A STUDY ON PROFITABILITY OF MIXED CROPPING IN SOME SELECTED AREAS OF MADARIPUR DISTRICT OF BANGLADESH

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CERTIFICATE

This is to certify that thesis entitled, ***"A STUDY ON PROFITABILITY OF MIXED CROPPING IN SOME SELECTED AREAS OF MADARIPUR DISTRICT OF BANGLADESH."*** *submitted to the Faculty of Agribusiness management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE in AGRICULTURAL ECONOMICS,*** *embodies the result of a piece of bona fide research work carried out by* ***ARPITA DHALI****, Registration No.* ***08-02952*** *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 availed of during the course of this investigation has duly been acknowledged.

Dated: July, 2015
Place: Dhaka, Bangladesh

(Monoj Kumar Majumder)
Assistant Professor
Supervisor

DEDICATED
TO
MY BELOVED
PARENTS

A STUDY ON PROFITABILITY OF MIXED CROPPING IN SOME SELECTED AREAS OF MADARIPUR DISTRICT OF BANGLADESH

ABSTRACT

The main purpose of the study was to measure the profitability of mixed cropping and explore the relationship between the input costing and the profitability of the mixed cropping and identify the problems faced by the farmers. The input costs of the mixed cropping used in this study were land, labor, seed and fertilizers. The study was conducted in four randomly selected unions from Kalkini upazila under Madaripur district. Data on cost and returns of pulse and oilseeds were obtained from 80 randomly selected mixed cropping farmers of those unions namely Nabagram, Kazibakai, Dasar and Gopalpur. Pearson's correlation co-efficient was used to explore the relationship between the concerned variables. Findings showed that the profitability of mixed cropping was Tk 9150.37 at Tk 120740.90 of total costs. The correlation co-efficient showed that land, labor, seed and fertilizers were positively correlated with profitability of mixed cropping. The study showed the problems faced by the farmers in practicing mixed cropping and also recommended some policies to overcome the problems.

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The Author

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CHAPTER 1
INTRODUCTION

1.1 Background

The economy of Bangladesh is the 31th largest economy in the world as measured by purchasing power parity (PPP). It has made significant strides in its economic sector since its independence in 1971. Bangladesh, a country of only 1,47,570 sq. km. has a population of 135 million. Bangladesh has traditionally been an agriculture based economy, the fertile soil and favorable climate have been important factors in making Bangladesh agriculturally rich and attracting large human habitation for earning livelihood. The contribution of agriculture to Bangladesh's GDP is 16.33 percent in the 2013-14 FY(source: Economic review, 2014). Bangladesh has three crop seasons which are commonly termed as a) Rabi (November- February), b) Kharif I (March - June) and c) Kharif 2 (July - October). Ideally there could be only three crops that can be grown in a year. It is a tough work for this country to feed the rapidly growing population within the traditional agricultural system. In this case, different cropping patterns may improve the condition. These methods not only increase production but also improve the soil fertility. The cropping pattern is the special and temporal combination of crops on a plot and the management used to produce them.

Bangladesh agriculture is complex, labor-intensive, and has a low technological and resource base. Moreover, agro ecological conditions are complex in most parts of

Bangladesh. There are several distinct land types in the country. Even in a village, at least three major land types exist. These land types determine different cropping patterns and make land use very complicated. Most farmers follow cropping patterns that involve sequential cropping, mixed-cropping, and relay cropping. Mixed cropping involves the simultaneous growing of two or more crops intermingled on the same land. Mixed cropping is growing of two or more crops simultaneously on the same piece of land. It is also known as multiple cropping. This type of cropping leads to an improvement in the fertility of the soil and increases in crop yield. The products and refuse from one crop plant help in the growth of the other crop plant and vice-versa. Mixed cropping is an insurance against crop failure in abnormal weather conditions. It also helps the farmer to improve its yield and economy and avoid crop failure which was very common in India and Asian countries. It is the judicious utilization of time and space to increase the total crop output per unit area. The process of growing and harvesting a short duration crop before canopy development and growth phase of the main crop is very much helpful for farmers to avert risk of crop failure. It is a very good practice to increase total crop yield balancing the nutritional requirements, higher monetary return and greater resource utilization and to fulfill the diversified needs of the farmers.

Mixed cropping in Rabi season is highly profitable. Generally pulse crops and oil seeds are the major crops grown as mixed cropping in Rabi season. Mixed cropping increases substantial yield compared to single cropping. In Bangladesh, mixed cropping in Rabi season is very much essential for the farmers to increase their total income. The importance of roots and tubers, pulses, oilseeds and vegetables are received little or no attention and as a result the production level of these crops had remained stagnant or declined. This has aggravated malnutrition and resulted in unbalanced diet of the most Bangladeshi people (Annonymous, 1991). This has prompted the Ministry of Agriculture of the Government of Bangladesh to attach priority to the policy of Mixed cropping during the Third and Fourth Five Year Plan with a view to increasing the production of non-cereal crops (Annonymous, 1985 and Annonymous, 1990).

In general, the theory is that planting multiple crops at once will allow the crops to work together. Possible benefits of mixed cropping are to balance input and outgo of soil nutrients, to keep down weeds and insect pests, to resist climate extremes (wet,

dry, hot, cold), to suppress plant diseases, to increase overall productivity and to use scarce resources to the fullest degree. Agronomists studying mixed crops have had mixed results determining if yield differences can be achieved with mixed versus crops that are singularly cultivated. If a combination of say, wheat and chickpeas works in one part of the world, it might not work in another. But, overall it appears that measurably good effects result, when the right combination of crops is cropped together.

A review of Bangladesh Rice Research Institute (BRRI) cropping system research published in 1992 shows that mixed and relay cropping are common practices in Bangladesh. Mixed cropping of wheat and chickpea is better than the mixed cropping of wheat and mustard, or wheat and lentil. Among the seed rate combinations, a 50:50 ratio is found to be better for both wheat and chickpea, and wheat and mustard. For wheat and lentil, however, the ratio 75:25 appeared better.

Mixed cropping increases total production and reduce chemical use, the risk of total crop failure and stabilizes yield. It was proved to be an excellent production system to increase total yield, higher monetary return and greater resource utilization and fulfill the diversified need of the farmers (Singh, 1996). Mixed cropping is also considered as a well recognized practice for better land use system along with substantial yield advantages compared to sole cropping. These advantages may be especially important because they are achieved not by means of costly inputs but also by the simple expedient of growing crops together (Willey, 1979). Practicing mixed cropping lentil with wheat, farmers can obtain wheat and pulse at the same time from the same land. Higher equivalent yields are obtained with intercropping.

By planting one line of one crop, then a line of another crop, both crops can get better. In one line a legume and in another line the main crop is sown. So, if the main crop takes the nitrogen from the soil, the legume fixes the soil. Nitrogen is fixed in the root nodules of the leguminous plants in the form of nitrates (soluble form of nitrogen) and keeps the soil fertile. This helps the farmers to produce more and more crops without the nitrogen being depleted from the soil.

Madaripur is a low lying district. Its soil is suitable to produce oil seed and pulse. If oil seed and pulse are sowed together, soil fertility is increased.

1.2 Mixed cropping pattern in different areas in Bangladesh

Now-a-days, poverty alleviation of resource poor farmers is an important slogan in Bangladesh and multiple cropping systems can be helpful to reduce poverty through the achievement of above benefits. Generally, resource poor farmers practice multiple cropping (Intercropping/Mixed cropping/Relay cropping) to utilize their land intensively, to engage their unemployed family labor and to get more profit than sole cropping.

Jhum cultivation in the Hill Tracts is a typical example of mixed cropping. Cropping systems research using a systematic approach, with the farmers as active participants, were initiated in 1974 by the Bangladesh Rice Research Institute. In 1980, a National Coordinated Cropping Systems Program was organized and coordinated by the Bangladesh agricultural research council (BARC) with the participation of institutes dealing with agricultural research. Recently, BARC has initiated a National Coordinated Farming Systems Research Program to design appropriate cropping patterns for different areas of the country. Creeper vegetables can be grown as mixed cropping over most areas of the country. Integrated rice-cum-fish culture in low-lying areas and fish-cum-layer chicken culture, and fish-cum-broiler chicken culture can be practiced in different areas of the country utilizing perennial water bodies.

During Kharif-I season of 2007, a research was conducted in Ishurdi, Pabna. In this research, it was found that the highest equivalent yield of mungbean (1476.00 kg/ha) was obtained by 70% mungbean with 30% sesame which was statistically identical to 90% mungbean with 10% sesame and 80% mungbean with 20% sesame but the lowest (949.00 kg/ha) was found in sole sesame (Ali, *et.al* 2007).

Mixed cropping system in rural Bangladesh helps to minimize households' vulnerability to floods. Nilphamari district is more vulnerable to flood. 66 percent of the farmers cultivated paddy rice (staple) and 32 percent produce groundnuts (cash crop) as major crops were in this district in 2005 when flash flood had occurred. The yield loss of the staple crop (paddy) was higher in proportion (95 percent) than for the cash crop. The proportion of yield damage in cash (groundnut) crop was reported to 84 percent. The Nilphamari district was affected by flash flood (caused by unexpected rain and sudden overflow of river basin) in early November and field survey was conducted during November 25th to December 5th. The average duration of the flood

was three days, and the average flood water height was 0.78 feet in the homestead as reported by the affected households. Most of the farmers faced crop damage due to the flood. The farmers reported that they mostly ploughed the Aman paddy rice and that the flood inundation occurred just before their harvesting time. According to the farmers, Aman paddy and groundnut both share a similar pattern of sowing and harvesting times. Thus, groundnut producers faced similarly the disastrous effect of the flood but less than the paddy producers, because of the height of the paddy plants is bit higher that the groundnuts (Rayhan and Grote 2010).

