INCREASING SMALL FARM INCOME AND RESOURCE USE
THROUGH AGRICULTURAL CREDIT IN BANGLADESH:
A CASE STUDY

by
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DECLARATION

Except where otherwise indicated, this dissertation is my own work.

A. Raquib

October 1977
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Finally, the author wishes to offer his gratitude to his affectionate parents who motivated him to higher ideals of life and to his wife Saleha, daughters Nazma, Munni and son Masud and brother A. Wadud for their prolonged patience and moral support.
Rural development with distributive justice is the major goal of the economic development strategy of Bangladesh. To achieve this goal efforts are being made to raise agricultural output and to create more employment opportunities for the rural unemployed. The adequate flow of agricultural credit to quicken the diffusion of capital and labour intensive HYV crops with increasing use of modern inputs is the major component in the rural development programme of the Government of Bangladesh.

This study is an attempt to assess the credit requirement of the small farmers and to analyse the impact of credit on cropping intensity, farm income and labour use in the "Barind" area of Rajshahi district of Bangladesh. A linear programming approach has been adopted.

The study has revealed that working capital is the most binding constraint and adequate availability of institutional credit substantially raises cropping intensity and farm income. But the credit for crop farming alone has a limited role in creating additional job opportunities.

Further, the study has shown that the relatively smaller farmers utilise credit more efficiently and as such their optimal credit need per acre is also much higher than that of the existing per acre credit ceiling of the institutional agencies.
Therefore to exploit fully the potentialities of the rural areas and to ameliorate the impoverished conditions of the small farmers an increased flow of rural credit for farming activities is essential.
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<td>Taka</td>
<td>The local standard currency. The term Tk. used in the text means Takas. $US1 = 15 Takas.</td>
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<td>Aus</td>
<td>A variety of rice grown in the Kharif season.</td>
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<tr>
<td>Boro</td>
<td>A variety of rice grown in the Rabi season.</td>
</tr>
<tr>
<td>Transplanted Aman</td>
<td>A variety of rice grown in the late Kharif season</td>
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<tr>
<td>Traccavi loan</td>
<td>A distress loan distributed by government administrative machineries during or after natural calamities to the farmers.</td>
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<tr>
<td>Maund</td>
<td>One maund = 82.286 pounds</td>
</tr>
<tr>
<td>Seer</td>
<td>One seer = 2.057 pounds</td>
</tr>
<tr>
<td>Lakh</td>
<td>One lakh = 100,000</td>
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<td>Barind</td>
<td>A geographical region consisting of old alluvium soil.</td>
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<tr>
<td>BKB</td>
<td>Bangladesh Krishi Bank (Agricultural Development Bank)</td>
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<tr>
<td>IRDP</td>
<td>Integrated Rural Development Program based on Comilla Cooperative approach</td>
</tr>
<tr>
<td>BIDS</td>
<td>Bangladesh Institute of Development Studies</td>
</tr>
<tr>
<td>BADC</td>
<td>Bangladesh Agricultural Development Corporation</td>
</tr>
<tr>
<td>Kharif</td>
<td>Crop growing season (April to July)</td>
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<tr>
<td>Late Kharif</td>
<td>Crop growing season (July to December)</td>
</tr>
<tr>
<td>Rabi</td>
<td>Crop growing season (October to April)</td>
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<td>Thana</td>
<td>The lowest administrative unit of the Government of Bangladesh.</td>
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CHAPTER 1

INTRODUCTION

The Dimension of Food Problem and Rapid Growth of Population in Bangladesh

Bangladesh is confronted with two major problems of chronic food deficit and the rapid growth of population. The persistent high rate of population growth against the stagnant growth in the agricultural sector has led to the chronic food shortage in the country. With a population of about 80 million, growing at a faster rate (about 3 per cent per annum) than the domestic foodgrain production, there has been a continuous increasing gap between the availability of foodgrain from total domestic production and actual food consumption requirement of the country, although more than 80 per cent of the cultivable land is devoted to food crops [84].

The critical food problem is very often aggravated by the occurrence of natural calamities like flood, drought and cyclones. Since 1964-65, on average, the annual foodgrain deficit has been about 2-3 million tons per annum [39, 40]. To make up this deficit, the annual import of foodgrains alone almost exhausts Bangladesh's foreign exchange earnings. For instance, the total export earnings in 1975-76 were Taka 5360 million, whereas the import of foodgrains alone cost Taka 5130 million [40]. For other essential consumer goods and capital goods for development, the country depends on foreign loans and assistance. The heavy import of foodgrains is, thus, causing secular
declining balance of trade and recurrent balance of payments deficit, as well as seriously constraining the economic development efforts. Moreover, the continuous dependence of an agrarian country, like Bangladesh, for the basic food requirement on foreign imports and foreign assistance makes the country economically and strategically vulnerable. Therefore, to achieve a self-sufficiency in foodgrain production for a self-reliant economic growth is the biggest challenge facing the country today.

**Potentialities to Attain Self-Sufficiency in Foodgrains Through Raising Domestic Production and Eliminating Possible Bottlenecks**

Food production can be increased either by expansion of the area under foodcrops or by raising the output per unit of land through more intensive methods of cultivation or by both. For Bangladesh the scope of bringing more land under food crops is very much limited, because the heavy pressure of population has brought almost all usable land under production, human habitation and settlement. Therefore, the major potential for raising production lies in increasing yield per acre of land.

The Green Revolution triggered off by the innovation of seed fertilizer based technology has brightened the prospects to exploit this potential for the land scarce and labour abundant economy of Bangladesh. The World Bank conducted several studies on the potential resources for agricultural development in Bangladesh and in some of their reports it has been indicated that merely by altering the use of seed, fertilizer and plant protection measures the present level of food production can be doubled [84].
The high yielding varieties (HYV) of rice are being adapted to the agro-climate conditions of Bangladesh through continuous research and extension activities. They have been found to be land-saving, labour intensive and neutral to scale. The seeds of HYV rice were first introduced in 1968 with a new variety of rice called 1R-8 which could be grown in "rabi" season with irrigation. In 1970 another variety called 1R-20, a late Kharif season crop was introduced. It is claimed by many experts that output can be increased substantially with this variety even under rainfed conditions. This was followed by import and indigenous development of a number of other HYV seeds. But, so far, the rate of adoption of this new technology has been very slow in Bangladesh. Preliminary findings from a recent Bangladesh Institute of Development Studies (BIDS) survey indicate that about 52 per cent of all farmers have adopted HYV but devoted only 18 per cent of their cultivated land to it. The HYV acreage in 1972-73 was 2.6 million acres which was about 11 per cent of the gross cropped area under rice. In 1974-75 the HYV acreage, however, increased to 3.5 million acres which was about 15 per cent of the gross cropped area under rice [3]. In output terms it contributed about 30 per cent of the total production in the country.

The main ingredients of HYV package are seeds/seedlings, chemical fertilizers, pesticides and irrigation water. At the initial stages of adoption of HYV, the adopters have to purchase all these inputs from external sources. Therefore the working capital requirement for HYV cultivation is substantially higher than that of traditional local varieties. The limited financial resources of the farmers and
the inadequate credit availability is one of the main reasons for the slow diffusion of HYV. This is particularly applicable to the small farmers who cannot adopt HYV cultivation due to their meagre farm income and savings. As a result the benefits of HYV so far have been mainly reaped by the few big and educated farmers who have sufficient capital and access to institutional credit [21, 59, 62]. In general the small size of holdings, dominated by subsistence cropping and traditional methods, results in low productivity and low income in Bangladesh agriculture. So most of the farmers suffer from vicious circle of poverty, and lack in saving capacity. There are no reliable statistics about savings from the agricultural sector. In a study of BIDS[3] an estimate was made based on macro-economic time series data, wherein it was indicated that rural savings as a proportion of rural income increased from 4.2 per cent in 1959-60 to 6.3 per cent in 1969. According to other estimates based on a cross-sectional survey of rural income, savings and investment, the saving ratio has been found to be 12 per cent [3]. Another estimate based on data from a micro village survey obtained a saving ratio of 21 per cent [55]. Despite such variation in the estimates of saving ratio, it can be safely postulated that farmers' own funds are quite inadequate to undertake any investment opened up by the technological breakthrough. The lack of capital has been acknowledged by the economic planning in the First Five Year Plan of Bangladesh [76] as one of the most serious constraints to the modernisation of traditional agriculture and as the key element behind the vicious circle of poverty.

Agricultural credit can play a vital role in meeting the capital gap of the small farmers and thus enable them to participate
in the process of agricultural development of the country. To have a meaningful agricultural development, the small farmers who constitute more than 60 per cent of the total farm families of the country, must be involved in the growth process and contribute positively.

Development Policy Objectives of the Government of Bangladesh

The Government in its First Five Year Plan (1973-78) has given top priority to agricultural development with the following specific objectives:

(1) To attain self-sufficiency in foodgrain production within the shortest possible time and to raise the overall agricultural productivity and agricultural income.

(2) To reduce rural poverty and the high rate of unemployment and to promote equity of income distribution. This is crucially important for Bangladesh where agriculture is dominated by small farmers and landless labourers. So the main strategy must focus on increasing the productivity of small farmers through better access to technological innovation and required inputs like credit, fertilizer, pesticides, irrigation water and markets.

(3) To contribute to the improvement of foreign exchange situation by increasing the production of import substitutes like rice, wheat, cotton, tobacco, oilseeds and the export crops like jute and tea.
Agricultural Credit Policy

To attain the abovementioned objectives the Government must succeed in mobilizing and allocating adequate financial and other resources to the agricultural sector. As such, the agricultural credit policy can have important implications in so far as it can be designed to serve the twin purposes of raising the agricultural productivity as well as to promote equity in income distribution. Agricultural credit directed to assisting small farmers is especially required, if they are to be able to purchase sufficient quantities of improved seeds, chemical fertilizers, plant protection, irrigation water. Adequate and timely flow of institutional credit along with adequate supply of improved seeds, fertilizer, pesticides and irrigation water holds the key position in Bangladesh agriculture. Accordingly the agricultural credit policy has also been re-oriented to increase the flow of institutional credit to ensure that the agricultural activities, particularly the HYV cultivation is not affected due to shortage of funds among the farmers.

