CHAPTER 1

Introduction

1.1. General background

Agriculture constitutes the largest sector of the economy of Bangladesh. About 84 percent of the total population live in rural areas and are either directly or indirectly engaged in a wide range of agricultural activities. Agriculture contributes about 32 percent of the country's GDP, 23 percent of which is contributed by the crop sector. About 63 percent of the labour force are employed in agriculture (MOA 1999). This population forms such a large proportion of the total that the national average per capita income is strongly influenced by income levels in agriculture. Therefore, increases in farm income are automatically reflected in higher levels of national income.

Agriculture in Bangladesh is characterised by mixed farming. Some farms have crops, livestock, fisheries and other components together, some have one or two of them, while some others have none but the homestead. The homesteads are the nucleus of the farm unit and it is the point at which all other components intersect. Vegetables, spices and trees are all produced in different combinations on the homesteads, and cattle, poultry and goats are housed there. The scope of modern agriculture has been widened significantly. Although agriculture used to be originally defined as the cultivation of land for producing crops only (MOA 1999), these days it relates to the production, development, preservation, processing, marketing and extension not only of crops, but also of other agricultural commodities. These
include poultry, dairy, fisheries and forest products which are universally accepted within the purview of agriculture.

1.2. Statement of the problem

Poor households in Bangladesh do not have food security because they lack sufficient food from their own production, cash incomes and other resources to acquire enough food (Shahabuddin 2002). While there is a general agreement that significant advances have been made in the production of food grain in the country, the small farmers, with a land area of 0.20-1 hectare, and medium farmers, 1-2 hectares who constitute 79% and 18% of farm holdings respectively (BBS 1999), by and large suffered from under employment, low productivity, malnutrition and low income. In Bangladesh, caloric levels continue to be low, while the average diet is deficient due to the shortage of nutritious foods. The predominance of cereals and the absence of nutritious foods such as vegetables leads to serious imbalances in the average diet. About 50% of babies in Bangladesh are born underweight (USAID 2001). Approximately 32 million of the 140 million people in the country cannot afford an average daily intake of more than 1800 calories while the average per capita intake is 2105 calories for developing countries and in developed countries it is 3377 calories (USAID 2001). Mirza (2000) stated that about 44.7% of the population in Bangladesh remained below the poverty line, as defined by a minimum calorie intake of 2122 calories per day per person. Although food production is increasing day by day this is not enough to meet the challenge of the country's ever increasing population.
Bangladesh agriculture is dominated by crops. Out of the 32 percent GDP in agriculture, 23 percent comes from the crop sector alone. Again out of the total labour force in agriculture, 53 percent are employed in the crop sector (MOA, 1999). About 70% of the land area of the country has been brought under crop cultivation. Rice alone accounts for about 75% of the total cropped area (Anon 1997). But production in the crop sector provides only seasonal, irregular and uncertain income to the farmers, which puts them entirely at the mercy of nature. The country's frequent floods, cyclones, and other natural disasters pose special problems for assuring food security (MOA 1999, USAID 2001). Therefore, farmers can be assisted through the incorporation of other enterprises which bring a regular flow of income throughout the year and are not as subject to the vagaries of nature. Dairy and poultry are examples of such enterprises. Moreover Bangladesh farming is characterised by a mixed culture of crop, livestock, fish, homestead and agro forestry sub-systems or enterprises. The development of farming means the development of all these enterprises existing in a farm. Hence developmental activities should be directed to the individual farm units which have different enterprises and different resource bases and managerial capabilities.

Rural women in Asia play an important role in agriculture (Kaur and Sharma 1991, Unnevehr and Stanford 1985). For example about 84% of active women are involved in agriculture in India with a positive correlation between agricultural growth rates and employment of female agricultural labour (World Bank 1991). Women in Asian countries, particularly from poorer households, balance their labour time between economic (wage earning and income replacing work like fuel, wood and water collection and care of livestock) and domestic (cooking, cleaning and childcare)
activities by working longer hours (Kabber 1994). In Bangladesh rural women constitute half of the work force which keep the family and the rural economy alive. Most agricultural research and development schemes ignore the role of women (Saha et al. 1990, Murshed 1998). Their labour contribution is often not taken into consideration. In fact, rural women make a significant contribution in various agricultural activities also. Despite their significant involvement in agricultural work, women have not received appreciation and recognition of their contribution. Since women constitute half of the total population of the country it is essential to assess the role and extent of women's involvement in different activities in farming systems.

It is also important to recognise that farmers practice and operate their farm business under a set of physical, social and economic constraints. It is, therefore, important to see how the farmers actually combine their enterprises under conditions of socioeconomic constraints. Farmers are used to cultivating in their own way. It is observed that farming systems practised by the farmers have been developed over time, through experience, to best suit the farmers needs, goals, aspirations and the resources they can invest. It is quite necessary to know, what is the farmers thinking when choosing an enterprise combination for cultivation? What are the social and economic factors which influence the selection of enterprises? If these questions are not considered the theoretical recommendations will not bring any benefit to the farmer.

In recent years the Farming Systems Research and Development (FSRD) approach has been followed with the goal of improving the welfare of resource poor farmers in Bangladesh. The farming systems approach involves farmers, agricultural extension
workers and researchers coming together on farms to identify farmer's problems/needs and to determine research priorities. The goal of FSRD is to generate appropriate technology in the farmer's field which should be technically feasible, economically viable and socio-culturally acceptable. Technological intervention for improving the well being of farm families is one of the objectives of farming systems research (FSR) in Bangladesh. To fulfil this general objective, the government of Bangladesh has initiated a number of research projects under the supervision of the national co-ordination committee located at the Bangladesh Agricultural Research Council (BARC). The project has already introduced a number of technologies in the areas of crop production, livestock and fish raising. As a part-requirement, the project personnel have also been engaged in assessing the impacts of introduced technologies.

The impact assessments have so far been conducted mainly in physical or technical terms and no serious attention has been paid to assess the socio-economic aspects of the farming systems. Moreover, most farm management studies in Bangladesh have been concerned with the analysis of average performance. Some studies have attempted production function analyses revealing the marginal condition of resource use with respect to production of individual enterprises. Such analyses, in additional to being partial in nature, address only the existing aspect in the organisation and operation of the farm business.

Since a typical farm business in Bangladesh consists of a number of enterprises, it seems worthwhile to analyse the performance of the whole farm business in respect to the organisation and operation of the farm business. This type of analysis, though
necessary, has always been lacking in farming systems research endeavours. This present piece of research is an attempt to fill this analytical gap in farming systems research. Keeping all these issues in mind the present study was undertaken with the following objectives:

1.3. Objectives of the study

The research reported in this thesis has 5 objectives, namely

1) to analyse the socio-economic characteristics of farm households under alternative farming systems.

2) to assess the relative performance of individual enterprises within different farming systems and compare the performance of alternative farming systems.

3) to determine the resource use efficiency in different components under alternative farming systems.

4) to compare utilisation of labour force and examine the distribution of labour by gender in different farming systems.

5) to find out the selection criteria of enterprises/components from the farmers point of view in different farming systems

1.4. Brief methods of achieving objectives

To achieve these objectives four villages in the Gazipur district of Bangladesh with diversified farming systems were selected and the four dominant farming systems were identified. One years data covering the period January to December 2000 was collected by the researcher using survey questionnaires administered through face to face interviews. A detailed account of data collection methods used in the study can be found in Chapter 3.
Objective 1

In analysing the socioeconomic characteristics of the farmer, family size and composition, age and educational status of the members of the family, utilisation pattern of the sample farmers' own land in selected farming systems, ownership of equipment and assets of the households were taken into consideration.

Objective 2

Gross margin, benefit cost ratio, returns to labour and residual income measure analysis were applied to compare and critically examine the performance of different farming systems.

Objective 3

The Cobb-Douglas production function analysis was performed to examine the input use efficiency of the production of crop, cattle, poultry and fish components.

Objective 4

To find out the role of gender in farming systems attention was given to determine the labour time spent by gender in crop, cattle, poultry and fish management in each farming system. Overall time spent by gender in agriculture as a whole were examined for different farming systems. In addition, the time spent by gender in household activities was also analysed for different farming systems.

Objective 5

Selection criteria of enterprises in farming systems are broadly determined by social, economical and biophysical conditions. Based on these assumptions, opinions of
farmers were collected. The ultimate objective is to establish and examine the different factors which influence the selection criteria of different enterprises in farming systems. Besides this, opinions of the extension workers related to agricultural activities of the study area were also collected to critically evaluate the opinion of farmers and views of extension workers.

1.5. Outline of the thesis

This thesis consists of nine chapters. The above analysis is performed and discussed in the eight chapters which follow. A brief review of the past studies related to the present investigation is presented in Chapter 2. Chapter 3 outlines the methodology used for data collection. Chapter 4 presents the socioeconomic characteristics of sample farmers. Chapter 5 assesses the relative performance of individual enterprises within different farming systems and compares the performance of alternative farming systems. Chapter 6 presents resource use efficiency for obtaining return in different components under alternative farming systems. Gender role in different farming systems is examined in Chapter 7. Selection criteria of enterprises in different farming systems is examined in Chapter 8. Finally major findings, recommendations and suggestions for further research are indicated in Chapter 9.
CHAPTER 2

Review of Literature

Work done by various researchers provides the knowledge to define a specific problem along with the scope of the study. A search of the literature provides a theoretical background to establish a perspective on the problem, to formulate appropriate objectives of the study and to acquire a broad knowledge of the research area. Since the area of the research is to evaluate alternative farming systems with special reference to income and gender roles in farming systems an attempt was made to review the earlier research which is related to (i) enterprise performance and (ii) Gender role in farming systems. Highlights of the previous research work are given below:

(1) Review of previous research regarding enterprise performance

In Bangladesh, the farming systems research programme so far has been conducted with an emphasis on improving existing farming systems by generating new and improved technologies in physical and technical aspects of farming (BARI, 2000-2001). It has been realised that emphasis of farming systems research activities should be given on socio-economic aspects of the livestock, poultry, fisheries, agro forestry and home gardening along with the crop sub-systems for the generation of income and employment of the resource poor farmers. However, there are few studies which have been conducted in relation to the socio-economic aspects in Bangladesh, where concentration was focussed on examining the performance of individual enterprises only. Although in few cases socio-economic performance of integrated farming systems was examined but it is done experimentally in farming systems research station which do not reflect the practical situation of the farmers falling under different farming systems (Rebeka 1994, Roy et al. 1993, Islam et al. 1994, BRRI 2000). Two studies were found where they
examined the performance of the whole farm business analysis (Taj-uddin 1995, Karim 1994). It is necessary to know what they examined in order to explore the area of research or indicate a gap for conducting further research. The highlights of a few works in relation to enterprise are given below:

Economic aspects of homestead enterprises in some selected areas of the Jessore district was conducted by Rebeka (1994). Rebeka examined the comparative performance of vegetables, perennial crops and livestock, which were based in the homestead area. This analysis reflected a partial view of the farming system because farmers income generating activities are not limited to homestead activities. The farmers are the owner of a piece of land where crops are cultivated and there may be a small pond where fish are cultured. In this study the way in which farmers utilise the homestead ground was the main consideration to the researcher. Since the researcher evaluated the farmers performance on the basis of only the homestead component it does not give a clear idea about the farming systems as a whole.

Roy et al. (1993) did work on "Rice-cum-fish culture in farmers rice field at the farming system research site of Janokinatupur, Rangpur. He compared the economic performance of rice-cum fish culture and rice farming system in terms of gross margin and benefit cost ratio and found that gross margin and benefit cost ratio were higher in rice and fish culture in comparison to rice cultivation only. It implied that integrated farming was more profitable than of only rice farming. It was seen that this research was conducted experimentally at a farming system research station. However, in general farmers have some crops, livestock, poultry or a fish enterprise. They do not only cultivate rice or rear fish. This is why a performance of existing farming systems was
not reflected here though it did provide a message for the farmers that integrating farming gave higher returns.

Similarly a survey was conducted by Islam et al. (1994). Islam emphasised only on examination of the performance of the homestead enterprise. However, this is not a reflection of existing mixed farming systems performed by most of farmers because farmers do not concentrate only in homestead activities. Testing the feasibility of integrated fish-poultry farming at farmers pond was conducted at the farming systems research site Palima, Tangail by Islam et al. (1994). The fish and poultry were reared for a period of 10 months. The average net income of fish obtained from integrated farming during the period of study was much higher than producing fish earlier individually. Islam showed that fish production and farmers income could easily be increased through integrated fish and poultry farming, by utilising water bodies. This research explained that if farmers use integrated farming it will produce a better result in terms of performance. Since this study was conducted experimentally by the researcher, it is presumed that input management and production practice was done here systematically which may not be possible for the farmers. Due to different factors such as capital constraint, labour efficiency, lack of technical knowledge and interaction of different components of the farming systems, farmers may not get the same result in their respective farming system. Therefore, we need to know the real situation in existing farming systems.

Accordingly, productivity evaluation of integrated rice and fish culture was conducted during Aman paddy season in 1999 at the farming systems research site in kapasia upazilla of Gazipur district (BRRI 2000). Four rice fields were selected for this purpose. Two rice fields were selected to compare the total productivity of
the rice-fish system. Performance analysis suggests that the rice-fish system was highly profitable. In both cases rice-fish systems earned a higher gross margin which were 175% and 127% higher respectively, than those from cultivating rice varieties individually. Here it is also seen that research was conducted experimentally in a demonstration field of the farmer. This is not a reflection of the farmers existing farming situation. However, this information indicates that if farmers cultivate fish it can improve the performance of the farming system. Most of the farmers cultivate mixed crop, poultry and cattle. It is observed from the field study that farmers do not take the initiative to cultivate fish. There are few farms that have a fish component. Therefore it is very important to know whether in existing farming systems fish enterprises were more profitable or not.

Similarly the performance of the rice-fish culture was examined in the farming systems research and development (FSR&D) site of Kapasia. In cooperation with Upazilla fisheries staff, scientists of FSR&D selected eight rice fields during the 1999-2000 boro season (BRRI 2000). Six rice fields were selected, side by side, where only rice was grown. Results showed that the rice-fish system gave an average rice yield of 5.45 ton/ha in addition to 0.66 ton/ha fish yield while rice only cultivation gave 5.11 ton/ha rice yield. The rice-fish system earned a higher gross margin, 126% higher than that of rice only cultivation.

From the above research it can seen that performance analysis was done for individual components of the farming systems. Few of the studies conducted in farming systems research stations examined the performance of two or more integrated components. This is not the ideal situation prevailing in an existing
farming situation. It is necessary to know the performance of a farming system as a whole.

However, there were two studies found in relation to performance analysis conducted for the farming system as a whole in some selected areas of Bangladesh. Karim (1994) conducted a study in the Nawabganj district of Bangladesh which is located under the high Barind tract in the north-west region and which is semi-arid. Karim categorised the farmers in relation to farm sizes of small, medium and large, and selected 88 farmers for different categories of farmers. Karim showed using a linear programming model, that with restricted capital availability, increases in employment were the highest under crop-poultry-farming systems for all categories of farms. The available resources were optimally allocated only among the crops under crop and poultry farming system of medium and large farms.

Another study regarding the performance of the whole farm business was done using a variety of income measures by Taj-Uddin (1995). In addition he examined optimum crop plan for the sample farms in some selected areas of Bangladesh. Forty farms falling in the crop-cattle-poultry-fish farming system were interviewed for the study. A linear programming technique for the crop component was used in this study. Relative performance of individual enterprises within crop-cattle-poultry-fish farming systems were ascertained through gross margin analysis and whole farm business was examined by applying different income measures such as net farm income and management income.

From the above research conducted by Karim (1994) it was seen that the emphasis was on the optimisation of resources. Since farmers are used to cultivating in their own way,
emphasis given to relative performance of the existing situation is more important than focussing on optimisation of resources. Taj-Uddin (1995) examined the relative performance of alternative farming systems, by using residual income measure and per taka of variable cost. In Bangladesh capital is scarce for the farmers. Another important thing is that for crop cultivation there is a fixed land area but for cattle and poultry enterprises there are no fixed land areas in farm households. In most cases, cattle and poultry rearing is performed in a free range area. Therefore, to make an amenable comparison, returns to labour is also needed to examine for different farming systems.

Outside of Bangladesh where there is a similarity of mixed farming systems similar to Bangladesh, related studies mainly concentrated on determining how to increase the income and employment of existing farming situations, by reorganising the resources in the whole farm business or comparing the performance of two or more specific enterprises. These studies are discussed below:

An integrated fish-poultry farming system using indigenous chickens was studied by Njoku and Ejiogu (1999) in selected villages of Indonesia. The researcher examined the performance of two varieties of chickens, exotic and indigenous, together with fish, in an integrated farming system. The effect of replacing exotic broilers with indigenous chickens in integrated homestead fish ponds, as a means of improving the income status of the small scale farmers was investigated. Indigenous chickens offered higher resistance, accepted crop wastes and trash as food, and generated an excreta load similar to that from more expensive broiler chickens. The results showed that substantial net income at all levels of poultry integration was higher with indigenous chickens, compared with a net deficit incurred by the farmer using exotic broilers. This research is confined to looking only at chicken enterprises.
Similarly the study conducted by Barrett, J.C. (1992) examined the performance of communal farmers and commercial farming in respect to cattle management. This study was related with the economic role of cattle in communal farming and commercial farming systems in Zimbabwe. Here it is seen that the researcher examined the performance of cattle only in relation to two types of farming. It can be argued that emphasis was given here to examining the performance of an individual enterprise, not a whole farm system.

Panin (1988) examined the impact of selected technologies on the farming systems of rural communities. The major findings of the analysis of the two farming systems (hoe and bullock) are as follows:

i) Bullock farmers were better equipped with land, labour capacity and livestock than hoe farmers.

ii) The total cultivated area of bullock farmers were 4 percent higher compared to hoe farmers.

iii) Bullock traction technology led to an increase in the number of different types of crops in mixed crops.

iv) There were substantially higher yields per hectare from all the major cropping patterns for bullock farmers.

Similarly, the economics of two rice based farming systems, i.e. rice-rice and rice-pulse, in Divi taluk, the Krishna District, of Andhra Pradesh of India were studied by Radha et al. (1989). This study indicated that the researcher examined the comparative income and input use pattern in rice-rice and rice-pulse farming systems. This study explained that this was confined to performance measure in specific fields of rice based farming.
The intensity of input requirement was higher for the rice-rice system than the rice-pulse farming systems and the per hectare expenditure on all inputs except seed was higher for the rice-rice farming systems. Net income was slightly higher for the rice-pulse farming system than the rice-rice farming systems. Other measures of income, family labour and farm investment were higher for the rice-rice farming systems. The average benefit cost ratio of two farming systems were 1.26 for pulse and 1.18 for rice-rice farming systems. Again, from this study it can be said that farmers only find out one thing, rice-pulse systems may give better benefit in terms of input requirement and enterprise performance. Since farmers cultivate different crops in a year, it may be more useful to find out the comparative performance, on the basis of which farmers will be able to select enterprises in terms of priority. It may be that on their farm the more profitable enterprise is other vegetables or cattle or fish. Overall performance measures will help more farmers to make decisions about which enterprise is the appropriate selection.

Over all, it can be argued that the studies conducted by Njoku et al. (1999), Barrett (1992), Panin (1988), Radha, et al. (1989) were confined to assessing the performance of individual enterprises instead of farming systems as a whole.

The point of consideration is: what sort of studies have been conducted for farming systems as a whole? In an existing farming system, the way in which the farm income and labour employment could be increased through dairying was examined by Bhaita and Gangware (1980). Farm survey methods were used for primary data collection and the linear programming technique was used for developing the optimum farm plans. The results of the study indicated that the existence of a marginal scope for increasing farm income is possible by simply reorganising the resources. Farm income can be substantially increased by adopting improved technology for both crops and livestock.
The study revealed that dairying provides additional employment for human labour on small farms with the additional availability of capital. The overall message from this study is that there is a possibility of increasing the income and human labour employment for different categories of farms, through the adoption of improved technology, with a crop and livestock enterprise.

Similarly, Sirohi et al. (1980) studied the possibilities of increasing income and labour employment through dairy and poultry enterprises on various sized farms in the union Territory of Delhi in India. In this study the research emphasised increasing performance of input and enterprise on the basis of farm categories. The main focus was on farm size rather than farming systems where comparative performance was examined in relation to farm size. The main objectives of the study were (i) to work out the optimal farm plans of marginal farms, small farms and medium farms with the availability of credit facilities, (ii) to determine the cropping pattern for mixed farms using dairy and poultry along with crops, (iii) to examine the increase in human labour employment including the hired labour in various months (iv) to compare the scope of human labour employment due to mixed farming between various sizes of farms.

Accordingly, the prospect of increasing income and employment on mixed farms was studied by Pandey et al. (1980) in the Aligar district of Uttar Pradesh. How to increase income and employment by reorganising the resources was the main point of consideration in this research. The data was collected from a sample of farmers by using an interview schedule. Pandey et al. worked out the optimum production plan with and without milch animals for small, medium and large farm situations using a linear programming technique. The results indicated that the milch animals contribute significantly to total farm income and employment under the existing crop and milk
production pattern on the farms, but the relative importance of milch animal declines with the increase in the size of holdings.

Another study, conducted by Bogahawatte (1984) in the dry zone of the rain fed district of Srilanka, evaluate the crop-livestock based farming system. The aim was to maximise the farm income from the crops and livestock components of the farming systems. A field survey was conducted to collect data from 153 farming families. The results showed that marginal value products were higher in the optimal plan than in the actual farm situation for low land rice, high land rice and sugarcane. In this study emphasis was given mainly to the crop component. In the case of livestock, only milch cattle were included.

The way in which income can be increased by reorganising the resources in existing farming situations was examined by Saini and Singh (1985) using the mixed integer programming for the small farms of Punjab in India. A simple random sampling method was used to select the number of sample farmers. An interview schedule was used for interviewing the farmers. The results showed that the diversification of arable farming with livestock activities increased farm income, ranging from 12% to 54%. The study indicated that the dairy enterprise could easily justify its role in diversifying crop farming for a higher income on small farms. Shatish and Sharma (1988) examined the possibilities of bringing the resource poor farmers of Andhra pradesh above the poverty line under different farming systems, accompanied by a liberal credit policy and recommended technology. Reorganising the resources to increase the income and employment of farm was the main objective of this research. Crop farming, crop-dairy farming, crop-sericulture farming and crop-dairy-sericulture farming systems were considered for analysis using the linear programming technique. Inclusion of dairy into
the plan increased net returns under restricted capital situation. Crop-sericulture farming system gave the highest income. However when capital constraint was relaxed, crop-dairy-sericulture farming system yielded higher returns.

Some studies have been conducted where emphasis was given specifically on input management, input requirement and input use efficiency which are discussed below:

The role of traditional and modern input use in the farming system in some selected areas of South Central Niger was studied by Abdoulaye and Lowenberg-Deboer (2000). They examined the trend of input use by the farmer in farming systems. The primary hypothesis was that farmers intensify first using traditional inputs, as they require less capital, but when they have exhausted the intensification potentiality of those traditional practices, they will adopt the modern inputs. Using information from the survey, farmers were classified according to their resources. Four farm categories were identified: (i) the very poor: this is the poorest segment of the population who have only a small area of dry land and rear only few chickens or guinea fowl,(ii) the poor: these households have a few sheep and goats but no cattle or irrigated crops, (iii) the average, these households have some cattle, but the bulk of the livestock consists of small ruminants and they do not have irrigated cropping activities and (iv) the above average, the main difference between the above average category and the average category is that these households have irrigated crops. The results indicated that intensification is a continuum, starting from traditional low plant density and extensive farming to using higher planting density and manure and eventually to ignoring fertiliser and using improved seeds and pesticides. One implication of this research is that extension and development efforts should start with intensification of traditional inputs, instead of promoting the use of modern inputs as the first step in intensification.
The resource use efficiency and productivity of potato farms in selected areas in Bangladesh was studied by Barman et al. (2001). The required data for this study was collected through a survey method from a sample of 90 farmers from two villages in the district of Bogra. The Cobb-Douglas production function model was chosen to analyse and estimate the input use efficiency of potato production and work out the coefficient of different inputs used. However, this study was conducted only for potato enterprise. This methodology can be applied for examining the resource use efficiency of different sub systems such as crop, cattle, poultry, fish or forestry, existing in different farming systems practised by the farmer.