1.3 Impact of mixed cropping

Mixed species cropping permits an intensification of the farm system, which results in increased overall productivity and biodiversity in cropped fields (Vandermeer, 1989). Mixed species cropping has been seen as a promising technique to develop sustainable farming systems because it often has multifunctional roles and can potentially provide a number of eco-services within the farm system. Examples may include the addition and recycling of organic material, water management, protection of soil from erosion and pest or disease suppression. This functional diversity contributes to ecological processes to promote the sustainability of the whole farm system (Altieri, 1999).

Studies on the effect of intercropping on pest attacks are numerous and often contradictory due to the difficulty of teasing out the ecological factors that can affect insect-plant relations. (Andow, 1991) analysed 209 studies involving 287 pest species. Compared with monocultures, the population of pest insects was lower in 52% of the studies (149 species) and higher in 15% (44 species). Of the 149 pest species with lower populations in intercrops 60% where monophagous and 28% polyphagous. The population of natural enemies of the pests was higher in the intercrop in 53% of the studies and lower in 9%.

Mixed species cropping has been shown to be an effective disease management tool, especially in cereals. For example, Meller-Vilich (1992), showed that mixtures of winter-rye/winter-wheat and spring-barley/oats reduced fungal leaf diseases and Lennartsson (1988) showed that a mixture of wheat and *Medicago lupulina* reduced the incidence of take-all disease of wheat, a soilborne pathogen. The underlying

epidemiology has also been extensively modelled (Garrett & Mundt, 1999) from the perspective of varietal mixtures and can simply be explained as the reduced chance of fungal spores encountering a susceptible plant in a mix. The effect tends to improve with increase in the number of genotypes in the mix and the randomness of the mix. Although the epidemiology of airborne epidemics makes them amenable to manipulation by mixed cropping it could also be expected to alter microclimates within the crop and from this point of view could affect disease development positively or negatively.

Mixed cropping can be an important method to control weeds (Trenbath, 1976) and offers a number of agronomic advantages, particularly when legumes are cropped with non-legumes (Ofori and stern,1987). The low-input *brassica* oil seed crop, false flax [Camelina sativa (L.) Crtz.], has been reported to be an advantageous but neglected crop (Putnam, *et.al,* 1993).

The inability to use artificial fertilizers and pesticides has forced organic farmers to rely on natures own mechanisms and in this respect intercropping is an interesting technology. In a Danish survey 20 ecological farmers who all grow cereal-grain legume intercrops were asked to point at some of the advantages of this cropping practice compared to sole cropping the two crops. Several aspects were mentioned, among these bettered harvest ability, reduced weed problems, no fertilizers needed, increased yield stability, lowered incidence of pests and increased grain quality. But what are the mechanisms that act in intercrops that enable them to provide these services? Firstly, differences in the way plant species respond to the environment in which they are grown are thought to lead to a more efficient use of available growth resources (nutrients, water, light) with the potential of increasing yields and the competitive suppression of weeds (Vandermeer, 1989). Secondly, plant species affect the environment differently and one crop may facilitate the growth of other crops directly, by ameliorating limiting environmental characteristics; or indirectly, by eliminating potential competitors, introducing other beneficial organisms such as soil microbes, mychorrhizae, or pollinators, or providing protection from herbivores. In an attempt to “design” intercrops that to a greater degree draw on the advantages of assembling different crop species or cultivars, the challenge is to link all of these ecological concepts thereby providing more functionality to the intercropping practice.

The most apparent gain from intercropping legumes and non-legumes is the opportunity for N-use complementarily (Jensen, 1996). The legume being forced to rely on N_2 fixation when the non legume is more competitive for soil inorganic nitrogen (N). Root competition from cereals decreased the mineral N concentration in the rhizosphere to an extent that the exposure concentration to pea inadvertently stimulated and augmented the proportion of Nitrogen derived from rhizobial fixation. Jensen (1996) pointed to pea-barley cropping as an opportunity of increasing the input of fixed Nitrogen into the cropping system without compromising cereal Nitrogen use or yield, as pea was much less competitive for soil inorganic Nitrogen.

1.4 Objectives of the study

1. To identify the socio-economic condition of the farmers.
2. To measure the profitability of mixed cropping.
3. To determine the relationship between the profitability and costing of mixed cropping.
4. To find out the problems faced by the farmers in mixed cropping.
5. To suggest some policies and the recommendation.

1.5 Justification of the study

Mixed cropping is growing of two or more crops simultaneously on the same piece of land. It is also known as multiple cropping. This type of cropping leads to an improvement in the fertility of the soil and increases in crop yield. For increasing yield, it is very common in the worldwide. Many researchers have worked with this topic in different countries in the world. But very few works has been done on this topic in Bangladesh. Madaripur is characterized by low lying land and soil is favorable to rice, bean and oil seed production. Mixed cropping improves its soil fertility and improves the farmer's economic condition. Mixed cropping is an insurance against crop failure in abnormal weather conditions. It also helps the farmer to improve its yield and economy and avoid crop failure. It is the judicious utilization of time and space to increase the total crop output per unit area. It also contributes to the national GDP. The researcher focuses on these matters on her study and the study may be the best way to learn more about the mixed cropping and its benefit. Relationship among variables also can be examined. The study areas that are selected by the researcher are favorable to mixed cropping in Rabi season and the farmers in

this geographical area can make profit by practicing this cropping pattern. So, this area is the best sampling area for the study. The study will be helpful for the researchers in future for the further information of similar nature.

CHAPTER 2
REVIEW OF LITERATURE

The purpose of this section is to review literature having relevance to the present study. This section deals with a brief review of previous research studies relating to the concept of profitability of mixed cropping in some selected areas in Madaripur district. The researcher took attempt to gather information related to the present study. A few of the recent studies which are relevant to this paper are briefly discussed in this chapter; the reviews are arranged under the following sections.

Akter, *et.al* (2005) conducted "Evaluation of Mixed and Intercropping of Lentil and Wheat" that Positive variation in different yield contributing characters except 1000seed weight of lentil and wheat to 40% of wheat seed rate and 1:1 line sowing were noticed indicating the agronomic suitability of mixed and intercropping of lentil and wheat in those practices. Line sowing performed better than sole broadcast sowing. All mixed seed rate decreased lentil yield but LER was increased in all the treatments over the sole crop lentil as broadcast. The maximum LER (1.52), monetary advantage (63%), benefit cost ratio (1.84) were achieved in lentil and 40% wheat as mixed cropping system.

Rämert, *et.al* (2005) revealed in "The use of mixed species cropping to manage pests and diseases – theory and practice" that Mixed species cropping, particularly row intercropping and strip intercropping, could be an important tool for pest and disease management in organic farming systems. However, it is only likely to be widely adopted by organic growers in the UK once the potential benefits –eco-services- have been fully evaluated and can be shown to outweigh the increased management and labor input that will to be necessary for the more complex cropping system. These benefits are especially likely to include improved techniques for management of soil fertility in addition to pest and disease control.

Ali, *et.al* (2007) found in "Study on mixed cropping mungbean with sesame at different seeding rates" that a field experiment was conducted at PRC, Ishurdi, Pabna during Kharif-I season of 2007 to evaluate the technological feasibility and economic validity of

mixed cropping mungbean with sesame by the different seeding rates. There were 7 seeding rates viz. mungbean (sole), sesame (sole), 90% mungbean seeds with 10% sesame, 80% mungbean seeds with 20% sesame, 70% mungbean seeds with 30% sesame, 60% mungbean seeds with 40% sesame, 50% mungbean seeds with 50% sesame. The seed yields of mungbean and sesame when mixed cropped under variable seeding rates were less than their sole crop yields but combined yields or equivalent yields of mungbean and sesame from mixed cropping were more than the sole crop yield of either mungbean or sesame. Significantly, the highest equivalent yield of mungbean (1476.00 kg/ha) was obtained by 70% mungbean with 30% sesame seeding ratio which was statistically identical to 90% mungbean with 10% sesame and 80% mungbean with 20% sesame but the lowest seed yield (949.00 kg/ha) was found in sole sesame.

Monim, *et.al* (2010) found in "Effect of intercropping different vegetables with groundnut" that all the intercropping combinations either in row or broadcast sowing (except spinach broadcast) in between two normal rows of groundnut are agronomically feasible and economically profitable for higher yield and economic return. All the intercropped and treatments involves red amaranth, spinach, coriander were found agronomically feasible and economically profitable. Results also showed that the highest groundnut equivalent yield 2.76 t/ha, LER 1.67 and the highest gross return of Tk. 74700 /ha were obtained from the intercropping treatment of one row of red amaranth in between two normal rows of groundnut. The highest net return of Tk. 60500/ha and benefit cost ratio 5.29 were also obtained from the same treatment.

