67.40 percent of the farmers adopted plant protection measures compared to 35.51 percent adopting recommended variety, 25.36 percent adopting line transplanting method and 11.25 percent adopting recommended dose of fertilizer.

Karim (1973) conducted an investigation on the adoption of fertilizers by the transplanted aman rice grower in Keyotkhali union of Mymensingh district. He studied the adoption of three fertilizers namely, Urea. Triple Super Phosphate and Muriate of Potash. Overall fertilizer adoption scores revealed that only 1.4 percent of the transplanted aman rice growers had high adoption of fertilizers, while 9.0 percent low adoption. Forty six percent of the growers did not use any of the three fertilizers.

Chowdhury (1996) found that urea application by farmers' scores ranged from 30 to 180. Average urea use was 83.77 kg per acre against 100 kg. Majority (55%) had low application of urea while 41 percent had medium application. Only 5% had higher dose of application.

Singh and Rajendra (1990) found that out of 150 farmers, 105 farmers adopted 767 variety of sugarcane, while only 45.0 percent of the respondents did not adopt. A high level of adoption was found in nitrogen fertilizer, weeding and intercultural (110 percent) operation followed by plant protection measures (74.3 percent), potassic fertilizer (33.1 percent), and only 28.6 percent adopted ridge sowing practices.

Akand (1995) studied the adoption of recommended dose of fertilizer and found that 36.64 percent respondents used recommended doses of Urea, 6.93 percent recommended doses of Gypsum in their potato cultivation.

Chowdhury (1996) observed that farmers used Urea TSP, MP, Zinc and Sulfur a 83.77. 80.39. 13.73. 0.85. and 0.14 kg/acre respectively against the recommended doses of urea 100 kg. TSP 80 kg, MP 40kg. Gypsum 40 kg, and Zinc Sulphate per acre It was evident from the study that all the farmers (100%) applied Urea while 87acre. percent used TSP and 72 percent applied MP. only 17 percent farmers used Zinc and one percent farmers adopted Sulfur.

Hoque (1999) found in Meherpur, that most of the respondents used Urea, TSP.MP among the chemical fertilizers .But sometimes in absence of TSP farmers used SSP as phosphatie fertilizer. 1 lie highest proportion of the farmers used organic matter in T. Aman (HYV) which was followed by wheal, jute and HYV Potato.

Hossain (1999) found in Sadar thana of Jhenaidha that all the winter vegetable growers used different types of fertilizers but none of them used recommended doses. The\ used either below or above the recommended doses.

2.2 Fertilizer use gap scenario of Bangladesh

Bangladesh is endowed with a climate favourable for the cultivation of a wide variety of both tropical and temperate crops. Rice is the staple food for above 150 million populations. Rice production system depends on a various management practices such as irrigation and fertilizer applications, crop management practices, use of new high yielding varieties and modern technologies. Boro rice is one of the major cereal food grains in Bangladesh which contributed more than 55% to the total rice production during 2008-09. Hybrid Boro rice yield depends on a considerable part on irrigation and fertilizer management practices. Fertilizer is the most important nutrient elements in soils and plays the most vital role in crop production in Bangladesh. Fertilizer application mainly depends on the soil types, growing season, irrigation applications and the cultivars used and agro-climatic conditions of the locations. Every year huge amounts of chemical fertilizer are imported from foreign countries and the import rate is significantly higher for non- urea fertilizer. Domestic production of urea fertilizer covered 50% to the total demand, where TSP (Triple supper phosphate) was only 10%, Gypsum was 40% and MoP (Murate of potash) was fully imported in 2008-09. Bangladesh government has set a target 19 million tons of Boro rice production under 4.8 million ha land in 2009-10.

Therefore, to achieve the targeted production of Boro rice in this year, the fertilizer supply would be one of the major concern things to the whole production system. The major fertilizer such as urea, TSP, MOP, gypsum and ZnSO4would be required 13.83,

5.65, 6.94, 0.41 and 3.06 lakh tons, respectively (applying fertilizer in recommendation dose). Applying on the basis of soil fertility, fertilizer requirement would be 13.2, 4.20, 4.64, 0.38 and 2.85 lakh tons, respectively and on the basis of farmer demand in field level, it would be 12.60, 5.23, 6.43, 0.39 and 2.51 lakh tons, respectively. The urea fertilizer stock will become 9.5 lakh tons after importing 3.5 lakh tons from Qatar. More than 3 lakh tons urea may be shortage in the total growing season which is above 24% compared to the total demand. From this study, it is clear that there is large gap between targeted production of Boro rice and fertilizer input. Therefore, timely supply and availability of fertilizer should receive top priority to sustain/increase Boro rice production when food availability is crucial factors for poverty stricken people, when the country being challenged with feeding increasing population.

Table 2.1 Recommended dose of nutrients for Boro rice production

Type of fertilizer	Amount of nutrient (Kg/ha)	Average value of nutrient (Kg/ha)	Average dose of fertilizer (Kg/ha)
Urea (N)	110-130	120	267
TSP (P)	50-55	52.5	109
MOP (K)	79-82	80.5	134
Zinc Sulphate (Zn)	2	2	8
Gypsum (S)	10	10	59

(Source: BRRI, 2016 and author's own calculation)

Table 2.2 Recommended dose of fertilizer for Boro rice production in Bangladesh considering soil fertility

Type of fertilizer	Type of soil	Dose (Kg/ha)	Average dose (Kg/ha)
Urea	Medium fertile soil	197.60	254.40
	Low fertile soil	311.22	
TSP	Medium fertile soil	61.75	81.51
	Low fertile soil	101.27	
MOP	Medium fertile soil	59.28	89.54
	Low fertile soil	119.80	
Zinc Sulphate	Medium fertile soil	4.94	7.41
	Low fertile soil	9.88	
Gypsum	Medium fertile soil	28.40	54.96
	Low fertile soil	81.51	

(Source: BRRI, 2016 and author's own calculation)

Table 2.3: Fertilizer application in Farmer-level in Bangladesh

Type of fertilizer	Dose (Kg/ha)	Average dose (Kg/ha)
Urea	224.5-262.0	243
TSP	89.9-112.0	101
MOP	112.3-134.7	124
Zinc Sulphate	7.5	7.5
Gypsum	37-60	48.5

(Source: BRRI, 2016 and author's own calculation)

2.3 Relationship between the Selected Characteristics of the Farmers and Fertilizer Use Gap

2.3.1 Age and fertilizer use gap of various practices

Karim (1973) conducted a study on the adoption of fertilizer in Keyotkhali union of Mymensingh district. He found that age of the farmers had significant negative relationship but farm size had positive relationship with their adoption of fertilizer.

Nimje *et al.* (1993) observed that there was no significant relationship between age and adoption of management practices of fertilizer by maize production.

Ahire *et al.* (2007) studied that majority of the member farmers of co-operative major farming society in Solapur district, India (44% and 35.33%) were from the age group of 36-45 and age group of up to 35 years, respectively. Majority of respondents belongs to medium age group and there was non-significant association between age and adoption.

2.3.2 Education and fertilizer use gap of various practices

El-Osta and Morehart (2002) found that education was positively impacted the decision to adopt a fertilizer application technology in wheat production.

Education has previously been found to have a positive association with the adoption of new technologies (Prokopy *et al.*, 2008).

In agriculture, education is a key determinant of technology adoption and education levels are highly correlated with technology adoption rates (Olwande *at al*., 2009).

Ngeno (2011) pointed out that the level of education has significant and positive effect on adoption efficiency of cotton farmers. Farmers with more education were found to be more dynamic and therefore were more willing to adopt new technology practices compared to their counter-parts who were less educated.