It has also been a concern of agricultural credit policy formulators to bring about necessary changes in the lending procedures and formalities of the credit agencies to ensure that a reasonable share of the relatively cheaper institutional credit goes to the small farmers who were so long by-passed due to the stringent security-oriented, complicated, loaning policies. Although various studies and surveys have established that productivity of small farmers is higher than that of the large farmers and the extent of default is not larger in the case of small farmers [12, 17, 62], production is suffering due to the inadequate credit facilities to the small farmers. It has been
found that despite various efforts made in the past, availability of credit facilities to small farmers has remained extremely limited due to various procedural, administrative, organisational and legal constraints [30]. The small farmers need credit not only for production purposes but also for maintenance (consumption loan) and for redemption of old usurious non-institutional debts. In Bangladesh Agricultural University at Mymensing, several Masters theses have been written on some aspects of rural credit. But the methodology used has been generally lacking in quantitative analysis. In these studies some general conclusions were reached regarding the utilisation, distribution and impact of credit on capital formation in the rural areas based on limited data from small samples. But the contention that the small farmers are not getting their due share from institutional credit sources is more or less commonly stated in these micro-studies [13, 59, 71, 83].

So far very little effort has been made to objectively determine the credit requirement of the small farmers and the effect of such credit on their income on the basis of empirical analysis. An attempt will be made here to pursue a quantitative analysis, to enquire into the credit requirement and its impact on farm income at the micro level. It is acknowledged however, that the data base for this study is less than ideal for country-wide conclusions. The method of analysis has been chosen because of the data limitations.

Objectives of the Study

The broad objective of this study is to investigate the role of agricultural credit in raising agricultural productivity and farm income.
Specifically, the study aims at:

(i) assessing the credit requirement of the small farmers for production purposes particularly for HYV cultivation;

(ii) analysing the impact of credit availability on cropping pattern, cropping intensity and farm income;

(iii) analysing the impact of credit availability on resource uses, particularly on labour utilisation;

(iv) carrying out sensitivity analyses incorporating the effects of variation in farm size and bringing a new crop, on credit requirement, net revenue and cropping intensity.

Data and Methodology

Because of limited time and finances it was not possible for the author to conduct a special field survey to collect data for this study. Instead, use was made of a survey conducted in 1975 by the Agricultural Credit Department of Bangladesh Bank (Central Bank of Bangladesh) in the Godagari "thana" of Rajshahi district to formulate an Area Development Project. The author was a member of the survey team for this survey.

It is acknowledged, however, that the data base for this study is less than ideal for country-wide conclusions. Heady and
Candler [47] point out that, "linear programming provides opportunity for application of the experience and judgement acquired by research workers, extension specialists and other analysts as they work with farm and marketing firms" (p. 196). Therefore it was considered that the limited data from the Bangladesh Bank Survey [74] can be supplemented by information collected from farm management and extension experts, agricultural economists and other published documents, and used in developing a linear programming model which can facilitate analysis pertinent to the objectives of the study.

The survey conducted by the Bangladesh Bank [74] covered three contiguous Union Councils of Pakri, Rishikool and Mohanpur having homogenous soil types and climatic conditions. The union council office maintains a list of farmers along with their farm size. The farms were grouped into the following four strata to take account of the difference in farm size:

(1) Less than 3 acres;
(2) 3 to less than 5.5 acres;
(3) 5.5 to less than 8 acres;
(4) Above 8 acres.

From each group, 25 farmers were selected at random. The average farm size for above four groups was 1.94, 4.13, 6.28 and 9.54 acres respectively. From selected farms, data were collected by personal interview for the crop year 1974-75. Since this study is concerned with only small farmers the data from the fourth group of farms was not used in the analysis.
The data from this survey was supplemented by communications with farm management and extension experts at Bangladesh Academy for Rural Development, Comilla [68], Mymensingh Agricultural University [67] and the Department of Agricultural Credit of Bangladesh Bank [66] and by consultation of published reports [39, 44] to derive the resource constraints and input-output relationships for various crops, included in the L.P. model.

On the basis of the above information, a linear programming model has been developed for 3 typical small farms of 2, 4 and 6 acres holding in the area to predict the impact of agricultural credit on cropping pattern, cropping intensity and farm income. The details of the L.P. model, and the sensitivity analysis carried out, are presented in relevant chapters.

Plan of the Study

The organisation of the remainder of the thesis is as follows:

Chapter 2 provides the necessary background information about Bangladesh's agricultural economy and some relevant facts about the area selected for study. A brief review of agricultural credit situation has also been made in this chapter.

Chapter 3 deals with the importance and applications of the technique of linear programming in farm planning and a description of the construction of the linear programming model and the sources of the model data.
In Chapter 4, the linear programming model is used to examine the role of credit in small farm development, its requirement and effect on the utilisation of the resources.

Chapter 5 presents an analysis of production possibilities and resource use with a new crop.

In the last chapter, the study and its conclusions are summarised and the policy implications of these conclusions are discussed.
CHAPTER 2
GENERAL BACKGROUND OF BANGLADESH'S AGRICULTURAL ECONOMY

This chapter is divided into three parts: Part 1 provides the brief description of the background information on Bangladesh's agricultural economy. Part 2 presents some general facts about the study area and the observed cropping pattern, cropping intensity and input-output characteristics. Part 3 consists of a brief review of agricultural credit situation in the country.

Agricultural Economy

Bangladesh is basically a rural and agricultural economy. About 90 per cent of the population lives in rural areas and overwhelmingly large proportion of the population depends on agriculture as the main source of livelihood. The agricultural sector has been contributing increasingly the largest share in the gross domestic product of the country. Its share in GDP was 57.6 per cent in 1969-70, 59 per cent in 1974-75 and more than 60 per cent in 1975-76 [40]. The major industries, like jute and leather, are also based on agricultural raw materials. Agricultural produce like raw jute, tea, hides and skin are the main foreign exchange earners of the country. The present population as estimated in the First Five Year Plan is 83.1 million and, according to the population and labour force survey conducted in the mid and late sixties, the labour force in the country constitutes 35 per cent of the population and 76 per cent of the labour is agricultural. Out of the total land area of 35.5 million acres, cultivable land area is 22.5 million acres and the per capita land availability is only 0.28 acre.
Topography, Climate, Rainfall and Their Influence on Bangladesh's Agriculture

Bangladesh agriculture is very much dependent on the vagaries of nature. Its topography, temperature, monsoon and rainfall are the main determining factors in the cropping pattern and agricultural productivity. Topographically, Bangladesh may be divided into two main physical divisions: (1) the vast alluvial plain, and (2) the marginal hills in the east and south east. The plain is criss-crossed by a network of rivers which have created an interesting drainage pattern. The activity and behaviour of these rivers greatly determine the activities of the people. The main three mighty rivers, the Ganges or the Padma, the Meghna and the Brahmaputra dominate the geography of the country. The major portion of the country is a vast, flat, even, alluvial plain intersected by these rivers, their tributaries and canals.

The evenness of the plain is somewhat broken by the occurrence of three distinct tracts of old alluvium - the Madhurpur tract, Barind and Lalmai. The Madhupur tract consists of an area of about 70 miles length and 35 miles width with hard red clays. The Barind is a tract of comparatively higher land consisting of old alluvium and rising above surface of the North Bengal plain. It is slightly elevated tract undulating with large level plains and gentle gradual slopes. The soils are yellowish to red in colour. Apart from the large streams following across the tract, its surface is also cut by small streams of local origin which have deep channels and are known as Kharis. The so-called Lalmai hills are a prominent topographical feature in the midst of the dead level plains of Comilla.
Bangladesh has generally a tropical monsoon climate with an excess humidity. Moderately warm, equable and humid climate prevails throughout Bangladesh. But within the general uniformity, weather and seasonal variations play a significant role in the agricultural activities. The north western monsoon and variable rainfall, frequent floods and drought, influence greatly the cropping pattern and cropping intensity. The maximum mean temperature during the hot summer (March-April-May) ranges from 88°F (in Coxes Bazaar) to 97°F in Rajshahi. The mean maximum temperature throughout Bangladesh is 86°F and the mean minimum is 10° less.

The annual rainfall is high in Bangladesh. A major part of the country receives a precipitation from 80 to 100 inches. But the rainfall is unevenly distributed. The maximum rainfall is concentrated during the main monsoon period (June to September) and about one-fifth of the total rainfall comes down in the season of the Nor'easter (March to May). The winter (November to February) rain is negligible all over the country. The rain from the Nor'easter which also accompanies the thunderstorm tornado and cyclones, varies from 8 inches to 15 inches in North Bengal and 12 inches to 25 inches elsewhere in the country. The Nor'easter rainfall is of vital significance for the timely sowing of the summer crops like jute, "aus", and broadcast "aman" paddy.

The main rainy season starts with the coming of the monsoon rains which are so important in Bangladesh that they are equated with the weather of the country. The monsoon rainfall is uneven in character. The actual sites of heaviest rainfall also vary from year to year.
Although the major portion of Bangladesh has an excess rainfall rather than a deficiency, the failure of rain at its due time or too much or too little of it at certain times seriously affects crop production. While abnormal excess often brings about damaging floods the untimely rain also causes crop failure. Although on a yearly basis Bangladesh receives much more water than can be used effectively, yet there are extreme variations from season to season and year to year. During the monsoon season (roughly from May to October) there is too much water and during the dry season (roughly November to April) there is too little. The problems of seasonal rainfall variation are compounded by the mighty rivers having most of their catchment outside Bangladesh. During the monsoon period the great rivers rise to high levels and, due to the flat topography of the country, extensive flooding is caused either by direct overflow from rivers or by impeded natural drainage. The soil and land capability surveys undertaken by UNDP/FAO [84] indicate that 30 per cent of the total cultivated area is flooded annually up to a depth of 3 feet and more. Two-thirds of the total area is flooded to a depth of more than one foot. Although flooding provides water and fertility for the crops in large areas and people have adapted farming practices to normal annual flooding, yet floods curtail crop production to a considerable extent. In addition to direct damage to crops by varying flood levels, the uncertainty of flooding in terms of area, depth, duration and time of occurrence inhibits agricultural development.