Tanko, *et.al* (2011) revealed in "Analysis of the competitiveness of mono-crop and mixed crop enterprises in farming system of smallholder farmers in Niger State, Nigeria" that resources were not optimally allocated and after optimization, gross margins could be increased. Cereal-legume cropping patterns showed dominance in both the existing and optimum plans. They suggested that cropping patterns under borrowed capital were more cash generating as the number of crops included in the optimum plans were observed to have increased. Credit plays a crucial role in smallholder agriculture as it enables the farmer to purchase production inputs and hire more labor to accomplish farm operations. The optimum plans also devoted the total cropped area to mixed cropping enterprises.

Parsons, *et.al* (2011) conducted "Improving cattle profitability in mixed crop-livestock systems in south central coastal Vietnam using an integrated modeling approach" that most farmers use natural weaning at 10-12 months. Cattle are typically sold at 3 years old at 300kg for approximately10M VND (AUD 450). Most farmers offer rice straw (4.5kg /cow/day), some of which is purchased off-farm, and supplement with cassava powder and rice bran; very little cut and carry is used. Some farmers grow elephant grass (Pennisetum sp.) in the backyard (~150 m2); and required labor for three animals is approximately 3 hours/day. Analysis of the baseline situation in Binh Dinh indicated farmers were making sufficient income to cover their living costs, but had a forage deficit of around 1600kg and taking 3 years to get animals to a marketable size. Growing 0.1ha of sown grass (elephant grass) in the upland and another 0.1ha in the backyard, and increasing the cut and carry to 25kg/day and selling animals at 2 years old, improved the feed supply to animals, increased the animal sale weight, and eliminated the forage deficit.

Khandaker (2011) found in "Effect of Mixed Cropping of Maize (*Zea mays*) and Cowpea (*Vigna unguiculata*) Forage on Fodder Yield, Chemical Composition and its *In-Vitro* Digestibility" that Mixed crop of maize and cowpea were grown as a forage crop after mixing seeds in different proportions i.e. 100% maize (T_1),75% maize+25% cowpea (T_2), 50% maize + 50% cowpea (T_3),25% maize e +5% cowpea, (T_4) and 100% cowpea (T_5) to study the effect of mixed cropping on forage yield, chemical composition and *in vitro* digestibillty of forages. Green forage production (t/ha) was maximum in T_2 (28.5) and lowest in T_5 (18.4). DM production was significantly ($P<0.05$) higher in T_2 as compared to other treatments. CP contents increased and EE and NFE decreased gradually from T_1 to T_5. DM, OM, CF and Ash content was not significantly different among the various treatments. There was no significant difference in the *in vitro* digestibility of OM and CF among the all treatments. However, DM digestibility apparently increased from T_1 to T_5 and CP digestibility increased progressively and significantly ($P<0.01$) over T_1. The

results indicated that mixed cropping of forage maize and cowpea using seed rate of 75% maize and 25% cowpea could improve forage availability.

Salam, *et.al* (2012) conducted "A Study on Relative Profitability of Sole and Mixed Cropping Enterprises among Smallholder Irrigation Farmers in the Hadejia-Nguru Wetlands of Northeastern Nigeria" that farmers have often practiced different cropping systems for various reasons, ranging from increased incomes, insurances against crop failures to other simple reasons like skill. This study compared the relative profitability of sole and mixed cropping enterprises among small holder irrigation farmers in the Hadejia-Nguru wetlands of Northeastern Nigeria. The findings revealed that all the irrigated cropping enterprises analyzed were profitable, a further comparison of the two dominant cropping systems revealed that mixed cropping enterprises were more profitable. However, sole pepper enterprise recording the highest net farm income of N404, 35, revenue cost ratio of 3.24 and rate of return of 224%.

Obayelu, *et.al* (2013) found in "Relative Profitability of Cassava-based Mixed Cropping Systems among Various Production Scale Operators in Ogun and Oyo States Southwest Nigeria" that the relative profitability of cassava producers and determined the effects of farm inputs on the level of profit of various scales of cassava producers in Ogun and Oyo States, Nigeria. Cross-sectional data were collected from 265 cassava-based farmers using a multistage sampling technique and were analyzed using normalized profit function and budgetary analysis. Results showed that cassava/cowpea enterprise had the highest net margins of N 127,249.63/ha and N 122,325.73/ha in Ogun and Oyo States respectively. The study recommends that small and medium-scale farmers should increase the application of herbicide; large-scale cassava operators in Oyo State should increase the use of labor, while those in Ogun State should also increase the cultivated acreage of land.

Islam, *et.al* (2014) found in "Adoption of Mixed Cropping in Rabi Season by the Farmers of Madaripur Sadar Thana Under Madaripur District" that number of family labor, cropping intensity, annual family income, credit received, training exposure and

knowledge on mixed cropping had significant positive relationship with the adoption of mixed cropping while age, level of education, land possession, extension contact, and organization participation had no significant relationship with the adoption of mixed cropping.

Murshid (2014) conducted “Impact of mixed cropping on groundwater based irrigation in south-west region of Bangladesh” that in terms of groundwater extraction, it is always beneficial to cultivate crops like small vegetables instead of rice during the dry period (November to April) of the year. Situating within the coastal zone, Khulna and Barisal regions are vulnerable to problems like soil and groundwater salinity and incessant extraction of groundwater will always make the problem worse. In future, due to sea level rise, an additional degree of worsening of the problem will be added up as salt water intrusion in the coastal aquifers will occur in a rapid rate. To cope up with these upcoming threats, it is important to make necessary adjustments and adaptation of mixed cropping cultivation practice.

Dheeba, *et.al* (2014) revealed in “Fertilizers and Mixed Crop Cultivation of Chromium Tolerant and Sensitive Plants under Chromium Toxicity” that Chromium (Cr) adversely affects both the growth and yield of plants. The soil properties vary with Cr and different fertilizer amendments and the yield of both plants were affected by Cr. They conclude that metal accumulation of seeds of green gram was higher than corn and the application of single fertilizer either farm yard manure (FYM) or nitrogen, phosphorous, and potassium (NPK) enhances the growth and yield of both the tolerant and sensitive plants in the mixed crop cultivations.

In a word, the present research is conducted on the profitability of mixed cropping and explored the relationship among input costs and profitability that is different from the previous researches.

CHAPTER 3
METHODOLOGY

Methodology is a system of broad principles or rules from which specific methods or procedures may be derived to interpret or solve different problems within the scope of a particular discipline. Methodology is not a formula but a set of practices.

The study was conducted to measure the profitability and relationship among input costs and profitability of mixed cropping in robi season in some selected areas in Madaripur district. Necessary data were collected from four unions of Kalkini Upozilla of Madaripur district and analyzed in terms of the objectives set for the study.

This study was based on field level data. There are several methods of collecting this basic information. The data for this study were collected by the structured questionnaire. Survey is a research technique in which information is gathered from a sample of people by use of a questionnaire or interview. The word “survey” refers to a method of study in which an overall picture of a given universe is obtained by systematic collection of all available data on the subject. It is a method of data collection based on communication with a representative sample of individuals. The main reasons why the survey method is preferred:

- Survey through sacrificing a certain details, enables quick investigation of large, medium and small cases.
- Survey entails much less cost.

- Surveys provide quick, inexpensive and efficient data.

3.1 Assumption

An assumption is the supposition that an apparent fact or principle is true in the light of the available evidence. The researcher had the following assumptions in mind while understanding this study.

1. The respondents included in the sample for the study were competent enough to furnish proper responses to the quarries included in the interview schedule.
2. The researcher who acted as interviewer was well adjusted to the social environment of the study area. Hence the data collected could be treated as reliable.
3. The responses furnished by the respondents were reliable. They expressed the truth about convictions and opinions.
4. Views and opinion furnished by the farmers of mixed cropping cultivation included in the sample were representative views and opinions of the whole population of the study area.
5. The findings of the study will have general application to other parts of the country with similar personal, socio-economic and cultural conditions of the study area.

3.2 Statement of the hypothesis

A hypothesis is a proposition which can be put to a test to determine its validity. It may be seen contrary to or accordance with common sense. It may prove to be correct or incorrect. In any event, however, it leads to an empirical test. In broad sense, hypothesis may be broadly divided into two categories, a) research hypothesis (H_1) and b) null hypothesis (H_0). When an investigator tries to find out relationship between variables, then formulates research hypothesis which states anticipated relationships between the variables. On the other hand, when a researcher tries to perform statistical test, then it becomes necessary to formulate null hypothesis. A null hypothesis states that there is no relationship between the concerned variables.

The following null hypothesis was formulated to explore the relationships between independent variables and mixed cropping.

“There is no relationship between the independent variables and the mixed cropping.”

The alternative hypothesis was formulated.

“There is a relationship between the independent variables and the mixed cropping.”

3.3 Selection of study area

The selection of the study area is an important step, which largely depends upon objectives set for the study. The area in which survey is to be made depends on the particular purpose of the survey and the possible cooperation from the farmers. The aim of the present study is to measure the profitability of mixed cropping in rabi season in the selected areas of Madaripur district. Four unions of Kalkini Upazila under Madaripur district are selected as the study area. These areas are Nabagram, Dasar, Kajibakai and Gopalpur. Kalkini Upazila is selected for this research because the main crops of this area are oil seed and pulse crops and farmers practice mixed cropping mostly.