Nimje *et al.* (1993) investigated that education and adoption of fertilizer manage mental practices were significantly associated with each other.

Ahire *et al.* (2007) found that there was significant relationship between education and adoption of fertilizer management practices. Among the 90% of the educated farmers, most of them (42.66%) had received primary education, 32.67% of member farmers received higher secondary and above education, 14.675% received secondary education and one tenth farmers were illiterate.

2.3.3 Farming experience and fertilizer use gap of various practices

Ngeno (2011) pointed out that the experience has significant and positive effect on adoption efficiency of rice farmers. Farmers with more years of experience was found to be more dynamic and therefore were more willing to adopt new technology practices.

Farming experience was negatively associated with adoption and use of Broadcast Fertilizer Application Technology (Kaaya *et al*, 2005).

Ahire *et al.* (2007) revealed that 42.67% of member rice farmers had fertilizer application experience up to10 years, 33.33% of the member farmers had experience between 11-20 years and nearly one fourth (24%) of the member farmers had experience in fertilizer management practices over 21 years and were significantly associated with adoption.

2.3.4 Annual family income and fertilizer use gap of various practices

Karim *et al*. (1987) reported that income of farmers had significant and positive relationship with their attitude towards the use of urea.

2.3.5 Farm size and fertilizer use gap of various practices

Wahab (1975) conducted a research on attitudes of farmers towards the use of fertilizer and reported that there was no relationship between farm size and attitude towards the use of fertilizer.

Quasem (1978) in a case study concluded that (1) fertilizer use was mainly dependent on the crops grown and their productivity (2) farm size did not have much effect on the use of fertilizer even under unfavourable tenurial system because of crisis of land.

2.3.6 Knowledge on fertilizer use and fertilizer use gap of various practices

Moullik *et al*. (1966) conducted a study on predicted values of some factors of adopting nitrogenous fertilizers by north Indian farmers in India. He found a significant positive relationship between agricultural knowledge and adoption of nitrogenous fertilizers among the cultivators.

Ranganatha *et al.* (1999) conducted a research on knowledge status of paddy farmers regarding organic farming practices at Karnataka in India and found that majority of the farmers (53%) possessed medium level of knowledge, while 23 and 24 percent of them had high and low level of knowledge regarding organic farming practices respectively.

Kumar and Mahalati (1994) revealed that 74 percent of the respondents had high level of knowledge about adoption of jute farming whereas 22 percent of respondents were in medium level of knowledge and only a few (4%) respondents possessed very poor knowledge which may be attributed to the factors like ignorance in getting sufficient information and lack of conviction.

2.3.7 Extension contact and fertilizer use gap of various practices

Rahman (1999) found that extension contact of the farmers had a significant and positive relationship with their adoption of balanced fertilizers in Boro rice cultivation.

The role of extension contact media in the adoption of new technologies was positively related (Feder and Umali, 1993).

The social extension contacting network was significant relationship to adopt the new practices (Conley and Udry, 2010).

2.3.8 Trainings on fertilizer application and fertilizer use gap of various practices

Ershad *et al*. (2004) conducted a study in Jessore district of Bangladesh observed that the overall production performance and net profit was found better in both of the trained farmer's categories as compared to general farmers on adoption of the cotton production performance of the farmers.

2.3.9 Time spent in farming and fertilizer use gap of various practices

The researcher didn't found any relationship between the time spent and fertilizer use gap between the recommended and farmer's dose practices.

2.3.10 Distance from farmer's home to fertilizer store and fertilizer use gap of various practices

The researcher didn't found any relationship between the distances from farmer's home to fertilizer store and fertilizer use gap between the recommended and farmer's practices.

2.3 Conceptual Framework of the Study

Review of past studies and literature indicated that various factors influence of fertilizer technology. It is hardly possible to deal with all the factors in a single use study.

The researcher therefore tried to assess the impact of some selected characteristics. It is assumed that the selected characteristics might have significantly influenced the farmers in fertilizer use gap. In this study, the selected characteristics of the farmers were considered as independent variables and fertilizer use gap as dependent variable (Fig 2.l)

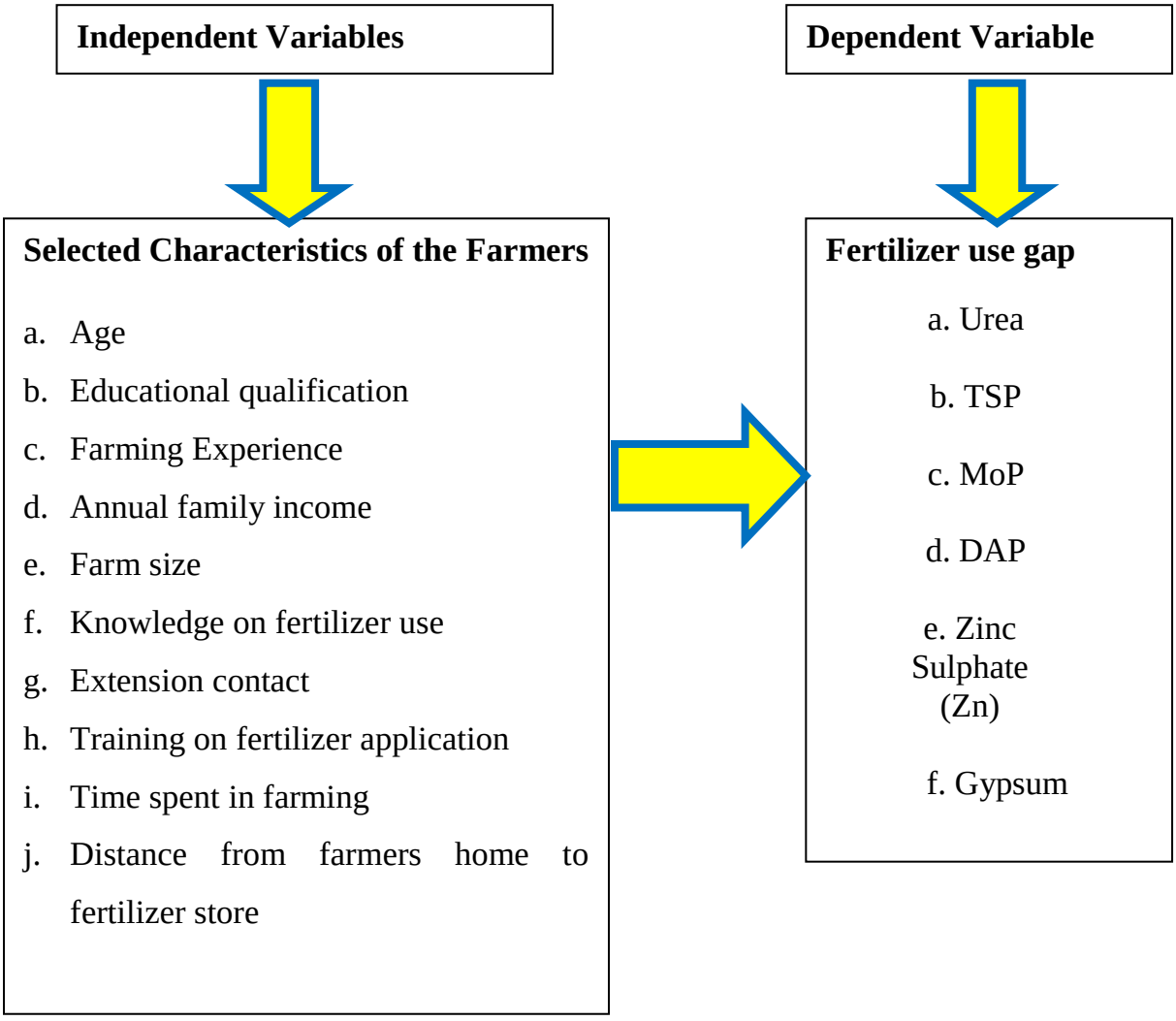

Figure 2.1 The Conceptual Framework of the Study

CHAPTER III

METHODOLOGY

Methodology deserves a very careful consideration in a scientific research. It is one of the most important parts before conducting a research work. To fulfill the objectives of the study, a researcher should be very careful while formulating methods and procedures in conducting the research. According to Mingers (2001), research method is a structured set of guidelines or activities to generate valid and reliable research results. The researcher has great responsibility to describe clearly as to what sorts of research design, methods and procedures he would follow in collecting valid and reliable data and to analyze and interpret those to arrive at correct summary and conclusion. Methodology of any study should be such as to enable the researcher to collect valid and reliable information to analyze the same properly and to arrive at appropriate decisions. Methods and procedures followed in conducting this study has been discussed in this chapter.