Regional variations are also considerable. The country can be divided into four roughly equal regions based primarily on hydrological
differences. In the north-west, north of the Ganges and west of Jamuna, the monsoon is the shorter and the dry season rainfall is very low; droughts are more serious than floods, surface water is scarce and irrigation has to be based on ground water. In the north-east the areas between the Meghna, Brahmaputra and Jamuna rivers and including the Sylhet basin - the flood problem is serious. Both droughts in the dry season and floods during the monsoon are serious in large parts of the south-east and south-west region. More than any other factor, hydrological conditions determine the present and future agricultural use of land and the cropping pattern in Bangladesh. Because of impeded drainage or flooding 75 per cent of all agricultural land is suitable only for rice and jute cultivation during the monsoon. On about 15 per cent of agricultural land nothing can be grown during the monsoon because of deep flooding. Dry season crop cultivation is limited to lands which retain moisture or are irrigated and can be greatly increased through irrigation facilities.

Irrigation Potential, Nature of Existing Irrigation Facilities and Coverage

Bangladesh has potential water resources both surface and ground level for irrigation purposes during the dry (Rabi) season. But this irrigation potential cannot be fully exploited due to the capital constraint and lack of technical expertise. Although the readily available surface ground water can easily irrigate 7 million acres (about one-third of the total cultivable area), up to 1975-76 only 1.7 million acres have been brought under a different system of small
scale irrigation like low-lift pumps, shallow tube-wells and deep tube-wells. This constitutes about 7.5 per cent of total cultivable land.

Irrigation coverage by the existing irrigation schemes has been shown in the table below.

**TABLE 2.1**

SMALL SCALE IRRIGATION COVERAGE IN BANGLADESH

<table>
<thead>
<tr>
<th>Year</th>
<th>Low Lift Pumps</th>
<th>Shallow Tube-Wells</th>
<th>Deep Tube-Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Area Covered (Acres)</td>
<td>No.</td>
</tr>
<tr>
<td>1972-73</td>
<td>25,500</td>
<td>970,252</td>
<td>2,938</td>
</tr>
<tr>
<td>1973-74</td>
<td>27,100</td>
<td>919,280</td>
<td>2,098</td>
</tr>
<tr>
<td>1974-75</td>
<td>36,449</td>
<td>1,323,000</td>
<td>778</td>
</tr>
<tr>
<td>1975-76</td>
<td>36,637</td>
<td>1,635,000</td>
<td>873</td>
</tr>
</tbody>
</table>


Cropping Season, Cropping Pattern and Cropping Intensity

The crop year in Bangladesh is divided into three seasons, namely, "Kharif", "Late Kharif" and "Rabi". "Kharif" season starts in April and lasts until October. "Late Kharif" season starts in July and ends in December, and "Rabi" season states in October and ends in April. Important Kharif crops are "aus" paddy and jute. Transplanted aman paddy is the example of late Kharif crops. Rabi crops include "boro" paddy, wheat, oilseeds, pulses, potatoes, brinjal, tobacco and sweet potato. Tea and sugarcane are long duration yearly crops.
Bangladesh agriculture is dominated by crop production and subsistence oriented family farming. Rice is the single main crop which is cultivated in about 80 per cent of the total cultivated area and contributes about 70 per cent of the agricultural value added [3]. Three varieties of rice, viz. "boro", "aus" and "aman" are grown in three different seasons in a crop year. In terms of acreage and total yield, "aman paddy" is the most important crop accounting for 46.6 per cent of the cultivated area. Land under "aus" and "boro" accounts for 25.3 per cent and 8.6 per cent respectively.

The overall cropping pattern and its variation over time has been brought out in Table 2.2. There has been no significant change in the net cropped area over the years in Bangladesh, but due to an increase in cropping intensity the gross cropped area increased from 25.91 million acres during 1954/55-1959/60 to 30.8 million acres in 1975/76. During the period, cropping intensity increased from a low level of around 120 per cent to about 143 per cent. A significant increase in cropping intensity was recorded during the mid-sixties particularly in the areas where HYV rice was introduced with irrigation. Furthermore, it has been found that the cropping intensity is higher in the densely populated districts than in the sparsely populated areas which also leads one to speculate that, other things remaining the same, intensity is higher in smaller farms as compared with larger farms. As evident from the table below, the acreage under food crops has been gradually increasing, which may be explained as a result of increased population pressure, government patronage and the increasingly relative profitability in rice production, particularly HYV.
<table>
<thead>
<tr>
<th>Crops</th>
<th>1955/56 to 1959/60 Area (Million Acres) %</th>
<th>1965/66 to 1969-70 Area (Million Acres) %</th>
<th>1973/74 (Million Acres) %</th>
<th>1975/76 (Million Acres) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>20.0</td>
<td>23.9</td>
<td>77.6</td>
<td>24.4</td>
</tr>
<tr>
<td>Jute</td>
<td>1.5</td>
<td>2.3</td>
<td>7.5</td>
<td>2.2</td>
</tr>
<tr>
<td>Wheat</td>
<td>0.1</td>
<td>0.2</td>
<td>0.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Potato</td>
<td>0.08</td>
<td>0.3</td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>0.3</td>
<td>0.4</td>
<td>1.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Tea</td>
<td>0.08</td>
<td>0.1</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Tobacco</td>
<td>0.1</td>
<td>0.1</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>0.8</td>
<td>0.8</td>
<td>2.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Other</td>
<td>3.0</td>
<td>9.1</td>
<td>2.0</td>
<td>6.4</td>
</tr>
<tr>
<td>Total Acreage</td>
<td>25.9</td>
<td>31.00</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Land Tenure System and Farm Size

Bangladesh is a land of small subsistence family farms. Farming is carried out on family land with family labour and mainly for family consumption. Tenant farming exists mainly in the form of share-cropping but the area under such tenant farming is very small. According to the Agricultural Census of 1960 [46] 61 per cent of all farms were owner farms covering 54 per cent of the total farm area, 37 per cent were owner-cum-tenant farms covering 45 per cent of the total farm area, and only 2 per cent were tenant farms covering 1 per cent of the farm area. Tenants operate land also on cash rent basis (see Table 2.3).

| TABLE 2.3 |
| BANGLADESH: LAND TENURE |

<table>
<thead>
<tr>
<th>Type of Tenure</th>
<th>Average Size of Farms (Acres)</th>
<th>Percentage of Farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner Farms</td>
<td>3.1</td>
<td>2.7</td>
</tr>
<tr>
<td>Owner-cum- Tenant Farms</td>
<td>4.3</td>
<td>4.0</td>
</tr>
<tr>
<td>Tenant Farms</td>
<td>2.4</td>
<td>3.0</td>
</tr>
<tr>
<td>Total</td>
<td>3.5</td>
<td>3.2</td>
</tr>
</tbody>
</table>

The average farm size was found to be 3.5 acres in 1960, while according to Agricultural Master Survey, in 1967/68, it declined to 3.2 acres. Average size of holdings varies from region to region according to the density of population but not very significantly. Percentage distribution of farms and farm areas are shown in Table 2.4. Data for 1974 are taken from a survey of eight villages carried out by BIDS during 1974.

**TABLE 2.4**

**DISTRIBUTION OF FARMS AND FARM AREA: BANGLADESH**

<table>
<thead>
<tr>
<th>Size in Acres</th>
<th>Farms (%) 1960</th>
<th>Farms (%) 1968</th>
<th>Farms (%) 1974</th>
<th>Area (%) 1960</th>
<th>Area (%) 1968</th>
<th>Area (%) 1974</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 0.5</td>
<td>13</td>
<td>12</td>
<td>32</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>0.5 - 1.0</td>
<td>11</td>
<td>13</td>
<td>9</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>1.0 - 2.5</td>
<td>27</td>
<td>32</td>
<td>25</td>
<td>13</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>2.5 - 5.0</td>
<td>26</td>
<td>26</td>
<td>22</td>
<td>26</td>
<td>30</td>
<td>34</td>
</tr>
<tr>
<td>5.0 - 7.5</td>
<td>12</td>
<td>9</td>
<td>7</td>
<td>19</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>7.5 - 12.5</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>19</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>12.5 and Above</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>20</td>
<td>16</td>
<td>11</td>
</tr>
</tbody>
</table>


From Table 2.4 it can be observed that the majority, and an increasing proportion, of farms belong to the less than 2.5 acres group but their share in the total farm area has increased from 16 per cent in 1960 to 24 per cent in 1974. More significantly, by 1974 one-third of the farms were less than half an acre in size and accounted for
only 2 per cent of the total farm area. There has been a rapid decline in the percentage of farmers owning 7.5 acres and above (declining from 11 to 4 per cent) and their share in total farm area has decreased from 39 per cent to 24 per cent. These trends can be explained by the high pressure of population and the laws of inheritance leading to sub­division and fragmentation of holdings and the break-up of the joint family system.

Agricultural Production Techniques and the Use of Modern Inputs

In Bangladesh, agriculture is carried out on traditional labour intensive methods. The main source of power is cattle. The small size of holdings, high degree of sub-division and fragmentation, existence of large unemployed labour and extreme poverty of the farmers, do not permit the capital intensive farm mechanisation programme for agricultural development. Farm mechanisation in Bangladesh has taken place to a very limited extent on an experimental basis in some government pilot projects.

Use of Chemical Fertilizers

Chemical fertilizer is one of the key inputs in the seed based technology of raising agricultural productivity. Increased use of fertilizers in proper doses is essential for the cultivation of HYV under irrigation. Table 2.5 shows the gradual increase in the level of use of fertilizers during recent years.

Fertilizer use in Bangladesh up until now, is limited to the HYV rice cultivation only. Proper extension services and widespread
popularity accompanied by adequate supply of credit may enhance the fertilizer use for other crops as well.