In the case of input use efficiency, another study was conducted by Rashid et al. (2001) with a view to analysis of the economic aspect of major crops such as wheat, potato, maize, oilseeds and pulses. The benefit cost ratio varied from 1.80 to 2.80 on a full cost basis. The return to labour was found to be highest in potato and lowest in mustard cultivation. The Cobb-Douglas production function was used to see the influence of various inputs on the yield of the crops. It revealed that the yields were influenced by the use of human labour, animal labour, seed and the application of fertiliser. These factors were directly or jointly responsible for the variation of these crop yields. Here it is also seen that resource use efficiency was examined in the case of cropping only, but similarly it can be applied to other sub-systems.

From the above studies it is observed that the performance analysis of existing farming systems, as a whole are very limited. Most of the studies have concentrated on the performance measures of individual enterprises. Some studies were conducted for the whole farm business but they were concerned with how to increase income and employment by reorganising resources with the application of linear programming. It is
very difficult for farmers to implement the theoretically better combination of enterprises which will increase income and employment. If farmers are advised that, they can increase income by increasing the cattle numbers, the question will then come from the farmer, where will they get money for purchasing cattle or rice may be the staple food for their family so they can not sacrifice this land for fish culture. If the opinion of the farmers is not taken into consideration, this type of optimal solution will not bring any better results for a practical situation.

It is more appropriate to know the performance of enterprises in existing situations of farming systems as a whole. This will assist the farmer to know in practice which enterprise is better. At the same time, another important thing is needed to consider, what factors influence them in selecting these enterprises? This information, gathered from farmers, will help extension workers and researchers to take appropriate step in future. This type of research has not been conducted before.

(2) Previous research related to gender roles in farming systems

By reviewing previous research in the field of gender roles in farming systems, it was found that few studies emphasised women's involvement or identified their authority by gender in agricultural farming (Choi et al. 1988, Sahari et al. 1991, Haque 1995, Mullins 1995, Das 2000). Few of them examined the contribution as well as gender role in decision making (Pape and Nordblom 1995, Jose and Shanmugaratnam 1999, Ahmed and Laarman 2000). The comparative contribution of males and females has been examined by several researchers (Sing and Sharma 1981, Noorginayuwaiti, 1995, Nongluck 1988, Benchawan et al. 1988, Halim et al. 1995). Overall, it has found that most researchers concentrated on finding out the role of women only. Some of them studied the contribution of males and females in farming systems but these studies were
concentrated either on household activities, crop or livestock activities. Contribution to
the farming system as a whole was absent in their study. Female or male members of the
family in mixed farming systems do not concentrate only on one activity. Since they
engage in different activities on their farm, it is necessary to examine the contribution
by gender as a whole in farming systems. The reason is that, in a particular activity,
males may contribute more or females may contribute more. This will not give a clear
picture of the comparative contribution by males and females in farming system.

However, the main findings and area of research conducted in Bangladesh were discussed
below:

The role of village women in poultry raising in the existing farming systems of
Bangladesh was studied by Haque (1995). This study was related to the involvement of
women in poultry raising in areas such as house construction, feeding, medication,
house cleaning, brooding management, decision of purchasing and selling of birds and
eggs and decisions about home consumption. Women of landless, marginal and small
farm categories were actively involved in poultry raising as part of their income earning
activities. On average women completed 80% of works in poultry husbandry. However,
poultry is only one of the components of mixed farming systems. This study only
informed us of the contribution of women in poultry rearing. Since in existing farming
situations there are more than one component, it is better to examine the role of gender
as a whole.

Similarly, another study was conducted by Halim et al. (1995) on 60 households at the
Kazirshimla Farming Systems Research Development Programme (FSRDP) site in
Bangladesh. Halim et al. examined the gender differences in relation to agricultural,
domestic and non-farm activities on the homesteads. It was found that the households covered large, medium and small farm categories with homestead sizes of 0.41, 0.12 and 0.06 hectares respectively. The average total contribution in all homestead activities was more than three times higher for women (592 labour days/year) than with men (183 labour days/year). Among the farm categories, women were the dominant contributors in all activities on small farms while on large and medium farms they contributed more in domestic and non-farm activities. This study was more effective for understanding the role of gender in different activities in farming systems, but in this research they took into consideration only the homestead area as an income source. In most agricultural activities, especially crop production, the main labour is carried out in the field which was not taken into consideration by this study.

Research into gender roles in homestead farming was studied by Islam and Haq (1994). The findings were that rural women in Bangladesh played a significant role in homestead farming, particularly at the production phase and decision making. Here it was also seen that the women’s contribution was analysed only for homestead activities. However, findings were that women’s specific roles varied widely depending upon socioeconomic and religious factors. Women who possessed different physiques and energy capabilities in comparison to men also had a wider range of daily activities than men in homestead agricultural production systems. Women were more involved in poultry raising and post harvest activities of homestead vegetables production. On the other hand, men play an essential role in goat raising and tree growing activities. Participation of women in different homestead activities varied depending on farm categories.

The role of women in two tribes, namely the Tanchangya and the Marma, from the Chittagong Hill tracts in Bangladesh, was conducted by Das (2000). The study was
conducted as a component of the farming system research and development programme of Bangladesh. This study's emphasis was on examining the time spent by women in field crop, household and livestock rearing activities. Findings revealed that women spend 68%, 95% and 85% of their time in field activities, household activities and livestock rearing respectively. The study also indicated that tribal women were interested in adopting new technologies. The study revealed that although the tribal women in hilly areas in Bangladesh are the pivot of the family unit, bearing a major responsibility of agriculture and other resource management, their opinions and suggestions remain unheard.

Research was conducted by Ahmed and Laarman (2000) to examine the gender equity in Social Forestry Programs in Bangladesh. This study examined the gender equity in relation to access to land, capital and credit, services (for example, extension and training), and decision making power in the household about selection and planting, marketing and household expenses. The study indicated that, he examined the role of gender for specific group of farmers those were involved in forestry project. Therefore it does not reflect the role of gender in farming systems as a whole.

Related studies were also conducted outside Bangladesh in relation to gender roles in farming systems which are discussed below:

The magnitude of human labour employment in dairy, crop and poultry enterprises, followed by different categories of household, was studied by Sing and Sharma (1981). They found that the utilisation of family and hired labour had a positive relationship with farm size. All the households of these villages were classified into three categories. The categories of households were small, medium and large on the basis of size of land
holdings. The data was collected through a designed survey schedule by interviewing the respondents. Labour utilisation in different enterprises was computed on the basis of actual hours of work put in operation of the enterprises by males and females. From this study it can be said that researchers gave more emphasis on gender role in relation to farm size rather than emphasis on gender roles irrespective of farming systems.

Choi et al. (1988) conducted a study in some selected villages of Korea to examine the changing role and status of rural women in household affairs, farming and community affairs. The results indicated that there is more room to encourage rural women to have a greater role and higher status in the society. Their status is very low in comparison with that of their husbands. Choi et al. (1988) showed that the status of wives of rural husbands was increasing but they still thought the status of rural women needed to be improved. Further intensive studies about the role and status of rural women in the area of households affairs, farming or earning activities as well as social affairs suggested that improvements should be carried out by a systems approach, and social education programmes, welfare policies or community development projects. Findings revealed that the older women had more farming responsibility with a lower status, where as younger women had less responsibility with a higher status. The more educated women were less engaged in farming with a higher status while the less educated showed the opposite. From this study it is seen that the emphasis was on examining the performance of women specifically. Again it is argued that since in farming systems males and females work together, it is better to examine their comparative performance. This will give an indication towards identifying the area in farming systems in which work is more convenient for males and which is more convenient for females.
Noorginayuwati (1995) conducted studies in four villages of south Kalimantan in Indonesia. A total 180 farmers were selected, using a simple random sampling techniques, were interviewed. It was seen that this research examined the performance of women in the household and off farm income. The major sector in farming systems agriculture was not taken in to consideration here. It is essential to know the role of gender in agriculture also. Results showed that all family members actively participated in various farming activities. Women in upland farming were directly involved in farming and non farming activities. The daily time allocation showed that women devoted most of their time towards household and farming activities at 11.4 hours a day (5.2 hours for household activities and 6.2 hours for searching income from off farm). Men spent less time in these activities doing about 10.4 hours a day (0.7 hour for household activities and 9.7 hours for off-farm income). The contribution of women to the total household income was 40 percent. The female role in decision making in relation to farming was relatively low, but was high in managing expenditure for foods and households.

The roles of male and female family members in labour and decision making processes at the family household and farm levels was examined by Pape and Nordblom (1995). This study examined the areas in which female performance is better. Obviously this study is very useful for improving the existing condition of farming systems, but the female contribution was examined here in the case of specific enterprises. The level at which women's responsibility was increasing in farming systems was also examined. Findings showed that the absence of male family members in off-farm activities increased the workload and responsibilities of female family members. It also increased women's contact with the market and thereby allowed them some control over household
expenditure. It was also found that women are responsible for fodder mixing and supplementary feeding of the flock.

The roles of women, children and elders in agriculture and household activities were studied by Nongluck (1988) in Thailand. In crop production, female contribution was not only found in every activity in cropping but also showed a greater proportion of labour hours compared to male labour (37% vs 34%). In livestock production however, female labour comprises a lower proportion than male labour with supplemental labour drawn from school-aged farm boys and elder males. The crop enterprise accounted for 25% of their time whereas the business enterprise consumed about 5% of children's total time. In this study it was found that females were more engaged in crop field activity in comparison to males. It is necessary to examine whether this trend is the same in farming systems research in Bangladesh. Normally it is presumed that in crop sector male contribute more in comparison to females.

A study of the differential role of men and women in the farming systems in Chiang Mai was conducted by Benchawan et al. (1988). The comparative contribution of males and females in different activities such as crop, livestock and off farm activities was examined by the researcher. It is observed from the results that women participated in land preparation also. Overall, this study revealed that women worked fewer hours than men in crop production. Woman's work in the fields comprised about 63-65 percent of the time spent by men in crop production. Results showed that female farmers spend on an average 35 hours per week on household compared to 11 hours per week spent by their male counterparts. This study also found that men consequently know more about farming and are decision makers when it comes to agricultural matters. Formal sources of information are more accessible to men than to women while women rely on informal
sources. Decision making in other important issues for the household were also usually made by men.

The effect of the National Dairy Development Programme on small farm women in a coastal area in Kenya was examined by Mullins (1995). It is seen that the researcher has taken in to consideration the small farms and examined the contribution of women only. This reflects a partial view of farming systems. In existing farming situations there may be a small farm, medium and large farm. On the other hand there is a contribution of both males and females. It is more effective to compare the comparative performance of males and females in farming systems irrespective of farm size. However, the study showed that in general 84% of the farms owned by men but 80% of the dairy farms were owned by women. The most interesting point is that although 80% of dairy operators were women, the extension message was delivered to the male.

Similarly, a study was conducted by Jose and Shanmugaratnam (1999) in the Palode Village, Trivandrum district, Kerala in India. The proportion of family and hired labour out of total female labour and the roles of women in decision making process was the main point of consideration in this study. To gather an idea about the gender roles in the farm decision making process, questions were asked as to who makes decisions on seven important farm activities. These were a choice of subsistence crops to be grown, cash crop to be grown, planting trees, livestock keeping, labour hiring, purchasing of agrochemicals and quantity of food produce to be sold. It is clearly observed from this study that researchers examined the gender role in decision making. However, it is also important to know the contribution of women in different activities within farming systems which was absent in this study.
Sahari et al. (1991) conducted a study on women’s participation in rice and corn farming systems in Jeneponto, South Sulawesi in Indonesia. The research was conducted at Bulo-Bulo Village, Jeneponto district to study the women's participation in rural farm area and the constraints faced by women in farm activities. Here it is also seen that women's performance was measured in relation to particular two crops. In Bangladesh, farming systems are a combination of different sub systems such as cattle, poultry or fish, so it is important to know the involvement of women in farming systems as a whole.

The conclusion is, from the above literature review it was found that the research conducted in relation to performance analysis of the whole farm business was very limited. Farming systems in Bangladesh are characterised by a mixed culture of crops, livestock, forestry and fish sub systems. In most cases they utilise common resources on the one hand and constitute only a fraction of the total farm income on the other. It seems worthwhile to analyse the performance of the whole farm business for farmers decision making in respect to organisation and operation of the farm business. From the above literature it was also observed that there was no study conducted to evaluate the gender role in farming systems as a whole. The studies emphasised gender role in poultry, homestead activities or household activities. The studies were partial in nature because female or male members of the family in mixed farming systems do not concentrate only on one activity.

In addition it is also necessary to know, what the farmer's view of selecting enterprises is and whether there is there any socio economic barrier regarding selecting enterprises. If the farmers opinions are not taken in to consideration, any kind of theoretical recommendation to the farmers will not necessarily be applicable. For example over 100 technologies have been generated in different farming systems research sites in
Bangladesh and recommended for demonstration and dissemination to the farmers by the Department of Agricultural Extension (DAE). It has been observed that farmers were adopting some of them, there was not as many as expected. Since land is very scarce in the country, the government has given emphasis to promoting livestock and fisheries along with cropping. In this regard it would be helpful to know, from the farmers, how they select enterprises and what factors they consider before selecting enterprises. This will also be helpful for extension workers and implementing authorities, in order to take appropriate steps for improving the situation of the farmer.

Overall conclusion is, performance and gender role in farming systems as a whole so far has not been previously examined thoroughly in the context of Bangladesh. In addition, the farmers point of view in selecting enterprises is also an important aspect which has not been studied earlier. Therefore, there is scope for further research in this regard.
CHAPTER 3

Data Collection Methods

The methods of data collection depends on the nature of the research problem, research goals, available resources, disciplinary and personal preferences (Singleton et al. 1993). In order to choose the data collection method, the objectives of the research need to be known. The objectives are in brief; to identify the socioeconomic characteristics of farmers, to assess the relative performance of enterprises and compare the performance of alternative farming systems, to compare the utilisation of labour by gender and to find out the selection criteria of enterprises in different farming systems.

3.1. Outline of different approaches for data collection

The widely used research approaches are experiments, surveys, field research and secondary data. For example, psychologists typically conduct experiments, sociologists most often do survey research, anthropologists characteristically conduct field research, and historians tend to make use of secondary data (Singleton, et al. 1993). According to Yang (1965) when a physicist or a chemist wants to solve a problem, they go to the laboratory. If an agronomist or a crop breeder wants to test something new, they conduct experiments at a research station. It is the nature of the work which guides the researcher to select the right procedure of data collection.

It is necessary to explain briefly the nature of different types of approaches such as experimental research, surveys, field research and using secondary information. Experiments are used almost exclusively for explanatory, hypothesis testing research. They are not used extensively for descriptive purposes. Surveys can address a much
broader range of research topics than experiments. Surveys are used extensively for both descriptive and explanatory purposes. Method of field research is based on observation. Field researchers rely on field jottings and mental notes as soon after their observations as possible. The source of secondary data is mainly official records, private documents and mass media sources.

3.2. Justification of selecting survey method

The previous section discussed the different options of survey instruments and the nature of these approaches for data collection. Now the question is, which technique of surveying fits in relation to the objectives set in this research. The objectives of this research which are briefly mentioned earlier explain that qualitative and quantitative data are required for achieving the goal of the research. It is clear from the nature of the objectives that experimental research or field research is not applicable here. Besides this, secondary data will not give the appropriate data for achieving these objectives. In Bangladesh one limitation is that farmers do not keep any records of their farm activities. Only the official records could be the source of information but this is not sufficient for achieving the objectives which were set for this research. Besides this, qualitative data which involves farmer's opinions, and thinking was not possible to gather from secondary data. Moreover it is also found that in socio economic research of farming systems many researchers (Bhatia and Gangware 1980, Sirohi et al. 1980, Bogahawatte 1982, Satish and Sharma 1988, Rebeka 1994, Islam et al. 1994, Karim, 1994, Barman et al. 2001, Rashid et al. 2001) used the survey method for collecting data.
Therefore, it is suggested that among all approaches, surveys offer the most effective means of social description. They can provide extraordinarily detailed and precise information. From this point of view it is argued that surveys are the best technique of collecting data from farmers. That is why the survey method was used for collecting data from farm households under different farming systems. Details about data collection procedure are presented below.

3.3. Selection of the study area

Farm management investigation usually requires the selection of an area which is particularly suitable for fulfilling the purpose for the study. According to Yang (1965), the area in which a farm business survey is to be made depends on the particular purpose of the survey and possible co-operation from the farmers. Besides this mobility which allows easy access to the study area, time saving and cost minimising are also considerable issues for the researcher in selecting an area.

3.3.1. Considering issues of selecting an area

Since the focus of the study is to evaluate the alternative farming systems, it is usual to locate an area where diversified farming systems are available. It should be mentioned here that in Bangladesh (except the Chittagong Hill Tracts) there is more or less a similarity among the farmers in choosing common enterprises. In this regard, it is presumed that there is a similarity among the farmers of the Gazipur district and other districts of Bangladesh except the Chittagong Hill Tracts. They all undertake more or less common enterprises. Access to secondary data will also be an advantage as there are a number of related research institutes and other offices operating near the study area such as the Bangladesh Agricultural Research Institute,
Bangladesh Rice Research Institute and Bangladesh Livestock Research Institute. The Agricultural Extension Office, Livestock Extension Office and Department of Fisheries are also very close. Finally there is an advantage of mobility and easy access to the study area which helps the researcher save costs in terms of time and money.

After selection of the Gazipur district the Kaliakair Upazilla was selected randomly. The Agriculture Officer, Fisheries Officer and Livestock Officer of that Upazilla were consulted to get ideas about agricultural activities prevailing in the Upazilla. It was learnt that regular weekly meeting (every Monday) on agricultural activities are held under the initiative of the Directorate of Agricultural Extension (DAE). The overall idea about agricultural activities was obtained from the weekly meetings, where the Block Supervisors usually discuss the activities relating to cropping and other farming enterprises. Block Supervisors are the field level staff of agricultural extension offices who are in charge of one block which is constituted of 4 to 5 villages. Considering all the features like availability of diversified farming systems, access to farm-house and co-operation from the block supervisors, four villages namely Kandapara, Chanpur, Hijaltali and Uttar Gazaria of Kaliakair Upazilla were purposively selected for the study.

3.4. Identifying the farming systems

The main purpose is to evaluate the alternative farming systems. That is why it is necessary to find out the different farming systems prevailing in the four selected villages. It was not possible in the context of time to go to each farm households in the four villages to list the farmers falling under different farming systems. After the
selection of four villages, it was discussed again with the Agriculture Officer, Fisheries Officer and Livestock Officer of that Upazilla who are responsible for monitoring that villages of agricultural activities. Figure 3.1 shows the linkage between the block supervisors and groups of farmers. It should be noted that Block supervisors are the bottom level staff of DAE, who is directly linked with farmer for knowing agricultural information from the farmer.
Figure: 3.1- Block supervisor's linkage with farmers group
It is a responsibility of Block supervisors to be aware of farmer's activities. According to the Agricultural Extension Manual (1999) of Bangladesh, Block supervisors maintain the records for the block on natural resources, population, area of different crops under cultivation, numbers and types of livestock in the block of different farmers along with other responsibilities. Therefore, the primary source of information about farmers under different farming systems was the block supervisor. Preliminary lists have been obtained from the block supervisors regarding farmers belonging to different farming systems from their records and a draft list of farmers in respect of farming systems was prepared.

Cross checking was done by discussions with different groups of farmers of that area. In this regard the Agricultural Officer Mr. Nasiruddin Bhuiya, Livestock Officer Dr. Aminul Islam, Additional agriculture Officers Mr. Akkas uddin and Mrs. Dilruaba of that Upazilla helped to organise the meeting in the study area. The farmers were gathered in four convenient places at different times where I attended to meet with them. At the time of discussion with the farmers the researcher of Bangladesh Agricultural Research Institute, Mazharul Anwar, Block supervisors; Mr. Zinnat ali, Abdus sabur, Rabindra and Abdul Latif were present. Accordingly the major farming systems have been identified as follows:

1. Crop-Cattle-Poultry-Fish (C-C-P-F)
2. Crop-Cattle-Poultry (C-C-P)
3. Crop-Cattle (C-C)
4. Crop-Poultry (C-P)
3.5. Sampling design

There are hundreds of farm in different farming systems. It is generally impossible to make a farm business survey covering all these farms and it is unwise to include too many farms in a survey because it will require more effort and larger expenditure to complete the survey. Ideally in sampling it is best to obtain a sample that will be representative of the target population. There are maximum and minimum practical sample sizes that apply to virtually all surveys. Ordinarily a sample of less than about 30 respondents will provide too little certainty to be practical. It is necessary to sample more than 10 percent of the population to obtain adequate confidence (Alreck and Settle 1985). However, this is not applicable in all situation. According to Bernard 2000 sample size depends on different factors, namely;

i) The heterogeneity of the population

ii) Population size in each subgroup

iii) The size of the phenomenon that the research is trying to detect

iv) How precise one wants to sample statistics.

For example, when all elements of a population have the same score on some measure, a sample of one can be taken from the lot. According to Yang (1965) when about 20 farms possess similar characteristics, the addition of more farms will not materially change the results. Therefore roughly 20 farms should be included in each of the classes in order to make reliable comparison.

Taking into consideration all of these theoretical conceptions, thirty samples have been selected randomly from each category of the four identified farming systems.
Since, it was intended to compare between and among the category of different farming systems, it can be said that an equal number of samples in each system would provide desirable opportunity.

3.6. Period of the study

Data collection covered the total crop seasons throughout the year and a truncated picture of other farm enterprises for the year. The present research was based on one years data covered the period from January to December 2000. The farming business is seasonal. It is noted that in Bangladesh there is a wide variety of crops which are broadly classified in to two groups according to the seasons in which they were grown. They are (a) Kharif crops and (b) Rabi crops. Kharif crops are grown in the spring or summer season and harvested in late summer or in early winter. Rabi crops are grown in winter and harvested in the spring or early summer. There by information for a farm business survey covered a whole year in order to include a complete sequence of operation. Data was collected from the farm households falling in the selected farming systems by the researcher.

3.7. Use of survey technique

The two most critical features for a successful survey research are the sample and the survey technique (Singleton et al. 1993). The sample technique has been discussed previously. In this section attempt has been made to discuss about survey technique. According to Martin (1995 cited May 1997) that data collection in surveys is conducted mainly through three types of questionnaires. These are mail or self completion questionnaire; the telephone survey and the face to face interview schedule. The types of population, the nature of the research question and resources
available will determine the type of questionnaire to be used. Bernerd (2000) stated that there are three methods for collecting survey questionnaire data. These are face-to-face interviews, self administered questionnaires and telephone interviews. Bernerd further explained that each of these data collection methods has its own advantages and disadvantages. There is no conclusive evidence that one method of administering questionnaires is better overall than others.