3.1 Locale of the Study

Selecting locale of the study is an important step for conducting a scientific study. It depends on the objectives of the research. The union named Ashujia of Kendua upazila under Netrokona district was selected purposively as the locale of the study. Primary data was collected from two villages namely Singhergoan and Bolaishimul under Ashujia union of Kendua upazila in Netrokona district. Two villages were considered as the locale of the study. A map of Bangladesh showing Netrokona district is shown in Figure 3.1 and a map of Netrokona district showing the study upazila (Kendua) is shown in figure 3.2.

Figure 3.1 Map of Bangladesh showing Netrokona district

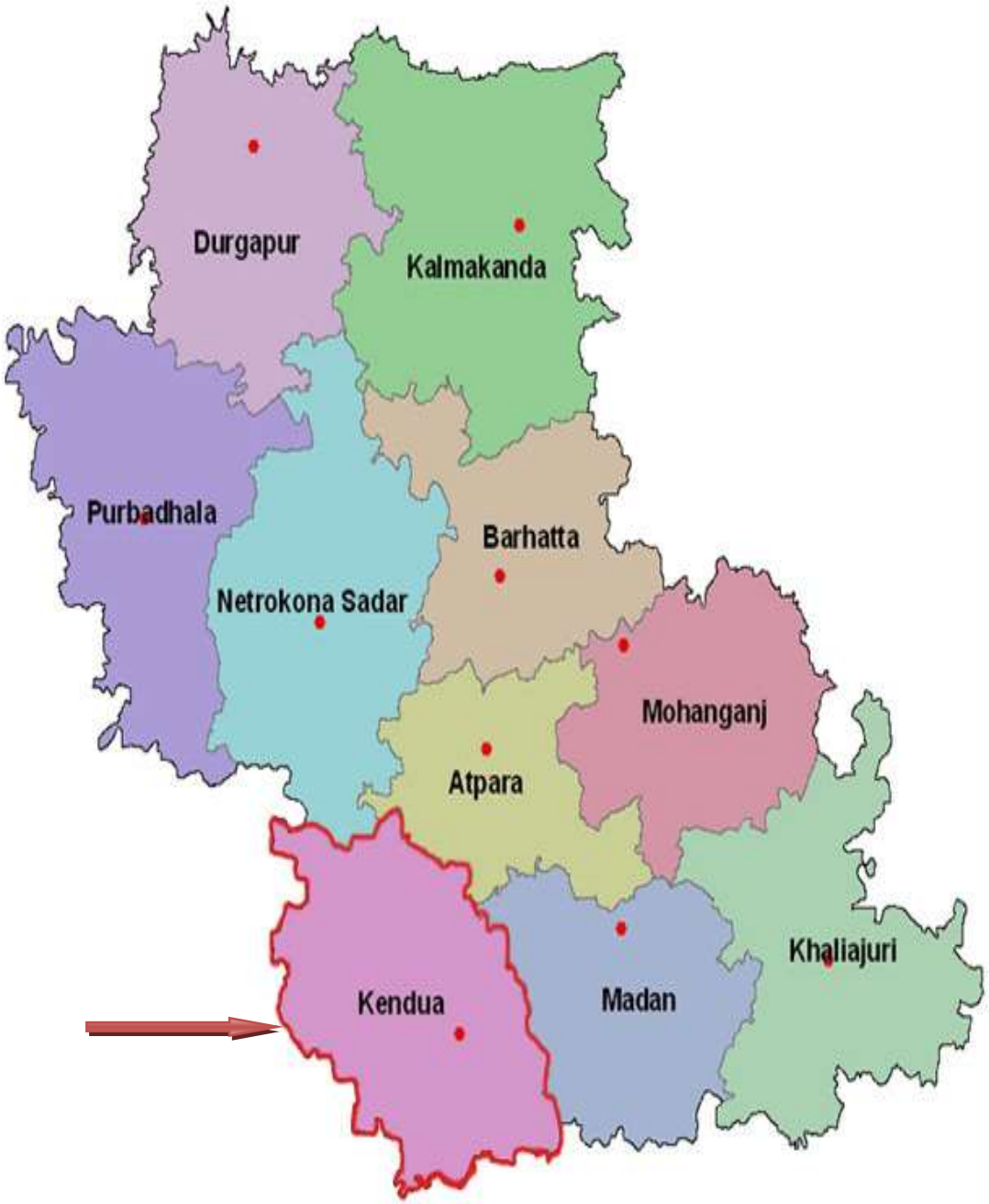

Figure 3.2 Map of Netrokona district showing the study upazila (Kendua)

3.2 Population and Sample of the Study

People involved in major crop production in the selected villages were constituted the active population of this study. The Researcher himself with the help of local leaders, concerned Upazila Agriculture Officer (UAO) and field agent prepared an updated list of all the farmers of the selected villages. The total number of farmers in these villages was 514. Out of them 103 (20%) of total population was selected as the sample size of the study.

Table 3.1: Population and sample size of the study area

Name of the upazila	Name of the villages	Number of farmers	Sample size
Kendua	Singhergoan	261	52
	Bolaishimul	253	51
Total		514	103

3.3 Instrument of data collection

In order to collect valid and reliable data from the farmers, an interview schedule (questionnaire) both in Bengali and English version was designed keeping the objectives in mind. The Bengali version of interview schedule was multiplied as per requirements to collect data from the respondents. The English version of interview schedule has been enclosed in appendix-A. Simple and direct questions and different scales were used to obtain information. Both open and closed form questions were designed to obtain information relating to qualitative variable which was finally be measured by ranking score. The interview schedule was pre-tested with 15 sample respondents from the study area. Questions were asked systematically and explanations were made whenever it was necessary. The respondents were interviewed at their leisure time by using local language to the extent possible so that they can give accurate information in a cool mind. Data collection was started in 2nd January, 2019 and completed in 5th February, 2019.

3.3 Data collecting method

Data were collected through personal interviewing by the researcher himself. All possible efforts were made to establish rapport with the respondent so that they could feel easy and comfort to response the questions in the interview schedule. Necessary steps were taken to explain the purpose of the study to the respondents and their answers were recorded sincerely. If any respondent felt difficulty in understanding any question, care was taken to help him getting understood. The researcher did not face any serious problem in data collection. The data collection took 33 days from 2nd January to 5thFebruary, 2019. The collected data were complied, tabulated and analyzed. Qualitative data were converted into quantitative form by means of suitable scoring whenever needed.