### TABLE 2.5

**QUANTITY OF CHEMICAL FERTILIZERS USED BY FARMERS IN BANGLADESH: 1917-72 TO 1975-76**

<table>
<thead>
<tr>
<th>Year</th>
<th>Urea</th>
<th>TSP</th>
<th>MP</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971-72</td>
<td>168,750</td>
<td>59,274</td>
<td>13,667</td>
<td>241,691</td>
</tr>
<tr>
<td>1972-73</td>
<td>220,000</td>
<td>55,000</td>
<td>14,000</td>
<td>271,000</td>
</tr>
<tr>
<td>1973-74</td>
<td>190,000</td>
<td>84,000</td>
<td>16,000</td>
<td>290,000</td>
</tr>
<tr>
<td>1974-75</td>
<td>176,000</td>
<td>76,000</td>
<td>18,000</td>
<td>270,000</td>
</tr>
<tr>
<td>1975-76</td>
<td>243,000</td>
<td>93,000</td>
<td>18,000</td>
<td>354,000</td>
</tr>
</tbody>
</table>

Source:  

There has been a gradual increase in the usage of fertilizer in the country with the expansion of HYV cultivation but still, in comparison with other developed countries, the level of fertilizer use remains at a low level. The reasons for the low usage of fertilizer are as follows:

1. Large risk factor due to lack of controlled water for irrigation.  
2. Lack of cash and absence of credit facilities to majority of the farmers.  
3. Lack of knowledge of the benefits of fertilizer use and of its application.  
4. Conservative attitude towards the use of fertilizers.  

*(TSP = Triple Superphosphate; MP = Muriate of Potash)*

**Some Facts about the Study Area**

**Location, Topography, Soil Condition, Climate and Rainfall**

The area selected for the study comprises three unions of Godagari thana in Rajshahi district of northern Bangladesh. The area was
originally chosen by the Agricultural Credit Department of Bangladesh Bank for formulation of an Area Development Project. A field survey was conducted during 1975 to collect data regarding investment opportunities in various fields of agricultural and non-agricultural activities and other potential resources of the area. The author was a member of the survey team and spent about a month in the area for data collection and acquaintance with the agro-economic conditions of the area. As such the area has been selected for the present study.

The total population of the three unions is 50,198 and the total cultivable area is 40,082 acres. The area is sparsely populated by national standards with density of 665 persons per square mile, whereas the average density of the whole district of Rajshahi, per square mile, is 1168 and for Bangladesh as a whole, it is 1286.

The area is a part of what is historically known as "Barind Region" which means older alluvial deposits. It is comparatively elevated and undulating tract and almost flood free. The soil type differs from the general soft alluvial fertile soil of the other parts of the country. The soil of the area is hard reddish clay and in the dry season it is not easy to plough.

The temperature in the area is generally higher than in other districts of the country. The mean maximum and mean minimum temperature range is 92°F to 45°F. The average monthly rainfall is also lower in the area than in other districts. Moreover, there is a high variation in rainfall throughout the year. During the winter dry season - November to February - the average monthly rainfall is less
than 1 inch. Of the yearly rainfall of 56 inches, no less than 50 inches occur in the monsoon months, with the maximum in the months of July and August.

Size of Holding, Cropping Pattern and Cropping Intensity in the Area

The average size of cultivated holdings in the area is 4.29 acres which is higher than that of the country average of 3.2 acres. But the distribution pattern of land among different size groups is skewed. More than half the total number of holdings are less than 3 acres in size, 19 per cent are between 3 and less than 5.5 acres, 13 per cent are between 5.5 and less than 8 acres and 12 per cent are above 8 acres in size.

TABLE 2.6
PATTERN OF LAND OWNERSHIP IN THE PAKRI, RISHIKOOL AND MOHANPUR UNIONS IN GODOGARI THANA - RAJSHAHI DISTRICT

<table>
<thead>
<tr>
<th>Size of Holding</th>
<th>No. of Holdings</th>
<th>Percentage of Total No. of Holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Under 3 acres</td>
<td>3227</td>
<td>56.0</td>
</tr>
<tr>
<td>2. 3 to less than 5.5 acres</td>
<td>1114</td>
<td>19.0</td>
</tr>
<tr>
<td>3. 5.5 to less than 8 acres</td>
<td>739</td>
<td>13.0</td>
</tr>
<tr>
<td>4. Above 8 acres</td>
<td>639</td>
<td>12.0</td>
</tr>
</tbody>
</table>

Source: Bangladesh Bank Agricultural Credit Department, "Area Development Project (Pakri, Rishikool, Mohanpur)", (mimeograph), 1976, p. 12.
As mentioned earlier in Chapter 1, 25 farmers were selected at random for interviews from each of the four size groups indicated in Table 2.6. The average size of the selected farms was found to be 1.94, 4.13, 6.28 and 9.54 acres respectively. Table 2.7 presents the cropping patterns of an average farm in the first three size groups. Consistent with Bangladesh's farm situation in general, paddy is the single most important crop grown in the area. The three varieties of paddy, namely, "aus", "aman" and "boro" account for about 90 per cent of the cropped area on 1.94 acre farms; the proportion of cropped area under paddy on 4.13 and 6.28 acre farms is about 88 and 86 per cent respectively. Pulses, oilseeds, wheat and vegetables are the other important crops in the area.

Cropping intensity is the commonly used measure in determining the extent of land use in the farming situation and is defined as:

\[
\frac{\text{Cropped area}}{\text{Cultivated area}} \times 100
\]

The cropping intensity on 1.94 acre farms is 127 per cent and it declines to 117 per cent on 4.13 acre farms and 109 per cent on 6.28 acre farms.

Economic Position of the Farmers in the Area

During the field survey in the area data were also collected on farm cost and income position of the farmers. Table 2.8 summarizes this information.

The gross revenue is the value of total crop produce valued at market price during the harvest season. The variable costs included
### TABLE 2.7
CROPPING PATTERN ON 3 AVERAGE FARM SIZES IN
THE PAKRI RISHIKOOL AND MOHANPUR UNIONS OF GODASARI THAN - RAJSHAHI DISTRICT

<table>
<thead>
<tr>
<th>Crops</th>
<th>1.94 Acre Farm</th>
<th>4.13 Acre Farm</th>
<th>6.28 Acre Farm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area (Acres)</td>
<td>Percentage of Cropped Area</td>
<td>Area (Acres)</td>
</tr>
<tr>
<td>Aus Paddy</td>
<td>0.304</td>
<td>12.39</td>
<td>0.50</td>
</tr>
<tr>
<td>Transplanted Aman Paddy</td>
<td>1.780</td>
<td>72.53</td>
<td>3.315</td>
</tr>
<tr>
<td>Boro Paddy (HYV)</td>
<td>0.100</td>
<td>4.08</td>
<td>0.230</td>
</tr>
<tr>
<td>Wheat</td>
<td>-</td>
<td>-</td>
<td>0.090</td>
</tr>
<tr>
<td>Pulses</td>
<td>0.107</td>
<td>4.36</td>
<td>0.150</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>0.083</td>
<td>3.38</td>
<td>0.120</td>
</tr>
<tr>
<td>Vegetables</td>
<td>0.080</td>
<td>3.26</td>
<td>0.212</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2.454</strong></td>
<td><strong>100</strong></td>
<td><strong>4.617</strong></td>
</tr>
<tr>
<td><strong>Cropping Intensity</strong></td>
<td><strong>126.5</strong></td>
<td></td>
<td><strong>111.8</strong></td>
</tr>
</tbody>
</table>

**Source:** Bangladesh Bank, Agricultural Credit Department, "Area Development Project (Pakri, Rishikool and Mohanpur), Annexure VI, (mimeograph), 1976.
TABLE 2.8
GROSS REVENUE, VARIABLE COSTS AND NET REVENUE ON 3 AVERAGE FARM SIZES IN THE PAKRI, RISHIKOOL AND MOHANPUR UNIONS OF GODAGARI THANA - RAJSHAHI DISTRICT

<table>
<thead>
<tr>
<th></th>
<th>1.94 Acre Farm</th>
<th>4.13 Acre Farm</th>
<th>6.28 Acre Farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Revenue (Tk)</td>
<td>3725.75</td>
<td>9036.90</td>
<td>12970.20</td>
</tr>
<tr>
<td>Variable Cost (Tk)</td>
<td>490.80</td>
<td>1396.40</td>
<td>1807.50</td>
</tr>
<tr>
<td>Net Revenue (Tk)</td>
<td>3234.95</td>
<td>7640.50</td>
<td>11162.70</td>
</tr>
<tr>
<td>Net Revenue per Cultivated Acre (Tk)</td>
<td>166.750</td>
<td>1850.00</td>
<td>1777.50</td>
</tr>
</tbody>
</table>

Source: Bangladesh Bank, Agricultural Credit Department, "Area Development Project (Pakri, Rishikool and Mohanpur)", (mimeograph), 1976.

expenditure on seed, fertilizers, pesticides and irrigation water, and net revenue is the difference between gross revenue and variable costs. The net revenue per cultivated acre on 1.94 acre farm is Tk. 1667.50. The corresponding figure for 4.13 and 6.28 acre farms is Tk. 1850.0 and Tk. 1777.50 respectively.

Agricultural Credit Situation in Bangladesh

Institutional Credit

Agricultural credit accompanied by an appropriate technology can play an effective role in raising farm productivity in Bangladesh. More importantly, agricultural credit programmes for small farmers can improve their economic conditions in three different ways: (1) direct
income transfers through debt redemption or subsidised interest rates (welfare), (2) increasing the available funds for more consumption (consumption credit), and helping the farmers increase their production and income potential. The Bangladesh Government has taken up the rural development oriented strategy of economic development with the objective of enabling the rural people from all segments of society to participate positively and effectively in the development programme. As such the agricultural credit policy has been reoriented to increase the flow of institutional credit and particularly to benefit the small farmers through easy and greater access to institutional credit facilities. The agricultural credit policy, particularly the institutional credit policy, is influenced by the following factors:

i) political orientation of the Government and the extent of Government commitment to farm credit programme;

ii) production and development strategy;

iii) extent of farmers' motivation towards yield raising and cost reducing technology;

iv) lending procedures and credit delivery capacity of the institutions;

v) creation and promotion of appropriate credit institutions;

vi) degree of existing supply of farm inputs and services;

vii) sources of funds for lending and the rate of inflation;
viii) nature of development and existing credit facilities;
ix) small farmers orientation.