3.7.1. Justification of choosing survey instrument

It is seen from earlier discussion that data can be collected in different ways. Without going to the arguments of advantage and disadvantage of using different techniques for collecting data, it is clearly said that self administered questionnaires or telephone interview are not applicable for collecting data from the farmers in Bangladesh. J. Martin and Manners (1995 cited May 1997) rightly pointed out that the types of population and nature of the research question will determine which type of questionnaire will be used for data collection. In this research the target group is farmers and in specific cases extension workers. In Bangladesh most of the farmer and their family members are less educated and in some cases illiterate. It is difficult for most farmers to read and recapitulate the question properly. There are also some qualitative questions that need to be included in interviewing farmers as well as extension workers for which face to face interviews will give more benefit. These causes justify that self administered questionnaires are not applicable for collecting data from the farmers in Bangladesh. Another option is the telephone interview. It is unfortunate that although farmers are the key men of the agricultural economy in the country, the subsistence level of farming is the common phenomenon in Bangladesh. Telephones are not affordable for the farmers in Bangladesh, even
extension workers such as Block supervisors have no telephone facilities. There is no alternative way of interviewing the farmers without face to face interviews in the context of Bangladesh.

3.8. Preparation of interview schedule

Interview schedule was developed in four stages. First a draft questionnaire was developed consulting with several sample questionnaire used in the field of farm survey in the context of Bangladesh. Since the success of a survey depends largely on the preparation of the survey schedule utmost care was taken in designing the draft questionnaire in conformity with the objectives of the study. The second stage, draft questionnaire was consulted with different experts in the field of farming systems and socioeconomic research in Bangladesh. The following expert members were consulted:

1. Dr. Rezaul Karim Talukder (Professor of Agricultural Economics, Bangladesh Agricultural University),
2. Professor Altaf Hossain (Professor of Agronomy, Bangladesh Agricultural University and Farming systems Research Specialist),
3. Dr. Razzaque, (Agronomist and Farming Systems Research Specialist, Bangladesh Agricultural Research Council),
4. Dr. Sirajul Islam (Professor of Agricultural Economics, Bangladesh Agricultural University),
5. Dr. Mafizur Rahman (Agricultural Economist and Principal Scientific Officer, Bangladesh Livestock Research Institute),
6. Dr. Rezaul Karim,(Senior Scientific Officer and Agricultural Economist, Bangladesh Agricultural Research Institute).
After receiving feedback from the experts, the questionnaire was modified. The third stage pre-test was then conducted. The basic reason for conducting a pre-test was to determine whether the instrument serves the purpose for which it was designed. It is the final technique for troubleshooting and improving the survey instrument, and without it, is not possible to know for certain whether the respondents will understand the questions the way researcher intended. Sample farmers for pre-testing should be as heterogeneous as possible for getting a neutral picture. In this aspect heterogeneity in relation to farming systems such as age, education and gender difference of the farmer was taken into consideration for selecting farmers for pre-testing.

Farmers were selected for pre-testing in such a way that it could give an overall unbiased picture which confirms the theme of the objective. For achieving this target I visited the Upazila Agricultural Office in a weekly meeting day (Monday) where all block supervisors were present. The objective was discussed with block supervisor assigned for selected villages and a time and place was settled with him to meet again in any one of the selected villages for conducting pre-testing on the questionnaire. The Block supervisor was met as per the schedule. I visited different farmers houses with the Block supervisor to fill the four categories of the draft questionnaire. I explained the purpose of the questionnaire to the farmer when I visited the houses. The opinion of the farmers may vary due to age, education or gender. To overcome this heterogeneity the questionnaire was pre-tested among two young farmers who were relatively educated than older ones, two old farmers and two female members from different farm households. In this way, six questionnaires were pre-tested for each category. Accordingly twenty four questionnaires were pre
tested for four dominant farming systems. The Pre-test also helped to know some local units of measurement used by the farmers. The interaction was also beneficial before final interviews with the farmers. However pre-testing required a necessary adjustment in the schedule. After the inclusion of information gained by pre-testing the final survey questionnaire was developed.

3.9. Issues with data quality

3.9.1. Interaction with farmers

Collection of accurate and reliable data and other necessary information from the field must be done properly since the success of the survey depends on reliability of data. Usually, the farmers do not keep records of annual/daily transactions or their activities. Hence, it was very difficult to collect accurate data and the researcher had to rely on the memory of the farmers. To overcome this problem, all possible efforts were made to ensure the collection of reasonably accurate data from the selected farmers through face to face interviews on recall basis. Before starting the interview, a general introduction was given in which the aims and objectives of the study were explained to the sample farmers in order to ensure cooperation from the respondents. After completion of each interview, the schedule was checked and verified to be sure that answer to each item listed had been properly recorded. If any data appeared to be inconsistent, the farmers were again interviewed for relevant questions. Data was collected by interviewing the selected farmers and their wives directly. The female members of the family were also asked to get their opinion for more accuracy and reliability of data.

It is worth to mentioning that in some cases after starting the interview, the farmer left for marketing, milking or harvesting crops which interrupted the session.
Some times farmers were not available at home which meant several visits were needed to administer a single interview schedule. Interviews were normally conducted in farmers house in their leisure time. Usually two farmers house were visited in a day, with consideration not to loose their patience or disturb their usual work.

3.9.2. Access to the female

In Bangladesh male farmers usually used the face to face interview. No female members of the family wanted to appear before the interviewer. It has become the convention that the head of the family (normally the male person) will face the interviewer. It was not an easy task to interview females because they were not bound to give an interview. In this regard Block supervisors who were familiar with all families of their block, helped to get access to female members of the sample farmers family.

3.9.3. Data were collected in local units

In order to minimise the error, data was collected from the farmers in local units. For example, in expressing the quantity of production received or quantity of input used in crop cultivation the farmers answered in a local unit such as maund, seer, chatak, or tola, whereas in standard units it should be kilogram or gram. In the case of labour utilisation for cattle management, poultry management or fish culture, they gave information like weekly, monthly or daily. In the case of quantity of eggs they replied as hali. In order to minimise errors, data was collected in local units and these local units were subsequently converted into appropriate standard units later on.
CHAPTER 4

Socio-Economic Characteristics of Sample Farmers

The farm households selected for the study were from the same area and were expected to possess similar attributes in respect to socio-economic variables. Since the farmers belonged to different farming systems, attempts were made to examine if some of the socio-economic characteristics varied among farms according to their belonging to different farming systems.

In analysing the socio-economic characteristics of the farmer, the family size and composition, age, family education, tenurial status of the farm family, utilisation pattern of own land, equipment ownership and other farm household assets of sample farmers were taken into consideration. These factors were considered for analysis because they were thought to reflect the farming communities awareness and ownership of agricultural resources. Tabular analysis was used to explain these characteristics of sample farmers. Data was also analysed using the General Linear Model (GLM) of analysis of variance (ANOVA) to find out whether there is any significant difference between gender for different age groups and educational level in different farming systems.

4.1. Distribution of family members by age and gender in the selected farming systems

Family size is defined as total number of persons living together and taking meals from the same kitchen under the administration of the head of the family. The term family includes wife, sons, unmarried daughters, father and mother. The age group
was divided here in to four categories which are; (i) below 10 years, (ii) 10-15 years, (iii) 16-55 years and (iv) above 55 years. The reason for this classification is that it is presumed that up to age 10 years a person is not able to engage themselves in any work individually or only work to help their family to perform any job. In the age range between 10-15 years they can assist their family in the kitchen or outside the house in the crop field. 16-55 years is the age of workable force when every person is able work independently. Above 55 age where persons can not contribute to work any more in rural communities.

The distribution of family members by age and gender in the selected farming systems is presented in Table 4.1. It appeared that the family size consisted of 5.02, 4.93, 4.16 and 3.95 members in the C-C-P-F, C-C-P, C-C and C-P farming systems respectively. The family size did not vary substantially across farming systems. However, it appeared from the result that family size was relatively higher in the C-C-P-F system. The proportion of male and female members for all the farming systems more or less conformed to the national picture, the ratio of which is 106:100 (BBS,1999). All the systems had the major proportion of the family members in the working age group (16-55 years).

An attempt was made to examine whether these difference between age group by gender is significant or not in different farming systems. It was found that there was no significant difference between genders among different age groups irrespective of farming systems. Also the interaction between farming system and gender was not significant. Hence data was aggregated regardless of gender for the test of four
farming systems. There was no significant difference among farming systems for individual age groups however, differences in farming systems for total ages (included male and female) was significant, \( (F_{3, 116} = 2.136, p = 0.027) \). A significant difference was detected only between C-P and C-C-P-F farming system by using Ryan's Q test method.
Table 4.1. Distribution of family members by age and gender in different farming systems (Sample for each system 30. Survey year 2001).

<table>
<thead>
<tr>
<th>Age group</th>
<th>Family members</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>C-C-P-F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below-10</td>
<td>21</td>
<td>12</td>
<td>16.5</td>
</tr>
<tr>
<td>10-15</td>
<td>21</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>16-55</td>
<td>54</td>
<td>61</td>
<td>57.5</td>
</tr>
<tr>
<td>Above-55</td>
<td>4</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Male-Female Ratio</td>
<td></td>
<td></td>
<td>51:49</td>
</tr>
<tr>
<td>Family size (Number)</td>
<td>2.56</td>
<td>2.47</td>
<td>5.02</td>
</tr>
<tr>
<td>C-C-P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below-10</td>
<td>11.22</td>
<td>11.89</td>
<td>11.55</td>
</tr>
<tr>
<td>10-15</td>
<td>15.49</td>
<td>13.21</td>
<td>14.35</td>
</tr>
<tr>
<td>16-55</td>
<td>68.41</td>
<td>66.08</td>
<td>67.24</td>
</tr>
<tr>
<td>Above-55</td>
<td>4.87</td>
<td>8.81</td>
<td>6.83</td>
</tr>
<tr>
<td>Male-Female Ratio</td>
<td></td>
<td></td>
<td>54:46</td>
</tr>
<tr>
<td>Family size (Number)</td>
<td>2.67</td>
<td>2.27</td>
<td>4.93</td>
</tr>
<tr>
<td>C-C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below-10</td>
<td>13.46</td>
<td>21.04</td>
<td>17.25</td>
</tr>
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<td>10-15</td>
<td>24.29</td>
<td>10.52</td>
<td>17.06</td>
</tr>
<tr>
<td>16-55</td>
<td>59.21</td>
<td>60.84</td>
<td>60.02</td>
</tr>
<tr>
<td>Above-55</td>
<td>3.03</td>
<td>7.59</td>
<td>5.31</td>
</tr>
<tr>
<td>Male-Female Ratio</td>
<td></td>
<td></td>
<td>48:52</td>
</tr>
<tr>
<td>Family size (Number)</td>
<td>1.97</td>
<td>2.18</td>
<td>4.16</td>
</tr>
<tr>
<td>C-P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below-10</td>
<td>9.85</td>
<td>27.46</td>
<td>18.48</td>
</tr>
<tr>
<td>10-15</td>
<td>18.07</td>
<td>5.18</td>
<td>11.82</td>
</tr>
<tr>
<td>16-55</td>
<td>70.59</td>
<td>62.17</td>
<td>66.58</td>
</tr>
<tr>
<td>Above-55</td>
<td>1.48</td>
<td>5.18</td>
<td>3.29</td>
</tr>
<tr>
<td>Male-Female Ratio</td>
<td></td>
<td></td>
<td>51:49</td>
</tr>
<tr>
<td>Family Size (Number)</td>
<td>2.03</td>
<td>1.93</td>
<td>3.95</td>
</tr>
</tbody>
</table>

Note:  C-C-P-F: Crop-Cattle-Poultry-Fish. 
       C-C-P: Crop-Cattle-Poultry. 
       C-C: Crop-Cattle. 
       C-P: Crop-Poultry.
4.2. Educational status of the members of the sample households under different farming systems

There are four tiers of educational level in Bangladesh. These are primary, secondary, higher secondary, tertiary and above. Primary level is up to year five, secondary is up to year 10, higher secondary is up to year 12 and graduation, in some cases a 2, 3 or 4 year course. In this study to identify the level of education among the farmers the above categories were followed. Since school level starts at the age of 5, below 5 years of age was shown separately. Illiteracy was also shown in table 4.2 separately.

The level of education of the sample farmers in the area studied is shown in Table 4.2. It is observed that regardless of gender there is not much difference between educational levels among the farming systems. However, educational level by gender for different farming systems was also examined to see whether there is any difference.

In primary level the result is very interesting. In every system the primary education of female members was more than male. The reason may be that the Government and different N.G.O. s are taking continuous programmes to inspire the woman of the country to get an education. As a result the number is increasing in primary level but drops off again which may be the result of early marriage and the socio-cultural attributes of rural people. Rural people think that woman should only do household work and they should not go to work outside. That is why primary education is considered enough for them. This trend is supported by the report published in the national daily news paper of Bangladesh, Daily Star on 20 January, 2002. The Report
claimed that early marriages normally end girls education in Bangladesh. Only five percent of girls continued education after marriage, compared to 68 percent among unmarried girls. According to the survey, there are about 28 million adolescents in the country and 13.7 percent of them are girls. About 5 percent of girls of 10-14 age group and 48 percent of 15-19 age group are married. (Haq, 2002). However, in Secondary School Certificate (S.S.C), Higher Secondary School Certificate (H.S.C) and above, the number of males was higher in every farming system. It is also seen that in every farming system females were more illiterate than males.

The average literacy rate was quite high for all the farming systems compared to the national average (32.4 percent according to the BBS, 1999). About 70 percent of family members had primary or secondary level education and nearly 20 percent were illiterate.

Data was analysed by using the General Linear Model (GLM) of analysis of variance (ANOVA, SPSS, 1999) to examine whether these difference were significant. It was found that there were no significant differences among farming systems for each educational level. Also the interaction between farming systems and gender was not significant for each educational level. However, there were significantly higher numbers of males was found in all farming systems for different educational levels such as in illiteracy (F₁, 232=8.904, p=0.003), SSC (F₁,232=9.6, p=0.0001), HSC (F₁, 232=5.94, p=0.016), graduates and above (F₁, 232=5.92, p=0.016).
Table 4.2. Educational status of the family members by gender in different farming systems (Sample size for each system 30, survey year 2001, selected villages in Kaliakair Upazilla).

<table>
<thead>
<tr>
<th>Educational Status</th>
<th>Male %</th>
<th>Female %</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-C-P-F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children below 5 years</td>
<td>8.74</td>
<td>6.50</td>
<td>7.67</td>
</tr>
<tr>
<td>Illiterate</td>
<td>11.41</td>
<td>20.32</td>
<td>15.74</td>
</tr>
<tr>
<td>Primary</td>
<td>38.03</td>
<td>40.65</td>
<td>39.37</td>
</tr>
<tr>
<td>Secondary</td>
<td>30.42</td>
<td>27.11</td>
<td>28.74</td>
</tr>
<tr>
<td>Higher Secondary</td>
<td>5.05</td>
<td>2.72</td>
<td>3.94</td>
</tr>
<tr>
<td>Tertiary and above</td>
<td>6.31</td>
<td>2.68</td>
<td>4.56</td>
</tr>
<tr>
<td>C-C-P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children below 5 years</td>
<td>3.66</td>
<td>4.42</td>
<td>4</td>
</tr>
<tr>
<td>Illiterate</td>
<td>7.32</td>
<td>22.13</td>
<td>14</td>
</tr>
<tr>
<td>Primary</td>
<td>29.30</td>
<td>48.67</td>
<td>38.07</td>
</tr>
<tr>
<td>Secondary</td>
<td>43.95</td>
<td>23.45</td>
<td>34.66</td>
</tr>
<tr>
<td>Higher Secondary</td>
<td>9.78</td>
<td>1.32</td>
<td>5.95</td>
</tr>
<tr>
<td>Tertiary and above</td>
<td>6.08</td>
<td>0</td>
<td>3.32</td>
</tr>
<tr>
<td>C-C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children below 5 years</td>
<td>3.20</td>
<td>11.87</td>
<td>7.67</td>
</tr>
<tr>
<td>Illiterate</td>
<td>9.70</td>
<td>18.26</td>
<td>14.17</td>
</tr>
<tr>
<td>Primary</td>
<td>37.18</td>
<td>41.09</td>
<td>39.05</td>
</tr>
<tr>
<td>Secondary</td>
<td>40.29</td>
<td>25.84</td>
<td>32.70</td>
</tr>
<tr>
<td>Higher Secondary</td>
<td>4.85</td>
<td>1.50</td>
<td>3.13</td>
</tr>
<tr>
<td>Tertiary and above</td>
<td>4.85</td>
<td>1.50</td>
<td>3.13</td>
</tr>
<tr>
<td>C-P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children below 5 years</td>
<td>0</td>
<td>8.85</td>
<td>4.20</td>
</tr>
<tr>
<td>Illiterate</td>
<td>16</td>
<td>30.97</td>
<td>23.10</td>
</tr>
<tr>
<td>Primary</td>
<td>40</td>
<td>44.25</td>
<td>42.01</td>
</tr>
<tr>
<td>Secondary</td>
<td>36</td>
<td>13.27</td>
<td>25.21</td>
</tr>
<tr>
<td>Higher Secondary</td>
<td>4</td>
<td>1.46</td>
<td>2.79</td>
</tr>
<tr>
<td>Tertiary and above</td>
<td>4</td>
<td>1.46</td>
<td>2.79</td>
</tr>
</tbody>
</table>

Note: C-C-P-F: Crop-Cattle-Poultry-Fish
C-C-P: Crop-Cattle-Poultry
C-C: Crop-Cattle
C-P: Crop-Poultry
4.3. Land ownership and operation of the sample farms in the selected farming systems

The aim of this section is to explain the land ownership picture of sample farmers of the study area. Land tenure is a broad term covering all those relationships established among men which determine their varying rights in the use of land. This section outlines the division of property rights among various owners and users of land in relation to the sample farmers studied. Land tenure refers to the possession of rights to the use of land. People hold varying kinds of right in the use of land and are said to belong to different tenurial classes (Bishop and Toussaint, 1958).

In Bangladesh farmers cultivate their own land as well as using rented in or rented out pieces of land. Farmers take leases from others which is known as a mortgage. For more clarity the terms are explained in brief.

**Rented in:** An arrangement where a piece of land is taken into possession to the farmer for a certain period of time by paying some amount of money. After that period the land will go to the possession of owner of the land.

**Rented out:** An arrangement where a piece of land handed over to the possession of another farmer for a certain period of time by receiving some amount of money.

**Mortgage in:** An arrangement where a piece of land is taken into possession from another farmer for a long term period by paying some amount of money. The land will be released to the owner after the full amount of money is paid back.
Mortgage out: An arrangement where a piece of land is handed over to the possession of another farmer for a long term period by receiving some amount of money. The land will be released to the owner after the full amount of money is paid back.

Table 4.3. Land ownership and operated area of farms in the selected farming systems

<table>
<thead>
<tr>
<th>Tenure categories</th>
<th>C-C-P-F Area (ha)</th>
<th>C-C-P Area (ha)</th>
<th>C-C Area (ha)</th>
<th>C-P Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Own</td>
<td>0.75</td>
<td>0.68</td>
<td>0.64</td>
<td>0.49</td>
</tr>
<tr>
<td>B. Rented in</td>
<td>0.16</td>
<td>0.18</td>
<td>0.07</td>
<td>0.08</td>
</tr>
<tr>
<td>C. Rented out</td>
<td>-</td>
<td>0.06</td>
<td>0.07</td>
<td>0.06</td>
</tr>
<tr>
<td>D. Crop land (operated)</td>
<td>0.91</td>
<td>0.80</td>
<td>0.64</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Land ownership and operation of farms falling in the selected farming systems is presented in table 4.3. This table states how the farmers cultivate crops by managing the land in various ways. It also gives an idea about the average crop land of the farmer. It appeared that crop land was highest in the C-C-P-F system followed by C-C-P, C-C and C-P systems subsequent by rented in and rented out pieces of land. It is also observed that in the C-C-P-F system owned area was also highest followed by C-C-P, C-C and C-P systems.

4.4. Utilisation pattern of owned land of sample farmers in the selected farming systems

Farm size is measured by the entire land area owned by the farmer (Yang, 1965). It is computed by adding the area of land rented from others and subtracting the area of rented out to others, to the area of land owned by the farmers which is treated as
crop land. In addition the homestead area, pond area, orchard and fallow land of the farmers falling under different farming systems were shown in table 4.4.

Table 4.4. Utilisation pattern of own land in the selected farming systems

<table>
<thead>
<tr>
<th>Land category</th>
<th>C-C-P-F Area (ha)</th>
<th>C-C-P Area (ha)</th>
<th>C-C Area (ha)</th>
<th>C-P Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop land</td>
<td>0.91</td>
<td>0.80</td>
<td>0.64</td>
<td>0.51</td>
</tr>
<tr>
<td>Homestead</td>
<td>0.07</td>
<td>0.07</td>
<td>0.05</td>
<td>0.06</td>
</tr>
<tr>
<td>Pond</td>
<td>0.23</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fallow</td>
<td>0.02</td>
<td>0.05</td>
<td>-</td>
<td>0.03</td>
</tr>
<tr>
<td>Orchard</td>
<td>0.02</td>
<td>0.01</td>
<td>0.36</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>1.25</td>
<td>0.93</td>
<td>1.05</td>
<td>0.60</td>
</tr>
</tbody>
</table>

In a farming systems approach, crop land and crop production activities constitute only one component of the whole farm business. As has been mentioned, homestead and water area provides enough scope for important economic activities. The average homestead area of farms reasonably provides a large scope for the homestead to constitute an important component of the farm business. The homestead area ranged from 0.05 hectare to 0.07 hectare for farms falling under different farming systems.

4.5. Farm resource inventory of households in the selected farming systems

Farm resource inventory means the machinery, equipment or structures which are owned by the farmer and are used for cultivating the crops, catching the fish and the management of cattle and poultry. This resource inventory will give an idea about the farmers in Bangladesh in that, they are very poor in resource endowment. Each of the farmers had a plough, ladder, rack, spade, swing basket, don, kachi and nirani. Equipment also included a fishing net and other simple appliances. In Bangladesh living spaces of the household are often used to preserve the farms equipment which is used for crop cultivation and catching fish. The only separate structure that can be
identified is the cattle shed and they build poultry sheds by clay in the homestead area or make wooden ones which remain in the living room. An inventory of these fixed assets is presented in appendix-1 table 5.

The total value of farm resources was highest for the C-C-P-F farming system amounting to Tk 6,851 followed by the C-C-P, C-C and C-P farming systems for which the total value of resources were Tk 6,690, Tk 5,310 and Tk 1,329 respectively. The lowest value of the farm resources were found in C-P farming system which was much lower than the other three systems. The reason was cattle component was not included here which incurred approximately Tk. 4,500 for construction of cattle shed in the other three systems.

**Conclusion:** The sample farms did not vary considerably across farming systems in socio-economic attributes, namely family size and educational status. However result showed that female were more than male in primary education but other educational level males were more than female in every system. More females are found illiterate in each system. Besides this, crop land area and total area of land were all higher for the C-C-P-F system.
CHAPTER 5

Performance Analysis of Different Farming Systems

In this chapter, performance of individual enterprises as well as the whole farm business have been examined using a variety of income measures. While examination of performance of individual enterprise or components has been limited to gross margin analysis, for the whole farm business this has been extended to a series of residual income measures such as net farm income and management income. Besides this, benefit cost ratio and returns to labour were also calculated to make comparisons among different farming systems and to examine the performance critically.