3.4 Variables and Their Measurement Techniques

In a descriptive social research, selection and measurement of the variable is an important task. A variable is any characteristics which can assume varying or different values are successive individuals' cases (Ezekiel and Fox, 1959). An organized research usually contains at least two identical elements i.e. independent and dependent variable. An independent variable is a factor which is manipulated by the researcher in his attempt to ascertain its relationship to an observed phenomenon. A dependent variable is a factor which appears, disappears or varies as the experimenter introduces, removes or varies the independent variables (Townsend, 1953). According to the relevance of the research area, 10 characteristics of the respondents were selected as the independent variables (e.g. age, education, farming experience, annual family income, farm size, knowledge on fertilizer use, extension contact, training on fertilizer application, time spent in farming, distance from farmers home to fertilizer store). On the other hand, fertilizer use gap was dependent variable. The following sections contain procedures of measurement of dependent and independent variables of the study.

3.4.1 Measurement of independent variables

The selected characteristics of the respondent farmers constituted the independent variables of the study. To keep the research within the manageable sphere, 10independent

variables were selected for the study. The procedure followed in measuring the independent variables have been discussed in the subsequent sections.

3.4.1.1 Age

Age of the farmers was measured in terms of actual years from their birth to the time of the interview, which was found on the basis of the verbal response of the rural people (Azad, 2003). No fractional year was considered for the study. A score of one (1) was assigned for each year of one's age. This variable appears in item number one (1) in the interview schedule as presented in Appendix-A.

3.4.1.2 Education

Education of a respondent was measured in terms of years of schooling completed by an individual in educational institute. If a respondent did not know how to read and write his literacy was taken as zero (0). A score of (0.5) was given to that respondent who could sign his name only. Besides a respondent got actual score of one (1) for every year of schooling i.e. '1' for class one, '2' for class two and so on. This variable appears in item number two (2) in the interview schedule as presented in Appendix-A.

3.4.1.3 Farming experience

Farming experience of the farmers was measured by the number of years a respondent engaged in major farming. The measurement included from the year of starting of first crop production till the year of data collection. A score of one (1) was assigned for each year of experience. This variable appears in item number three (3) in the interview schedule as presented in Appendix-A.

3.4.1.4 Annual family income

The annual family income of a farmer is an important indicator of how much he can invest in his major farming. Annual family income of a respondent was measured in taka on the basis of total yearly earnings from major crops farming system and other sources in which the respondent as well as his family members were involved. The method of

ascertaining income from farming involved two aspects. The aspects are: agriculture and non-agriculture sources of income. In calculating the annual income of the respondents, the total yield from all the sources making in the preceding year were converted into cash income according to the prevailing market price and added together to obtain total income of a respondent. However unit score of 1 was taken for every Tk 1000/- of annual income. This variable appears in item number four (4) in the interview schedule as presented in Appendix-A.

3.4.1.5 Farm size

Farm size was measured as the size of the respondent's farm on which he/she continued his/her farming operations during the period of study. The area was being estimated in terms of full benefit to the growers. The data were first recorded in terms of local unit i.e; *bigha, katha or pakhi*and then were converted to hectare and the size was measured by using the following formula:

$$FS = A_1 + A_2 + 1/2(A_3 + A_4) + A_5$$

Where, FS = Farm size

A_1 = Homestead area (Including pond)

A_2 = Own land under own cultivation

A_3 = Land given to others as borga

A_4 = Land taken from others as borga

A_5 = Land taken from others as lease

This variable appears in item number five (5) in the interview schedule as presented in Appendix-A.

3.4.1.6 Knowledge on fertilizer use

Knowledge is defined in this study included those behaviours and test situations which emphasized the remembering either by recognition or recall of ideas, material or phenomenon (Bloom *et al*, 1956). This variable indicated the extent of knowledge the respondent possessed at the time of interview as evident from his responses to a set of

questions related to fertilizer use gap. The respondents were asked to select appropriate answer from variety of possible answers. A score of '2' was given for each correct reply and '0' for incorrect reply for each item. The summation of scores for correct replies of all the 11 items of a particular respondent indicated his or her knowledge on fertilizer use gap. This variable appears in item number six (6) in the interview schedule as presented in Appendix-A.

3.4.1.7 Extension contact

The extension contact with different communication media was computed for each respondent to determine the degree of his or her contact on the basis of his or her visit to the different communication media on different purposes. The following scale was used for computing the contact with different communication media's scores of the item:

Nature of visit	**Scores assigned**
Not at all	0
Rarely	1
Occasionally	2
Regularly	3

Logical frequencies were assigned to each four alternative nature of visit as indicated in the interview schedule. Finally, contact with different communication mediascore of a respondent was measured by adding all the scores obtained for all the 6 purposes. Thus, score of a respondent could range from 0 to 18 while '0' indicating no contact with different communication media and '18' indicating very high contact with different communication media. This variable appears in item number seven (7) in the interview schedule as presented in Appendix-A.

3.4.1.8 Training on fertilizer application

Training exposure of a respondent was measured on the basis of number of days of training received from different sources in the last five years on fertilizer application.

Training exposure score of a respondent was measured in terms of number of days for receiving training. For example, if a farmer received no training his/her score was zero (0) and score one (1) was assigned for receiving one day training. This variable appears in item number eight (8) in the interview schedule as presented in Appendix-A.

3.4.1.9 Time spent in farming

Time spent in farming of the respondent was measured by the number of hours spent per week a respondent engaged in farming. A score of one (1) was assigned for each number of hour spent per week. This variable appears in item number nine (9) in the interview schedule as presented in Appendix-A.

3.4.1.10 Distance from farmer's home to fertilizer store

Distance from farmer's home to fertilizer store in farming of the respondent was measured by the number of kilometers a respondent gone in farming. A score of one (1) was assigned for each number of kilometers. This variable appears in item number ten (10) in the interview schedule as presented in Appendix-A.

3.4.2 Measurement of dependent variable

Fertilizer use gap between recommended and farmer's practices was the dependent variable in this study. It was measured on the basis of recommended doses how much fertilizer was given Upazila Extension Officer. How quantity of fertilizers used by the farmers on their field. Finally, we calculated fertilizer use gap between farmers and recommended by average of gap.

The extent of use gap scores of a respondent was measured by adding the score of all the 6 fertilizers application practices as shown in item number 11 of the Interview schedule as presented in Appendix-A. Thus, the extent of fertilizer use gap scores of a respondent could range from 6 to 30, where '6' indicating very low use gap of fertilizer application practices and '30' indicate highest use gap of fertilizer application practices.

3.5 Hypothesis of the Study

According to Kerlinger (1973) a hypothesis is a conjectural statement of the relation between two or more variables. Hypothesis are always in declarative sentence form and they are related, either generally or specifically from variables to variables. In broad sense hypotheses are divided into two categories: (a) Research hypothesis and (b) Null hypothesis.

3.5.1 Research hypothesis

Based on review of literature and development of conceptual framework, the following research hypothesis was formulated:

“Each of the ten (10) selected characteristics (age, education, farming experience, annual family income, farm size, knowledge on fertilizer use, extension contact, training on fertilizer application, time spent in farming, distance from farmers home to fertilizer store) has significant relationship to fertilizer use gap between recommended and farmer's dose practices”. However, when a researcher tries to perform statistical tests, it becomes necessary to formulate null hypothesis.

3.5.2 Null hypothesis

A null hypothesis states that there is no contribution between the concerned variables. The following null hypothesis was formulated to explore the contribution of the selected characteristics of farmers on their fertilizer use gap between recommended and farmer's practices. Hence, in order to conduct tests, the earlier research hypothesis was converted into null form as follows:

“There is no contribution of the selected characteristics (age, education, farming experience, annual family income, farm size, knowledge on fertilizer use, extension contact, training on fertilizer application, time spent in farming, distance from farmers home to fertilizer store) of the farmers on their fertilizer use gap between recommended dose and farmer's dose practices”.