The agricultural credit structure, or in other words, the rural capital market in Bangladesh consists of two components. Institutional credit agencies and non-institutional private sources. At present there are five major public and semi-public institutions which provide credit to the farmers:

(a) Bangladesh Krishi Bank (Agricultural Development Bank)
(b) Jatiya Samabaya Bank (Apex Cooperative Bank)
(c) Comilla Cooperative (Integrated Rural Development Programme)
(d) Nationalised Commercial banks
(e) Government "Taccavi" credit through Revenue Department

Among non-institutional private sources, village money lenders, well-to-do farmers, friends and relatives, marketing agents, and shop keepers are important. Institutional credit agencies have played, so far, an insignificant role in terms of both the total volume of credit advanced and the number of farmers receiving such credit. Institutional sources meet only about 15 per cent of the total credit needs of the farmers. There is a lack of information as to the annual total credit requirement in Bangladesh. However, in the First Five Year Plan a projected estimate of farm credit needs at the end of the year 1977-78 has been made. The short term credit need has been estimated on the basis of need for financing a portion (ranging from 30 to 40 per cent) of the cost of crop production. The medium term
and long term credit need has been estimated on the basis of the development programme envisaged in the first plan. The estimated credit requirement for farm expenditure is 3,650 million Takas, of which 2,570 million Takas are for current farm expenditure. The farmers need credit not only to meet farm expenditure, but also to meet family expenditure (consumption credit). According to the Rural Credit and Unemployment Survey of Dacca University (1956) it was found that about 77 per cent of credit is utilised for family expenditure and only 23 per cent is utilised on farm expenditure. Another survey report on agricultural credit (1967) of the Cooperative Department showed that 57 per cent of the credit is utilised by the farmers for family expenditure and 43 per cent for farm expenditure. During this period of 10 years, it seemed a significant change in the pattern of use of credit had taken place in favour of farm expenditure. A recent estimate by Islam [58] on the assumption that the ratio of credit use for farm expenditure (capital and current) and non-farm expenditure (subsistence and other expenditure) is 4 to 6, places the farm and non-farm credit requirements at 3650 million Takas and 5475 million Takas respectively. The First Five Year Plan set up an ambitious target of meeting 45 per cent of total production credit of 3,650 million, i.e. Tk. 1627 million through institutional agencies by 1977-78. Accordingly, the Plan made a tentative phasing of annual distribution of credit by the credit agencies as indicated in Table 2.9.

On the basis of this tentative institutional credit distribution programme, the Bangladesh Bank (Central Bank of the country) carries out an annual credit budgeting in consultation with the concerned agencies and departments and sets up the annual targets, keeping
<table>
<thead>
<tr>
<th>Yearwise Credit</th>
<th>Total Volume of Credit to be Distributed</th>
<th>Agencies Responsible for Distribution of Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Samabaya Bank (Apex Cooperative Bank)</td>
</tr>
<tr>
<td>Short Term Credit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973-74</td>
<td>305</td>
<td>170</td>
</tr>
<tr>
<td>1974-75</td>
<td>410</td>
<td>225</td>
</tr>
<tr>
<td>1975-76</td>
<td>550</td>
<td>310</td>
</tr>
<tr>
<td>1976-77</td>
<td>830</td>
<td>450</td>
</tr>
<tr>
<td>1977-78</td>
<td>1177</td>
<td>600</td>
</tr>
<tr>
<td>Sub-Total:</td>
<td>3272</td>
<td>1755</td>
</tr>
<tr>
<td>Medium and Long Term Credit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973-74</td>
<td>150</td>
<td>20</td>
</tr>
<tr>
<td>1974-75</td>
<td>210</td>
<td>25</td>
</tr>
<tr>
<td>1975-76</td>
<td>285</td>
<td>30</td>
</tr>
<tr>
<td>1976-77</td>
<td>325</td>
<td>40</td>
</tr>
<tr>
<td>1977-78</td>
<td>450</td>
<td>70</td>
</tr>
<tr>
<td>Sub-Total:</td>
<td>1420</td>
<td>185</td>
</tr>
<tr>
<td>Grand Total:</td>
<td>4692</td>
<td>1940</td>
</tr>
</tbody>
</table>

in view the past performance of the different agricultural credit institutions and the production target estimated for the incoming year. Except the commercial banks which have been recently inducted to agricultural financing, the sources of finance for BKB and BJSB, are the borrowing from the Bangladesh Bank. Table 2.10 shows the actual loan operations of various credit agencies in Bangladesh.

In Table 2.10 we have excluded IRDP agency since it borrows funds from one of the commercial banks. So its disbursement of loans has been taken into account in the amount of loans disbursed by that commercial bank.

From this loan operation of the credit agencies it can be observed that they failed to disburse the sanctioned amount of credit to the farmers every year. Actual disbursement of credit has been far below the target amount - as, for example, during 1974-75 the annual target for institutional credit distribution was Tk. 620 million, whereas actual disbursement was Tk. 433 million; and in 1975-76 the target was Tk. 835 million whereas the actual disbursement was Tk. 516.2 million (Table 2.9). So it is clear that even half of the production credit requirements of the farmers could not be met by the institutional agencies not to speak of the family expenditure needs of the farmers. However, very recently the Government has decided to mount a credit programme of Tk. 1000 million by the Bangladesh Krishi Bank and the six nationalised commercial banks during the current calendar year 1977, in order to expand the flow of institutional credit. This 1,000 million Taka crash credit programme is in addition to the usual annual credit budget of Tk. 658.5 million for the financial year 1976-77 from the
TABLE 2.10
ACTUAL AGRICULTURAL LOAN OPERATIONS AT FARMER'S LEVEL BY CREDIT AGENCIES IN BANGLADESH

<table>
<thead>
<tr>
<th>Item</th>
<th>1974-75 (Million Takas)</th>
<th>1975-76 (Million Takas)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BKB</td>
<td>BJSB</td>
</tr>
<tr>
<td>Sanction</td>
<td>167.5</td>
<td>167.5</td>
</tr>
<tr>
<td>Disbursement</td>
<td>176.2</td>
<td>104.9</td>
</tr>
<tr>
<td>Due for Recovery</td>
<td>433.0</td>
<td>321.1</td>
</tr>
<tr>
<td>Overdue at Farmer's Level</td>
<td>279.0</td>
<td>353.3</td>
</tr>
<tr>
<td>Outstanding Including Overdue</td>
<td>692.3</td>
<td>198.4</td>
</tr>
<tr>
<td>Recovery</td>
<td>199.9</td>
<td>99.9</td>
</tr>
<tr>
<td>Percentage of Recovery</td>
<td>46%</td>
<td>30%</td>
</tr>
</tbody>
</table>

institutional agencies. The objective of this crash credit programme [92] is to disburse the credit as near as possible to the farmers' own villages, particularly to the small farmers, through the rural branches of BKB and commercial banks, and forming mobile units in the area where there are no bank branches and by simplifying the disbursement procedures. For this purpose, elaborate guidelines have been formulated and committees from district to union level have been organised with representation from farmers and relevant government agencies to help the bank officials in implementing the programme.

**Non Institutional Sources of Credit**

There is no authentic documentation based on comprehensive rural credit survey in the country as to the relative share of institutional and non-institutional sources of credit. But different studies and official estimates indicate that institutional credit supply in the country at present will be within the range of 15 to 20 per cent of total farm credit. Therefore, non-institutional sources like money lenders, well-to-do farmers, friends and relatives, shop keepers, and marketing agencies, can be assumed to provide 80 to 86 per cent of the rural credit in the country.

The most important non-institutional sources of credit are the well-to-do farmers who supply about 50 per cent of the total credit through land mortgage systems. In this system the borrower has to transfer the right of ownership and use of land mortgaged to the lender as security. Most of the poor borrowers cannot release their mortgaged lands due to the rigid terms and conditions of mortgage and due to
further deterioration in their economic condition as a result of reductions in cultivable land. In the process, the small farmers can lose their land assets to the big farmers.

**Interest Rates for Agricultural Credit**

Rural capital/credit market in Bangladesh is extremely imperfect. The main constituents of the rural credit market, i.e. the non-institutional sources which supply the bulk of the credit to the farmers are not within the purview of the monetary control of the Central Bank of the country. As such, the monetary policy, more specifically the bank rate policy of the Central Bank, has got no bearing on the private lenders' lending rate of interest. By virtue of the near monopoly position of the money lenders in their respective areas, they charge exorbitant rates of interest depending on the urgency of the need for credit of the farmers. Although there are no comprehensive empirical studies on the interest rate charged by the money lenders, some micro level village studies indicate that there is a wide variation in this rate. In one study it was found that the rate of interest varies from 40 per cent to 60 per cent per annum, whereas in another village study it was indicated that the private money lending rate ranges from 100 per cent to 200 per cent per annum, particularly in the case of kind loans in terms of rice [99, 83, 88].

The interest charged by the institutional agencies for agricultural loans is determined by their cost of procurement of funds and the administrative costs involved in channelling and realisation of these loans.
The main source of funds for the institutional agencies is the Bangladesh Bank which provides counter finance facilities at concessional rates of interest viz 2 per cent below bank rate with a minimum of 6 per cent at present. Since there are heterogeneous institutions providing agricultural credit to the farmers for different purposes and with different levels of supervision and related services, rates of interest among these institutions vary accordingly.

Bangladesh Krishi Bank's lending rates of interest during 1974-75 were 11 per cent for short term and 11.5 per cent for medium and long term loans. The interest rates on short term tea and jute loans were 10.5 per cent [16]. Traditional cooperatives charge interest at 12 per cent plus a recovery charge of 4 per cent on overdue loans. Comilla Cooperatives (IDRP) realise interest at the rate of 12 per cent plus service charges of 5 per cent at the farmers' level. The nationalised commercial banks' rates of interest for agricultural financing range from 12 to 13 per cent which are also their commercial lending rates. In the recent special credit programme of Tk. 1000 million to be disbursed by the Bangladesh Krishi Bank (BKB) and the other six nationalised commercial banks during the year 1977-78, a uniform rate of interest of 12 per cent has been fixed by the Government to be charged to the farmers.
CHAPTER 3
A LINEAR PROGRAMMING APPROACH TO FARM PLANNING
WITH AGRICULTURAL CREDIT IN BANGLADESH

In this chapter a linear programming model is developed and used to study the impact of credit availability on the cropping pattern, cropping intensity and farm income and to estimate the optimum amount of credit requirements for different farm sizes. It is assumed that the farmers in the area under study are economically rational and seek to maximise net revenue by exploiting fully their potential farm resources with the help of the additional borrowing of capital. The assumption that the farmers in developing countries behave rationally and economically is supported by the research findings of a number of economists. Professor Schultz of the University of Chicago finds that "there are comparatively few significant inefficiencies in the allocation of factors of production in traditional agriculture [9]." Mellor cites evidence that because the physical, economic and cultural environment is relatively static over time, high efficiency in the subsistence agriculture has been attained relative to the levels of inputs available [70]. The farmers' behaviour in Bangladesh in response to the changes in relative prices of jute and paddy, also amply testify that farmers' decisions are more guided by economic motives [87].