Gross margin has limitations, it can not depict the whole picture of individual enterprises or the whole farm business. However, it is a convenient technique of analysis in situations where some of the cost items, especially the fixed ones, cannot be allocated to individual enterprises. Gross margins are only a short term decision making criteria. Whether or not a farm business is profitable in the long-run will depend on the residual income which remains after charging for the fixed inputs. In the present analysis, attempts have been made to derive some selected measures of success of the whole farm business by considering the opportunity cost of the fixed resources equal to the market price for the services of resources. The measures of performance of the alternative farming systems are analysed here in terms of the residual income measures such as "net farm income", and "operators labour and management income" (Castle et al. 1972 and Yang 1965).
5.1. Specification and derivation of income measures

The relative performance of different enterprises and that of the whole farm business were assessed in terms of the following income concepts:

5.1.1. Gross output

5.1.2. Gross margin

5.1.3. Net Farm Income

5.1.4. Operators labour and management income

5.1.5. Returns to labour per hour

5.1.6. Benefit cost ratio (BCR).

5.1.1. Gross output

Gross output was calculated by multiplying the total volume of production of an enterprise by the farm gate price. For crop enterprise, it consisted of the values of main and by-products. For cattle, poultry and fish, gross output consisted of the values of main products, by products and net change in inventory. Net change in inventory was calculated as: (closing stock + sold + consumed) - (opening stock + purchased).

5.1.2. Gross margin

Gross margin was derived by subtracting variable cost from the gross output (Gross output-variable cost). For the purpose of this study, the opportunity cost of family labour other than that of the operator was considered as a variable cost and as such was deducted from the gross output to arrive at the gross margin. The sum of the gross margin of the individual enterprises represented gross margin for the whole
farm business. For crop enterprises, gross margins per hectare were calculated for the operated area of the crop enterprises.

5.1.3. Net farm income

Net farm income represents return to the farm family for contribution of labour, capital and management. It is calculated by subtracting the selected fixed cost items namely rental value of land use, rental value of shelter cost for cattle, poultry and depreciation of farm resources from the sum of the gross margin for the whole farm business (Net farm income = Gross margin-fixed cost).

5.1.4. Operator’s labour and management income

Operator’s labour and management income was derived as the difference between the value of net farm income and opportunity cost of operating capital. Thus operator’s labour and management income = (Net farm income – opportunity cost of operating capital).

5.1.5. Returns to labour per hour

Returns to labour per hour = Gross output-Cost of all other inputs except labour cost which is divided by total labour hours. This can be written as Gross margin+ Total labour cost/ Total labour hour (IRRI 1984 pp-38). In this analysis gross margin per farm of different components in each farming system were summed up. For example gross margin for crop, cattle, poultry and fish components of C-C-P-F systems were added for obtaining the total gross margin per farm. Then total labour cost for individual components were also combined (summed). Similarly, total labour hours required for crop, cattle, poultry and fish culture were summed up. The same procedure was applied in other systems.
5.1.6. Benefit cost ratio (BCR)

Benefit cost ratio (BCR) was calculated by gross output divided by variable cost. Gross output for different components in each farming system were summed up. Similarly, variable costs for different components in each system were summed up. For example, for getting the gross output per farm of the C-C-P-F system, gross outputs of crop, cattle, poultry and fish enterprise were added. Similarly, variable costs of crop, cattle, poultry and fish enterprise were added. Accordingly, BCR was calculated for other farming systems.

5.2. Evaluation of cost items

To determine the relative profitability of crops it was necessary to compute all cost items which were deducted from the value of outputs. Farmers in the study area used purchased inputs as well as home supplied inputs. The cost of purchased inputs such as fertilisers, irrigation, insecticides and hired labour were valued at the prevailing market rates or at the farmers purchasing prices. For some unpaid inputs, such as family labour, home supplied animal power and manures, no cash price was actually paid. In calculating the cost of family labour, home supplied animal labour and manures, the principle of opportunity cost was followed. Opportunity cost of an input is defined as the income which an input is capable of earning in an alternative employment in or outside the farm (Bishop and Toussaint, 1958). The following cost items were included:

5.2.1. Cost of labour

5.2.2. Animal or mechanical power cost

5.2.3. Land use cost

5.2.4. Cost of manure
5.2.5. Cost of fertiliser
5.2.6. Cost of insecticide
5.2.7. Cost of irrigation
5.2.8. Cost of maintaining domestic animal and poultry birds
5.2.9. Interest on operating capital
5.2.10. Depreciation of farm resources

5.2.1. Cost of labour

Labour was the most important input in the production of different enterprises. Labour was classified into two categories, namely family labour, which includes the operator himself, other male and female members of the family and hired labour which includes permanently hired labour, casual labour and labour employed on contract basis.

In determining family labour cost, days/hours devoted to different categories of workers were taken into account. Eight adult male hours were assumed equivalent to one man-day. The total cost of family labour was calculated by multiplying the total man-days by the market wage rate, which gave the opportunity cost of family labour. Family labour = Total man days worked × rate of hired labour.

In working out the cost of annually hired labour, the total cash paid was added to the value of whatever was paid in kind. In computing the cost of other hired labour actual wages paid were charged and in the case where the hired labour was provided with a meal, the money value of such payment was added to the cash paid. Family
labour was priced at the rate of the hired labour and in the study area the wage rate was Tk. 80 for eight hours work or one man-day

5.2.2. Animal/Mechanical power cost

In the present study two types of power, namely animal and power tiller were used. Animals were generally used for ploughing, laddering, seedbed preparation, threshing and carrying, whereas power tiller was used only for land preparation. Animal power consisted of six working hours a day. For computing animal labour cost, the cost of human labour was deducted from the cost paid for the services of a pair of animals with the ploughman. The cost of a ploughman was included in the human labour cost. Animal labour cost = Animal hired cost-human labour cost.

In the study area the cost of hired animal pair-day was Tk.60.00. In this study, home supplied animal pair-day was priced according to the prevailing market rate in the area which was Tk. 60.00 per pair for six hours working day. Some of the sample farms used mechanical power (power tiller) instead of animal power from hired sources for the preparation of their land. In this case the hired charge of power tiller was included as a cost figure.

5.2.3. Land use cost

In this study, the cost of land use was calculated by taking the rental value per unit of land per year in the study area. The average rental value in the study area varied within 5 to 7 thousand taka per hectare. This value was ascertained from discussions with the farmer. In this study, rental value of the land were assumed 6,000 taka per hectare per year. It is noted that the average land area of C-C-P-F, C-C-P, C-C and
C-P systems were 1.25, 0.93, 1.05 and 0.60 hectares. The rental value of the land was calculated by multiplying the land area for each system. In this way rental values were found, Tk. 7,500, Tk. 5,580, Tk. 6,300 and Tk. 3,600 for C-C-P-F, C-C-P, C-C and C-P system respectively.

5.2.4. Cost of manures

For producing different crops, most of the farmers used cow dung as manure. Farmers used both purchased and home produced manures. On the basis of the prevailing local rates, the cost of cow dung was charged at the rate of 0.50 Taka/Kg.

5.2.5. Cost of fertiliser

Farmers in the study area used three kinds of chemical fertiliser, namely urea, triple super phosphate (TSP) and murate of potash (MP). The cost of fertilisers were charged at the prevailing market rates in the area during the study period and the rates were Tk 5.5/ kg of urea, Tk. 12.00 /kg of TSP and Tk. 9.00/kg of MP.

5.2.6. Cost of insecticide

A considerable number of farmers applied insecticides to some crops. The cost was computed on the basis of actual cost paid by the farmers. The cost of insecticides represented the amount of money actually paid by the farmers for the input.
5.2.7. Cost of irrigation

In the study area, farmers had to depend on mechanical irrigation. The cost of irrigation represented the amount of money actually paid for the input. In the study area there was an irrigation scheme. Farmers contacted the project manager for providing irrigation to their land as per requirement. The money which had been paid by farmers was taken into consideration as irrigation cost.

5.2.8. Cost of maintaining domestic animals and poultry birds

In the study area, for maintaining domestic animals and poultry birds mainly straw, grass, oil cake, grain, bran were used. Among these feeds, some were home supplied and some were purchased. Farmers own supplied feed was valued at the prevailing market rate in the area studied and the cost of purchased feed represented the actual prices paid by the farmers for purchasing of feed. Veterinary expenses represented the actual money paid by the farmers for hiring of doctor’s services and purchase of medicines for the treatments of domestic animals and poultry birds.

5.2.9. Interest of operating capital

In the present study, interest rate was assumed at the rate of 9 percent per annum, considering the bank interest rate for depositing the money in a savings account. If the farmers do not invest their money in to farming and keep it in savings account, this is the consideration for calculating the opportunity cost of working capital. The interest rate varied from 8-10 percent per annum in savings accounts in the commercial banks of Bangladesh. The amount of operating capital considered here was all the variable costs such as labour, cost of hired bullock, cost of hiring
tractor/power tiller, fertiliser, manure, irrigation costs, seed, feed cost, veterinary costs.

5.2.10. Depreciation of farm resources

The cost of equipment was calculated by taking into account the charges for the depreciation of the equipment. Depreciation was calculated by the present value of the equipment, being adjusted for salvage value, was divided by the remaining life of the concerned implements to arrive at an annual depreciation cost. The depreciation values of the implements for each system were summed to get the annual depreciation. In this way annual depreciation of C-C-P-F, C-C-P, C-C and C-P systems were found Tk. 1420, Tk. 1264, Tk. 1083 and Taka 294 respectively. Details calculation was presented in appendix 1- table 5.

5.3. Analysis of farm business of the selected farming systems

This section contains the results from analysis for the four farming systems under study. The comparative performance of the crop component was examined first in section 5.4. followed by analysis of the livestock and fish components for respective farming systems in section 5.5. (5.5.1-5.5.3). An overall relative performance of alternative farming systems was presented in section 5.6. In addition the residual income measures approach was discussed in section 5.7.
5.4. Comparative performance of crop component under alternative farming systems

The gross margin per hectare, per farm and BCR for the individual crop component under different farming systems are presented in Table 5.1, 5.2, 5.3 and 5.4 respectively. It is observed that gross margin and BCR for individual enterprises varied in different systems. From this study it is revealed that, on an average, in every system vegetables earned higher gross margins and BCR in comparison to other enterprises. Since vegetable production required less variable costs in relation to return, better gross margin and BCR were achieved by the farmer in every system.

However, it is expected that farmers will consider overall income by utilising their whole crop land in respective farming systems. Thereby, it is important to know which systems earned higher gross margin per hectare, in respect of crop production, by utilising their total crop land area. Highest gross margin per hectare was found in the C-P system (Table 5.4.) of Tk. 36,959 although this system had the lowest crop land area of 0.51 hectare. Lowest gross margin per hectare was found in the C-C system of Tk 29,997, the crop land area of this system was 0.64 hectare (Table 5.3). The result implied that, over all performance by sample farmers in the C-P system was relatively better in comparison to the other three systems for producing different crops.
Table 5.1. Gross margin and BCR of crop component under C-C-P-F farming system

<table>
<thead>
<tr>
<th>Name of crop/product</th>
<th>Area (ha)</th>
<th>Gross output (Tk)</th>
<th>Variable cost (Tk)</th>
<th>Gross margin (Tk) Per farm</th>
<th>Gross margin (Tk) Per hectare</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boro paddy</td>
<td>0.61</td>
<td>32622</td>
<td>16104</td>
<td>16518</td>
<td>27079</td>
<td>2.03</td>
</tr>
<tr>
<td>Mustard</td>
<td>0.16</td>
<td>3419</td>
<td>1977</td>
<td>1442</td>
<td>9013</td>
<td>1.73</td>
</tr>
<tr>
<td>Aman paddy</td>
<td>0.21</td>
<td>5751</td>
<td>3029</td>
<td>2722</td>
<td>12962</td>
<td>1.90</td>
</tr>
<tr>
<td>Pulse</td>
<td>0.10</td>
<td>1832</td>
<td>1200</td>
<td>632</td>
<td>6320</td>
<td>1.53</td>
</tr>
<tr>
<td>Jute</td>
<td>0.14</td>
<td>3218</td>
<td>2461</td>
<td>757</td>
<td>5407</td>
<td>1.31</td>
</tr>
<tr>
<td>Vegetables</td>
<td>0.17</td>
<td>10271</td>
<td>4841</td>
<td>5430</td>
<td>31941</td>
<td>2.12</td>
</tr>
<tr>
<td>Total</td>
<td>0.57</td>
<td>57113</td>
<td>29612</td>
<td><strong>27501</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop land area</td>
<td>*0.91</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Gross margin per hectare of crop land area = 30221**

Note: *Table 4.3 chapter 4

**Gross margin per hectare of crop land area = Total gross margin per farm divided by crop land area.

Table 5.2. Gross margin and BCR of crop component under C-C-P farming system

<table>
<thead>
<tr>
<th>Name of crop</th>
<th>Area (ha)</th>
<th>Gross output (Tk)</th>
<th>Variable cost (Tk)</th>
<th>Gross margin (Tk) Per farm</th>
<th>Gross margin (Tk) Per hectare</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boro paddy</td>
<td>0.62</td>
<td>33,833</td>
<td>17,629</td>
<td>16,204</td>
<td>26135</td>
<td>1.92</td>
</tr>
<tr>
<td>Mustard</td>
<td>0.22</td>
<td>3899</td>
<td>2753</td>
<td>1146</td>
<td>5209</td>
<td>1.42</td>
</tr>
<tr>
<td>Aman paddy</td>
<td>0.09</td>
<td>3250</td>
<td>2112</td>
<td>1138</td>
<td>12644</td>
<td>1.54</td>
</tr>
<tr>
<td>Wheat</td>
<td>0.10</td>
<td>2338</td>
<td>1496</td>
<td>842</td>
<td>8420</td>
<td>1.56</td>
</tr>
<tr>
<td>Pulse</td>
<td>0.12</td>
<td>1759</td>
<td>1175</td>
<td>584</td>
<td>4867</td>
<td>1.50</td>
</tr>
<tr>
<td>Jute</td>
<td>0.09</td>
<td>2159</td>
<td>1687</td>
<td>472</td>
<td>5244</td>
<td>1.28</td>
</tr>
<tr>
<td>Vegetables</td>
<td>0.21</td>
<td>12,885</td>
<td>7480</td>
<td>5405</td>
<td>25738</td>
<td>1.72</td>
</tr>
<tr>
<td>Total</td>
<td>0.60</td>
<td>60,123</td>
<td>34,332</td>
<td><strong>25791</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop land area</td>
<td>*0.80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Gross margin per hectare of crop land area = 32239**

Note: *Table 4.3 chapter 4

**Gross margin per hectare of crop land area = Total gross margin per farm divided by crop land area.
Table 5.3. Gross margin and BCR of crop component under C-C farming system

<table>
<thead>
<tr>
<th>Name of crop</th>
<th>Area (ha)</th>
<th>Gross output (Tk)</th>
<th>Variable cost (Tk)</th>
<th>Gross margin (Tk)</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Per farm</td>
<td>Per hectare</td>
</tr>
<tr>
<td>Boro paddy</td>
<td>0.44</td>
<td>21536</td>
<td>11280</td>
<td>10256</td>
<td>23309</td>
</tr>
<tr>
<td>Mustard</td>
<td>0.11</td>
<td>1563</td>
<td>1249</td>
<td>314</td>
<td>2855</td>
</tr>
<tr>
<td>Aman paddy</td>
<td>0.10</td>
<td>3344</td>
<td>2190</td>
<td>1154</td>
<td>11540</td>
</tr>
<tr>
<td>Jute</td>
<td>0.14</td>
<td>3263</td>
<td>2285</td>
<td>978</td>
<td>6986</td>
</tr>
<tr>
<td>Vegetables</td>
<td>0.18</td>
<td>10541</td>
<td>4045</td>
<td>6496</td>
<td>36088</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>40247</td>
<td>21049</td>
<td><strong>19198</strong></td>
<td></td>
</tr>
</tbody>
</table>

Crop land area | *0.64 |

**Gross margin per hectare of crop land area = 29997

Note: *Table 4.3 chapter 4
**Gross margin per hectare of crop land area = Total gross margin per farm divided by crop land area.

Table 5.4. Gross margin and BCR of crop component under C-P farming system

<table>
<thead>
<tr>
<th>Name of crop</th>
<th>Area (ha)</th>
<th>Gross output (Tk)</th>
<th>Variable cost (Tk)</th>
<th>Gross margin (Tk)</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Per farm</td>
<td>Per hectare</td>
</tr>
<tr>
<td>Boro paddy</td>
<td>0.39</td>
<td>20697</td>
<td>7507</td>
<td>13190</td>
<td>33821</td>
</tr>
<tr>
<td>Mustard</td>
<td>0.12</td>
<td>2095</td>
<td>1631</td>
<td>464</td>
<td>3867</td>
</tr>
<tr>
<td>Aman paddy</td>
<td>0.16</td>
<td>4662</td>
<td>2520</td>
<td>2142</td>
<td>13388</td>
</tr>
<tr>
<td>Wheat</td>
<td>0.09</td>
<td>1941</td>
<td>1164</td>
<td>777</td>
<td>8633</td>
</tr>
<tr>
<td>Jute</td>
<td>0.07</td>
<td>1609</td>
<td>1357</td>
<td>252</td>
<td>3600</td>
</tr>
<tr>
<td>Vegetables</td>
<td>0.06</td>
<td>3289</td>
<td>1265</td>
<td>2024</td>
<td>33733</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>34293</td>
<td>15,444</td>
<td><strong>18849</strong></td>
<td></td>
</tr>
<tr>
<td>Crop land area</td>
<td>*0.51</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Gross margin per hectare of crop land area = 36 959

Note: * Table 4.3 chapter 4
**Gross margin per hectare of operated area = Total gross margin per farm divided by crop land area.
5.5. Comparative performance of cattle, poultry and fish component of alternative farming systems

Gross output and gross margin of the cattle, poultry and fish components of different farming systems are presented in Tables 5.5, 5.6 and 5.7, respectively.

5.5.1. Gross margin and BCR of cattle component of alternative farming systems

As mentioned earlier, gross output of the cattle component consisted of the value of the animal products and by-products. Income from the cattle included the income from draft power, selling milk and cow dung and straw. Inventory of the cattle included the bullock, cow and calf of sample farmers.

Table 5.5. Gross margin and BCR per farm of cattle component under alternative farming systems

<table>
<thead>
<tr>
<th>System</th>
<th>Income (Tk)</th>
<th>Net change (Tk)</th>
<th>Gross output (Tk)</th>
<th>Variable cost (Tk)</th>
<th>Gross margin per farm (Tk)</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-C-P-F</td>
<td>7695</td>
<td>10984</td>
<td>18679</td>
<td>9233</td>
<td>9446</td>
<td>2.02</td>
</tr>
<tr>
<td>C-C-P</td>
<td>9315</td>
<td>9716</td>
<td>19031</td>
<td>8304</td>
<td>10727</td>
<td>2.29</td>
</tr>
<tr>
<td>C-C</td>
<td>8334</td>
<td>12598</td>
<td>20932</td>
<td>8688</td>
<td>12244</td>
<td>2.41</td>
</tr>
</tbody>
</table>

Table 5.5. illustrates that gross margin and BCR appeared lowest in C-C-P-F system. In this system more time was spent in cattle management. Overall performance was best in the C-C farming systems since gross margin per farm and BCR both were highest in this system.
5.5.2. Gross margin and BCR of poultry component of alternative farming systems

Gross output of poultry also consisted of the value of poultry products and by-products and net change in the inventory of the poultry birds. Income from poultry included the sale of hens, cocks and chickens and the sale of eggs. Inventory of the poultry birds included the hen, cock and chicken of the sample farmer. Derivation of gross margin and BCR for the selected farming systems is shown in table 5.6.

Table 5.6. Gross margin and BCR per farm of poultry component under alternative farming systems.

<table>
<thead>
<tr>
<th>System</th>
<th>Income from poultry (Tk)</th>
<th>Net change in inventory (Tk)</th>
<th>Gross return (Tk)</th>
<th>Variable cost (Tk)</th>
<th>Gross margin per farm (Tk)</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-C-P-F</td>
<td>1451</td>
<td>912</td>
<td>2363</td>
<td>840</td>
<td>1523</td>
<td>2.81</td>
</tr>
<tr>
<td>C-C-P</td>
<td>1490</td>
<td>1068</td>
<td>2558</td>
<td>918</td>
<td>1640</td>
<td>2.79</td>
</tr>
<tr>
<td>C-P</td>
<td>1010</td>
<td>895</td>
<td>1905</td>
<td>677</td>
<td>1228</td>
<td>2.81</td>
</tr>
</tbody>
</table>

Table 5.6. illustrates that the gross margin per farm was highest in the C-C-P system. In this system, variable cost was also high. But in relation to the other two systems gross output was much higher. As a result of which, gross margin became higher in the C-C-P system compared to the other systems. Gross margin per farm was the lowest for the C-P system, although this group of farms had a slightly higher BCR in comparison to the C-C-P system. This group of farms also had the lowest variable cost (Tk. 677). Because poultry rearing does not require much labour and has low feed cost in the existing farming situation in Bangladesh, poultry are not reared commercially.
5.5.3. Gross margin and BCR of the fish component of C-C-P-F farming system

Derivation of gross output and gross margin and BCR for the fish component are presented in table 5.7.

**Table 5.7. Gross margin and BCR per farm of fish component under C-C-P-F farming System.**

<table>
<thead>
<tr>
<th>System</th>
<th>Gross output (change in inventory) (Tk)</th>
<th>Variable cost (Tk)</th>
<th>Gross margin per farm (Tk)</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-C-P-F</td>
<td>77672</td>
<td>38809</td>
<td>38863</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Table 5.7 shows that fish were the most profitable of all enterprises in terms of gross margin. Though initial investment is high, farmers received a good market price for fish, due to a higher demand of fish. It is noted that in Bangladesh per capita annual fish intake is 12.04 k.g whereas per capita annual fish requirements are 18.0 k.g. This justifies that farmers can earn more from fish cultivation. (Source: Fisheries resources information of Bangladesh 1999-2000).

5.6. Relative performance of alternative farming systems

The previous section dealt with the derivation and interpretation of gross margin and BCR for individual enterprises or components under alternative farming systems. In an individual component analysis it was observed that the crop component showed good performance in one system whereas the cattle component showed better performance in another system. Similarly, the poultry component showed better performance in another system. These results give an idea of which component or enterprise achieved good gross margins and BCR.

However, better performance in one enterprise or sub systems such as cattle, poultry or fish will not give a clear performance picture of the systems as a whole. In this
section the performance of different systems as a whole is examined. Returns to labour per hour for different farming systems were also taken into consideration to make an amenable comparison among the farming systems. Gross output, variable cost, gross margin per farm, BCR and returns to labour per hour for four different farming systems are presented in Table 5.8.

Table 5.8. Relative performance of alternative farming systems (per farm)

<table>
<thead>
<tr>
<th>Systems</th>
<th>Gross output (Tk)</th>
<th>Variable cost (Tk)</th>
<th>Gross margin (Tk)</th>
<th>BCR</th>
<th>Returns to labour per hour (Tk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-C-P-F</td>
<td>155827</td>
<td>78494</td>
<td>77333</td>
<td>1.99</td>
<td>30</td>
</tr>
<tr>
<td>C-C-P</td>
<td>81712</td>
<td>43554</td>
<td>38158</td>
<td>1.88</td>
<td>27</td>
</tr>
<tr>
<td>C-C</td>
<td>61179</td>
<td>29737</td>
<td>31442</td>
<td>2.06</td>
<td>28</td>
</tr>
<tr>
<td>C-P</td>
<td>36198</td>
<td>16121</td>
<td>20077</td>
<td>2.25</td>
<td>28</td>
</tr>
</tbody>
</table>

In terms of gross margin per farm, it is observed that gross margin is higher in the C-C-P-F, with a large gap in performance compared to other systems. The reason was that the fish component appeared to be the most profitable in this system. The highest BCR was found in the C-P system followed by C-C, C-C-P-F and C-C-P. On the other hand, in terms of returns to labour per hour was highest in C-C-P-F system.