3.6 Data Processing

After completion of field survey, all the data were coded, compiled and tabulated according to the objectives of the study. Local units were converted into standard units. All the individual responses to questions of the interview schedule were transferred into a master sheet to facilitate tabulation, categorization and organization. In case of qualitative data, appropriate scoring technique was followed to convert the data into quantitative form.

3.7 Statistical Analysis

The data were analyzed in accordance with the objectives of the proposed research work. Qualitative data were converted into quantitative data by means of suitable scoring technique wherever necessary. The statistical measures such as range, means, standard deviation, number and percentage distribution were used to describe the variables. The analysis of data was performed using statistical treatment with SPSS (Statistical Package for Social Science) computer program, version 20. Regression analysis was used to identify the linear combination between independent variables used collectively to predict the dependent variable (Miles and Shevlin, 2001). Regression analysis helps us understand how the typical value of the dependent variable changes when one of the independent variables varied. Ordinary Least Squares (OLS) is used most extensively for estimation of regression functions. In short, the method choose a regression where the sum of residuals, ΣUi is as small as possible (Gujarati, 1995). As shown in the following equation, explanatory variable included in model consist of those measuring various asset endowment and demographic characteristics of farmers.

In order to estimate the contribution of the selected characteristics of farmers to the fertilizer use gap between recommended and farmers dose practices, multiple regression analysis (B) was used. Throughout the study, five (0.05) percent and one (0.01) percent level of significance were used as the basis for rejecting any null hypothesis. If the computed value of (B) was equal to or greater than the designated level of significance (*p*), the null hypothesis was rejected and it was concluded that there was a significant contribution between the concerned variable. Whenever the computed value of (B) was

found to be similar at the designated level of significance (*p*), the null hypothesis could not be rejected. It was concluded that there was no contribution of the concerned variables.

The model used for this analysis can be explained as follows:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + e$$

Where, Y = Fertilizer use gap between recommended and farmer's dose practices;

Of the independent variables, x_1 is the farmer's age, x_2 is educational qualification, x_3 is farming experience, x_4 is annual family income, x_5 is farm size, x_6 is knowledge on fertilizer use, x_7 is extension contact, x_8 is training on fertilizer application, x_9 is time spent in farming, and x_{10} is distance from farmer's home to fertilizer store. On the other hand, b1, b_2, b_3, b_4, b_5, b_6, b_7, b_8, b_9 and b_{10} are regression coefficients of the corresponding independent variables, and e is random error, which is normally and independently distributed with zero mean and constant variance.

CHAPTER IV
RESULTS AND DISCUSSION

A consequential and detailed discussion on the findings of the scientific research study has been presented in this chapter. The chapter includes three sections. In the first section, independent variables i.e. characteristics of the respondents have been discussed. The second section dealt with dependent variable i.e., Fertilizer use gap between recommended and farmer's dose practices and finally, the relationship between the dependent and independent variables have been discussed in the third section.

4.1 Selected Characteristics of the Farmers

Ten characteristics of the farmers were selected to describe and to find out their relationships with their fertilizer use gap between recommended and farmer's dose practices. These selected characteristics were age, education, farming experience, annual family income, farm size, knowledge on fertilizer use, extension contact, training on fertilizer application, time spent in farming, distance from farmers home to fertilizer store confronted in fertilizer use gap between recommended and farmer's dose practices. The noticeable topographic of the 10 characteristics of the major farming farmers, each of which constituted an independent variable.

4.1.1 Age

The age of the sample farmers ranged from 25 to 68 years with a mean of 40.23 and standard deviation of 10.29. The respondents were classified into three categories on the basis of their age (Table 4.1) following Rashid *et al*. (2014).

Table 4.1 Distribution of the farmers according to their age

Categories (years)	Farmers		Mean	Standard Deviation
	Number	Percent		
Young aged (up to 35)	39	37.9	40.23	10.29
Middle aged (36-50)	47	45.6		
Old aged (above 50)	17	16.5		
Total	103	100		

Data showing that the highest value of proportion 45.6 % of the farmers were middle aged compared to 37.9 % were young and 16.5% were old aged. Data also indicates that the middle and young aged category constitute 83.5 percent of total farmers. According to Lionberger (1960) elderly farmers seem to be somewhat less motivated to adopt new farm practices than younger ones. Young and middle aged people generally show more favorable attitude towards trying new ideas than the older. The extension agents can target those people in designing their extension activities.

4.1.2 Education

The education score of the farmers ranged from 0-18, with a mean of 6.79 and standard deviation of 5.05. The respondents were classified into five categories on the basis of their education as shown in Table 4.2.

Table 4.2. Distribution of the farmers according to their education

Categories (Years)	Respondent farmers		Mean	Standard Deviation
	Number	Percent		
Illiterate (0)	21	20.4	6.79	5.05
Primary education (1-5 class)	22	21.3		
Secondary education(6-10 class)	41	39.9		
Above secondary level	19	18.4		
Total	103	100		

It is determined from the Table 4.2 that 39.9% of the respondents comprised of secondary education, 21.3% comprised of primary education, 18.4 % had above secondary education, and 20.4 % were illiterate. Table 4.2 also showed that 61.2 percent out of the selected respondents got primary to secondary level of education.

4.1.3 Farming experience

The score of farming experience in major crop production by the farmers ranged from 3 to 40 years with a mean and standard deviation of 17.24 and 7.61, respectively. The respondents were classified into three categories on the basis of their experience (Table 4.3) in the following way.

Table 4.3 Distribution of the farmers according to their farming experience

Categories (years)	Farmers		Mean	Standard Deviation
	Number	Percent		
Low (up to10)	18	17.5	17.24	7.61
Medium (11-24)	69	67		
High (above 24)	16	15.5		
Total	103	100		

Table 4.3 indicates that the farmers belonged to medium experience in major crop production category constituted the highest proportion (67%) followed by high experience (15.5%) and low experience (17.5%). The results indicate that the famers experience in crop production was low to medium. Higher experiences would help the farmers to adopt improved fertilizer application practices in crop production. So the necessary technical support should be provided to the low and medium experienced farmers for increasing their knowledge on fertilizer use gap between recommended and farmer's dose practices.

4.1.4 Annual family income

The annual family income of the respondents under this study ranged from 70 to 800 thousand (BDT) with an average of 260.77 and standard deviation of 117.79 respectively. The respondents were classified into three categories on the basis of their annual family income (Table 4.4) in the following way.

Table 4.4 Distribution of the farmers according to their annual family income

Categories ('000')	Farmers		Mean	Standard Deviation
	Number	Percent		
Low (up to 143 Thousand BDT)	10	9.7	260.77	117.79
Medium (144-377 Thousand BDT)	81	78.6		
High (above 377 Thousand BDT)	12	11.7		
Total	103	100		

Data presented in the Table 4.4 indicates that farmers having medium annual income constitute the highest proportion (78.6%), while the lowest proportion in high family income (11.7%) and the low annual family income constituted with 9.7 percent. Overwhelming (90.3%) farmers have high to medium level of annual income.

4.1.5 Farm size

The farm size of the farmers ranged from 0.19 ha to 3.44 ha with a mean of 0.82 and standard deviation of 0.58. The respondents were classified into five categories following the categorization used by DAE on the basis of their farm size (Table 4.5) following.

Table 4.5 Distribution of the farmers according to farm size

Categories (hectare)	Farmers		Mean	Standard deviation
	Number	Percent		
Small farm (0.2-1 ha)	81	78.6	0.82	0.58
Medium farm (1.01-3 ha)	19	18.5		
Large farm (above 3 ha)	3	1.9		
Total	103	100		

Table 4.5 indicates that the small farm holder constitutes the highest proportion (78.6) followed by medium farm holder (18.5%) and 1.9% of the farmers had large farm category. The findings of the study revealed that majority were small to medium sized farm holder. The average farm size of the study area (0.82) was higher than that of national average (0.60 ha) of Bangladesh (BBS, 2014).