3.3.1 The main reasons for selecting study area

The main reasons for selecting study area were as follows:

- Availability of information about mixed cropping pattern.
- Easy accessibility and good communication facilities in this area.
- No study of this type was conducted previously in the study area.

The researcher was familiar with the language and the anticipated cooperation from respondent was high which indicated the likelihood of obtaining a reasonably accurate set of data.

3.4 Preparation of survey schedule

The survey schedule was designed in accordance with the objectives of the research. Data were collected from the farmers of mixed cropping through personal interview with the farmers for which necessary schedule was to prepare. Survey schedule was prepared for the study. Information about farmers’ land, input cost, income and problem faced by the farmers were collected.

3.5 Data collection procedure and sampling

It is not possible to make a field survey covering field. For this reason, sampling was done to select representative to minimize time and cost of the study. For the selection of samples for a study two things need to be taken into consideration. In other words, administration of field research, processing and analyzing of data should be manageable within limits imposed by physical, human and financial resource. Considering all this aspects about 80 samples were randomly selected .The data were collected by the researcher herself using a prepared interview schedule. A purposive random sampling technique was followed in this study.

3.6 Data collection period

Data were collected by the researcher herself through personal interviews with the respondents. Data were collected during the period from January, 2015- March, 2015. Prior to final data collection the interview schedule was pretested by collecting information from selected samples.

3.7 Data collection method

This study is based on survey methodology and generally the household heads were interviewed with a pre-tested interview schedule on trial and error basis. 'Household head' means the person who plays the main role in the decision-making process of a family. In absence of the household head, the second-important adult member of the family was interviewed. Using this process a total of 80 persons was interviewed.

Gathered data were edited manually and entered into computer. Average, percentage and profitability analysis were used for the presentation of information. Single and multivariate analyses of data were calculated.

3.8 Accuracy of data

Generally most of the farmers do not want to give correct information about their income and expenditure. To overcome this problem, all possible efforts were made by the researcher herself to ensure the collection of reasonably accurate information from the field on recall basis. So, it has not been possible to apply any other method of investigation such as cost or financial accounting which would require detailed and

accurate information based on properly kept records and accounts. Survey method has the advantage that it facilitates quick investigation and involves the less cost. In order to collect relevant information before taking interview, the whole academic purpose of the study was clearly explained and made clear to the sample respondents. The researcher herself collected the relevant data from the selected farmers through face to face interview. At the same time of interview, the researcher asked questions systematically and explained whenever felt necessary. Data so collected were checked and verified in the field for accuracy and consistency.

3.9 Problems encountered in collecting data

The researcher had to face the following problems in collecting data from the field:

- Generally most of the farmers did not want to give correct information about their income. It was very difficult to collect actual data.
- Most of the farmers were illiterate which caused another problem to data collection to the researcher.
- Sometimes respondent could not answer to questions accurately and to the point.
- The farmers usually remained busy with the work. So, the researcher had to pay more than two visits to meet the farmers.
- Most of the farmers did not feel comfortable to answer questions. So, the researcher had to pay more time to gain their confidences.

3.10 Variables of the study

In a research, the selection of variables constitute an important task. In this connection, the researcher looked into literature to widen her understanding about the nature and scope of the variables involved in the research studies. An independent variable is that factor which manipulated by researcher in her attempt to ascertain the relationship to an observed phenomenon. A dependent variable, on the other hand, is that factor which appears, disappears or varies as the researcher introduces, removes or varies the independent variables. The dependent variable is often called the “criteria” or “predictive variable” whereas the independent variables are called “treatment”, “experimental” or

"antecedent" variable. The independent variables of the study are variable cost and fixed costs. List of variable and fixed costs is given below:

Table 3.1: List of variable and fixed costs

Items	Independent variables
Fixed cost	1. Land
Variable cost	1. Seed 2. Fertilizer i. Urea ii. TSP iii. MP 3. Labor

The independent variables used in the study were seed, fertilizer (Urea, TSP and MP) labor and land. Labors are two types, such as; 1) Family labor and 2) Hired labor. In this study, hired labors were calculated.

The dependent variable of the study was profitability made in mixed cropping cultivation by using independent variables.

3.11 Analytical tools

Both descriptive and statistical tools were used in this study.

3.11.1 Descriptive analysis

Mean, standard deviation, percentage etc were used as descriptive analysis. Besides following formula were used to calculate profitability.

The formula of this is explained below:

Gross profit= $\Sigma P_i Y_i - \Sigma P_i X_i$ - TVC

Profit = $\Sigma P_i Y_i - \Sigma P_j X_j$ -TC

And, TC = TVC + TFC

Where,

TC = Total cost

TVC = Total variable cost

TFC = Total fixed cost

Y_i = Amount of output

X_j=Amount of input

Pi = Price of Y_i

P_j= Price of X_j

3.11.2 Statistical Analysis

After collection, data were compiled, tabulated, coded and analyzed in according with the objectives of the study. Qualitative data were converted into quantitative data by means of suitable scoring method wherever necessary. Pearson's product moment correlation co-efficient were used in order to explore the relationship between concerned variables.

Pearson's product moment correlation co-efficient equation:

$$r_{xy} = \frac{\sum(x_i - \bar{x})\,(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}}$$

r_{xy}= Pearson's product correlation coefficient

$\bar{x}$ = The mean value of x

$\bar{y}$ = The mean value of y

CHAPTER 4

DESCRIPTION OF STUDY AREA

4.1 Background

Madaripur is a district of central Bangladesh and it is a part of Dhaka Division. Madaripur subdivision was established in 1854 under the district of Bakerganj (Barisal). It was separated from Bakerganj (Barisal) in 1873 and annexed to Faridpur district Madaripur subdivision was turned into a district in 1984. Madaripur district was named after Sufi (Saint) Badruddin Shah Madar (15th century). He was one of the Sufis (Saint) who came to Bangladesh from Middle Eastern country in the 15th century to propagate Islam in Bengal. Shah Madar's dargah or tomb on the bank of the Arial Khan is visited every year by countless people seeking the blessings of the Saint(Source: Banglapedia, 2015).

4.2 Geographic area and location

The district is bounded on the north by Faridpur and Munshiganj districts, on the east by Shariatpur district, on the south by Gopalganj and Barisal districts and on the west by Faridpur and Gopalgonj districts. The total area of the district is 1125.69 sq. km (434.63 sq.miles)(Source: Banglapedia, 2015).

The Geographical position of the district is between 23˚ to 20˚30’ North latitudes and between 89˚56’ to 90˚21’ east longitude(Source: Banglapedia, 2015).

Kalkini is an Upazila of Madaripur District. Its area is 279.98 sq km, located in between 23°00' and 23°10' north latitudes and in between 90°06' and 90°21' east longitudes. It is bounded by madaripur sadar and shariatpur sadar upazilas on the north, gaurnadi upazilas on the south, gosairhat, muladi and damudya upazilas on the east, kotalipara and Gaurnadi upazilas on the west(Source: Banglapedia, 2015).

4.3 Annual average temperature and rainfall

The annual average temperature of this district varies from maximum 35.8°C to minimum 12.6°C. 12.6c. The annual rainfall is 2105 mm.(Source: Banglapedia, 2015)