This chapter has been divided into two parts. Part 1 deals with the importance of linear programming technique particularly in agro-economic research and farm planning and its applications. Part 2 consists of a brief outline of a structural specification of the model and the sources of data used.
Importance of Linear Programming Technique in Agro-Economic Research and Farm Planning and its Application

Linear programming is an important empirical research tool for economic analysis. It has been widely used in managerial and decision problems. As a mathematical technique it can be used in any economic activity involving the allocation of limited resources in various uses to obtain the optimal level of output or profit. It gained practical utility initially in war planning strategy and management of industries which were confronted with the problem of decision-making regarding the allocation of resources and selection of methods within an operational framework of constraining factors to achieve certain objectives, i.e. maximum output or profit or minimisation of cost.

Linear programming has also been increasingly used by agricultural economists in agro-economic research and farm management and farm planning. It has been applied in both macro and micro level farm planning. As farm planning involves decision-making concerning the allocation of the limited resources of the farms in different alternative activities and processes of operation, linear programming techniques can conveniently be used to find an optimum farm plan to achieve profit maximisation or minimisation of costs in farming activities.

This technique has been widely applied by the agricultural economists to specify the optimal organisation of resources and enterprises on farms to suggest desirable farm planning and adjustments, to specify profit maximising mixes of commodities produced by marketing firms, to specify cost minimising methods of processing products such as fertilizers or producing feed mixes, to specify spatial equilibrium
patterns in the flow of agricultural products, to indicate optimal interregional patterns of resource use and product specialisation in agriculture, and to solve related types of problems [47]. There are many types of problems that are ideally suited to a practical solution through linear programming. The development of the simplex method by George B. Dantzig in 1947 and the invention of the high speed computer, together with the vast improvements in software have facilitated LP computation and consequent widespread application. This technique can also easily be applied in policy decision problems.

Linear programming is particularly appropriate for the problem under study because variations in the quantum of agricultural credit availabilities and policy parameters can easily be incorporated in the input/output matrix. But it is to be noted that LP is mainly a procedure for providing normative answers to problems which are so formulated. The normative results obtained by LP suggest the course of action which ought to be taken by an individual business unit, area or other economic sector to attain the desired objective within the stated conditions and restrictions. But it does not explain the action actually taken by them. For example, a farmer may not be persuaded to follow the optimum farm plan indicated by LP if it does not fully fit the farmer's agronomic conditions and his set of goals, conditioned by the risk and uncertainty of elements in farming like weather, climate, input supplies, price and technological variations. Similarly, a farmer may not readily be inclined towards sufficient borrowing for optimal resource use partly due to psychological apathy to indebtedness and partly due to shyness to face the unfamiliar and threatening environment of institutional credit organisations.
Limitations of Linear Programming

The underlying assumptions of linear programming limit its applicability because, unless these assumptions apply to the problem under consideration, linear programming may not provide a sufficiently precise solution. The assumptions are as follows:

(a) A linear input-output relationship or constant returns to scale in each process of production.
The drawbacks of this assumption can be reduced by appropriate specification of activities so that the continuous, smooth functions of production theory can be approximated with linear facts.

(b) Both resources and farm enterprises (activities) are infinitely divisible and additive in order to achieve a maximum value of the objective function.
This assumption is not a serious limitation since a program can ordinarily be rounded to include activities produced to the nearest whole unit without causing serious decision-making errors.

(c) It is assumed that there is a finite number of alternative activities and resource restrictions which need to be considered. This is a practical assumption because farmers and marketing or processing firms are generally interested in a comparatively small number of activities. As such, this assumption is also not a serious limitation on the use of LP.
(d) Single-valued expectations. This means that resource supplies, the input/output coefficients, prices of resources and activities are known with certainty. This highly unrealistic assumption is usually confronted with appropriate sensitivity analysis.

In spite of these limitations, the technique of linear programming has been widely used by the agricultural economists. A few of the related studies using this technique are cited below.

Egbert and Heady [51] used this technique in 1961 to develop US national agricultural models. Subsequently numerous additional models have been formulated by Heady and Whitelessly [53], Heady and Skold [50] and Broken and Heady [52]. Hutton [54] used this technique to select optimal cropping pattern. Gotsch [37] applied the linear programming technique to investigate the optimal allocation of farm resources in the Panjab (Pakistan) during the sixties when the introduction of improved agricultural technology was in its infancy. On the basis of a limited survey of 50 farms in 1971, Ahmed [63] used a linear programming model to predict the impact of tractor mechanisation in Pakistan Panjab. The use of linear programming technique in dealing with policy issues is demonstrated by Khan's [63] study of alternative farm mechanisation and water development policies in Pakistan. A comprehensive field survey of 222 farms in 1973 formed the basis of linear programming matrix.

Naseem [75] used a multiperiod linear programming technique to investigate how the relationship between size, technological change
and the ability to accumulate is affected by government policies regarding agricultural credit, interest rates and product prices in the Panjab (Pakistan). His study substantiated the hypothesis that the shortage of operating capital is a serious handicap to the growth of farm income and to the adoption of new technology by the small farmers. Sharma and Prasad [90] used the linear programming technique to estimate the credit requirement and its impact on the cropping pattern and farm incomes in three districts of the north-western region of Uttar Pradesh (India) and concluded that proper dose of institutional credit substantially raises farm income even without new technology. Singh and Jha [89] also used this technique for the similar purposes in their study area of Union Territory of Delhi (India) and asserted that the shortage of capital is a crucial constraint to the fuller exploitation of the available resources of the farmers and the demand for credit among the farmers is inelastic even at the higher rates of interest than the current rates.

Structural Specification of the Model and the Sources of Data

The mathematical and schematic representation of the linear programming model, a brief description of the objective function, the constraints and sources of the model data form Part 2 in this chapter.

Mathematical and Schematic Representation of the Linear Programming Model

The objective of the following programming model is to maximise:
The objective of (i) is to be maximised subject to the linear constraints that:

\[
(i) \quad \sum_{i=1}^{n} a_{ij} x_i \leq b_j \quad j = 1 \ldots P
\]

where,

\[a_{ij} = \text{the input-output coefficients of the jth resource for one unit of the ith activity}\]

\[b_j = \text{levels of jth resource availabilities}\]

\[P = \text{the number of constraints}\]

\[
(iii) \quad x_i \geq 0 \quad i = 1 \ldots n \quad b_j > 0
\]

Description of the Model

(i) The Objective Function

The objective of the model is to maximise the total net revenue of the farm subject to the technical constraints of the production
function and the level of resource availability. The gross revenue is entered in the objective function while variable cost for seeds, fertilizers, insecticides/pesticides and irrigation cost for seeds, fertilizers, insecticides/pesticides and irrigation water are treated through cash requirements for individual crops.

To obtain the basic solution, the gross revenue has a positive sign for the crop activities. The activities other than crop influencing the net revenue are the cost of borrowing, daily wage for hiring labour and the per day cost for hiring bullock power; all of them are entered with a negative sign.

(ii) The Activities

(a) Crop Activities

The model has two types of activities, the crop and the resource augmenting activities. Based on the existing cropping pattern discussed in Chapter 2 and the available information from the study areas, 9 major crops have been included in the model. Three varieties of paddy grown in three different time periods with different levels of inputs and technique have been treated as different activities. The crop activities included in the model are as follows:

1. High Yielding Variety of Boro Paddy
2. High Yielding Variety of Wheat
3. Oilseed
4. Pulse
5. HYV Potato
6. Onion
7. Brinjal
8. Aus Paddy
9. Transplanted Aman Paddy
Table 3.1 shows the sowing/planting and harvesting times and the period of land occupation by the selected crop activity.

**Rabi Crops**

The land preparation for oilseeds, onion and brinjal starts from late October and their sowing/planting is completed by November. In comparison with onion and brinjal the maturity period for oilseeds is shorter. Harvesting of oilseeds is completed by the month of February whereas onion and brinjal are harvested up to the end of March. The growing period of these three crops clashes with that of transplanted "aman" paddy.

The land preparation and sowing of wheat, potato and pulses is done during the month of November while for "boro" paddy it is done in December. The planting period of "boro" paddy coincides with the harvesting time of transplanted "aman" paddy. The months of November and December are therefore the peak period for farming activities in the area.

**Kharif and Late Kharif Crops**

Aus and transplanted "aman" paddy are grown during the "Kharif"and late "Kharif" crop seasons. The land preparation and sowing of "aus" paddy starts in late April after the harvesting of most of the "Rabi" crops. The month of April is also another peak period for farming activities because the harvesting of HYV "boro" paddy is also done during this month. The land preparation and planting of transplanted
### TABLE 3.1
SOWING/PLANTING/HARVESTING TIME AND PERIOD OF LAND OCCUPATION BY SELECTED CROPS

<table>
<thead>
<tr>
<th>Crops</th>
<th>Sowing/* Planting Time</th>
<th>Harvesting Time</th>
<th>Season and Period of Land Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aus Paddy</td>
<td>Late April</td>
<td>July</td>
<td>Kharif, 4 months</td>
</tr>
<tr>
<td>Transplanted Aman Paddy</td>
<td>Late July</td>
<td>December</td>
<td>Late Kharif, 6 months</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>Late October</td>
<td>February</td>
<td>Rabi, 4 months</td>
</tr>
<tr>
<td>Onion</td>
<td>Late October</td>
<td>March</td>
<td>Rabi, 5 months</td>
</tr>
<tr>
<td>Brinjal</td>
<td>Late October</td>
<td>March</td>
<td>Rabi, 5 months</td>
</tr>
<tr>
<td>Pulses</td>
<td>Late November</td>
<td>March</td>
<td>Rabi, 4 months</td>
</tr>
<tr>
<td>Potato</td>
<td>Late November</td>
<td>Early March</td>
<td>Rabi, 4 months</td>
</tr>
<tr>
<td>Boro Paddy (HYV)</td>
<td>December</td>
<td>Early April</td>
<td>Rabi, 5 months</td>
</tr>
<tr>
<td>Wheat (HYV)</td>
<td>Late November</td>
<td>Early March</td>
<td>Rabi, 4 months</td>
</tr>
</tbody>
</table>


* Includes land preparation period.