However, another important thing is that the average returns to labour per hour for different farming systems were found to be around Taka 30 in different farming systems. It is noted that in Bangladesh labour could be hired in agriculture and other related activities within the range of 10-15 taka per hour. The returns to labour obtained from this study suggests that although labour is surplus in agriculture, it is more profitable to invest time in one's own farm rather than going out as hired labour.
5.7. Comparative performance of alternative farming system on residual income measures basis

In the present analysis, an attempt has been made to derive some selected measures of success of the whole farming business by considering the opportunity cost of the fixed resources equal to the market price for the services of resources. The measures of performance of the alternative farming systems are analysed here in terms of the residual income measures such as "net farm income", and "operator's labour and management income"

**Net farm income** = Gross margin-fixed cost. Gross margin of respective farming systems were presented in table 5.8. Fixed cost included the rental value of operated land and depreciation of farm resources for respective farming systems. The calculation procedure of the rental value of land and depreciation of farm resource were discussed in 5.2.3 and 5.2.10.

**Labour and management income** = Net farm income-opportunity cost of working capital. Opportunity cost of working capital was calculated by multiplying the variable cost by the interest rate per annum, if the farmers had deposited the money in a savings account of a bank rather than investing in the farm business. Interest rate per annum was assumed at 9%. The calculation of interest on working capital was discussed on 5.2.9 and the variable cost for each system was presented earlier in table 5.8. Income measures were derived for the C-C-P-F, C-C-P, C-C and C-P farming systems and the results are presented in table 5.9.
Table 5.9. Residual income measures of performance of alternative farming systems (in Taka).

<table>
<thead>
<tr>
<th>Systems</th>
<th>Fixed cost</th>
<th>Net farm income</th>
<th>Opportunity cost of working capital</th>
<th>Labour and Management income</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-C-P-F</td>
<td>8920</td>
<td>68413</td>
<td>7064</td>
<td>61349</td>
</tr>
<tr>
<td>C-C-P</td>
<td>6844</td>
<td>31314</td>
<td>3920</td>
<td>27394</td>
</tr>
<tr>
<td>C-C</td>
<td>7383</td>
<td>24059</td>
<td>2676</td>
<td>21383</td>
</tr>
<tr>
<td>C-P</td>
<td>3894</td>
<td>16183</td>
<td>1451</td>
<td>14732</td>
</tr>
</tbody>
</table>

It appeared from table 5.9 that the C-P farming system had the lowest labour and management income. Although poultry had limited costs, in existing farming practice farmers could not earn more by poultry rearing due to limited numbers of poultry birds. The C-C-P-F farming system had the highest labour and management income in comparison to all systems. It appeared that due to the fish component, the gross margin was higher in the C-C-P-F system in comparison to the other three systems. From the above discussion, it can be said that although all farming systems earned positive labour and management income under all possible full cost considerations, the C-C-P-F system would be the most viable.

5.8. Conclusion

The performance of different systems varied with the application of different performance measures (Table 5.8). Comparative performance measures such as gross margin, BCR and returns to labour per hour for the whole farm business suggests that farmers could choose either the C-C-P-F or C-P system. The C-C-P-F system seemed to be better because in this system the gross margin was much higher than in the other three systems. Returns to labour was also higher in C-C-P-F in comparison to other three systems. On the other hand, farmers can choose the C-P system, although gross margin was lowest in this system, because BCR was higher than for the other
systems. Another performance measure such as returns to labour per hour in the C-P system was also close to the highest. In Bangladesh capital as well as land is scarce for poor farmers. Therefore, it would be expected that most farmers give more importance to BCR in selecting farming systems. On the other hand, using the residual income measure approach, it was found that the C-C-P-F system was the best of all systems (Table 5.9).

It is not possible to draw any conclusive decision from the above result regarding which system is the best. It is the farmer's choice which performance criteria will be acceptable to them in the context of their economic condition. On the basis of above discussion, farmers can choose either the C-C-P-F or C-P system. However, in general the C-C-P-F system seemed to be relatively better because, other than BCR, economic performance was found to be highest in this system.
CHAPTER 6

Resource Use Efficiency by Using Cobb-Douglas Production Function

The previous section dealt with determination and comparison of relative profitability of alternative farming systems. In this section input use efficiency for producing output was examined. The production function analysis was done to examine the effects of application of variable inputs to the production of crop, cattle, poultry and fish components. There were various types of production functions, quadratic production function, constant elasticity (CES) production function and polynomial production function. It has long been accepted that none of the production function is unequivocally superior to others in all circumstances.

It is generally argued that the Cobb-Douglas production function is the more appropriate in the context of agricultural production (Heady and Dillon, 1961). The choice of functional form was based on its theoretical fitness to agriculture and its computational manageability (Barman 2001). Further, most production studies in agricultural sector have used this function (Sahota 1968, Dhawn and Bansal 1977, Ashrafuzzaman 1995, Anwar, 1998, Azad 1999, Awal 2000, Barman et. al 2001, Rashid 2001). Hence, Cobb-Douglas production function model was used in this study. In empirical research, the function form is expected to be not only logically justifiable but also computational feasible. Moreover, the algebraic model provides a compromise between (a) adequate fit of the data and (b) sufficient degrees of freedom used to allow for statistical testing. Since the function takes the form of multiple linear regression in logarithm, it can be solved by the procedure of Ordinary
Least Square (OLS) and it is an “efficient user” of degrees of freedom. Such efficiency is important where research resources are limited. However, the specification of production function models are given below:

6.1. Specification of production function model for different components of alternative farming systems

6.1.1. Crop component

The Cobb–Douglas functional form of the multiple regression equation for crop component is specified as follows:

\[ GR = a Tc^b_1 S_c^b_2 L_c^b_3 P_c^b_4 FRC^b_5 INc^b_6 IRc^b_7 e^U \]

The function was linearised by transforming it into the following logarithmic (Double Log) form:

\[ LNGR = Lna + b_1 Lna Tc + b_2 Lnc + b_3 Lnc + b_4 Lnc + b_5 Lnc + b_6 Lnc + b_7 Lnc + U \]

Where

GR = Gross Return from crop production (Tk/farm/year)

a = Constant or intercept value.

Tc = Total cropped area (ha/farm/year)

Sc = Cost of seed/seedlings (Tk/farm/year)

Lc = Cost of labour (Tk/farm/year)

Pc = Cost of mechanical power (Tk/farm/year)

FRc = Cost of fertiliser (Tk/farm/year)

INc = Cost of insecticide (Tk/farm/year)

IRc = Cost of irrigation (Tk/farm/year)

U = Error term

b_1,...,b_7 = Co-efficient of respective variables.
6.1.2. Cattle component

The Cobb-Douglas functional form of the multiple regression equation for cattle component is specified as follows:

\[ GR = aLc^{b1}Fc^{b2}Vc^{b3}e^u \]

The function was linearised by transforming it into the following logarithmic (Double -log) form:

\[ \text{LNGR} = \text{Lna} + b_1\text{LnLc}+b_2\text{LnFc}+b_3\text{LnVc} + U \]

where,

\[ GR = \text{Return from cattle and cattle product (Tk/farm/year)} \]

\[ a = \text{Constant or intercept value} \]

\[ Lc = \text{Cost of labour (Tk/farm/year)} \]

\[ Fc = \text{Cost of feed (Tk/farm/year)} \]

\[ Vc = \text{Cost of veterinary (Tk/farm/year)} \]

\[ U = \text{Error term} \]

\[ b_1, b_2, b_3 = \text{coefficient of the respective variables.} \]

6.1.3. Poultry component

The Cobb- Douglas functional form of the multiple regression equation for poultry component is specified as follows:

\[ GR = aLc^{b1}Fc^{b2}Vc^{b3}e^u \]

The function was linearised by transforming it into the following logarithmic (Double log ) form:

\[ \text{LNGR} = \text{Lna}+b_1\text{LnLc}+b_2\text{LnFc} +b_3\text{LnVc} + U \]

Where,

\[ GR = \text{Return from poultry and poultry product (Tk/farm/year)} \]
a = Constant of intercept value
Lc = Cost of labour (Tk/farm/year)
Fc = Cost of feed (Tk/farm/year)
Vc = Cost of veterinary (Tk/farm/year)
U = Error term

$b_1, b_2, b_3 = co-efficient of the respective variables.$

6.1.4. Fish component

The Cobb-Douglas functional form of the multiple regression equation for fish component is specified as follows:

$$GR = aPa^{b_1}Lc^{b_2}Fc^{b_3}FRc^{b_4}Mc^{b_5}e^u$$

The function was linearised by transforming it into the following logarithmic (Double-log) form:

$$\text{LNGR} = na + b_1\text{LnPa} + b_2\text{LnLc} + b_3\text{LnFc} + b_4\text{ LnFRc} + b_5\text{LnMc} + U$$

where,

GR = Return from fish production (Tk/farm/year)

a = Constant or intercept value

Pa= Pond area (ha/farm/year)

Lc = Cost of labour (Tk/farm/year)

Fc = Cost of feed (Tk/farm/year)

FRc = Cost of fertilizer (Tk/farm/year)

Tc = Cost of treatment (Tk/farm/year)

U= Error term

$b_1, ..., b_5 = Co-efficient of the respective variables.$
6.2. Factors affecting production of different enterprises

6.2.1. Crop

The inputs employed for producing crops were mainly total cropped area, seed/seedling, labour, mechanical power, manure, fertiliser, insecticide and irrigation cost. These inputs were considered as the explanatory variables responsible for the crop production functional analysis. Accordingly, a Cobb-Douglas production function was specified to determine the possible relationships between the production of crops and inputs used. Other independent variables include land quality and soil condition which might affect farm income substantially were assumed to be subsumed in error term of the estimated regression equation due to lack of appropriate information about these factors.

6.2.2. Cattle

In the study area, the inputs employed for producing cattle were mainly labour, feed and veterinary costs. These inputs were considered as the explanatory variables responsible for the cattle production function analysis. Therefore, these inputs are hypothesised to explain the variation in output of cattle. Other independent variables which may affect farm income such as housing, quality of feed, time of rearing and quality of breed were not included due to lack of information and assumed to be subsumed in the error term of estimated regression function.

6.2.3. Poultry

In case of poultry, the major inputs used were labour, feed and veterinary costs. These inputs were considered as the explanatory variables responsible for the poultry production function analysis. Therefore, these inputs are hypothesised to explain
variation in output of poultry. Accordingly, the Cobb-Douglas production function is specified to determine the possible relationships between the production of poultry and inputs used. Other independent variables which may affect poultry farm income such as housing, feed condition, quality of breed were assumed to be subsumed in the error term of estimated regression function.

6.2.4. Fish

In producing fish the major inputs used were pond area, labour, feed, fertiliser and medicine. Accordingly, a Cobb-Douglas production function is specified to determine the possible relationships between the production of fish and input used. Other independent variables which may affect fish farm income such as depth of water, soil condition, size of fingerlings, quality of feed, quality of breed were assumed to be subsumed in the error term of estimated regression function.

Although management is an important input for all these components, it was not possible to include that variable in the estimated model. Specification and measurement of management factor is not easy job to accomplish, particularly in peasant agriculture where a farm operator is both a labourer and a manager and the farm and the household constitute an inseparable complex (Heady and Dillon, 1961).
6.3. Estimates of the Cobb-Douglas production function model for different components in C-C-P-F farming system

6.3.1. Crop component

The model (Cobb-Douglas) for crop component fitted the data quite well as indicated by F-value and R-square. The co-efficient of multiple determination $R^2$ is 0.85, which means that the explanatory variables included in the model explained 85 percent of the variation in gross return from crop production. The F-value of the equation is significant at 1 percent level of confidence implying that the variation in crop production depends mainly upon the explanatory variables included in the model.

Table: 6.1. Estimated values of the co-efficient and related statistics of Cobb-Douglas production function for crop component of C-C-P-F farming system

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Co-efficient</th>
<th>t-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>0.359</td>
<td>0.960NS</td>
</tr>
<tr>
<td>Labour</td>
<td>0.06</td>
<td>0.324**</td>
</tr>
<tr>
<td>Animal and mechanical power</td>
<td>0.154</td>
<td>1.77***</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>-0.045</td>
<td>-0.388 NS</td>
</tr>
<tr>
<td>Manure</td>
<td>0.348</td>
<td>2.161**</td>
</tr>
<tr>
<td>Seed</td>
<td>0.115</td>
<td>1.789***</td>
</tr>
<tr>
<td>Insecticides</td>
<td>-0.03</td>
<td>-0.346NS</td>
</tr>
<tr>
<td>Irrigation</td>
<td>0.08</td>
<td>0.822NS</td>
</tr>
</tbody>
</table>

R – Square 0.85, F – Value 13.56, level of significance 0.001.
*Significant at 0.1- 1 percent level, ** Significant at 5 percent level, *** Significant at 10 percent level, NS: Non-significant.

From the value of the coefficient of different variables it is seen that except for fertiliser and insecticide, every input had a positive impact on return. The negative impact of fertiliser may be due to the lack of knowledge regarding application of fertiliser at the proper time in the proper dose. For example, if any farmer applied fertiliser such as urea at the time of sowing seed, it will not have any effect on the

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growth of that plant, because the effect of urea does not last more than 14 days after application. Urea is required at the growing stage of the crop/vegetable. Alternatively, farmers believe that if they applied more fertiliser it will result in increased yield without considering the proper dose, but beyond the optimum level of fertiliser use, there will be a negative impact on return. Similarly, the selection of proper insecticide and procedure of application properly is also very important. If an insecticide is required for spraying and the farmers applies it at the root of the plant it will harm the crop. Insecticide is applied at the harvesting stage of certain crops or vegetables will be harmful for the yield. It is presumed that either farmers applied these inputs excessively or in an improper way, as a result of which a negative impact showed on the return.

6.3.2. Cattle component

Estimated values of the co-efficient and related statistics of the Cobb-Douglas production function for the sample farms producing cattle are presented in table 6.2. The relative contribution of specified factors affecting productivity of cattle can be seen from the estimates of regression equation. Only veterinary costs were found to have a negative impact on return. The reason may be that farmers did not spend veterinary costs economically. In practical situations, farmers often do not take cattle to the veterinary doctor when treatment is necessary. Without consulting any doctor they purchase medicine for cattle which may not be effective.
Table 6.2. Estimated values of the co-efficient and related statistics of Cobb-Douglas production function model for cattle component of C-C-P-F farming system

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Co-efficient</th>
<th>t-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>0.95</td>
<td>8.883*</td>
</tr>
<tr>
<td>Feed</td>
<td>0.05</td>
<td>0.986NS</td>
</tr>
<tr>
<td>Veterinary (VC)</td>
<td>-0.09</td>
<td>-1.323 NS</td>
</tr>
</tbody>
</table>

R square 0.81, F value 36.76, level of significance 0.000.
*Significant at 0.1-1 percent level, NS: Non-significance.

6.3.3. Poultry component

Estimated values of the co-efficient and related statistics of the Cobb-Douglas production function for the sample farms producing poultry are presented in table 6.3. Here it is found that labour and feed had a positive impact on return. The estimated co-efficient 0.37 of labour revealed that a 1 percent increase in human labour cost, keeping other factors remaining constant, would increase the gross return from poultry by 37 percent.

Table 6.3. Estimated values of the Co-efficient and related statistics of the Cobb-Douglas production function model for poultry component of C-C-P-F farming system

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Co-efficient</th>
<th>t-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour (LC)</td>
<td>0.37</td>
<td>3.214*</td>
</tr>
<tr>
<td>Feed (FC)</td>
<td>0.56</td>
<td>4.311*</td>
</tr>
<tr>
<td>Veterinary (VC)</td>
<td>-0.19</td>
<td>-1.535NS</td>
</tr>
</tbody>
</table>

R – Square,0.76, F – Value 26.97, level of significance 0.000.
*Significant at 0.1-1 percent level, NS: Non-significant.

Similarly the estimated co-efficient 0.56 of feed revealed that a 1 percent increase in feed cost keeping other factors remaining constant, would increase the gross return from poultry by 56 percent. However, veterinary costs had a negative impact on
return. It may be that few farmers spent treatment cost according to necessity and some others did not use them properly.

6.3.4. Fish component

Estimated values of the co-efficient and related statistics of the Cobb-Douglas production function for the sample farms producing fish are presented in table 6.4. The positive co-efficient of different variables of the fish component imply that the selected inputs contributed positively to the returns from the fish component. However, a relatively lesser coefficient value of labour and treatment implied marginal impact on return was very consistent with the real situation of fish farming. Lack of technical knowledge regarding fish culture may be the barrier of labour utilisation.

Table 6.4. Estimated Values of the Co-efficient and related statistics of Cobb-Douglas production function model for fish component of C-C-P-F farming System

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Co-efficient</th>
<th>t-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pond area</td>
<td>0.35</td>
<td>2.281 **</td>
</tr>
<tr>
<td>Feed</td>
<td>0.62</td>
<td>3.317*</td>
</tr>
<tr>
<td>Treatment</td>
<td>0.05</td>
<td>0.542 NS</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>0.60</td>
<td>3.434*</td>
</tr>
<tr>
<td>Labour</td>
<td>0.03</td>
<td>0.741 NS</td>
</tr>
</tbody>
</table>

R Square 0.80, F - Value 18.85, level of significance 0.000. *Significant at 0.1-1 percent level, ** Significant at 5 percent level, NS: Non-significant.

Similarly, in the case of treatment of fish, farmers normally use different types of lime for maintaining the quality of water for fish culture. There are different types of lime available on the market. These are calcium carbonate (CaCO₃), calcium hydroxide (Ca(OH)₂), calcium oxide (CaO). The most appropriate choice of lime,
due to different fish and quality of water, may not be known to the farmers, leading to an inefficient use of lime.

6.4. Estimates of the Cobb-Douglas production function model for different components in C-C-P farming system

6.4.1. Crop component

It is seen from table 6.5 that, except fertiliser and manure, value of the coefficient of all variables were found to have a positive impact on return. However the negative coefficient value of fertiliser is consistent with most farmers attitude towards using this input for production.

Table 6.5. Estimated values of the co-efficient and related statistics of Cobb-Douglas production function model for crop component of C-C-P farming system.

<table>
<thead>
<tr>
<th>Explanatory variable crop</th>
<th>Co-efficient</th>
<th>t-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>0.32</td>
<td>2.950 *</td>
</tr>
<tr>
<td>Lab</td>
<td>0.35</td>
<td>2.190**</td>
</tr>
<tr>
<td>Animal and mechanical power</td>
<td>0.39</td>
<td>1.271NS</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>-0.08</td>
<td>-0.553 NS</td>
</tr>
<tr>
<td>Manure</td>
<td>-0.03</td>
<td>2.168**</td>
</tr>
<tr>
<td>Seed</td>
<td>0.013</td>
<td>2.153**</td>
</tr>
<tr>
<td>Insecticide</td>
<td>0.15</td>
<td>1.062 NS</td>
</tr>
<tr>
<td>Irrigation</td>
<td>0.10</td>
<td>2.521**</td>
</tr>
</tbody>
</table>

R – Square 0.76, F value- 4.24, level of significance 0.005.  
*Significant at 0.1-1 percent level, ** Significant at 5 percent level, NS: Non-significant.

This was attributed to the farmers believe that a higher use of fertiliser resulted in a good yield without considering the proper dose for the proper crop. It is also indicated from the result that if manure application increased it will bring negative
impact on return, although the value of co-efficient was negligible. However, the result suggested that it is needed to apply these two variables very cautiously.

6.4.2. Cattle component

The relative contribution of specific factors affecting productivity of cattle can be seen from the value of the coefficient which implied that labour had much relevance to the increase in return.

Table 6.6. Estimated value of the co-efficient and related statistics of Cobb-Douglas production function model for cattle component of C-C-P farming system.

<table>
<thead>
<tr>
<th>Cattle</th>
<th>Co-efficient</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>0.90</td>
<td>11.385 *</td>
</tr>
<tr>
<td>Feed</td>
<td>0.06</td>
<td>1.138NS</td>
</tr>
<tr>
<td>Treatment</td>
<td>0.12</td>
<td>1.451NS</td>
</tr>
</tbody>
</table>

$R^2 = 0.94$, F- Value - 138.689, significance level 0.000.  
*Significant at 0.1-1 percent level, NS: Non-significant.

On the other hand feed and veterinary cost had marginal effect on return as the value was non significant.

6.4.3. Poultry component

It was seen from the coefficient value of labour and feed (Table 6.7) that, return from poultry can be increased by using more of these inputs as revealed from the highly significant values. From the primary data it shows that normally farmers feed the poultry only rice bran.

Table: 6.7. Estimated values of the co-efficient and related statistics of Cobb-Douglas production function for the poultry component of C-C-P farming system

<table>
<thead>
<tr>
<th>Poultry</th>
<th>Co-efficient</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>0.32</td>
<td>3.996 *</td>
</tr>
<tr>
<td>Feed</td>
<td>0.73</td>
<td>8.778*</td>
</tr>
<tr>
<td>Veterinary</td>
<td>0.003</td>
<td>0.326NS</td>
</tr>
</tbody>
</table>

$R^2 = 0.94$, F- Value - 419.72, significance level 0.000.  
*Significant at 0.1-1 percent level, NS: Non-significant.
Thereby cost incurred in relation to return is very low. If farmers improve the quality of feed there is a scope for increasing the return. However, from the coefficient value of veterinary costs, it implied that this input had a marginal impact on return.

6.5. Estimates of the Cobb-Douglas production function model for different components of C-C farming system

6.5.1. Crop component

It is seen from the table 6.8. that, animal and mechanical power and insecticide were found to have a negative impact on return. The negative coefficient value of animal power and insecticide suggested that these inputs had an excessive use in crop cultivation. This may be because animal and mechanical power in crop cultivation was mainly used at the time of land preparation and threshing. Most farmers used animal and power tiller for preparation of the same land. Their belief was that for loosening the soil intensively, the power tiller is more effective.

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>Co-efficient</th>
<th>t-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>1.56</td>
<td>5.081 *</td>
</tr>
<tr>
<td>Lab</td>
<td>0.34</td>
<td>3.064 *</td>
</tr>
<tr>
<td>Animal and mechanical power</td>
<td>-0.10</td>
<td>-0.843NS</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>0.26</td>
<td>3.161 *</td>
</tr>
<tr>
<td>Manure</td>
<td>0.13</td>
<td>2.054**</td>
</tr>
<tr>
<td>Seed</td>
<td>0.08</td>
<td>1.009NS</td>
</tr>
<tr>
<td>Insecticide</td>
<td>-0.01</td>
<td>-0.41NS</td>
</tr>
<tr>
<td>Irrigation</td>
<td>0.09</td>
<td>1.296NS</td>
</tr>
</tbody>
</table>

R - square 0.774, F- Value 9.212, Significance level 0.000.
*Significant at 0.1-1 percent level, ** Significant at 5 percent level, NS: Non-significant.
At the same time, farmers used animal ploughing for same land which was not necessary. As a result of excessive use it might bring a negative impact. Similarly it may be that insecticide application was not done properly for disease and pest control. Correct application and choice of insecticide is an important factor in the cost efficiency of insecticide.