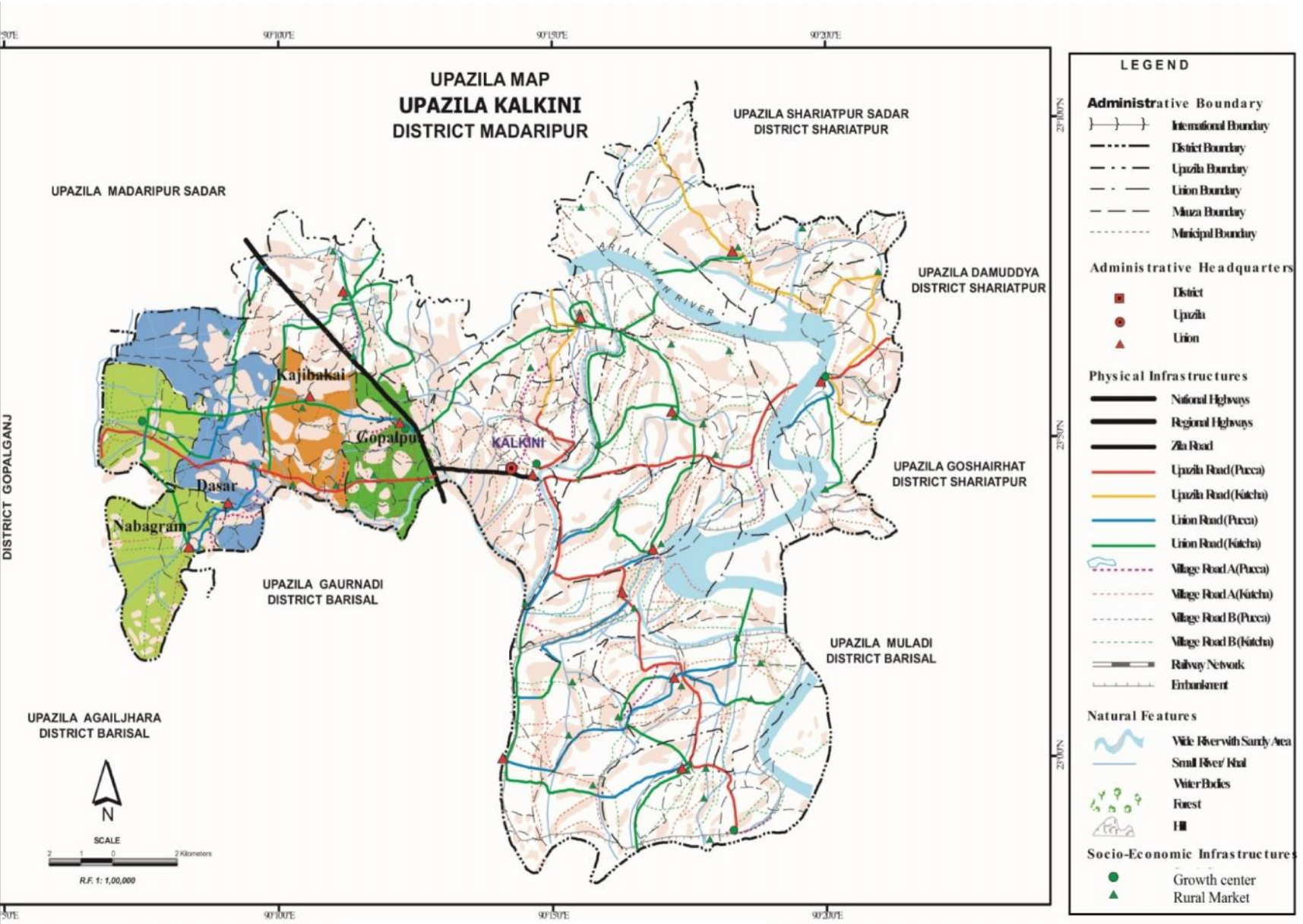

Figure 4.1: Map showing the study sites

4.4 Administration

Madaripur district was established in 1984. The district consists of 4 upazilas, 59 unions, 479 mauzas and 1062 villages. It also comprised of 3 paurashavas, 27 paura words and 89 mahallas. The upazilas are Madaripur sadar, Shibchar, Rajoir and Kalkini.(Banglapedia, 2015)

Kalkini Thana was formed in 1909 and it was turned into an upazila on 1 February 1984. Kalkini has 1 powrashava, 14 Unions, 161 Mauzas/Mahallas, and 190 villages. Kalkini has 1 (one) Upazila porishad and 2 police thana. The name of present chairman Kalkini Upazila Porishad is Tawfiquzzaman Shahin. (Source: Banglapedia, 2015).

The selected unions of Kalkini upazila are Nabagram, Kazibakai, Gopalpur and Dasar. The area, population and literacy rate are given follow:

Table 4.1. : Areas, population and literacy rate of four unions of kalkini upazila

Sl No	Name of unions and GO code	Area (Acre)	Population		Literacy rate (%)
			Male	Female	
1	Nabagram 75	4801	7359	6456	62.95
2	Kazibakai 63	2581	5774	5523	44.17
3	Gopalpur 44	2200	4205	3885	46.32
4	Dasar 31	3968	7351	7387	50.21

(Source: Banglapedia, 2015)

4.5 Main rivers

The Padma, Arial Khan and Kumar are main rivers of this district. Main rivers of kalkini upazila are Arial khan, Ghagar and Tarki (Banglapedia, 2015).

4.6 Population

Total population of Madaripur district is 11,65952, of them male is 5,74582, and female is 5,91370.(Banglapedia, 2015)

Total population of Kalkini is 271796; male 137558, female 134238; Muslim 236625, Hindu 34443, Buddhist 683 and others 45. This Upazila's eighteen up population is 118534. Kalkini has an average literacy rate of 35.9% (7+ years), and the national average of 32.4% literate. (Banglapedia, 2015)

4.7 Main occupations

Main occupations are Agriculture 33.32%, fishing 1.1%, agricultural laborer 23.53%, wage laborer 3.87%, industry 1%, commerce 11.98%, transport 1.93%, construction 1.19%, service 10.14% and others 11.94%. (Banglapedia, 2015)

Main sources of income of Kalkini upazilla are Agriculture 70.23%, non-agricultural laborer 2.78%, industry 0.48%, commerce 9.80%, transport and communication 1.49%, service 7.12%, construction 1.50%, religious service 0.27%, rent and remittance 1% and others 5.33%(Source: Banglapedia, 2015).

Ownership of agricultural land Landowner 75.11%, landless 24.89%; agricultural landowner: urban 63.32% and rural 77.10% (Source: Banglapedia,2015).

4.8 Main crops

The main crops of Madaripur district are jute, paddy, peanut, onion, garlic, chili, sugarcane, mustard, pulse and wheat.(Source: Banglapedia, 2015)

Main crops of Kalkini upazila are paddy, jute, sugarcane, mustard, pulse, wheat, sweet potato. Extinct or nearly extinct crops are betel leaf, water-melon, bangi. Main fruits are mango, jackfruit, papaya, coconut, banana, date. This upazila has a number of fisheries, dairies and poultries. Main exports are jute, jute goods, date and sugarcane molasses. (Source: Banglapedia, 2015)

4.9 Economic situation

The economy of Madaripur is predominantly agricultural. Out of the total about 244 thousand holdings of the district, 57.68% holding are farms that produce varieties of crops, namely local and HYV paddy, wheat, vegetables, spices, cash crops, pulses and others (Source: Banglapedia, 2015). Various fruits like mango, banana, jackfruit guava, coconut and betel nut etc. are grown. Fish of different varieties abound in the district.

Varieties of fishes caught from river, tributary, channels and creeks and even from paddy field during rainy seasons. (Source: Banglapedia, 2015)

Non-farm activities also play an important role in the economy of Madaripur district. The following table shows type and number of establishments in rural and urban area along with persons engaged in those establishments by activity.

Table 4.2: Number of establishment and persons engaged by activity

Activity	Establishments			Persons engaged		
	Total	Urban	Rural	Total	Male	Female
Mining and quarrying	0	0	0	0	0	0
Manufacturing	217	633	154	104	761	286
Electricity, gas and water supply	30	3	27	118	91	27
Construction	2	0	2	9	6	3
Wholesale and retail trade	16017	5255	1076	29010	28047	963
Hotels and restaurants	1097	559	2	3080	2831	249
Transport, storage and communication	443	244	538	997	989	8
Bank, insurance and financial institution	144	105	199	1336	1203	133
Real estate and renting	167	109	39	327	326	1
Public administration and defense	168	82	58	1361	1311	50
Education	1423	173	86	6442	5456	986
Heath and social work	46	99	1250	1019	809	210
Community, social and personal services	7007	923	361	11866	11374	492
			6084			
Total	**29134**	**8185**	**20949**	**66046**	**60060**	**5986**

(Source: Banglapedia, 2015)

4.10 Access to electricity

All the wards and unions of Kalkini upazila are under rural electrification net-work. However 33.96% of the dwelling households have access to electricity. (Source: Banglapedia, 2015)

4.11 Sources of drinking water

The sources of drinking water of Kalkini upazil are Tube-well (89.95%), tap (0.20%), pond (4.07%) and others (5.78%). The presence of intolerable level of arsenic has been detected in shallow tube-well water of the upazila. Sanitation (20.73%)(urban 16.15% and rural 21.50%) of dwelling households of the upazila use sanitary latrines and (67.65%) (urban 77.44% and rural 66%) of dwelling households use non-sanitary latrines; (11.62%) of households do not have latrine facilities. (Source: Banglapedia, 2015) .

CHAPTER 5

SOCIO-ECONOMIC CHARACTERISTICS OF THE FARMERS

The findings of the study and interpretation of results are presented in this chapter. These are conveniently presented in three sections according to the objectives of the study. The first section deals with the selected characteristics of the farmers, the second section deals with the profitability of mixed cropping, the third section deals with the relationship between independent variables and the profitability of mixed cropping.

5.1 Selected characteristics of the farmers

The salient features of the selected characteristics of the farmers are shown in the table and described in the following sub-sections:

Table 5.1: The salient features of selected characteristics of the farmers.

SL NO	Items	Mean	Standard deviation
1	Age	26.67	13.20
2	Education	11.43	7.7
3	Occupation	20	15.64
4	Farm size	26.67	19.29
5	Credit received	22.33	9.29
6	Family annual income	26.67	21.5
7	Family size	3.09	2.53

The values of the mean and of age, education, occupation, farm size, credit received, family annual income and family size of the mixed cropping farmers are 26.67, 11.43, 20, 26.67, 22.33, 26.67 and 3.09. The standard deviation of age, education, occupation, farm size, credit received, family annual income and family size are 13.20, 7.7, 15.64, 19.29, 9.29, 21.5 and 2.53 respectively.

5.1.1 Age

The age of the farmers ranged from 19 to 75. The percentage of the farmer's age up to 30 was 18.75%, from 31 to 50 was 51.5% and above 50 was 30%. The table indicated that the more than half of the farmers are middle age. On the other hand, the number of young people whose age was up to 30 was less than the old man whose age was above 50.