4.1.6 Knowledge

Knowledge on fertilizer use gap scores of the farmers observed ranged from 8 to 19 with a mean of 12.22 and standard deviation of 2.36. On the basis of knowledge on fertilizer use gap scores, the respondents were classified into three categories on the basis of observed range Table 4.6.

Table 4.6 Distribution of the farmers according to their knowledge

Categories (Scores)	Farmers		Mean	Standard Deviation
	Number	Percent		
Low (up to10)	32	31.1	12.22	2.36
Medium (11-14)	56	54.3		
High (above 14)	15	14.6		
Total	103	100		

Data in the Table 4.6 show that the highest proportion (54.3 %) of the respondents had the medium knowledge, 31.1 percent had low knowledge and 14.6 percent respondents had high knowledge on fertilizer use gap. The results indicate that most of the famer's knowledge on fertilizer use gap was medium to low (85.4%) knowledge on fertilizer use gap. So, for getting more crop production, the DAE have to increase the farmer's knowledge on fertilizer use gap by giving proper information and training.

4.1.7 Extension contact

The computed extension contact scores of the respondents ranged from 6 to 16 with a mean of 10.92 and standard deviation of 2.10 against the possible range of 0 to18. On the basis of extension contact on fertilizer application, In case of this characteristic, the respondents were classified into three categories on the basis of their observed range (Table 4.7).

Table 4.7Distribution of the farmers according to their extension contact

Categories (scores)	Farmers		Mean	Standard Deviation
	Number	Percent		
Low (up to 8)	15	14.6	10.92	2.10
Medium (9-12)	64	64		
High (above 12)	22	21.4		
Total	103	100		

Data presented in Table 4.7 indicated that the highest proportion (64%) of the farmers of the study area had medium extension contact, while 21.4 percent had high and 14.6 percent had low extension contact. The results indicate that most of the famers extension contact on fertilizer use gap was medium to high (85.4%) on fertilizer application. So, for getting more crop production, the DAE have to increase the farmer's extension contact on fertilizer application by arranging farmer's day, fair and by giving proper information and training to the farmers.

4.1.8 Training on fertilizer application

The observed range about training on fertilizer application was from 0 to 15 with a mean and standard deviation of 3.91 and 3.38 respectively. According to their length of training score, the respondents were classified into three categories based on observed range. The distribution of the respondents according to their training exposure has been presented in Table 4.8.

Table 4.8 Distribution of the farmers according to their training exposure

Categories (days)	Farmers		Mean	Standard Deviation
	Number	Percent		
No training (0)	38	36.9	3.79	3.64
Low (1-5)	37	35.9		
Medium (6-10)	17	16.5		
High (above 10)	11	10.7		
Total	103	100		

The Table 4.8 showed that the percentage of no training, low training, medium training and high training were 36.9%, 35.9%, 16.5% and 10.7% respectively. Table 4.11 shown that 36.9% of total farmers had no training exposure, while 35.9% and 16.5% farmers had low and medium training exposure respectively. Farmers of no to low training exposure (72.8%) were very high compared to medium and high category. Training makes the farmers skilled and helps them to acquire deep knowledge about the respected aspects. Trained farmers can better tackle any kind of challenges about the adverse situation on fertilizer application. So, the farmers have to give proper training on various aspects of fertilizer application.

4.1.9 Time spent in farming

Time spent in farming scores of the farmers observed ranged from 21 to 56 with a mean of 42.04 and standard deviation of 8.79. On the basis of time spent in farming scores, the respondents were classified into three categories that were shown in Table 4.9.

Table 4.9 Distribution of the farmers according to their time spent

Categories (hours)	Farmers		Mean	Standard Deviation
	Number	Percent		
Low (up to 34)	16	15.5	42.04	8.79
Medium (35-50)	76	73.8		
High (above 50)	11	10.7		
Total	103	100		

Data in the Table 4.9 show that the highest proportion (73.8%) of the respondents had the medium time spent, 15.5 percent had low time spent and 10.7 percent respondents had high time spent in farming. The results indicate that most of the famers time spent in farming was low to medium (89.3%) time spent in farming. So for getting more crop production, the DAE have to inspire the farmers to give more time in their farming by giving proper information, training and other services.

4.1.10 Distance from farmer's home to fertilizer store

The distance from farmers home to fertilizer store under this study ranged from 0.5- 5, with an average of 2.15 and standard deviation of 0.90.The respondents were classified into three categories on the basis of the distance from farmers home to fertilizer store(Table 4.10) following.

Table 4.10 Distribution of the farmers according to the distance from farmers home to fertilizer store

Categories (km)	Farmers		Mean	Standard Deviation
	Number	Percent		
Short (up to 1)	19	18.4	2.15	0.90
Medium (2-3)	77	74.8		
Long (above 3)	7	6.8		
Total	116	100		

Data presented in the Table 4.10 indicates that majority (74.8%) of the respondents' had medium distance from farmers home to fertilizer store compared to 18.8 percent short and 6.8 percent long distance from farmers home to fertilizer store. The findings of the study revealed that overwhelming majority (93.2 %) of the farmers had short to medium distance from farmer's home to fertilizer store. Short distance from farmer's home to fertilizer store helps the farmers to collect the necessary amount of fertilizers at the right time within a very short time.

4.2 Fertilizer use gap between recommended and farmer's dose practices

The observed range of fertilizer use gap between recommended and farmer's practices scores of the farmers was 14.60 to 38.60 with a mean of 24.94 and standard deviation of 4.41. On the basis of fertilizer use gap between recommended and farmer's practices scores, the respondents were classified into three categories as shown in Table 4.11.

Table 4.11 Distribution of the farmers according to their fertilizer use

Categories (scores)	Farmers		Mean	Standard Deviation
	Number	Percent		
Low (up to 20)	12	11.7	24.94	4.41
Medium (21-29)	71	68.9		
High (above 29)	20	19.4		
Total	116	100		

Data in the Table 4.11 show that the highest proportion (68.9 %) of the respondents had the medium use gap, 11.7 percent had low use gap and 19.4 percent respondents had high use gap on fertilizer application. The DAE have to take the proper policy for maintaining the proper fertilizer use gap between the recommended and farmer's dose of fertilizer application practices.

4.3 Contribution of Selected Characteristics of the Farmers to Their Fertilizer Use Gap Between Recommended and Farmer's Dose Practices

For this study 10 characteristics of the respondents were selected and each of the characteristics was treated as independent variable. Of the independent variables, x_1 is the farmers age, x_2 is education, x_3 is farming experience, x_4 is annual family income, x_5 is farm size, x_6 is knowledge on fertilizer use, x_7 is extension contact, x_8 is training on fertilizer application, x_9 is time spent in farming, x_{10} is distance from farmers home to fertilizer store. Y= is the fertilizer use gap between recommended and farmers practices as dependent variable of the study.