6.5.2. Cattle component

The coefficient value of labour and feed (Table 6.9) were highly significant which indicated much relevancy to the impact on return. The value of the production coefficient of labour 0.58, indicated that 1 percent increase in labour cost, keeping other factors remaining constant, would increase the gross return by 58 percent.

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>Co-efficient</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>0.58</td>
<td>3.967*</td>
</tr>
<tr>
<td>Feed</td>
<td>0.39</td>
<td>2.252**</td>
</tr>
<tr>
<td>Veterinary</td>
<td>0.03</td>
<td>0.749NS</td>
</tr>
</tbody>
</table>

R - square0.94, F value-149.10, significance level 0.000.
*Significant at 0.1-1 percent level, ** Significant at 5 percent level,
NS: Non-significant.

Similarly, a 1 percent increase in feed cost would increase the return from cattle by 39 percent. In the case of feed it may be that farmers did not use quality or balanced food for the cattle. There is a scope of increasing the return by using a balanced diet for cattle. However, value of coefficient of veterinary costs indicated that this variable had a marginal impact on return.
6.6. Estimates of the Cobb-Douglas production function model for different components of C-P farming system

6.6.1. Crop component

Estimated values of the co-efficient and related statistics of the Cobb-Douglas production function for the sample farms producing crops are presented in table 6.10. The coefficient of different variables indicate that, except insecticide, all variables had a positive impact on return. The variation of coefficient values for different inputs implied that few inputs had more and few had less relevance to the impact on gross return. The negative coefficient value of insecticide might be the improper or excess use of insecticide.

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>Co-efficient</th>
<th>t-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>0.49</td>
<td>0.166NS</td>
</tr>
<tr>
<td>labour</td>
<td>0.41</td>
<td>2.91*</td>
</tr>
<tr>
<td>Animal and mechanical power</td>
<td>0.03</td>
<td>1.539NS*</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>0.08</td>
<td>0.930 NS</td>
</tr>
<tr>
<td>Manure</td>
<td>0.03</td>
<td>2.18**</td>
</tr>
<tr>
<td>Seed</td>
<td>0.18</td>
<td>2.41**</td>
</tr>
<tr>
<td>Insecticide</td>
<td>-0.02</td>
<td>-1.19NS</td>
</tr>
<tr>
<td>Irrigation</td>
<td>0.02</td>
<td>1.076NS</td>
</tr>
</tbody>
</table>

R - square 0.72, F- Value 6.632, significance level 0.000.
*Significant at 0.1-1 percent level, ** Significant at 5 percent level, NS: Non-significant.
6.6.2. Poultry component

Estimate values of the co-efficient and related statistics of the Cobb-Douglas production function for the sample farms producing poultry are presented in table 6.11. The coefficient value of labour and feed indicated that the increase of labour and feed had much relevance to the increase in return from the poultry component.

Table: 6.11. Estimated values of the co-efficient and related statistics of Cobb-Douglas production for poultry component of C-P farming system

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>Co-efficient</th>
<th>t-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>0.61</td>
<td>3.716*</td>
</tr>
<tr>
<td>Feed</td>
<td>0.76</td>
<td>0.894NS</td>
</tr>
<tr>
<td>Veterinary</td>
<td>0.04</td>
<td>0.674NS</td>
</tr>
</tbody>
</table>

R² = 0.82, F- Value 38.663, significance level 0.000.
*Significant at 0.1-1 percent level, NS: Non-significant.

However the less coefficient value of veterinary costs implied that these inputs had a marginal contribution to the gross return from the poultry enterprise of C-P-system.

6.7. Conclusion

It is found that in crop components for different farming system area, labour, seed/seedling and irrigation had a positive impact on return although in some cases impact was more and in some cases these had a marginal relevance to the return. This variation may be the application of these inputs by different farmers in different ways. Time of application, quality of seed, type of land and proper amount of input may be the causes of variation. However, farmers can take an advantage of increasing the labour, use of quality seed and irrigation for increasing their crop production. It is true that if area could be increased more yields would be possible. However area is scarce for every farmer in Bangladesh. Other inputs such as fertiliser were seen to have a negative impact on return in the C-C-P-F and C-C-P
systems, animal and mechanical power had a negative impact on the C-C system only, insecticide was found to have a negative impact on the C-C-P-F, C-C and C-P systems. These inputs needed to be applied cautiously. In the cattle and poultry components all variables such as labour, feed and veterinary costs were found to have a positive impact on return except veterinary costs in the cattle and poultry component of the C-C-P-F system. In the fish component all variables such as pond area, feed, treatment, fertiliser and labour cost were found to have a positive impact on return although results indicated that treatment and labour cost were less relevant to the gross return of the fish enterprise.

Over all, the results indicated that most of the inputs had a positive impact on return although all values were not at a significant level. The positive coefficient indicated that farmers can increase the use of these inputs for a better return from the farm.

However, it is noted that the Cobb-Douglas production function model was used for a specific data under this study. It is not possible to draw any conclusive decision that this model will fit for another data series. Thereby it is suggested for further testing of model with independent data set which will give confidence regarding application of this model for examining the resource use efficiency.
CHAPTER 7

Gender Role in Farming Systems

The previous section dealt with the resource use efficiency of the production of different enterprises. In this section attempt has been taken to examine the gender role in different farming systems. Traditionally, women are dependent on men and their opportunities to develop as independent members of the society are very limited in Bangladesh. Since the society is male dominated there is social segregation and gender differentiation which passively take away the females initiative. Although women perform a wide range of activities within and outside households, the socioeconomic worth of their achievements is seldom recognised.

This thesis has determined the contribution with respect to time spent by males and females in agricultural activities and household activities. While household activities are not directly part of agriculture these activities cannot be separated from farming systems activities. Since the objective is to examine the labour utilisation in farming systems, the time spent by family members for this activity has also been taken in to consideration. Labour time in agricultural activities includes the labour needed for crop cultivation, cattle, poultry and fish management in different farming systems. Household activities includes the cleaning, cooking, washing, child care and marketing activity. Data were collected through survey questionnaire from the farmers belonging to different farming systems.

In this chapter analysis has been conducted to examine the labour utilisation by gender for crop field activities, livestock and fish management in each farming
system. Overall labour utilisation by gender in agriculture was determined for alternative farming systems. In addition the time spent by males and females in household activities was also examined. Gender wise, labour involvement in agricultural activities is discussed in sections 7.1 to 7.6 and household activities in section 7.7.

7.1. Proportionate time spent by male and female in pre harvest and post harvest activities in different farming systems

The crop activity was categorised separately as pre harvest and post harvest. Pre harvest activities include ploughing, seedling, weeding, fertilising, cutting and harvesting. Post harvest activities include threshing, drying and storing. The pre harvest activities was confined in crop field directly. Post harvest activities were performed outside the crop field and the homestead ground was used for this activity. Therefore, the aim is to examine whether there is any variation of labour use as a whole and proportionate contribution of male and female in pre and post harvest activities. This will give a clear idea about the trend of labour involvement by gender in crop field activities.

Figure 7.1. illustrates that around 80% of male labour is involved in pre harvest activities whereas 20% of male labour involved in post harvest activities in different farming systems. On the other hand, around 40% of female labour is involved in pre-harvest activities and 60% involved in post harvest activities in various systems. It is clear from the result that female labour is more involved in post harvest operation in comparison to pre harvest activities and the involvement of male labour in post harvest activities is less than their involvement in pre harvest activities.
Data were analysed by using the General Linear Model (GLM) of analysis of variance (ANOVA). It was found that there was no significant difference between different farming systems in use of male and female labour. However, the time spent by male labour for pre and post harvest activities was significantly different $F_{1, 473} = 509.41, p< .0001$ for all farming systems. It is meant that male labour was more in pre harvest in different farming systems. On the other hand, a significantly higher number of female labour activity was found in post harvest operations in every systems $F_{1,473} = 2.54, p< .01$. Although females were more involved in post harvest operation but in both activities (pre and post harvest) there was a higher level of male labour than female. Statistically these differences were significant (Pre harvest activities in crop production. $F_{1, 473} = 688.89, p< .0001$, post harvest activities in crop production $F_{1,473} = 4.33, p=.038$) in all systems.

It was also found that regardless of gender (includes male and female) there was a significantly more labour was engaged in pre harvest activities in comparison to post harvest activities in all systems ($F_{1, 467} = 222.261, p < 0.0001$). The reason was time spent in pre harvest activities required more labour because major three activities in pre harvest such as ploughing, transplanting and weeding required more labour.
7. 2. Proportionate time spent by male and female in crop field activities in different farming systems

The previous section discussed contribution of males and females separately in pre harvest and post harvest activities. The contribution of males and females in crop field activities as a whole also needs to be known because this will give an idea about male and female participation in crop field activities. The contribution by gender in crop field activities in different farming systems is shown in Figure 7.2. It is observed from (Figure 7.2) that the percentage of male labour in all systems was around 85% and female labour hour was around 15%. From the above result it is seen that in every farming system time spent by male labour was much higher than female but the difference between male and female labour hours had a similarity in every system. The total time spent in crop field activities in different farming systems were shown in appendix 1- table 6.
Statistical analysis did not demonstrate a significant difference between different farming systems of total time spent (includes male and female) in crop field activities. But comparatively more difference was observed between the C-C-P-F and C-P systems by the Games and Howell test. The reason was that in the C-C-P-F system there was an existence of four components therefore time spent in different components by family members were much higher. On the other hand, in the C-P system fish and cattle components were absent. In addition, time spent for poultry component was very low. That is why there is a difference between time spent for these two components. Details in appendix 1- table-6.

![Bar chart](image)

**Figure 7.2.** Contribution of labour by gender in crop production in different farming systems

7.3. **Percentage contribution by male and female in cattle activity in different farming systems**

The management of cattle includes the time spent for feeding, cleaning, milking, and marketing the products. Data were collected for cattle management in each of the different systems on the basis of these activities. The total time spent for cattle
management as a whole and by gender for different farming systems were analysed. There is quite an interesting result in labour utilisation in cattle management. The female labour involvement was higher than the male in all systems. The ratio of male to female in C-C-P-F, C-C-P and C-C systems were 46:54, 46:54 and 47:53 respectively (Figure 7.3). Data were analysed using General Linear Model (GLM) of analysis of variance. The results demonstrated that there was no significant difference regarding time spent by males and females among farming systems but a significant difference was detected within the farming system ($F_{1,174} = 3.238, p=.074$) between males and females.

The reason for higher female labour was, in most cases milking, and in some cases cleaning, was performed by female members of the family (Appendix 3: Photo 3.8). Even feeding the cattle inside the homestead area was also done by female member. In some cases feeding the cattle inside and outside the household was performed by male members of the family. Since women took relatively more responsibility of cattle management, labour hour spent was higher in case of females in every farming system (Gender wise labour utilisation is shown in appendix-1-table-6).

Total time spent in cattle management in C-C-P-F, C-C-P and C-C systems were 462 hours, 324 hours and 345 hours per year respectively (appendix-1,table-6). Primary data showed that in C-C-P-F system, feeding the cattle required more time and as a result total labour hour increased. Normally feeding the cattle was performed in two ways. Farmers fed them within the house and animals were taken to graze outside in open field. But open field are not always adjacent to the farmers household. It may
be that due to the further distance of the open field from farmers house, the required time for feeding the cattle in C-C-P-F system was higher.

![Chart showing percentage of labour hours per year by gender in different farming systems](chart)

Figure 7.3. Contribution of labour by gender in cattle management in different farming systems

Data were analysed using the General Linear Model (GLM) of analysis of variance (ANOVA, SPSS 1999) to examine whether these differences were statistically significant. The result showed that there is a significant difference in case of total time spent in cattle management regardless of gender between different farming systems ($F_{2, 174} = 2.663, p=0.073$). The LSD test showed that total time spent was significantly higher in C-C-P-F systems in comparison to the C-C-P and C-C systems.

### 7.4. Percentage contribution by male and female in poultry management in different farming systems

Poultry management includes feeding, cleaning the shed and marketing the poultry birds or eggs. Data were collected for different farming systems in regards to these activities and were analysed to determine the contribution of males and females to
poultry management for each farming system. It is observed that (Figure 7.4.) time spent by female labour in poultry management was much higher than with the contribution of male labour in poultry management.

![Bar chart showing percentage of labour hour per year by gender across different farming systems.](chart)

Figure 7.4. Contribution of labour by gender in poultry management in different farming systems

The reason is that in existing farming situations farmers rear few poultry birds. These poultry birds are usually kept in a shelter which was built from wood or clay. Normally this type of shelter is kept in the living house of the farmers or the homestead ground. When poultry birds come out from this shelter a female member of the family usually feeds them in the homestead ground. Women also clean the shelter. It is observed that it has become a sole responsibility of the female members of the family to rear the poultry birds. Since this job does not require a high level of physical strength and can be done within the household, it is performed by women (Appendix 3: Photo 3.2). Selling the eggs in the local market was performed by women. As a result, labour requirement in poultry management was mostly done by female member of the family. It is also observed that it requires very few labour in comparison to other component such as crop, cattle and fish. Since cleaning the
sheds or feeding them virtually takes no considerable time so time required for poultry rearing was very low.

Statistical analysis performed using the General Linear Model of Analysis of Variance (ANOVA, SPSS, 1999). Results demonstrated that there was no significant difference between different farming systems for time spent for poultry management regardless of gender and also no significant difference between the utilisation of male and female labour separately in different farming system. But there was a significant difference between gender in every farming system \((F_{1,174} = 206.034, p<.0001)\) supporting the statement that women contribute most of labour for poultry management.

7.5. Percentage contribution by male and female in fish culture in C-C-P-F system

The labour involvement in fish culture includes feeding the fish, applying fertiliser/lime, cleaning the pond and marketing the fish. Data were collected in respect to this activity from sample farmers and analysed to examine the contribution of male and female of household in fish culture. It is noted that fish enterprise here is included only in C-C-P-F system.

Out of total 280 labour hours per year (appendix-1-table-6), the percentage contribution of male labour hour was 94% and contribution of female labour hour was 6% (Figure 7.5). It was observed that activities of fish rearing were mainly performed by the male. Catching fish by fishing equipment is laborious and carried out by men (Appendix 3: Photo 3.5.). Marketing of the fish is usually done by the male members of the family. Analysis showed that higher time spent by male labour
in fish management was significantly different to time spent by female labour \( F_1, 58 = 81.955, p < 0.0001 \).

![Bar chart showing percentage of labour hours per year for male and female in C-C-P-F farming system.](image)

Figure 7.5. Contribution of labour by gender in fish culture in C-C-P-F system

7.6. Labour utilisation by gender in agricultural activities as a whole in different farming systems

Labour utilisation in agricultural activities as a whole included the time spent for different components in each system. The total male and female labour in each system are shown in Figure 7.6.

It is seen from Figure 7.6 that both male and female labour is highest in C-C-P-F system followed by C-C-P, C-C and C-P system. It is also observed from Figure 7.6 that male hours were much higher in C-C-P-F in comparison to other three systems. But C-C-P and C-C systems had similar male hours while in C-P system male hour was less than all other systems.

The reason for higher male labour hours in C-C-P-F system was due to the fish component being included in this system. The activities of fish culture were mainly
done by male members of the family. It was seen from the (appendix-1-table-6) that time spent by male hours in the fish component was 262 hours. This time was reflected in the total male hours in C-C-P-F system. The reason for less male hours in C-P system was the absence of major two components such as cattle and fish in this system. However the question may arise, the C-C system is also a two component system like C-P system. Whereas C-C-P is a three component systems. Then why was labour hour very close to C-C and C-C-P systems? (Figure 7.6). The reason was that poultry activities did not require much male labour in C-C-P system (Appendix-1-table-6).

On the other hand, in case of females, though there was a difference in labour hour between farming systems but the gap was small with the exception of the C-P system (Figure 7.6). The main reason for this difference was that cattle were not included in C-P system where around 200 hours spent by females in other systems. As a result female labour hour was much lower in C-P system in comparison to other three systems.

![Graph](image.png)

Figure 7.6. Total labour hours by gender in agriculture as a whole in different farming systems
Data were then analysed to examine whether there was a significant difference between time spent by male and female separately among different systems and also within the system. The Games-Howell test showed male labour hours of C-C-P-F system was significantly higher than male labour hours of all other systems. Similarly, male labour hours of C-P system was significantly lower than other three systems. There were no significant difference of male labour hour utilisation between C-C-P and C-C systems. In case of females it is seen that there was no significance difference among labour hours spent by C-C-P-F, C-C-P and C-C systems, but female labour hour was significantly lower in C-P system in comparison to the other three systems.

In addition, analysis was done to examine the total utilisation of labour hour between different farming systems. Results indicate that there was a significant difference between the farming systems in case of total utilisation of labour hour ($F_{3,116} = 45.334, p<0.0001$). Games and Howell test indicated that total labour hour of C-C-P-F systems was significantly higher in comparison to all other systems. On the other hand, total labour hours of C-P system was significantly lower than other three systems. There was no significant difference in case of total labour utilisation between C-C-P and C-C systems.

7.7. Proportionate contribution by gender in household activities in different farming systems

Household activities form an important activity and need to be examined as part of any labour profile. Household activities include cleaning the compound and houses, cooking, washing, childcare and marketing. In Bangladesh women are responsible
for various activities in the household. Rural women mostly work in domestic activities. However their contribution was not measured in real wage nor considered as an important economic activity. It is not directly related to agricultural activities but this contribution can not be ignored. The percentage contribution of males and females in separate household activities for each farming system are shown in Figures-7.7 to 7.11 and total time in household activities are shown in figure 7.12.

7.7.1. Cleaning the Compound and Household

In rural areas it is observed that when family members of the household wake up early in the morning male farmers used to go into the crop field and female members start their morning work with cleaning the whole premises of the household. It can be easily realised that in most cases female spent their time in this activity. From the Figure 7.7. it is seen that around 5% of total contribution was spent by male members of the family in cleaning activities whereas around 95% of work was done by female members in different farming systems.

7.7.2. Cooking

It is presumed that this is the sole responsibility of female members of the family. Male members cannot think of engaging themselves in cooking although in some parts of the world it is performed by both. It is observed from Figure-7.8 that, the proportionate contribution of male members in cooking is around 3% only.

The average time required for cooking, including processing food, were found to be 3 to 3.5 hours per day. Similar studies conducted by Saha et al. (1990) whose result showed that on average women spent 2.98 hour/day for cooking. Since there is no
gas in rural areas female are used to cook by fire wood or cow dung as fuel in the study area. In a few cases if the women remain busy for child care or any other necessary activities the male members participate which is very rare.

7.7.3. Washing Clothes

Male participation in washing clothes was slightly higher in comparison to their proportionate involvement in cleaning the compound and cooking activities. On average it is found that (Figure-7.9) the proportionate contribution of males is around 10-20% whereas females contributed 80-90% of time in different farming systems. Normally in rural areas the male/female goes to the open pond for washing the clothes because there are no facilities within the household for washing. In a few cases there is a tube well adjacent to farmer's house where they also go to wash the clothes.

7.7.4. Child Care

The percentage contribution of males and females are shown in Figure 7.10. Out of total time spent for child care male contributes around 10% in each farming system and females contribute the remaining 90%. Child care in this case means to spend time with the child within the farmers household. Female or male members of the family look after their own children. There are no child care centres in rural areas of Bangladesh. Even in urban areas it is not often observed. Only in few cities there are limited child care centres available. The reason may be that most of the women do not engage in any job outside the household in rural areas. Besides this, extended family in rural areas are everywhere. There by children grow up within the family environment.
7.7.5. Marketing/Shopping

This was the only activity of the household where male members of the family spend more time than the females. The percentage contribution of males and females are around 80% and 20% respectively (Figure 7.11.). Although shopping/marketing is mainly done by male workers but some times female involvement occurred. The reason for that is there are small local markets within the village where women also go for selling and buying few essential goods. In this case the female member of the family spends some time for marketing. However, it is also seen that in C-C system the percentage of female was slightly higher (Figure 7.11.) in comparison to other three systems. The actual reason was not identified by the findings. The reason might be that there were some local markets which were very close to the sample farmers homes where female access was very convenient for shopping.
Figure 7.7. Labour by gender in cleaning activity of different farming systems

Figure 7.8. Labour by gender in cooking activity of different farming systems

Figure 7.9. Labour by gender in washing activity of different farming systems
Figure 7.10. Labour by gender in childcare activity of different farming systems

Figure 7.11. Labour by gender in marketing activity of different farming systems
7.8. Total time spent by gender for household activities in different farming systems

Total time spent in household activities of different farming systems by males were 247 hours, 206 hours, 192 hours and 185 hours respectively for the C-C-P-F, C-C-P, C-C and C-P respectively. On the other hand, time spent by females were 1939 hours, 1965 hours, 1947 hours and 1944 hours in C-C-P-F, C-C-P, C-C and C-P system respectively (Figure 7.12.). The statistical results showed that there is no significant difference between farming systems in the case of time spent by males and females for household activities (F$_{3,232}= 0.924$, p= 0.430). Significant differences between gender was found in each farming system (F$_{1, 232}= 1329.65$, p< 0.0001).

It is observed that on average males spent 4 hours weekly on household activities whereas female spent 37 hours weekly carrying out household activities in different farming systems. Among different household activities women spent the maximum time (3.38 hours/day) on cooking followed by cleaning the compound (0.93 hours/day), child care, washing and marketing.
The total time spent by women in household activities was estimated as 6.37 hours/day (Saha et al. 1990). The study conducted by Noorginayuwati et al. (1995) also found that women spent 5.2 hours/day in household activities while men spent 0.7 hours/day. Benchawan et al. (1988) found that in household activities female spent on average 35 hours per week compared to 11 hours per week by their male counterpart. Ahmed (2000) also found that in house works men spent virtually no time while women spent a total of about 5 hours/day. In comparison to the above findings it is observed that there is a similarity of time spent by women in household activities.

7.9. Conclusion

Agricultural activities in farming systems were found to be clearly gender tasked. Male members were involved mostly in crop and fish culture whereas role of women’s were found to be higher in cattle and poultry management in all systems. It is also observed that within the crop field activities proportionate contribution of females were higher in pre harvest in comparison to post harvest while males were
higher in pre harvest in comparison to post harvest activities. Male labour
collection appeared much higher in C-C-P-F system due to more male labour
involvement in fish component. In household activities the time spent by male was
negligible in all systems. If household activities were taken into consideration in total
time of the farming systems activities, it is seen that in every farming system the
female spent more time. In reality female time spent in household activities remains
invisible. They are not rewarded for it. It can not be ignored that due to higher
involvement of females in household activities indirectly helps the male members of
the family to engage themselves more in other activities in farming systems.
CHAPTER 8

Selection Criteria of Enterprises

Farm households make decisions based on the interaction between biophysical, social and economic factors. Social and economic conditions include: social setting, cultural setting, traditional practice and economic capacity of the farmers. These conditions have a major influence on decision making (FAO 2001). Based on this assumption it is presumed that there are many factors that farmers consider when making a decision to choose enterprises in their farming systems. Understanding the selection criteria of different enterprise in their farming systems from the farmers point of view is very important for researchers and extension workers to take appropriate step for the betterment of poor farmers in Bangladesh. It is very difficult to execute any research findings or to introduce new enterprises in the farming system if the farmers opinion are not considered. Therefore it is very important to know the selection criteria of enterprises/components at different farming systems of farmers.

To determine the farmers decision making process the following questions were raised with farmers.