"aman" paddy are made during late July. "Aus" paddy is harvested in July, therefore the month of July is also a peak period for farming activities in the area. On the basis of all the available information on cultural practices and their appropriate timing [65, 66], the crop year has been divided into nine periods (namely, $P_1$ - November, $P_2$ - December, $P_3$ - January and February, $P_4$ - March, $P_5$ - April, $P_6$ - May,
P_7 - June, P_8 - July, P_9 - August to October) to take into account the timeliness in the farming operations for the different crops.

(b) Resource Augmenting Activities

In addition to the crop activities there are three types of resource augmenting activities - labour hiring, bullock hiring and money borrowing. Labour hiring is made only during the peak periods of sowing/planting, weeding and harvesting. Payment of wages to hired labour is made both in kind and cash. With the rising prices of subsistence food crops and other agricultural commodities, labourers nowadays prefer payment in kind. Mutual exchange of labour among the farmers is very often made to meet the peak periods labour requirement among the small farmers. It has been assumed that the cash requirement for labour hiring is met by the farmers from their own resources. Labour hiring has been included in all the nine periods in the model. A higher wage rate of Tk. 8 per day which prevails during the peak periods has been used for November, December, April and July, while for the other periods a wage rate of Tk. 6 per day has been used. Bullock hiring has also been taken as an activity for four peak periods of November, December, April and July. Most of the bullock hiring takes place in the form of mutual exchange of bullocks among the fellow farmers. Sometimes the small farmers can borrow simply the bullock from big farmers in exchange for human labour. However, where the money payment is involved in hiring bullocks, the farmers manage by selling crops from their stock. The borrowing activity has been assumed once a year since the institutional credit agencies mostly disburse
loans in one instalment. In all, the total number of activities in the model comes to 23.

(iii) The Constraints

The constraints may be divided into three categories:

(1) Fixed resources on the farm including land, family labour and bullocks;

(2) Resource augmenting constraints which include limit on borrowing, limit on labour hiring and bullock hiring;

(3) Special constraints which restrict the range of feasible cropping patterns.

Due to the seasonal nature of crop production, not only the total amount of various resources but also their availability during different stages of crop production is important. As such, the amount of land, family labour days, and bullock days have been expressed as constraints for each of the nine periods into which the crop year has been divided.

Now the various constraints will be discussed individually.

(a) Land Constraint

The average size of holding in the area under study has been found to be about 4 acres in the field survey. Since the study is mainly
concerned with small farms, three typical farms of 2 acres, 4 acres and 6 acres holding have been selected for our model. For each of the nine time periods the size of the farm (2, 4 and 6 acres respectively) has been expressed as the land constraint for the alternative crops.

(b) Bullock Days Constraint

The findings of the field survey indicated that both 2 and 4 acres farms generally maintain a pair of bullocks and 6 acres farm maintains 3 bullocks. Farm Management Survey Report on adjoining district of Bogra [39] indicated that the bullocks can be used for ploughing for 26 days a month and eight hours a day. Therefore the monthly availability of bullock power days, for 2 acres and 4 acres farms is 26 and for 6 acres farm bullock power days availability is 39 days.

(c) Family Labour Constraint

From the field survey it has been observed that the average family size in the area varies from 7 to 8 members. But the availability of working members per family varies according to the age and sex structures of the family. Excluding the female members who do not work in the field, it was found that there are 2.5 adult working members for 2 and 4 acres farm families: the farmer himself, one adult son and a minor son who is also supposed to help farm work and taken as half an adult male equivalent. The working capacity has been assumed to be 8 hours a day and 26 days a month. So, the monthly man days of family labour availability stands to 65 both for 2 acres and 4 acres farms.
It has been observed during the field survey that the relatively larger farms generally maintain a permanent hired labourer who stays with the farm family [74, 86]. So for the 6 acres farm we have included a permanent hired labourer as a family labourer. As such the monthly family labour availability for 6 acres farm comes to 91 man days.

(d) Working Capital or Cash Constraint

From the field survey data which have been collected on a yearly basis, it is not possible to find out the cash availability of the farmers on periodical basis. However, from revenue and cost information for various groups of farms (Table 2.8) the net revenue of 2, 4 and 6 acre farms has been derived at about Tk. 3335, Tk. 7400 and Tk. 10 665 respectively.¹ On the basis of the findings of the various micro level studies on rural savings and investment conducted by Bangladesh Institute of Development Studies and the Socio-Economic Research Board of Dacca University [55, 4] it has been assumed that saving out of net revenue stands at about 15 per cent. The estimate of saving ratio in these studies ranged from 12 to 21 per cent. On the basis of the 15 per cent saving ratio assumed, we have rounded out the "own-fund availability" of the 2 acres, 4 acres and 6 acres farm to Tk. 500, Tk. 1100 and Tk. 1600 respectively. The cash expenditures (variable costs in Table 2.8) have been supposed to be incurred by the farms mainly for purchased inputs like improved seeds, fertilizers, insecticides/pesticides and irrigation water. With the increased market

¹ That is to say the figures in Table 2.8 have been converted to represent these farm sizes, e.g. $3235 \div 1.94 \times 2 = 3335$. 
orientation to farming and the introduction of seed-fertilizer technology the cash requirement of the hitherto traditional subsistence farming has substantially increased. To augment the cash resources of the farms, borrowing activity has been included in the model. Therefore the total cash availability consisted of farmers' own funds plus the availability of credit from the institutional sources.

(e) Labour Hiring and Bullock Hiring Constraints

Labour hiring has been taken as constraint because, although labour is abundently available in the study area, the farmers' ability to hire labour is restricted by the limited availability of funds. They cannot hire any amount of labour they need because of the shortage of their funds. It has been assumed that for the peak months of April, July, November and December, when labour is less abundant and cost of hiring labour is higher, hired labour constraint is 30 man days and for the rest of the periods the monthly hired labour constraint is 40 man days. Bullocks are needed for land preparation in April, July, November and December for the major crops and a constraint of 30 bullock pair days for these months has been included in the model.

(f) Special Constraints

The model contains a set of constraints which restrict the feasible cropping pattern to one that includes a certain acreage limitation on vegetables like potato, onion and brinjal. Due to market consideration and the perishable nature of these commodities, the maximum constraint on potato acreage has been placed at 0.125 acre and for onion and brinjal at 0.07 acre each for 2 acres farm.
In the case of the 4 acres farm, the permissible acreage for potato, onion and brinjal has been doubled in consideration of the fact that the 4 acres farm, having the same family size as the 2 acres farm, has the greater ability to grow more cash crops. For the same reasons, the permissible acreage for potato, onion and brinjal has been increased to 0.50 acre, 0.25 acre and 0.25 acre respectively for the 6 acres farm.

The fixed resources availability of the 2, 4 and 6 acres farms has been shown in Table 3.2.

Sources of Data

In addition to the fixed resources available on the farms, information is required regarding the per acre inputs of the different fixed resources needed in producing a unit of output of these crops. These input-output relationships show the inputs required per acre to produce a certain level of output. Such information was not available from the field survey report. Farm management and extension experts and agricultural economists familiar with the farming conditions in the area were contacted to provide this information [65, 68]. Published reports were also consulted in deriving the final input-output coefficients used in the model.

Information about crop yields per acre and the harvest price was needed to determine the gross revenue from each crop. The input-output calculations provided the yield per acre. The data on harvest prices were obtained from the field survey.
### TABLE 3.2
THE FIXED RESOURCES AVAILABILITY ON 2, 4 AND 6 ACRES FARMS

<table>
<thead>
<tr>
<th>Period</th>
<th>2 Acres Farm</th>
<th></th>
<th>4 Acres Farm</th>
<th></th>
<th>6 Acres Farm</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Family Labour (Days)</td>
<td>Bullock Power (Days)</td>
<td>Family Labour (Days)</td>
<td>Bullock Power (Days)</td>
<td>Family Labour (Days)</td>
<td>Bullock Power (Days)</td>
</tr>
<tr>
<td>November</td>
<td>65</td>
<td>26</td>
<td>65</td>
<td>26</td>
<td>91</td>
<td>39</td>
</tr>
<tr>
<td>December</td>
<td>65</td>
<td>26</td>
<td>65</td>
<td>26</td>
<td>91</td>
<td>39</td>
</tr>
<tr>
<td>Jan-Feb</td>
<td>130</td>
<td>52</td>
<td>130</td>
<td>52</td>
<td>182</td>
<td>78</td>
</tr>
<tr>
<td>March</td>
<td>65</td>
<td>26</td>
<td>65</td>
<td>26</td>
<td>91</td>
<td>39</td>
</tr>
<tr>
<td>April</td>
<td>65</td>
<td>26</td>
<td>65</td>
<td>26</td>
<td>91</td>
<td>39</td>
</tr>
<tr>
<td>May</td>
<td>65</td>
<td>26</td>
<td>65</td>
<td>26</td>
<td>91</td>
<td>39</td>
</tr>
<tr>
<td>June</td>
<td>65</td>
<td>26</td>
<td>65</td>
<td>26</td>
<td>91</td>
<td>39</td>
</tr>
<tr>
<td>July</td>
<td>65</td>
<td>26</td>
<td>65</td>
<td>26</td>
<td>91</td>
<td>39</td>
</tr>
<tr>
<td>Aug-Oct</td>
<td>195</td>
<td>78</td>
<td>195</td>
<td>78</td>
<td>273</td>
<td>117</td>
</tr>
</tbody>
</table>