Full model regression was initially run with the 10 independent variables. But it was observed that the full model regression results were misleading due to existence of interrelationships among the independent variables. Therefore, in order to avoid the misleading results and to determine the best explanatory variables, the method of stepwise multiple regressions was administrated and 10 independent variables were fitted together in stepwise multiple regression analysis. Table 4.12 shows the summarized results of stepwise multiple regression analysis with 10 independent variables on

fertilizer use gap between recommended and farmer's dose practices. It was observed that out of 10 variables only 4 independent variables namely training (x_8), time spent (x_9), extension contact (x_7) and farming experience (x_3) were entered into the regression equation on fertilizer application. The regression equation is so obtained below:

Table 4.12 Summary of stepwise multiple regression analysis showing the contribution of selected characteristics of the farmers to the fertilizer use gap between recommended and farmer's practices

Variables entered	Standardized Partial 'b' Coefficients	Value of 't' (with probability level)	Adjusted R^2	Increase in R^2	Variation explained in percent
Training (x_8)	-.226	-2.298 (0.024)	.218	0.218	21.8
Time spent (x_9)	-.249	-2.912 (0.004)	.287	0.069	6.9
Extension contact (x_7)	-.244	-2.561 (0.012)	.337	0.05	5.0
Farming experience (x_3)	-.180	-2.173 (0.032)	.368	0.031	3.1
Total				0.368	36.8

Multiple R=0.606;

R-square= 0.368

Adjusted R-square= 0.342;

F-ratio= 14.244 at 0.000 level of significance

Constant = 2.652

The multiple R, R^2 and adjusted R^2 values were found 0.606, 0.368 and 0.342, respectively and the corresponding F-ratio was 14.244 which were significant at 0.000

levels. For determining unique contribution of each of the four variables the increase in R^2 value was determined on fertilizer use gap between recommended dose and farmer's dose practices. These four variables combinedly explained 36.8 percent of the total variation to the fertilizer use gap between recommended and farmer's practices. Training on fertilizer application alone contribute 21.8 percent where time spent (6.9%), extension contact (5%), and farming experience (3.1%) had rest of variation to the fertilizer use gap between recommended and farmer's practices.

4.3.1 Contribution of training on fertilizer application to the fertilizer use gap between recommended and farmer's practices

The contribution of training on fertilizer use gap between recommended and farmer's practices was measured by testing the following null hypothesis:

"There is no contribution of training on fertilizer use gap between recommended and farmer's practices".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of training on fertilizer application was 21.8 percent.

b. It was the highest contribution to the fertilizer use gap between recommended and farmer's practices

c. The null hypothesis could be rejected.

Based on the above finding, it can be stated that a respondent's training on fertilizer application had an important effect on fertilizer use gap between recommended and farmer's practices. Training on fertilizer application enhances the abilities of the respondents at a short time than others which transformed them to fertilizer use gap between recommended and farmer's practices.

4.3.2 Contribution of time spent on fertilizer application to fertilizer use gap between recommended and farmer's practices

The contribution of time spent in farming on fertilizer application to fertilizer use gap between recommended and farmer's practices was measured by testing the following null hypothesis:

"There is no contribution of time spent in farming on fertilizer application to fertilizer use gap between recommended and farmer's practices".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of time spent in farming on fertilizer application was 6.9 percent.
b. It was the important contribution to the fertilizer use gap between recommended and farmers practices
c. The null hypothesis could be rejected.

Based on the above finding, it can be stated that a respondent's time spent in farming fertilizer application had an important effect on the fertilizer use gap between recommended dose and farmers practices. Time spent in farming on fertilizer application enhances the abilities of the respondents at a short time than others which transformed them to fertilizer use gap between recommended and farmer's practices.

4.3.3 Contribution of extension contact on fertilizer application to fertilizer use gap between recommended and farmer's practices

The contribution of extension contact on fertilizer application to fertilizer use gap between recommended and farmer's dose practices was measured by testing the following null hypothesis:

"There is no contribution of extension contact on fertilizer application to fertilizer use gap between recommended and farmer's practices".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of extension contact on fertilizer application was 5.0 percent.
b. It was the important contribution to the fertilizer use gap between recommended and farmer's practices.
c. The null hypothesis could be rejected.

Based on the above finding, it can be stated that a respondent's extension contact on fertilizer application had an important effect on fertilizer use gap between recommended and farmer's practices. Extension contact on fertilizer application enhances the abilities of the respondents at a short time than others which transformed them to fertilizer use gap between recommended and farmer's practices.

4.3.4 Contribution of farming experience on fertilizer application to fertilizer use gap between recommended and farmer's practices

The contribution of farming experience on fertilizer application to fertilizer use gap between recommended and farmer's practice was measured by testing the following null hypothesis:

"There is no contribution of farming experience on fertilizer application to fertilizer use gap between recommended and farmer's practices".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of farming experience on fertilizer application was 3.1percent.
b. It was the important contribution to the fertilizer use gap between recommended and farmers practices.
c. The null hypothesis could be rejected.

Based on the above finding, it can be stated that a respondent's farming experience on fertilizer application had an important effect on the fertilizer use gap between recommended and farmer's practices. Farming experience on fertilizer application enhances the abilities of the respondents at a short time than others which transformed them to fertilizer use gap between recommended and farmer's practices.

CHAPTER V
SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The study was conducted in the Kendua upazila under Netrokona district to find out the fertilizer use gap between recommended and farmers practices. Total 519 farmers were selected from the study area as the population and the respondents comprised of 103 farmers constituted the sample of the study. A well-structured interview schedule was developed based on objectives of the study for collecting data. The independent variables were: age, education, farming experience, annual family income, farm size, knowledge on fertilizer use, extension contact, training on fertilizer application, time spent in farming, distance from farmers home to fertilizer store in fertilizer application. Data collection was started in 2 January, 2019 and completed in 4 February, 2019. Various statistical measures such as frequency counts, percentage distribution, average and standard deviation were used in describing data. In order to estimate the contribution of the selected characteristics of farmers to fertilizer use gap between recommended and farmers dose practices, multiple step-wise regression analysis (B) was used. The major findings of the study are summarized below:

5.1 Major Findings

5.1.1 Selected characteristics of the farmers

Age: The middle-aged farmers comprised the highest proportion (45.6%) and lowest proportion by old aged category (16.5%).

Educational qualification: Secondary education constituted the highest proportion (39.9%) and the lowest 18.4 percent was high.

Farming experience: Medium experience constituted the highest proportion (67%) and high experience constituted the lowest proportion (15.5%).

Annual family income: The medium annual family income constituted the highest proportion (78.6%), while the lowest proportion in low annual family income constituted with (9.7%) farmers.

Farm size: The medium farm holder constituted the highest proportion (78.6%), whereas the only 1.9% 0f the farm holder was large farm size.

Knowledge on fertilizer use: The highest proportion (54.3%) of the farmers had medium knowledge on fertilizer application compared to the lowest proportion (14.6%) had high knowledge of the farmers.

Extension contact: The highest proportion (64%) of the farmers had medium extension contact as compared to 14.6 percent of them having low extension contact category.

Trainings on fertilizer application: The highest proportion (36.9%)of the farmers had no training exposure and 10.7 percent had high training exposure category.

Time spent in farming: The highest proportion (73.8%) of the farmers had medium time spent compared to 10.7 percent in high time spent in farming.

Distance from farmer's home to fertilizer use: Short category distance from farmer's home to fertilizer use comprised the highest proportion (74.8%) and high category distance from farmers home to fertilizer use constituted the lowest proportion (6.8%).

5.1.2 Fertilizer use gap between recommended and farmer's dose practices

The highest 68.9 percent of the farmers belong to the group of medium fertilizer use gap category and the lowest percentage 11.7 percent in low fertilizer use gap category of fertilizer use gap between recommended and farmers practices.

5.1.3 Contribution of the selected characteristics of the farmers to their fertilizer use gap between recommended and farmer's dose practices

The multiple R and R^2 values were found 0.606 and 0.368 respectively and the corresponding F-ratio was 14.244 which were significant at 0.000 levels. For determining unique contribution of each of the four variables the increase in R^2 value was determined on fertilizer application of fertilizer use gap between recommended and farmer's practices. These four variables combinedly explained 36.8 percent of the total variation to the fertilizer use gap between recommended and farmer's practices. Training on fertilizer application alone contribute 21.8 percent where time spent in (6.9%), extension contact (5.0%) and farming experience (3.1%) had rest of variation to the fertilizer use gap between recommended and farmer's practices.