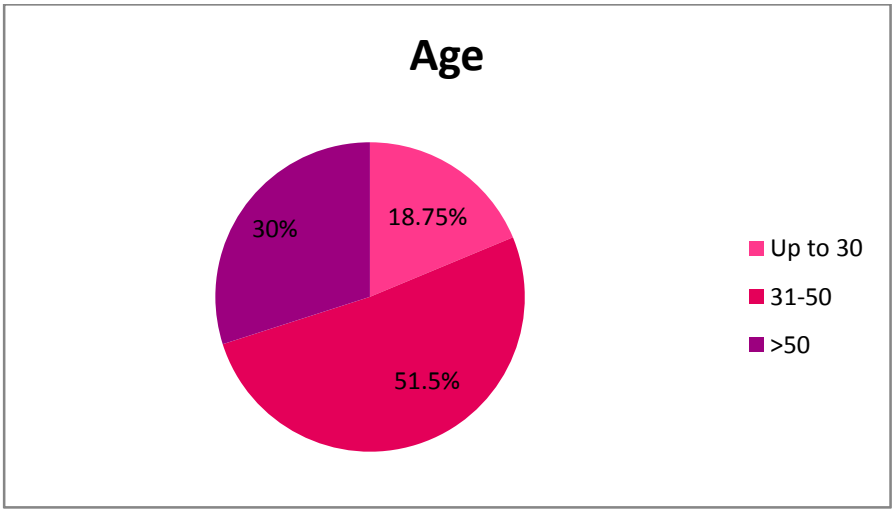

Figure 5.1: Percentage of age of the farmers

The value of mean and standard deviation of age of the farmers were 26.67 and 13.20 respectively.

5.1.2 Education

The level of education score of the farmers ranged from 1 to graduation. One-fifth of the farmers knew only how to signature. The proportions of the higher secondary education and above higher secondary education were same. The highest proportion of the farmers had secondary education compared to junior education (21.25%) and primary education.

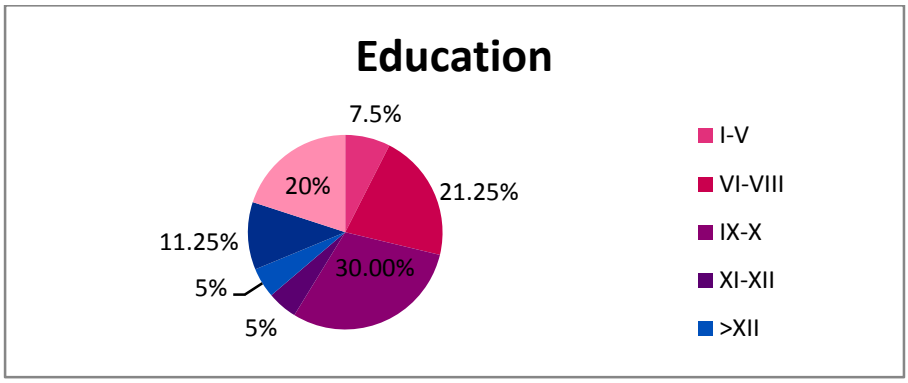

Figure 5.2: Education of the farmers

The value of mean and standard deviation of education scored of the respondents were 20 and 15.64 respectively.

5.1.3 Occupation

From the figure**,** the main occupation of more than half the respondents was agriculture. One fifth of the respondents were businessmen. The service holders were 6.25% and a big portion of the farmers were blacksmith, day labor, carpenter etc. which was considered as others.

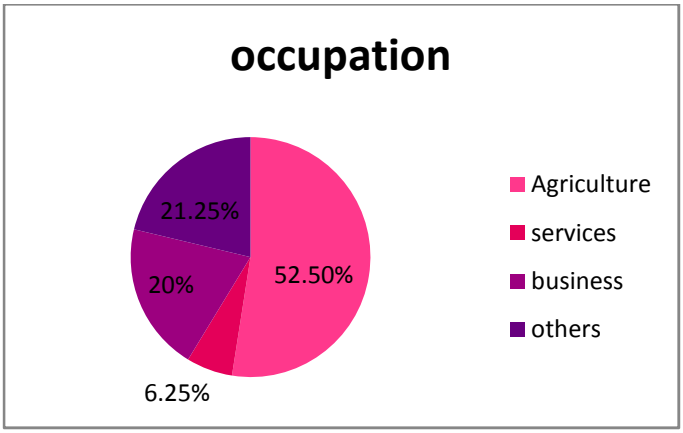

Figure 5.3: Occupation of the farmers

The value of mean and standard deviation of the occupation of the respondents were 20 and 15.64 respectively.

5.1.4 Family size

Based on the family size, the respondents were divided into three catagories. Most of the family sizes of the respondents were medium. Large family size was decreased day by day for their consciousness about family planning and the number of small family size was more than large family size. The average household size in Bangladesh is 4.4 persons per family, down from 4.8 in 2001 and 5.5 in 1991. The average Bangladeshi woman now has 2.15 children compared to 5.1 children in 1981(Kulkarai, 2011). The researcher found similar findings in her study.

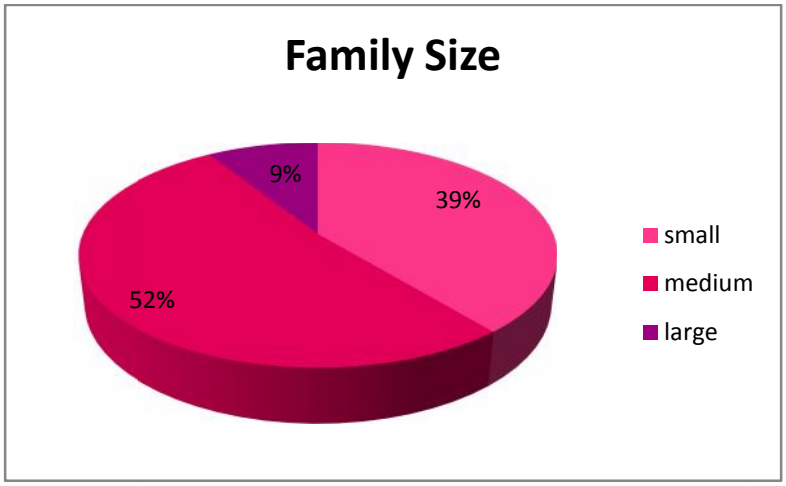

Figure 5.4: Family size of the farmers

The value of mean and standard deviation of the respondents were 3.09 and 2.53 respectively.

5.1.5 Farm size

Farm size in the study area was found to vary from 0.36 to 10.93 hectares. According to farm size, the respondents were divided into three categorized. From the figure, most of the respondents had farm more than 1 hector compared to 37.5% population whose had land less than 0.1hector and 7.5% farmers had farm more than 3 hector land.

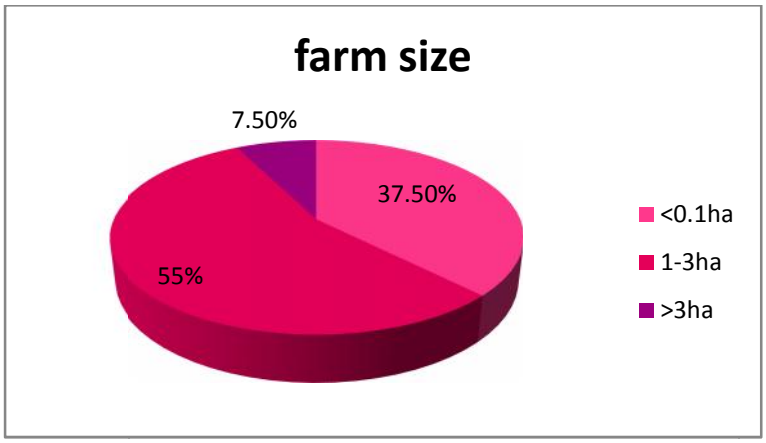

Figure 5.5: Farm size of the farmers

The values of mean and standard deviation of the farm size were 26.67 and 19.21 respectively.

5.1.6 Credit received

Credit received scores of the farmers ranged from 0 to 100000 Taka. From the figure, one fifth of the farmers received 10000 Taka. The highest proportion of credit received was up to 40000. The difference between the numbers of farmers was 6.25 between no credit received and highest credit received (up to 100000).

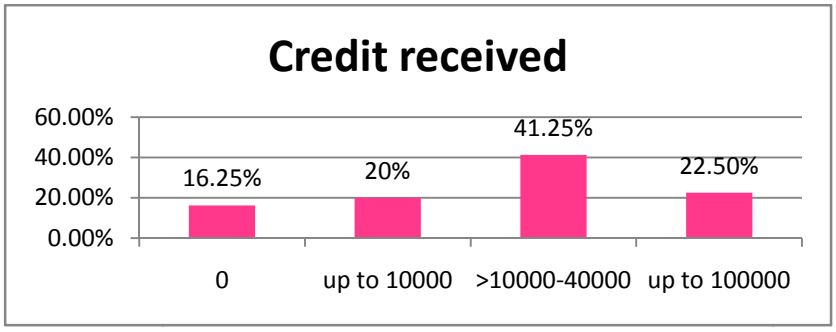

Figure 5.6: Credit received by the farmers

The values of mean and standard deviation of credit received were 22.33 and 9.29 respectively.