- How do farmers select an enterprise to include in their farming system?
- What is the farmer thinking when choosing enterprises for their farming systems?
- What influences their decision making- institutional, traditional or neighbour influence?
• Do the farmers make decisions individually or share with their wife or other family members?

• Are there any social, cultural, biophysical or economic barrier to selecting any enterprises?

On the basis of the above questions several other relevant questions were asked of the farmers for getting their opinion about the selection criteria of enterprises at different farming systems. Some open questions were included to get answers and a few new points were raised by participants through the sample questionnaire. Based on these aspects, opinions of farmers were categorised and expressed in tabular form. The opinions of extension workers who are engaged in activities in the study area were also collected through survey questionnaire and critically evaluated together with the views of farmers.

8.1. Reasons for selecting and not selecting enterprises in different farming systems

The information which was collected is summarised and presented in Table 8.1-8.8 below:

8.1.1. Selection of enterprise by farmer/ farm family

As seen from table 8.1. that in selecting enterprises, farmers decisions came from the family in three ways, namely (i) Self decision (ii) Consultation with wife and (iii) Consultation with other family members. Over all it is observed that the trend of consultation with their wife is common in every farming system. It is also observed
Table 8.1. Involvement of farmer or farm family in selecting enterprise (% of farmers)

<table>
<thead>
<tr>
<th>Reasons</th>
<th>C-C-P-F(%)</th>
<th>C-C-P(%)</th>
<th>C-C(%)</th>
<th>C-P(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self Decision</td>
<td>16</td>
<td>23</td>
<td>33</td>
<td>38</td>
</tr>
<tr>
<td>Consultation with wife</td>
<td>67</td>
<td>57</td>
<td>47</td>
<td>42</td>
</tr>
<tr>
<td>Consultation with other family members</td>
<td>17</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

that a higher percentage of farmers consult with their wives in the C-C-P-F (67%) and C-C-P (57%) farming systems in comparison to the other two systems. On the other hand it appeared from the result that influence of self decision is more in the case of C-C (33%) and C-P (38%) farming systems in comparison to C-C-P-F and C-C-P farming systems. It might be that when farmers want to integrate more component in their farming system they pay more attention to share their views with their wives.

8.1.2. Institutional or related influence in selecting enterprise

Institutional influence means the cooperation from extension service, research organisation or Non Government Organisation (NGO). Traditional means when farmers select enterprise from their ancestors. It is revealed from table 8.2 that traditional influence was high in all systems, though it was less in C-C-P-F (40%) and highest in C-P system (77%). On the other hand trend of institutional influence was more in C-C-P-F and C-C-P systems in comparison to C-C and C-P systems.

Table 8.2. Reasons for selecting enterprise as institutional and related influence (% of farmers)

<table>
<thead>
<tr>
<th>Reasons</th>
<th>C-C-P-F(%)</th>
<th>C-C-P(%)</th>
<th>C-C(%)</th>
<th>C-P(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional</td>
<td>33</td>
<td>30</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>Traditional</td>
<td>40</td>
<td>47</td>
<td>67</td>
<td>77</td>
</tr>
<tr>
<td>Neighbours</td>
<td>27</td>
<td>23</td>
<td>16</td>
<td>13</td>
</tr>
</tbody>
</table>
It may be that when farmers with more complex farming systems seek advice from a wide range of sources.

8.1.3. Reasons for selecting different crops as enterprise

Sample farmers from different farming systems cultivated different crops which include rice, jute, vegetables, wheat, mustard, pulse etc. All the farmers cultivate rice and vegetables in each farming system. Jute is also cultivated by the majority of farmers in different farming systems. So the opinion of farmers based on these three crops are taken in to consideration. Since few sample farmers cultivate wheat, mustard, pulse and hence may not represent the whole population therefore their opinions are not presented statistically.

8.1.4. Reasons of selecting rice as an enterprise

The main reasons for selecting rice as an enterprise were asked of the sample farmers among different farming systems. Three reasons were provided by the farmers for selecting rice as an enterprise, namely: (i) consumption as staple food (ii) traditional attitude of farmers of using land for rice cultivation and (iii) source of income through selling for maintaining family needs (Table 8.3).

Table: 8.3. Reasons for selecting rice as an enterprise (% of farmers)

<table>
<thead>
<tr>
<th>Reasons</th>
<th>C-C-P-F(%)</th>
<th>C-C-P(%)</th>
<th>C-C(%)</th>
<th>C-P(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption as staple food</td>
<td>60</td>
<td>67</td>
<td>73</td>
<td>66</td>
</tr>
<tr>
<td>Traditional activity</td>
<td>27</td>
<td>20</td>
<td>20</td>
<td>27</td>
</tr>
<tr>
<td>Selling</td>
<td>13</td>
<td>13</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

It is observed that most of the farmers (60-70%) produce rice for home consumption as staple food in all systems. About 20-30 percent of farmers of different farming systems cultivate rice traditionally. According to farmers opinion since they have
developed their potential skills to cultivate rice, therefore they prefer to cultivate rice instead of other crops.

8.1.5. Reasons of selecting vegetables as an enterprise

Primary data shows that every farmer, irrespective of farming system, cultivates vegetables, since vegetables are possible to cultivate in the homestead ground. The majority of farmers in all systems produce vegetables because of their profitability (Table 8.4). Farmers stated that vegetable cultivation requires less labour and is easy to supervise by female members and in some cases it requires less fertiliser therefore it is manageable and profitable. Their main target is to market the product for cash earning to increase household income.

Table: 8.4. Reasons for selecting vegetable as an enterprise (% of farmers)

<table>
<thead>
<tr>
<th>Reasons</th>
<th>C-C-P-F(%)</th>
<th>C-C-P(%)</th>
<th>C-C(%)</th>
<th>C-P(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling</td>
<td>53</td>
<td>60</td>
<td>67</td>
<td>73</td>
</tr>
<tr>
<td>Consumption</td>
<td>17</td>
<td>13</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Selling &amp; consumption</td>
<td>30</td>
<td>27</td>
<td>27</td>
<td>20</td>
</tr>
</tbody>
</table>

Family consumption and selling is the second reasons for producing vegetables. On the other hand there are some farmers producing vegetables for their own consumption. Therefore it is concluded that the vegetables are grown by the farmers mainly for selling purposes.
8.1.6. Reasons for selecting Jute as an enterprise

Jute was once known as the golden fibre of Bangladesh and was an important cash crop for earning foreign currency, however farmers currently are not getting a considerable profit due to a low product price in the market. The farmers are now reluctant to produce jute as before. However, opinions of the farmer of different farming system were collected and summarised in table 8.5.

<table>
<thead>
<tr>
<th>Reasons</th>
<th>C-C-P-F(%)</th>
<th>C-C-P(%)</th>
<th>C-C(%)</th>
<th>C-P(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household uses and selling</td>
<td>75</td>
<td>72</td>
<td>67</td>
<td>62</td>
</tr>
<tr>
<td>Traditional practice</td>
<td>25</td>
<td>28</td>
<td>33</td>
<td>38</td>
</tr>
</tbody>
</table>

It was observed from the result that presently farmers are not producing jute only for selling. Farmers stated that since they were not getting good market price thus were reluctant to cultivate jute as before which is consistent with low gross margin per hectare of jute calculated earlier in chapter 5.

8.1.7. Reasons for selecting cattle as an enterprise

Farmers were asked to list the reasons for selecting cattle as an enterprise. Majority of the farmers belonging to different farming systems expressed that use as draft power is the main reason for selecting cattle as an enterprise. According to their opinion it is essential for ploughing activities in crop cultivation. The second and third criteria for selecting cattle as a component in their farming systems were using it as a regular flow of income by selling milk and using cattle waste products as fuel/manure (Table 8.6).
Table: 8.6. Reasons for selecting cattle as an enterprise (% of farmers)

<table>
<thead>
<tr>
<th>Reasons</th>
<th>C-C-P-F(%)</th>
<th>C-C-P(%)</th>
<th>C-C(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used as draft power</td>
<td>60</td>
<td>54</td>
<td>50</td>
</tr>
<tr>
<td>Regular flow of Income</td>
<td>27</td>
<td>33</td>
<td>30</td>
</tr>
<tr>
<td>Used as fuel and manure of cattle waste product</td>
<td>13</td>
<td>13</td>
<td>20</td>
</tr>
</tbody>
</table>

According to the farmers opinion since crops are not grown throughout the year and some times are damaged by natural disaster it is therefore useful to rear cattle to reduce risk and for maintenance of family needs throughout the year.

8.1.8. Reasons for not selecting cattle as an enterprise

The farmers in the farming systems where farmers did not select cattle as an enterprise were asked to provide reasons for not selecting cattle. Farmers provided three main reasons namely: (i) high initial investment ii) scarcity of green grass at certain periods throughout the year and (iii) combination of both.

Farmers stated that due to their limited income they are not able to spend large amounts at a time. Also it does not give much benefit in relation to investment which was expressed by 55% of total farmers in C-P farming system. Twenty percent farmers stated in favour of the problem of green grass at certain periods throughout the year and those in favour of both were 25%.

8.1.9. Reasons for selecting poultry as an enterprise

It is seen from the table 8.7. that most of the farmers in all systems used poultry for family consumption. Few sample farmers gave emphasis to rearing poultry birds only for feeding egg and meat to their growing children. They told that they can not
afford to take meat and egg for the entire family members but it is essential for the growing children.

**Table: 8.7. Reasons for selecting poultry as an enterprise (% of farmers)**

<table>
<thead>
<tr>
<th>Reasons</th>
<th>C-C-P-F(%)</th>
<th>C-C-P(%)</th>
<th>C-P(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family consumption</td>
<td>67</td>
<td>60</td>
<td>53</td>
</tr>
<tr>
<td>Less cost involvement &amp; easy to rearing</td>
<td>23</td>
<td>33</td>
<td>40</td>
</tr>
<tr>
<td>Selling only</td>
<td>10</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

It is observed that in the existing farming situation no farmers were found to rear poultry on a commercial basis however, a few poultry birds were marketed in every systems.

**8.1.10. Reasons for not selecting poultry as an enterprise**

The farming systems where poultry enterprises were not present were asked to provide the reasons for not selecting poultry as an enterprise. The following reasons were identified: (i) it harms field crops or destroys homestead vegetables (ii) it makes the house dirty. However the percentage of farmers that answered in favour of the above mentioned two reasons were 57% and 43% respectively.

**8.1.11. Reasons for selecting fish as an enterprise**

It should be noted here that the fish component is present only in the C-C-P-F farming system. The farmers were asked to explain the reasons for selecting fish as an enterprise. They mentioned three reasons: (i) it is profitable (ii) demand for fish is high so easy to market (iii) it satisfies household demand. According to the above mentioned opinions the percentage of sample farmers were 67%, 27%, 6% respectively.
8.1.12. Reasons of not selecting fish as an enterprise

The major causes for not selecting fish as an enterprise were also determined for farmers belonging to C-C-P, C-C, C-P farming systems. On the basis of priority they mentioned three reasons (i) initial investment is high (ii) lack of knowledge about fish culture (iii) fear of theft. It was found that the majority of farmers (53-66%) in every farming system stated that initial investment was a great concern for not selecting fish as an enterprise.

Table: 8.8. Reasons for not selecting fish as an enterprise( % of farmers)

<table>
<thead>
<tr>
<th>Reasons</th>
<th>C-C-P</th>
<th>C-C</th>
<th>C-P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial investment is high</td>
<td>60</td>
<td>53</td>
<td>66</td>
</tr>
<tr>
<td>Lack of knowledge about fish culture</td>
<td>27</td>
<td>23</td>
<td>13</td>
</tr>
<tr>
<td>Fear of theft</td>
<td>13</td>
<td>23</td>
<td>20</td>
</tr>
</tbody>
</table>

8.2. Opinion of extension workers

The view of extension workers are also important because extension workers are directly related with farmers. They are assigned by the Government to supervise and monitor the day to day farmers activities. Do they agree with the farmers opinion regarding selection of enterprises? It is very important to know because doing anything for farmers betterment, necessary to identify the actual reasons. For this purpose extension workers including Agricultural Officer, Livestock Officer, Fisheries Officer and Block Supervisors who are directly or indirectly related with the agricultural activities of that study area were interviewed. They were asked about their opinions in regards to the enterprise selection process used by the farmers. Among the traditional, institutional, neighbour farmers influence what encouraged the most in selecting an enterprise? What were their opinions about
profitable enterprises and why? In addition few questions were asked based on the farmers opinion for obtaining the views/comments of extension workers.

Summarising the opinion of the extension workers, the following points were identified:

1) Factors affecting the selection of crop enterprise include consumption and selling, farm size, education and family labour for agriculture.

2) Institutional cooperation from agricultural extension workers, livestock, fisheries and N.G.O workers inspire the farmers to make decisions for selecting enterprises.

3) Enterprise selection does not depend only on financial capacity and types of land which they use. In addition few farmers do not want to take risk of choosing new enterprises and a lack of technical knowledge is a barrier when choosing new enterprises.

4) In existing farming situations most farmers cultivate crops and rear poultry for home consumption and maintaining day to day family needs but farmers are thinking about cultivating a few crops commercially.

5) Since rice is the staple food, the primary target of farmers was to cultivate rice for home consumption rather than selling. They plan to sell some products when the opportunity comes.
6) Farmers are used to cultivate few crops traditionally though it does not bring much benefit to them.

7) Fish cultivation is profitable but due to suitable land and initial high investment, farmers generally do not want to select this component in their farming systems.

8) Ideas or concepts about enterprises come from institution, traditional, or neighbour influence, however, the decision on how much to produce, what to produce, where to produce and where to sell are determined through self decision followed by consultation with wife and other family members.

8.3. Critical discussion about the opinion of farmers and extension workers

The reasons provided by the farmers for selecting or not selecting enterprises were discussed in section 8.1 and views of extension workers regarding selection of enterprises by the farmers were discussed in section 8.2. In this section attempt has been taken to critically discuss their opinions.

It is observed that there was a difference between the farmers and extension workers point of views in few cases though in most cases they expressed the same opinion. For example, extension workers stated that in decision making of selecting the enterprise farmers gave emphasis on self decision which was followed by consultation with wife and other family members. In farmers opinion consultation with wife was the first choice followed by self decision and consultation with other family members.
Like extension workers, farmers also stated that institutional influences inspired the farmers to select enterprises. However, farmers expectation is to get more cooperation from the extension workers. Fisheries Officer and Livestock Officer also admit that due to their limited human resources it would not be possible to supervise the farmers problem timely and properly. Result also showed that traditional influence was still higher in every farming systems of selecting enterprise.

Extension workers opinions on selecting rice as an enterprise was similar to answers provided by the farmers, where most farmers produced rice for home consumption and the surplus was kept for selling. The trend was the same in every farming system. Farmers and extension workers expressed same opinion that other than financial capability, technical know-how and risk factors were also the determinant factors in selecting enterprises. Results of the study indicated that due to high initial cost investment and lack of technical know-how farmers did not want to include a fish component in their system.

The point is that the different opinions of farmers and extension workers could not bring better performance in farming system. It was not expected that farmers, would select crops in traditional attitude although they do not bring much benefit to them. It is not desirable that although certain enterprise would give much benefit but farmers were not including this component due to the initial high investment or lack of technical knowledge. It is necessary to sort out the problem. Why do farmers cultivate few crops traditionally when it does not bring much benefit? Why are farmers reluctant to include some enterprise (for example: fish) which could bring much benefit?
In this stage more close interaction with the farmers and extension workers is necessary. In this regard participatory research and extension could play a very important role to overcome the problem. There is an increasing recognition that participation of agricultural professionals and rural people is essential for sustained agricultural change. It is proved that only teaching mentality can not bring the desirable change. Learning from farmers is also necessary. A move from a teaching to learning style has profound implications for agricultural development institutions. (Pretty, 1995). Participatory approaches allow scientists to get a better feeling for how their research field fits into the total system and provides an appreciation of management concerns and issues (Allen et al. 1995).

8.4. Conclusion

It is found that in the selection process self decision, consulting with wife, institutional influence and traditional influence played an important role in decision making. Consumption as staple food, household uses and selling purpose were the main reasons of producing rice, jute and vegetables respectively in every system. The use of draft power and regular flow of income were the main reasons for selecting the cattle as an enterprise. On the other hand high initial investment and the scarcity of green grass through out the year were the reasons for not selecting cattle as a component. Family consumption, less cost involvement and ease of rearing were the main reasons for the selection of poultry. On the other hand main reasons for not selecting poultry were found that it harms the crops and vegetables. The main reasons for selecting fish cultivation was it is profitable and demand is high therefore easy to market.
CHAPTER 9
Summary and Conclusion

This chapter summarises the major findings of the study. Section 9.1 presents the major findings, recommendations and suggestions for further research are presented in sections 9.2 and 9.3 respectively.

The study was undertaken to analyse the performance of farm businesses under alternative farming systems in selected areas of Bangladesh. The villages of Kandapara, Chanpur, Hijaltali and Uttar Gazaria under Kaliakair Upazilla of Gazipur district were selected for the study considering the diversified farming systems, time and cost savings. The following four major farming systems were identified:

(i) Crop-Cattle- Poultry- Fish (C-C-P-F)
(ii) Crop-Cattle-Poultry (C-C-P)
(iii) Crop-Cattle (C-C)
(iv) Crop-Poultry (C-P).

Thirty samples from each of four categories were selected randomly. One year's data covering the period January to December 2000 was collected by the researcher, through interviewing farmers face to face.

The specific objectives of the study were as follows, to:

i) Identify the socio-economic characteristics of farm households under alternative farming systems.
ii) Asses the relative performance of individual enterprises within different farming systems and compare the performance of alternative farming systems

iii) Determine the resource use efficiency in different components under different farming systems.

iv) Compare utilisation of labour force and examine the distribution of labour by gender in different farming systems.

v) Find out the selection criteria of enterprises/components of different farming systems from the farmer's point of view.

9.1. Major findings

9.1.1. Performance analysis in farming systems

Performance analysis of individual components such as crop, cattle, poultry and fish revealed that in the crop component, vegetable production was most profitable in every system. The reason was that labour costs in vegetable cultivation were very low. In the case of the cattle enterprise, gross margin and BCR were highest in the C-C system compared to the other three systems. Performance of the poultry component was better in the C-C-P system compared to the other systems. Among all components of the farm business, in terms of gross margin, fish appeared to be the most profitable.

The relative performance of the farming systems as a whole was studied using gross margin, BCR and returns to labour per hour. In addition, the residual income measure approach was applied by using income measures such as gross margin, net farm income and operators labour and management income. It was found that (Chapter 5 Table 5.8) gross margin was much higher in the C-C-P-F system in
comparison to the other three systems. The reason was that fish was the most profitable enterprise in comparison to any other enterprise in different systems. The returns to labour per hour was highest in C-C-P-F system. The analysis with the residual income measures revealed that although all of the farming systems earned positive labour and management income, it was highest in C-C-P-F system. On the other hand the highest BCR was found in the C-P farming system. Since variable cost was relatively low in poultry management, in relation to return this was reflected in the higher BCR of C-P systems.

From the aforesaid comparative analysis of the farming systems it is difficult to come to a conclusive decision for selection about a system in terms of economic performance. However, it is presumed that if the farmers are very poor they would give more emphasis to BCR because scarcity of capital is a great concern for poor farmers. On the other hand, if the farmers become economically well off they may consider gross margin in the context of Bangladesh.

However, another important finding is that the average returns to labour per hour were found to be 27 to 30 taka in different farming systems. It is noted that in Bangladesh labour could be hired in agriculture and other related activities within the range of 10-15 taka per hour only. The returns to labour obtained from this study suggests that although labour is in surplus in agriculture, it is more profitable to invest time in one's own farm rather than going out as hired labour. This is a very important message for a country like Bangladesh where employment opportunity has a very limited scope. If the farmers extend their activities in a system, and invest
more time in agriculture, it could be more effective in increasing the income in their farming business.

9.1.2. Gender role in farming systems

Gender role in farming systems was calculated in consideration of time spent in agricultural and household activities. It was found that in crop field activities the proportionate engagement of male labour was significantly higher in pre-harvest compared to post-harvest activities and proportionate time spent of female labour was significantly higher in post-harvest activities compared to pre-harvest activities in each farming system.

In cattle management the result showed that female labour involvement was higher than male in all systems. The scenario was more interesting in the case of poultry management. In poultry management, female labour utilisation was not only higher than male but the contribution of male labour was very negligible. It was also observed that it required very few labour hours in comparison to other components such as crop, cattle and fish. The reason is that poultry rearing is possible within the homestead area, besides this, poultry feeding was also performed by the female member of the family within the homestead ground. In fish culture, the involvement of females was very negligible.

The results revealed that activities in farming systems were found to be clearly gender tasked: pre-harvest activities were exclusively performed by men whereas post-harvest activities were performed by women. Similarly, cattle and poultry
management was done by women and on the other hand fish culture was performed by men.

The present study confirms that, the claim that women are actively involved only in household activities is an underestimation of women's contribution to agricultural production. It may be inferred from the results of the study that women exclusively perform all the household work. On average women devote 37 hours/week whereas men devote only 4 hours/week in household activities, although the female contribution to household activities remain invisible in a society like Bangladesh. After doing almost all the total household work, the females further employed themselves in agricultural activities.

9.1.3. Selection criteria of enterprises in farming systems

Selection of enterprises in different farming systems was mainly dependent on social and economical conditions. In the case of selecting enterprises, results showed that a majority of farmers consulted with their wives in every farming system. Traditional influence was higher in every system, although institutional influence was highest in C-C-P-F system. In selecting rice as an enterprise, results indicated that around 60-70 percent of farmers cultivated rice for their staple food. The reasons for selecting vegetables as an enterprise was mainly for selling purposes.

In selecting cattle as an enterprise, draft power was the main reason in each farming system. In selecting poultry as an enterprise, it was found that farmers rear poultry mainly for family consumption. It was also found that a majority of farmers were enthusiastic to incorporate poultry as an enterprise, as it had less cost
involvement. The main consideration of selecting fish as an enterprise was that it was profitable. On the other hand high initial investment cost was the great concern of not selecting fish as an enterprise.

The overall conclusion is that there is no one right choice of farming systems because performance of different systems varied due to the application of different economic measures. It is also observed that farming systems were found to be clearly gender tasked. Females were more involved in cattle and poultry activities whereas males were involved in pre harvest and fish culture. So the selection of enterprise will be influenced by individual preference. In general it can be argued that the system where there is a greater opportunity of cross gender involvement, might bring better performance for the farmer.

9.2. Recommendations

In view of the major findings of the study, the following recommendations were made:

(1) The results indicated that within the crop component, vegetables gave relatively higher returns. Thus farmers can take advantage of expanding the area for vegetable cultivation instead of other enterprises in respective farming systems.

(2) Within the whole farming business, fish offered the highest return among the components of the whole farming system. Extension workers may encourage farmers of similar areas of the country to follow this component.
(3) The activities in farming systems were clearly gender tasked. That is why enterprises would be selected in such a way that both male and female members of the family can engage themselves in total farming systems.

(4) A participatory approach could provide effective tools for better understanding among farmers, extension workers and researchers, which would help with the selection of enterprises by the farmers, on the basis of socio-economic and bio physical limitations. It is observed in the study area that in selecting enterprises (Chapter 8) in a few cases some farmers included enterprises in their system traditionally. Similarly, they did not want to include enterprises such as fish, due to high initial investment cost and lack of technical knowledge even though they knew that this enterprise would bring more benefit to their farm. In that case the participatory approach could be an effective tool in overcoming this situation.
9.3. Suggestions for further study

A number of areas are identified where further study may be conducted to develop policies dealing with the sector as a whole or in part. The following suggestions could be considered:

1) Further study could be adopted on the basis of farm size, to discover whether there is any impact of farm size on economic performance and gender role in different farming systems.