5.2 Conclusions

The findings and relevant facts of research work prompted the researcher to draw following conclusions.

i. About 93.2% of the farmers were in low to medium fertilizer use gap category. Therefore, fertilizer use gap between recommended and farmer's practices need to maximize by using fertilizer application practices in rice production.

ii. Training on fertilizer application of the farmers had influenced in decreasing the fertilizer use gap between recommended and farmer's practices. Therefore, in order to increase fertilizer use gap between recommended and farmers practices, necessary steps should be taken to increase training of the farmers by giving them proper training on fertilizer application.

iii. Time spent in farming had significant effect to the fertilizer use gap between the recommended and farmers practices. So, the DAE and NGO_s should

influence the farmers to give more time for getting more crop production by using the optimum range of fertilizer application doses.

iv. Extension contact had negative significant effect to the fertilizer use gap between the recommended and farmer's practices, which indicates more the extension contact on fertilizer application more will be concern about fertilizer use gap. So, the farmers should maintain more extension contact in their farming to increase fertilizer use gap between the recommended and farmer's dose practices.

v. Farming experience had negative significant effect to the fertilizer use gap between the recommended and farmer's practices. So, the farmers should gather more farming experiences on fertilizer application to fertilizer use gap in major cropping in rice production for getting more crop production by using the optimum range of fertilizer application doses.

5.3 Recommendations

5.3.1 Recommendations for policy implications

On the basis of observation and conclusions drawn from the findings of the study following recommendations are made:

i. It is recommended that the activities of personnel of Department of Agriculture Extension (DAE) and Soil Resource Development Institute (SRDI) should be more intensified for motivating farmers to apply necessary fertilizers including (Urea, TSP, Mop, DAP, Zinc Sulphate, Gypsum) based on location specific demand and application of organic matter should be

increased in land for all crops and demonstration on compost preparation should be extended. In that context soil-testing facilities should be provided adequately and result should be demonstrated regularly in the farmer's filed.

ii. It is recommended that the extension workers should arrange more training program for the farmers to decrease their gap on fertilizer application that could help the farmers to adopt more of fertilizer use gap between recommended and farmers practices on fertilizer application for getting higher/increased crop production.

iii. It is recommended that the farmers should spent more time in farming that could help the farmers to make more fertilizer use gap between the recommended and farmers practices and ultimately the farmers could get more crop production and benefit from the fertilizer application.

iv. It is recommended that the extension workers should encourage the farmers to take extension contact on fertilizer application that could help the farmers to make more fertilizer use gap between the recommended and farmers dose practices and ultimately the farmers could get more crop production and benefit from the major the farming.

v. It is recommended that farmers should gain more farming experience that should encourage the farmers in farming on fertilizer application that could help the farmers to make more fertilizer use gap between the recommended and farmer’s dose practices and ultimately the farmers could get more production and benefit from the farming.

5.3.2 Recommendations for further study

On the basis of scope and limitations of the present study and observation made by the researcher, the following recommendations are made for further study.

i. The present study was conducted in Kendua upazila under Netrokona district. It is recommended that similar studies should be conducted in other areas of Bangladesh.

ii. This study investigated the contribution of 10 characteristics of the farmers with their fertilizer use gap between the recommended and farmer's dose practices by the farmers as dependent variable. Therefore, it is recommended that further study should be conducted with other characteristics of their fertilizer use gap between the recommended and farmer's dose practices in crop production in riceproduction.

iii. The present study was concern only with the extent of fertilizer use gap between the recommended and farmer's dose practices in crop production. It is therefore suggested that further studies should be included more reliable use of concerned variable is necessary for further study.

iv. The study was based on the fertilizer use gap between the recommended and farmers dose practices. Further studies may be conducted in respect of fertilizer use gap between the recommended and farmer's dose practices on fertilizer application for the crop production.

v. In the study, contribution of the selected characteristics of the farmers has been examined with the fertilizer use gap. Further research is necessary to examine the contribution with other agricultural activities of the farmers.

vi. This study investigated the effects of ten characteristics of the farmers with fertilizer use gap. Further study should be conducted involving more characteristics of the farmers.

CHAPTER VI
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APPENDIX A
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FERTILIZER USE GAP BETWEEN RECOMMENDED AND FARMER'S PRACTICES IN RICE PRODUCTION

Sample no……

Personal Information:

Name: …….....

Village: ……
Union:..……
…….

Upazila: …… District: ……

Mobile: …….

1. **How old are you?**……years.
2. **Educational qualification:** Please mention your educational qualification.
   a) Cannot read and write…….
   b) Can sign only……
   c) ……..class passed

3. **Farming Experience:** How many years you are engaged in agricultural farming? ……years.
4. **Annual family income:**Please mention your annual family income from different sources.

(A) Agriculture

Sl.No.	Sources of income	Amount(Tk.)
1	Rice	
2	Vegetables	
3	Fisheries	
4	Poultry	
5	Others	
Total		

(B) Non-Agriculture

Sl.No.	Sources of income	Amount(Tk.)
1	Service Own- Other Members-	
2	Business	
3	Laboring	
4	Others	
Total		

5. Farm size: Please mention your land area furnishing the following information.

Sl. No.	Type of land use	Area of land	
		Local Unit	Hectare
1	Homestead (including pond)		
2	Own land under own cultivation		
3	Land given to others as Borga		
4	Land taken from others as Borga		
5	Land taken from others as Lease		
Total			

6. Knowledge on fertilizer use:

Sl. No.	Questions	Total Marks	Marks Obtained
1	Mention two methods of fertilizer use.	2	
2	How many types of fertilizers are used for rice production?	2	
3	Mention three major fertilizers for rice production.	2	
4	Mention two problems in fertilizer use?	2	
5	What do you mean by recommended dose of fertilizer?	2	
6	What is the function of MoP?	2	
7	What is the function of TSP?	2	
8	Which urea is more needed?	2	
9	What type of equipments is required for fertilizer use?	2	
10	Mention different stages of urea for rice production.	2	
11	Mention different major functions of urea for rice production.	2	
	Total	22	

7. Extension contact: Please mention the extent of contact with the following media in respect of various information related to your fertilizer use.

Sl. No.	Communication media	Regularly (3)	Occasionally (2)	Rarely (1)	Not at all (0)
1	Friend/Neighbor	9-12 times/month	5-8times/month	1-4 times/month	0 time/month
2	Fertilizer Input Dealers	5-6 times/month	3-4 times/month	1-2 times/month	0 time/month
3	Local leader	4-5 times/month	3 times/month	1-2 times/month	0 time/month
4	Sub Assistant Agriculture Officer (SAAO)	4-5 times/month	3 times/month	1-2 times/month	0 time/month
5	NGO worker	4-5 times/month	3 times/month	1-2 times/year	0 time/year
6	Upazila Agriculture Officer/Agriculture Extension Officer	5-6 times/year	3-4 times/year	1-2 times/year	0 time/year

8. Fertilizer use training exposure: Please mention your training information regarding the following table.

Si. No.	Title of training	Duration for training (Day)
1		
2		
3		

9. Time spent in farming ……hours/week.

10. Distance from farmers home to fertilizer store.....km.

11. Fertilizer use gap: Please mention the nature of the following fertilizer use gap in rice field.

Sl. No.	Name of Fertilizer	Recommended Dose (Kg/Ha)	Farmer Use (Kg/Ha)	Gap (Kg/Ha)	Gap(%)	Average Gap
1	Urea					
2	TSP					
3	MOP					
4	DAP					
5	Zinc Sulphate (Zn)					
6	Gypsum(S)					

(Thank you for your nice cooperation)

……..

Signature of interviewer

Date: …….