5.1.7 Annual family income

Annual family income of a farmer is determined by adding his income from agriculture, services, business and other sources during last year. From the figure, the number of

farmers whose annual income was up to 120000 was high. The lowest number was the farmers whose annual income was ranged from 40000 to 100000. The percentage of the farmers whose annual income were more than 40000 but up to 100000 was 33.75%.

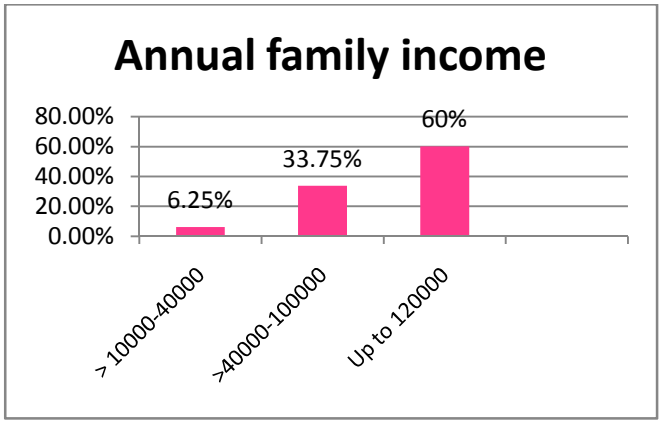

Figure 5.7: Annual family income of the farmers

The values of mean and standard deviation of the annual family income were 26.67 and 21.5.

CHAPTER 6

PROFITABILITY OF MIXED CROPPING

For the study, the researcher chose 80 samples from four unions of Kalkini upazila of Madaripur district to measure the profitability of mixed cropping system in Rabi season. To measure the profit of mixed cropping cultivation, the researcher used the following profitability method:

Profit= $\Sigma P_i Y_i - \Sigma P_i X_i - TC$

Where,

TC=Total Cost

6.1 Cost and return in mixed cropping practices

All variable cost incurred for seed, fertilizer and labor were considered for the cost of mixed cropping. Irrigation and insecticide or pesticides were not needed for mixed cropping. The average of total cost per ha and variable cost per hectare were 120740.90

and 44831.98. The net profit per hectare and gross profit were 9150.3and 85059.29 respectively.

Table 6.1: Cost and return in mixed cropping practices

Item	Amount (tk)
1. Variable cost i. Seed ii. Fertilizer iii. Labor Total variable cost Total variable cost per ha	 767.56 2553.65 939.85 4261.06 44831.98
2. Fixed cost i. Land used	 75908.92
Total cost per ha	120740.90
3. Gross profit 4. Net profit per ha	85059.29 9150.37

The calculated mean and standard deviation of total cost per hectare, total revenue, net profit and net profit per hectare were given the following table:

Table 6.2: The calculated mean and standard deviation of total cost per hectare, total revenue, net profit and net profit per hectare

Items	Mean	Standard deviation
Total variable costs per ha	44831.98	9336.84
Total cost per ha	120740.90	94336.84
Total revenue	129891.27	97774.61
Gross profit Net profit per ha	85059.29 9150.37	344065.90 240
Total land area (ha)	0.1	0.023

The above table indicated that the farmers made profit to cultivate mixed crops in their low land. The values of mean of total cost per ha and variable costs per ha were Tk 120740.90 and Tk 44831.98. In this cultivation, fixed cost was one item such as, land used. No credit received was required in this cultivation. The values of mean of net profit per ha and gross profit were Tk 9150.37 and Tk 85059.29 respectively. The farmers produced more products at low variable costs in mixed cropping cultivation.

The researcher collected data from the plots of mixed cropping cultivation where pulse and oil seeds were cultivated together. Because the pulse plants increased the soil fertility where the oil seeds were planted to increase the production of pulse. The oil seeds were planted only to increase the production of pulse, not for making profitability. The production of pulse was increased for cultivating with oil seeds. The pests and diseases did not attack when pulse and oil seeds were cultivated together. For this, no pesticide and insecticide was used in these productions. As a result the farmers produced more production at low cost in mixed cropping cultivation.

6.2 Relationship between dependent variable and independent variables

The relationship between dependent variable and independent variables are given the following table:

Table 6.3: Relationship between dependent variable and independent variables

Dependent variable(Y)	**Independent variable(X)**	**Value of "r"**	**t- value**	**t- value**	
				5%	1%
Profitability of mixed cropping	1. Cost of seed(X_1) 2. Cost of fertilizer(X_2)	0.874^{**} 0.858^{**}	4.194 4.209 4.274	0.195	0.252

	3. Cost of labor(X_3) 4. Cost of land(X_4)	0.369^{**} 0.323^{**}	4.134		

*Significant at 5% level with 78 df

**Significant at 1% level with 78 df

6.2.1 Relationship between seed and mixed cropping

The relationship between seed and mixed cropping was examined by testing the null hypothesis:

"There is no relationship between seed and mixed cropping."

Computed value of the co-efficient of correlation between seed and mixed cropping was found to be 0.874 as shown in table. The following observations are recorded regarding the relationship between the two concerned variables on the basis of the co-efficient.

Firstly, the relationship showed a tendency in the positive direction between the concerned variables. Secondly, the computed value of "r" (0.874) was significant, because t_c=4.194 to be greater than t_t=0.252 with 78 degrees of freedom at 0.01 level of significant. Thirdly, significant relationship was found to exist between the two variables.

Based on the above finding the null hypothesis could not be accepted and hence the researcher concluded that seed had significant positive relationship with mixed cropping. It might be due to that disease free and healthy seed was suitable for mixed cropping.

Most of the diffusion researchers, however, observed the similar significant relationship of seed and mixed cropping practices.

6.2.2 The relationship between fertilizer and mixed cropping

The relationship between fertilizer and mixed cropping was examined by testing the null hypothesis:

"There is no relationship between fertilizer and mixed cropping."

Computed value of the co-efficient of correlation between fertilizer and mixed cropping was found to be 0.858 as shown in table. The following observations are recorded regarding the relationship between the two concerned variables on the basis of the co-efficient.

Firstly, the relationship showed a tendency in the positive direction between the concerned variables. Secondly, the computed value of "r" (0.858) was significant, because the value of t_c=4.209 is greater than the value of t_t=0.252 with 78 degrees of freedom at 0.01 level of significant.Thirdly, significant relationship was found to exist between the two variables.

Based on the above finding the null hypothesis could not be accepted and hence the researcher concluded that fertilizer had significant positive relationship with mixed cropping. It might be due to that appropriate amount of fertilizer was suitable for mixed cropping.

Most of the diffusion researchers, however, observed the similar significant relationship of fertilizer and mixed cropping practices.

6.2.3 The relationship between labor and mixed cropping

The relationship between labor and mixed cropping was examined by testing the null hypothesis:

"There is no relationship between labor and mixed cropping."

Computed value of the co-efficient of correlation between labor and mixed cropping was found to be 0.369 as shown in table. The following observations are recorded regarding the relationship between the two concerned variables on the basis of the co-efficient.

Firstly, the relationship showed a tendency in the positive direction between the concerned variables. Secondly, the computed value of "r" (0.369) was significant, because the value of t_c=4.27 is greater than the value of t_t=0.252 with 78 degrees of freedom at 0.01 level of significant. Thirdly, significant relationship was found to exist between the two variables.

Based on the above finding the null hypothesis could not be accepted and hence the researcher concluded that labor had significant positive relationship with mixed cropping. It might be due to that experience and competent labors were suitable for mixed cropping.

Most of the diffusion researchers, however, observed the similar significant relationship of labor and mixed cropping practices.

6.2.4 Relationship between land and mixed cropping

The relationship between land and mixed cropping was examined by testing the null hypothesis:

"There is no relationship between land and mixed cropping."

Computed value of the co-efficient of correlation between land and mixed cropping was found to be 0.023 as shown in table. The following observations are recorded regarding the relationship between the two concerned variables on the basis of the co-efficient.

Firstly, the relationship showed a tendency in the positive direction between the concerned variables. Secondly, the computed value of "r" (0.323) was significant, because the value of t_c=4.134 is greater than the value of t_t=0.252 with 78 degrees of freedom at 0.01 level of significant. Thirdly, significant relationship was found to exist between the two variables.

Based on the above finding the null hypothesis could not be accepted and hence the researcher concluded that land had significant positive relationship with mixed cropping. It might be due to that fertile land was suitable for mixed cropping.

Most of the diffusion researchers, however, observed the similar significant relationship of land and mixed cropping practices.

6.3 Problem faced by the farmers in mixed cropping

Problem faced by the farmers in mixed cropping was given below:

Table 6.4: Problem faced by the farmers in mixed cropping

SL No	Problems	No of respondents	Rank
1	Lack of healthy and fresh seed	67	1
2	Unfavorable climate	53	2
3	Lack of technical knowledge	39	3
4	Lack of extension services	35	4
5	Difficult to practice in mixed cropping	29	5
6	Seasonal earning	15	6

6.3.1 Lack of healthy and fresh seed

Lack of healthy and fresh seed is the big problem for the mixed cropping. Because most of the farmers use growers seed. This type of seed may be diseased and unhealthy seed. As a result, the production decreases.

6.3.2 Unfavorable climate

Unfavorable climate is another problem for mixed cropping. Now-a-days during winter, sometimes rainfall is occurred and temperature rises. It is so harmful for mixed cropping.