2) Women's involvement was significant in different farming activities however, the question about their role in decision making in the farming family could also be studied.

3) Cobb-Douglas production function model fitted well for the data used for this research. Further testing of the model with an independent data set, will give more confidence about the model for examining the resource use efficiency in different farming systems.

4) Reasons for selecting enterprises may vary from place to place due to different agro ecological factors. Institutional cooperation may also vary from place to place. Farmers flexible attitude may change over time. In this regard data may be collected from different areas of the country and time series data may be taken for analysis in order to know the reasons for enterprise selection.
REFERENCES


Dhawn, K.G. Bansal., 1977. Rationality of the use of various factors of production on different sizes of farm in Punjab. *Indian Journal of Agricultural Economics_, 32(3);121-130.


APPENDICES
Appendix 1: Table 1: Time of sowing, transplanting and harvesting of some crops in Bangladesh

<table>
<thead>
<tr>
<th>Crops</th>
<th>Time of Sowing/Time of Transplanting</th>
<th>Time of Harvesting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Aus paddy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Local</td>
<td>Mid March to Mid April</td>
<td>Mid July to Early August</td>
</tr>
<tr>
<td>(b) HYV</td>
<td>Mid March to Mid April</td>
<td>July to August</td>
</tr>
<tr>
<td>(c) HYV</td>
<td>Mid March to Mid April</td>
<td>Late July to August</td>
</tr>
<tr>
<td>2 Aman Paddy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Local Transplant</td>
<td>End June to Early September</td>
<td>December to January</td>
</tr>
<tr>
<td>(b) Local Broadcast</td>
<td>Mid March to Mid April</td>
<td>Mid Nov to Mid Dec</td>
</tr>
<tr>
<td>HYV transplant</td>
<td>Late June to Mid August</td>
<td>December to January</td>
</tr>
<tr>
<td>3 Boro Paddy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Local</td>
<td>Mid November to Mid January</td>
<td>April to May</td>
</tr>
<tr>
<td>(b) HYV</td>
<td>December to Mid February</td>
<td>Mid April to June</td>
</tr>
<tr>
<td>4 Wheat</td>
<td>November to December</td>
<td>March to Mid April</td>
</tr>
<tr>
<td>5 Jute</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) White</td>
<td>Early March to Mid April</td>
<td>July to August</td>
</tr>
<tr>
<td>(b) Tossa(olitortius)</td>
<td>Mid April to Early May</td>
<td>August to September</td>
</tr>
<tr>
<td>6 Mustard</td>
<td>Mid October to Mid November</td>
<td>January to February</td>
</tr>
<tr>
<td>7 Masur (Lentil)</td>
<td>Mid Oct to Mid December</td>
<td>February to March</td>
</tr>
<tr>
<td>8 Kheshari</td>
<td>Mid October to Mid December</td>
<td>Mid Feb to Mid April</td>
</tr>
<tr>
<td>9 Cauliflower</td>
<td>Late October to Mid November</td>
<td>January to March</td>
</tr>
<tr>
<td>10 Potato</td>
<td>Mid September to November</td>
<td>November to April</td>
</tr>
<tr>
<td>11 Brinjal</td>
<td>October to Mid November</td>
<td>November to April</td>
</tr>
<tr>
<td>12 Water gourd</td>
<td>Mid July to Early November</td>
<td>Early January to Early March</td>
</tr>
<tr>
<td>13 Beans</td>
<td>Late June to Early September</td>
<td>Late November to Mid April</td>
</tr>
<tr>
<td>14 Lady's finger</td>
<td>Mid April to Mid June</td>
<td>Mid June to Mid August</td>
</tr>
<tr>
<td>15 Patal</td>
<td>Mid August to Mid October</td>
<td>Mid January to March</td>
</tr>
<tr>
<td>16 Chichinga (snake gourd)</td>
<td>Mid February to Late April</td>
<td>July to September</td>
</tr>
<tr>
<td>17 Jhinga (Ribbed gourd)</td>
<td>Mid April to Mid July</td>
<td>Mid June to Mid August</td>
</tr>
<tr>
<td>18 White Gourd</td>
<td>Mid March to Mid June</td>
<td>Mid July to October</td>
</tr>
<tr>
<td>19 Sweet gourd</td>
<td>Second halaf of November</td>
<td>Beginning April to Mid June</td>
</tr>
<tr>
<td>20 Danta (Amaranth)</td>
<td>Mid February to Late June</td>
<td>Late August to Mid November</td>
</tr>
</tbody>
</table>
Table 2: Existing crops and adapted cropping pattern on the basis of soil and land characteristics for high land with rain fed and irrigated conditions of the study area

<table>
<thead>
<tr>
<th>Land Class</th>
<th>Existing Crops without Irrigation</th>
<th>Adopted Cropping Pattern(without Irrigation)</th>
<th>Existing Crops with Irrigation</th>
<th>Adopted Cropping Pattern(With Irrigation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mashkalai, Lal Sak,Palong Sak,Chalkumra,,Bean,T.Aman.</td>
<td>1.Kharif Vegetable-Rabi crops.</td>
<td>Maize,Cucumber,Chichinga,Karala,La dy’s finger,Brinjal ,Data,Pui Sak,Lal Sak</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. B.Aus-Cotton</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.Mixed Banana and Ginger/Tumeric</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.Mixed Sugarcane and Masur/Mustard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Table 3: Existing crops and adopted cropping pattern on the basis of soil and land characteristics for medium high land with rain fed and irrigated conditions of the study area

<table>
<thead>
<tr>
<th>Land class</th>
<th>Existing Crops without Irrigation</th>
<th>Adopted cropping pattern(without irrigation)</th>
<th>Existing Crops with Irrigation</th>
<th>Adopted Cropping Pattern(with Irrigation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium high Land</td>
<td>B.Aus,Til,Maize,Mushkalai</td>
<td>Wheat, Maize, Mustard, HYV, Local, B.Aman.</td>
<td>Kharif-1</td>
<td>B.Aman(HYV)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. B.Aus/Jute(Local)-Mushkalai/Maize/water Melon.</td>
</tr>
</tbody>
</table>
Table 4: Existing crops and adapted cropping pattern on the basis of soil and land characteristics for low land with rain fed and irrigated conditions of the study area

<table>
<thead>
<tr>
<th>Land Class</th>
<th>Existing Crops without Irrigation</th>
<th>Adapted Cropping Pattern (With out Irrigation)</th>
<th>Existing Crops with Irrigation</th>
<th>Adopted Cropping Pattern (With Irrigation)</th>
</tr>
</thead>
</table>

Source: Land and Soil Resources Use Guide SRDI, Dhaka
Table 5: Farm resource inventory of households in the selected farming systems

<table>
<thead>
<tr>
<th>Name of assets</th>
<th>C-C-P-F</th>
<th>C-C-P</th>
<th>C-C</th>
<th>C-P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No &amp; expected life (Yrs)</td>
<td>Current Value (Tk.)</td>
<td>Annual Depreciation (Tk.)</td>
<td>No &amp; expected life (Yrs)</td>
</tr>
<tr>
<td>Cattle shed</td>
<td>1.0(5)</td>
<td>4500</td>
<td>900</td>
<td>1.0(5)</td>
</tr>
<tr>
<td>Plough</td>
<td>1.0(6)</td>
<td>250</td>
<td>41.66</td>
<td>1.0(5)</td>
</tr>
<tr>
<td>Ladder</td>
<td>1.0(3)</td>
<td>150</td>
<td>50.00</td>
<td>1.0(3)</td>
</tr>
<tr>
<td>Rack</td>
<td>1.0(6)</td>
<td>250</td>
<td>41.66</td>
<td>1.0(5)</td>
</tr>
<tr>
<td>Spade</td>
<td>1.5(5)</td>
<td>100</td>
<td>20.00</td>
<td>1.0(5)</td>
</tr>
<tr>
<td>Katchi</td>
<td>1.5(4)</td>
<td>20</td>
<td>5.00</td>
<td>1.5(4)</td>
</tr>
<tr>
<td>Nirani</td>
<td>2.0(3)</td>
<td>15</td>
<td>4.86</td>
<td>1.5(4)</td>
</tr>
<tr>
<td>Swing basket</td>
<td>1.0(3)</td>
<td>36</td>
<td>12.00</td>
<td>1.0(3)</td>
</tr>
<tr>
<td>Don</td>
<td>1.0(4)</td>
<td>280</td>
<td>70.00</td>
<td>1.0(3)</td>
</tr>
<tr>
<td>Fishing equipment</td>
<td>1.0(4)</td>
<td>450</td>
<td>112.5</td>
<td>-</td>
</tr>
<tr>
<td>Dheki</td>
<td>1.0(8)</td>
<td>300</td>
<td>37.50</td>
<td>1.0(8)</td>
</tr>
<tr>
<td>Poultry shelter</td>
<td>1.0(4)</td>
<td>500</td>
<td>125.00</td>
<td>1.0(3)</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>6851</td>
<td>1420</td>
<td>-</td>
</tr>
</tbody>
</table>

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Table-6: Genderwise labour utilisation in agricultural activities in different farming systems

<table>
<thead>
<tr>
<th>Items</th>
<th>Per farm use of labour (hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C-C-P-F</td>
</tr>
<tr>
<td>Crop</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>425</td>
</tr>
<tr>
<td>Female</td>
<td>60</td>
</tr>
<tr>
<td>Cattle</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>214</td>
</tr>
<tr>
<td>Female</td>
<td>248</td>
</tr>
<tr>
<td>Poultry</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3</td>
</tr>
<tr>
<td>Female</td>
<td>48</td>
</tr>
<tr>
<td>Fish</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>262</td>
</tr>
<tr>
<td>Female</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>905</td>
</tr>
<tr>
<td>Female</td>
<td>374</td>
</tr>
</tbody>
</table>

Table-7: Labour used for agriculture and household activities in different farming systems

<table>
<thead>
<tr>
<th>Items</th>
<th>Per farm use of labour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C-C-P-F</td>
</tr>
<tr>
<td>Agriculture</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>905</td>
</tr>
<tr>
<td>Female</td>
<td>374</td>
</tr>
<tr>
<td>Household</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>247</td>
</tr>
<tr>
<td>Female</td>
<td>1939</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1152</td>
</tr>
<tr>
<td>Female</td>
<td>2313</td>
</tr>
</tbody>
</table>
Appendix 2: DESCRIPTION OF THE STUDY AREA

1.1. General information of the study area

Kaliakair, is one of five Upazillas in the Gazipur district of Bangladesh. The study area was located under this Upazilla. Kaliakair Upazilla as illustrated in Map-1. The Upazilla occupies an area of 314.14 sq.km. It was located in the western part of the Gazipur district in Bangladesh between 24°00 and 24°15 North latitudes and between 90°09 and 90°22 east longitude. The Upazilla was bounded on the north by Sreepur and Shakhipur Upzilla, on the east by Gazipur Sadar Upazilla, and on the south by Savar and Dhamrai Upazilla of the Dhaka district and on the west by Mirzapur Upazilla of the Tangail District (BBS 1993).

1.2. Agro-Ecological Zone (AEZ)

The land use pattern of the country is influenced by agro ecology, soil physiography and climate factors. According to the variations of all these factors and agricultural potential the total land area has been classified into thirty agro-ecological zones in Bangladesh. The study area was covered under two Agro-Ecological Zones which are AEZ-8 and AEZ-28 as illustrated in Map 2.
Image unavailable due to copyright restrictions.

Please refer to print copy
Map 2: Agro-Ecological Zones of Bangladesh. The study area was covered under two Agro-Ecological Zones which are AEZ-8 and AEZ-28.
1.3. Climate, Temperature and Rainfall

The climate of the study area was more or less the same as that of the other parts of the district. There are predominantly three seasons. They are the rainy season which covers the month from July to October, winter season which covers the time from November to February and summer season which covers the time from March to June. The temperature of the project area goes up and down according to the seasons and determined the crop sustainability. The average month wise lowest and highest temperature varies from 10°C to 40°C. The average rainfall is about 2578 mm with the lowest in the month of January and highest in the month of July. November to March is the dry period with only a few mm rainfall. The rainfall is mainly confined with in the months of April to October.

1.4. Occupation

Agriculture was the main source of employment of the people in the study area. Most of the households in the study area had agriculture as the main source of income. A small number of people were engaged in services with different government and autonomous bodies. The main occupations of the landless and marginal farmers were selling of daily labour, rickshaw pulling, petty trading etc.

1.5. Institutions

Many local, national and international organisations were working with the Government to eradicate illiteracy from the Upazilla. Satellite and community schools are being set up to give education to uneducated people including children in the study area. There are primary schools and secondary schools in the village but no college in the study area. However, in the Upazilla there are three boys colleges and
one women's college. After completing the secondary education they have to go away from their village for higher secondary education.

1.6. Communication and transport

The study area was connected with Dhaka city via Gazipur sadar. The road network was good. Paved, semi paved and unpaved road are being built and total length is 399 sq km. Due to good communication with the urban area of Kaliakair upazilla, Gazipur and Dhaka districts, farmers generally received good price for their products. The growers often sell their products directly to the market. The rich farmers were used to selling different crops from their households or for farms. The metalled road and unpaved road passed through the village. Rickshaw, cycles, scooters move regularly to and from the villages.

1.7. Non government organisations activities (N.G.O) Activities

Some renowned national and local NGO were working in the study area for the alleviation of poverty by taking different ways and means. Bangladesh Rural Advancement Committee (BRAC), PROSHIKA (An acronym of three Bengali words stands for training, education and action) and World Vision are educating adult people who are engaged with them and these organisation are also educating the other members at adult education centre. For non school children they also have set up satellite schools to educate those children. The above NGOs have training programme on health, nutrition and sanitation. They organise office training and field training among their group members in the study area. The activities of BRAC involved in crop production, pisciculture, health care, plantation and to promote literacy. Proshika is also training the farmers to promote leadership among the
farmers, group formation of farmers and to distribute loans to the agricultural sector and other income generating projects.

2. Agricultural information

2.1. Main crops

The crops grown vary during the year due to variation in seasonal conditions. Three crop seasons namely Aus, Aman and Boro prevail in Bangladesh year round. Another way it can be said that a wide variety of crops which are broadly classified into two groups according to seasons in which they were grown. They are (a) Kharif crops and (b) Rabi Crops. Kharif crops are grown in the spring or summer season and harvested in late summer or in early winter. Rabi crops are sown in winter and harvested in the spring or early summer. The main crops in the study area included aus, aman, boro, jute, and a few farmers cultivate wheat, mustard and pulse. Among the horticultural crops vegetables amaranth, brinjal, chickpea, sweet gourd, cucumber, radish, cauliflower, bitter gourd, potato, cabbage, tomato, barbati, palongsak (spinach), lax sak, kakrol, Jhinga (Ribbed gourd), puisak (Indian Spinach), chalkumra (White gourd) & bean are grown.

2.2. Pests of crops

The major insect pests found in the study area were rice stem borer, brown plant hopper, rice bugs, aphids, cucurbit beetles, shoot and fruit borer and cut-worms. Bacterial diseases like wilting brinjal and cucurbits, fungal diseases like late blight of potato, stem rot of banana and papaya, black band of jute and anthracnose of chilli and viral mosaic diseases of lady’s fingers, tomato, papaya and cabbage are noticed.
2.3. Cropping pattern

Cropping pattern means the number of crops grown in different cropping seasons on a given field during a 12 months period. Cropping patterns include single, multiple and mixed cropping. The sample farmers utilised their land in different cropping patterns most of which consisted of triple cropped, double cropped and single cropped patterns. The triple cropped patterns were Jute- T. Aman (MV)- vegetables, Vegetable-Aus & Aman, Double cropped pattern were Boro-fallow-Aman, Jute-fallow-Boro, Jute-fallow-vegetable, Jute-fallow-Wheat, Vegetable-Aus-fallow, Mustard-Boro-fallow, Vegetable-T..Aman-Mustard and single cropped patterns were fallow-fallow-Aman, Boro-fallow-fallow, fallow-fallow- Vegetables. The most predominant patterns were Vegetable-T.Aman-Mustard, Fellow-T.Aman-Boro, Fallow-T..Aman-Mustard, Jute-Fallow-Wheat, Vegetable-Fallow-Boro, Jute-T.Aman-Vegetable

2.4. Livestock

The farmers of the study area raised cattle, chicken and duck. There were no buffalo in the study area but very few sheep in the area. The diseases of cattle found were foot and mouth diseases, bloating, anthrax and diarrhoea while with fowls were Newcastle disease, fowl pox, fowl cholera and duck plague.

2.5. Fisheries

Few of the homesteads had pond where culture of fishes like Ruhi, Katla, Mrigal, Silver Carp, Mirror Carp, Nilotica, Thai Sarputi, Boal, Pangas, Thai Magor and Grass Carp were practiced. Homestead ponds were the main sources of fish production. The farmers also caught fish from the river and ditches of the rice fields.
Appendix 3: Photographs of day to day farmers activities (These photo were taken from farmers field/household in Bangladesh on July 2002).

**Photo-3.1.** Farmer using homestead ground for drying the cow dung which will be used for fuel. Since in rural area there is no gas so this dried cow dung is used as fuel for cooking. It may be noticed that female member of the family is helping her husband to collect dried cow dung for preservation.

**Photo-3.2.** Poultry feeding in homestead. Usually poultry are fed when they are at free range. Homestead ground is utilised for this purpose.
**Photo-3.3.** The cattle are feeding on straw from a large pot. The cattle shed is adjacent to it which is made by jute stick. Besides the cattle shed, straw was stored which will be used for cattle feeding and fuel when necessary.

**Photo 3.4.** A female farmer is harvesting matured white gourd for seed from her homestead garden. Seed will be preserved for next years planting and also for marketing.
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Photo 3.7. Farmers are harvesting crops from their field.

Photo 3.8: Female member of the family is milking their own cow.
Evaluation of Alternative Farming Systems with Reference to Income and Gender in Selected Areas of Bangladesh

By

Sajjadul Hassan

A thesis
Presented to the School of Environment and Agriculture
University of Western Sydney
in fulfilment of the requirements for the degree of
Master of Science (Honours)

June, 2002

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PLEASE NOTE

The greatest amount of care has been taken while scanning this thesis,

and the best possible result has been obtained.
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To my parents I extend my immeasurable appreciation. Thanks to other relatives and well wishers who supported me in different ways.

Finally, I gratefully acknowledge my wife Olivia for her enduring support and to my beloved son Shadab.
Statement of Authentication

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in whole or in part, for a degree at this or any other institution.

..........................  (Signature)

.........................  (Signature)
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ACRONYMS AND ABBREVIATIONS

BBS .............................................. Bangladesh Bureau of Statistics
BARC ............................................ Bangladesh Agricultural Research Council
BARI ............................................. Bangladesh Agricultural Research Institute
BCR ............................................... Benefit Cost Ratio
C-C-P-F ........................................ Crop-Cattle-Poultry-Fish
C-C-P ............................................. Crop-Cattle-Poultry
C-C ................................................ Crop-Cattle
C-P ................................................ Crop-Poultry
CSR ............................................... Cropping Systems Research
DAE ............................................... Department of Agricultural Extension
FSR ............................................... Farming Systems Research
FSRDR ........................................... Farming Systems Research & Development
GB .................................................. Gross Benefit
GDP ............................................... Gross Domestic Product
HYV ............................................... High Yielding Variety
ha .................................................. Hectare
MOA ............................................... Ministry of Agriculture
MP .................................................. Murate of Potash
MV .................................................. Modern Variety
NCFSRD ......................................... National Coordinated Farming
                                             Systems Research and Development
NARS ............................................. National Agricultural Research System
OFR ............................................... On-Farm Research

Tk .................................................. Taka (Currency unit of Bangladesh)
                                           1 US Dollar = 58 Taka (approx.)
                                           1 Australian Dollar = 28 Taka (approx.)

TSP ............................................... Triple Super Phosphate
GLOSSARY

Chatak................................. Used in local unit equal to 58.319 gm.

Dheki ................................ Country made tool used for husking paddy.

Don ................................ Country made tool for irrigation made of palm trunk.

Hali ..................................... 1 hali = A set of four.

Kachi .................................. Sickle shaped tool for harvesting.

Ladder .................................. A country made tool by bamboo for levelling the land.

Maund.................................. Local unit equal to 37.32 kg.

Nirani .................................. Country made tool used for weeding and loosening the soil.

Rack ................................ Country made tool used for weeding.

Seer ................................ Local unit equal to 0.93 kg.

Swing basket........................ Local irrigation tool.

Tola ................................ Local unit equal to 11.66 gm.
ABSTRACT

Farming systems in Bangladesh are characterised by a mixed culture of crop, livestock, poultry, fish and agro forestry sub systems of agricultural enterprise. Low productivity and inefficient resource use are the main constraints to farming in Bangladesh. It is necessary to improve the performance of all enterprises in existing farming systems which depends on the proper utilisation of the existing level of resources. The overall objective of this study was to evaluate the alternative farming systems in terms of income and gender participation. The specific objectives were (i) to identify the socio-economic characteristics (ii) to assess the relative performance of individual enterprises and sub systems (iii) to determine the resource use efficiency in different farming systems (iv) to compare utilisation of labour force and examine the distribution of labour by gender and (v) to find out selection criteria of the enterprise from the farmers point of view in different farming systems.

To achieve these objectives a study was conducted in four villages of Kaliakair Upazilla in the Gazipur district of Bangladesh. Four major farming systems were identified from the selected areas, which are as follows:

1) Crop-Cattle-Poultry-Fish (C-C-P-F),
2) Crop-Cattle-Poultry (C-C-P),
3) Crop-Cattle (C-C) and
4) Crop-Poultry (C-P).

Thirty sample farmers were selected randomly from each of the four dominant farming systems. Data pertaining to one agricultural year (January to December 2000) were collected through an interview schedule.

The comparative analysis of alternative farming systems carried by using various technique such as gross margin analysis, returns to labour and benefit cost ratio suggests that there is no one right choice for selecting a farming system. Relatively better performance was achieved by C-C-P-F system. Results demonstrated that gross margins and returns to labour were highest in the C-C-P-F system. On the other hand, the highest benefit cost ratio was found in the C-P system. The residual
income measures such as net farm income and labour and management income indicated that although all the systems earned positive labour and management income, the C-C-P-F farming system was highest.

Gender roles in farming systems were assessed in consideration to time spent in agricultural activities including time spent in crop, cattle, poultry and fish culture. In addition, time spent in household activities was also calculated. Results demonstrated that proportionate time spent by male labour was more in pre harvest and female were more in post harvest operation in crop field activities. In cattle management, female time spent was higher than male. In poultry management time spent by female labour was much higher than male. On the other hand time spent by female in fish culture was negligible. In household activities, the average time spent by males and females was 4 hours/week and 37 hours/week respectively.

Self or family decision and institutional factors played important role in the selection process of farming systems. Family consumption was the main reason for selecting rice and poultry enterprise. Vegetables were mainly produced for selling. The cattle were selected for using as draft power and regular flow of income. Profitable concern was the major consideration of selecting fish as an enterprise. On the other hand few farmers did not select cattle and fish due to high initial investment cost. The main reason for not selecting poultry was because it harms the crops and vegetables.

The conclusion is that, there is no one right choice of selecting farming systems. It depends on farmers individual preference based on their socio-economic condition. However, the system where there is an opportunity of cross gender involvement in farming activities might bring a relatively better performance for the farmers.