6.3.3 Lack of technical knowledge

There is a shortage of trained manpower to handle commercial floriculture activities such as production, post harvest handling, product development and biotechnology. Most of the farmers keep a little knowledge about modern technology.

6.3.4 Lack of extension services

Farmers need to introduce new information and technologies about mixed cropping because of new practice of commercial mixed cropping. There are 35 respondents that claim lack of extension services.

6.3.5 Difficult to practice in mixed cropping

Difficult to practice in mixed cropping is one of the problems. Having lack of knowledge about mixed cropping is the cause of low production.

6.3.6 Seasonal earning

Seasonal earning is another problem. The cultivated lands are low lying and lie under water during Karif 1 (June to October) and unfavorable to cultivate at this time. So, this time, some farmers remain unemployed.

CHAPTER 7

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter is based on recommendation, conclusion and summary. Summary is the overall discussion of the thesis paper and Conclusion is based on result and findings of

the present research. Recommendation is made on mixed cropping for the farmers, policy maker and the Government and for further information for future researchers.

7.1 Summary

Bangladesh is an agricultural country. Most of the people are dependent on agriculture. Mixed cropping pattern practices in all areas of Bangladesh. Mixed cropping, also known as inter-cropping or co-cultivation, is a type of agriculture that involves planting two or more of plants simultaneously in the same field. It is not modern phenomenon. It has been practicing from prehistoric period. This type of cropping leads to an improvement in the fertility of the soil. It may be an insurance against crop failure in abnormal weather conditions. It is the judicious utilization of time and space to increase the total crop output per unit area. Mixed cropping in Rabi season is highly profitable. Generally pulse crops and oil seeds are the major crops grown as mixed cropping in Robi season. Mixed cropping increases substantial yield compared to single cropping. In Bangladesh, mixed cropping in Rabi season is very much essential for the farmers to increase their total income. The importance of roots and tubers, pulses, oilseeds and vegetables are received little or no attention and as a result the production level of these crops had remained stagnant or declined. The study has conducted in four unions such as Nabagram, Dasar, Kajibakai and Gopalpur of Madaripur district. Data have collected from 80 mixed cropping farmers.

In this study, the age of the farmers ranged from 19 to 75. The percentage of the farmer's age up to 30 was 18.75%, from 31 to 50 was 51.5% and above 50 was 30%. The value of mean and standard deviation of age of the farmers were 26.67 and 13.20 respectively.

The proportions of the higher secondary education and above higher secondary education were same. The highest proportion of the farmers had secondary education compared to junior education (21.25%) and primary education (7.50%). The value of mean and standard deviation of education scored of the respondents were 20 and 15.64 respectively.

The main occupation of more than half the respondents was agriculture. One fifth of the respondents were businessmen. The service holders were 6.25% and a big portion of the farmers were blacksmith, day labor, carpenter etc. which was considered as others. The

value of mean and standard deviation of the occupation of the respondents were 20 and 15.64 respectively.

Based on the family size, the respondents were divided into three categories. Most of the family sizes of the respondents were medium. Large family size was decreased day by day for their consciousness about family planning and the number of small family size was more than large family size. The value of mean and standard deviation of the respondents were 3.09 and 2.53 respectively.

Farm size in the study area was found to vary from 0.36 to 10.93 hectares. According to farm size, the respondents were divided into three categorized. Most of the respondents had farm more than 1 hector compared to 37.5% population whose had land less than 0.1hector and 7.5% farmers had farm more than 3 hector land. The values of mean and standard deviation of the farm size were 26.67 and 19.21 respectively.

Credit received scores of the farmers ranged from 0 to 100000 Taka. From the figure, one fifth of the farmers received 10000 Taka. The highest proportion of credit received was up to 40000. The difference between the numbers of farmers was 6.25 between no credit received and highest credit received (up to 100000). The values of mean and standard deviation of credit received were 22.33 and 9.29 respectively.

The number of farmers whose annual income was up to 120000 was high. The lowest number was the farmers whose annual income was ranged from 10000 to 40000. The percentage of the farmers whose annual income were more than 40000 but up to 100000 was 33.75%. The values of mean and standard deviation of the annual family income were 26.67 and 21.5 respectively.

The farmers made profit to cultivate mixed crops in their low land. The values of mean of total cost per ha and net profit per ha were Tk 120740.90 and Tk 9150.37. The farmers produced more products at low variable costs in mixed cropping cultivation.

There are the positive relationships among the input costs and profit made on mixed cropping pattern. Computed value of the co-efficient of correlation between cost of seed and mixed cropping was found to be 0.874 and was strongly significance. Computed

value of the co-efficient of correlation between cost of fertilizer and mixed cropping was found to be 0.858 and was strongly significance. Computed value of the co-efficient of correlation between cost of labor and mixed cropping was found to be 0.369 and was significance. Computed value of the co-efficient of correlation between cost of land and mixed cropping was found to be 0.323 and was significance. But they have to face some problems to practice the mixed cropping pattern. The problems are Lack of extension services, lack of technical knowledge, unfavorable climate, lack of healthy and fresh seed, difficult to practice in mixed cropping and low production in mixed cropping. The Government and concerned authorities should take some necessary steps to overcome these problems.

7.2 Conclusion

Mixed cropping is a well recognized practice for better land use system along with substantial yield advantages compared to sole cropping. These advantages may be especially important because they are achieved not by means of costly inputs but also by the simple expedient of growing crops together. The farmers produced more products at low variable costs in mixed cropping cultivation. From the above findings, it is said that mixed cropping is more profitable. Correlation test indicates positive relationship between input costs and profitability of mixed cropping. But the farmers have to face some problems in this practice. The concerned authority should take some important steps to overcome these problems.

7.3 Recommendation

From the above findings it could be said that the Mixed Cropping was quite satisfactory. Correlation test indicated positive relationship between total costs (seed, labor and fertilizer) and Mixed Cropping. It is recommended that effective steps are given below:

1. The Government should supply healthy and disease free seed among farmers.
2. The concerned authority should arise awareness among farmers about unfavorable climate by different programs on global warming to overcome the damage.
3. The Government should be taken programs to motivate the farmers in accepting Mixed Cropping and to train about modern technology and proper methods of mixed cropping by arranging training program.
4. As Madaripur district is low lying district, the cultivated lands of this district lie under water during Karif 1(June to October) and are unfavorable to cultivate at this time, the Government should arrange employment facility to the farmers.

The recommendations are made for future research to arrive at generalizations as to the Mixed cropping behavior of the farmers in the country and to draw up policy measures for the whole of the nation, similar research efforts are needed at other locations.

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APPENDIX

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INTERVIEW SCHEDULE ON

A STUDY ON PROFITABILITY OF MIXED CROPPING IN RABI SEASON BY THE FARMERS OF SOME SELECTED AREAS OF KALKINI UPAZILA UNDER MADARIPUR DISTRICT

Name of farmer:…….....……. Age …….....……..

Education…….....……. Mobile:….....……..

(Please Answer the following Questions)

1. Please tell about your family members
   1. I-V= Primary, 2.VI-VII= Junior, 3.IX-X=S.S.C, 4.XI-XII=H.S.C, 5.Above H.S.C/ Graduation
   1=Agriculture, 2=Services, 3=Business, 4= others

Member	Relation with Household head	Education	Occupation	
			Main	Sub

2. Information about the area of your total land:

Land Description	Local unit	Hactor
Homestead land		
Cultivated land		
Pond		
Fallow		
Total		

3. Please indicate the cultivated area:

Land Description	Local unit	Hactor
Owned land		
Rent in		
Rent out		
Mortgage in		
Mortgage out		

4. Please indicate your annual family income from different sources.

Agriculture	Area	Production	Income	Total amount in Tk
Rice				
Vegetable (specific)				
Fisheries				
Business				
Livestock				
Services				

5. Please indicate the number of crops cultivated in the land in a year.

Season	One crop	Two crops	More than two	fallow	Comments
Kharif -1 (May/June-Sept/Oct)					
Kharif-2 (Oct/Nov-Dec/Jan)					
Rabi (Dec/Jan-April/May)					

7. Do you take credit? Yes …….. No ……

If Yes, Please indicate the sources of credit received by you

Source	Amount	Time in a year

Bank		
NGO		
Samabay Samity		
Money Lender		
Businessman		
Relatives		
Others		

6. Cost of inputs for mixed cropping cultivation

Type of crops	Name of input		Use of total amount	Cost of input
Mixed Cropping	Seed/ Seedling			
Mixed Cropping	Fertilizer	Urea		
		TSP		
		MP		
		MOP/Manure		
Mixed Cropping	Labor	Family		
		Hired		
Mixed Cropping	Harvesting	Labor		
		Machine		

7. Please indicate sold crops amount and their price

Name of crops	Total yield (UNIT)	Total Sold		Household consumption
		Quantity sold in (unit)	Market price per unit	

Mixed Cropping				

8. Where do you sell your crops

Variety	Farm gate	Farias/Baparies	Local or primary market	Secondary market
Mixed				

9. Problem faced by you

Problem	Response		Comments
	Agree	Disagree	
Extension services			
Lack of technical knowledge			
Unfavorable climate			
Lack of healthy and disease free seed			
Difficult to practices in mixed cropping			
Seasonal earning			