The prices for purchased inputs like seeds, fertilizers, pesticides/insecticides, and irrigation were obtained from the field survey. Information on the wage rates, the rate of interest, and the cost of bullock hiring, was also available from the field survey report. The details of the labour requirement, bullock requirement, and cash expenditure, and gross revenue for each crop activity have been shown in Tables 3.3 and 3.4 respectively. The input-output matrix constructed on the basis of the above information for the 4 acres farm is presented in Appendix A. The same input-output matrix has been used for the other two farms with necessary adjustments in fixed resource constraints.
<table>
<thead>
<tr>
<th>Code</th>
<th>Crop Activity</th>
<th>Labour Requirement per Period (Man Days)</th>
<th>Bullock Days Requirement per Period (Bullock Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nov</td>
<td>Dec</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P1</td>
<td>P2</td>
</tr>
<tr>
<td>X1</td>
<td>Boro Paddy (HYV)</td>
<td>37</td>
<td>40</td>
</tr>
<tr>
<td>X2</td>
<td>Wheat (HYV)</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>X3</td>
<td>Oilseeds</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>X4</td>
<td>Pulse</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>X5</td>
<td>Potato</td>
<td>42</td>
<td>26</td>
</tr>
<tr>
<td>X6</td>
<td>Onion</td>
<td>36</td>
<td>5</td>
</tr>
<tr>
<td>X7</td>
<td>Brinjal</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>X8</td>
<td>Aus Paddy</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>X9</td>
<td>T. Aman Paddy</td>
<td>-</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 3.4
GROSS REVENUE AND CASH EXPENSES PER ACRE
OF CROP ACTIVITIES USED IN THE LINEAR PROGRAMMING MODEL

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Yield per Acre (Maunds)</th>
<th>Price per Maund (Takas)</th>
<th>Gross Revenue per Acre (Takas)</th>
<th>Cash Expenses</th>
<th>Irrigation Cost per Acre (Tk.)</th>
<th>Total per Acre (Takas)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Seed/Seedlings per Acre (Tk.)</td>
<td>Fertilizers per Acre (Tk.)</td>
<td>Pesticides per Acre (Tk.)</td>
</tr>
<tr>
<td>$X_1$</td>
<td>Boro Paddy (HYV)</td>
<td>40</td>
<td>65</td>
<td>2600</td>
<td>150</td>
<td>352</td>
<td>40</td>
</tr>
<tr>
<td>$X_2$</td>
<td>Wheat (HYV)</td>
<td>30</td>
<td>60</td>
<td>1800</td>
<td>80</td>
<td>327</td>
<td>25</td>
</tr>
<tr>
<td>$X_3$</td>
<td>Oilseeds</td>
<td>7</td>
<td>150</td>
<td>1050</td>
<td>15</td>
<td>173</td>
<td>25</td>
</tr>
<tr>
<td>$X_4$</td>
<td>Pulse</td>
<td>12</td>
<td>120</td>
<td>1440</td>
<td>100</td>
<td>114</td>
<td>25</td>
</tr>
<tr>
<td>$X_5$</td>
<td>Potato</td>
<td>125</td>
<td>35</td>
<td>4375</td>
<td>1000</td>
<td>461</td>
<td>30</td>
</tr>
<tr>
<td>$X_6$</td>
<td>Onion</td>
<td>60</td>
<td>40</td>
<td>2400</td>
<td>200</td>
<td>327</td>
<td>25</td>
</tr>
<tr>
<td>$X_7$</td>
<td>Brinjal</td>
<td>40</td>
<td>40</td>
<td>1600</td>
<td>30</td>
<td>201</td>
<td>25</td>
</tr>
<tr>
<td>$X_8$</td>
<td>Aus Paddy</td>
<td>15</td>
<td>68</td>
<td>1020</td>
<td>50</td>
<td>176</td>
<td>25</td>
</tr>
<tr>
<td>$X_9$</td>
<td>T. Aman Paddy</td>
<td>24</td>
<td>74</td>
<td>1776</td>
<td>60</td>
<td>176</td>
<td>25</td>
</tr>
</tbody>
</table>
Limitations and Reliability of the Data

The survey conducted by the Bangladesh Bank was for purposes other than the purpose of this study. Accordingly the information available from the report of this survey had to be supplemented, on aspects like input requirements for each crop, various cultural operations and their timing and work ability of family labour and bullocks from other sources.

Secondly, the survey data are based on observations for one year only, i.e. for the crop year 1974-75. Year to year variations have not been taken into account. As such, the study is limited to a static analysis rather than a dynamic one. Thirdly, the survey data were collected by personal interview with farmers. The farmers do not normally maintain written records of their input use and the measurement of their output. As a result, most of the information was based on recall. Forthly, the average prices of the crops which the farmers used to receive from the local markets immediately after harvest were taken and the variation of prices in the rest of the year was not taken into account. Finally, the prices of the inputs, particularly chemical fertilizers, have been taken as those prices at which farmers bought from open market because most of the farmers reported that they could not get the fertilizers in required quantity at the Government controlled prices.
CHAPTER 4

OPTIMUM RESOURCE USE IN SMALL FARMS

In Chapter 3 we discussed the procedures and the sources of the model data used in the construction of the Linear Programming model. The results obtained from the model solutions through computer programming are presented and analysed in the present chapter.

To estimate the role of credit in small farm development and its requirement and effect on the utilisation of the resources, a comparative analysis for three small farm sizes, viz. 2, 4 and 6 acres farms in three different situations will be attempted.

(A) A situation where the farm operators exclusively depend on their own financial resources without any credit availability from outside sources.

(B) A situation where the farm operators' own financial resources have been supplemented by optimal credit availability from institutional sources.

(C) A situation where sensitivity analysis will be made by varying the limit of credit availability from a low level of Tk. 100 up to maximum requirement for the 4 acres farm which is the representative average farm size in the area. The sensitivity analysis will be made for only one farm because it is assumed that the same sort of analysis will be applicable to the 6 acres farm but that more detailed
data is required for 2 acres farm before definite credit recommendations can be made.

Optimal Solutions for 2, 4 and 6 Acres Farms Without Credit (Situation A)

The optimal solutions obtained for Situation A refer to the case where the farmers have no access to credit at all. Cash requirements for purchased inputs - seeds, fertilizers, pesticides, irrigation water, etc. are met from their own cash resources. Farming in the study area is mainly carried on traditional methods where the traditional local crops dominate the cropping pattern. However, it has been assumed that the farmers can adopt the new HYV cultivation particularly the HYV of "boro" paddy, HYV of wheat and potato, when the irrigation water from the surface water is available through low-lift power pumps, although the extent of irrigation water availability is limited in the present situation due to the limited number of low-lift power pumps supplied by the Government.

The cropping patterns indicated by the LP solutions for all the three farm sizes differ from the existing state of farming conditions. The optimum farm plans and the most binding constraints for the farms indicated by the solutions suggest that mere optimal allocation of existing resources have no significant impact on farm's incomes in the absence of credit. The activities included in the optimal farm plans and the net revenues have been presented in Table 4.1.

The farm plan given by the optimal solution for 2 acres farm for a situation without credit includes only two crops - brinjal
<table>
<thead>
<tr>
<th>Code Activity</th>
<th>Level (Acres)</th>
<th>Percentage of Total Cropped Acreage</th>
<th>Net Revenue</th>
<th>Code Activity</th>
<th>Level (Acres)</th>
<th>Percentage of Total Cropped Acreage</th>
<th>Net Revenue</th>
<th>Code Activity</th>
<th>Level (Acres)</th>
<th>Percentage of Total Cropped Acreage</th>
<th>Net Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>X&lt;sub&gt;7&lt;/sub&gt; Brinjal</td>
<td>0.060</td>
<td>3</td>
<td>96</td>
<td>X&lt;sub&gt;4&lt;/sub&gt; Pulses</td>
<td>2.076</td>
<td>47.10</td>
<td>2989.44</td>
<td>X&lt;sub&gt;4&lt;/sub&gt; Pulses</td>
<td>3.022</td>
<td>47.18</td>
<td>4351.68</td>
</tr>
<tr>
<td>X&lt;sub&gt;9&lt;/sub&gt; Transplanted Aman Paddy</td>
<td>1.857</td>
<td>97</td>
<td>329</td>
<td>X&lt;sub&gt;7&lt;/sub&gt; Brinjal</td>
<td>0.125</td>
<td>2.83</td>
<td>200.00</td>
<td>X&lt;sub&gt;7&lt;/sub&gt; Brinjal</td>
<td>0.250</td>
<td>3.90</td>
<td>400.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X&lt;sub&gt;8&lt;/sub&gt; Aus Paddy</td>
<td>0.408</td>
<td>9.25</td>
<td>416.16</td>
<td>X&lt;sub&gt;8&lt;/sub&gt; Aus Paddy</td>
<td>0.405</td>
<td>6.32</td>
<td>416.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X&lt;sub&gt;9&lt;/sub&gt; Transplanted Aman Paddy</td>
<td>1.799</td>
<td>40.82</td>
<td>3195.02</td>
<td>X&lt;sub&gt;9&lt;/sub&gt; Transplanted Aman Paddy</td>
<td>2.728</td>
<td>42.60</td>
<td>4844.93</td>
</tr>
<tr>
<td>Hiring Activities</td>
<td>-4</td>
<td></td>
<td></td>
<td>Hiring Activities</td>
<td>-1300</td>
<td></td>
<td></td>
<td>Hiring Activities</td>
<td>-1302.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1.917</td>
<td>100</td>
<td>3390</td>
<td>4.408</td>
<td>100</td>
<td>5500</td>
<td></td>
<td>6.405</td>
<td>100</td>
<td>8710</td>
<td></td>
</tr>
<tr>
<td>Cropping Intensity</td>
<td>97%</td>
<td></td>
<td></td>
<td>110%</td>
<td></td>
<td></td>
<td></td>
<td>106%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
and transplanted aman paddy. The maximum acreage that can be cultivated with its own available cash is under transplanted aman paddy. Ninety-seven per cent of the total cropped acreage is under transplanted aman paddy. In the cases of the 4 acre and 6 acre farms, the optimal farm plans include 4 crops - two Rabi crops, namely pulses and brinjal; and two Kharif crops, namely aus paddy and transplanted aman paddy. Compared with 2 acre farms, the cropping patterns of the 4 acre and 6 acre farms as indicated by the optimal solution are more diversified. From Table 4.1 it can be observed that both in the 4 acre and 6 acre farms the Rabi pulse crop dominates the cropping pattern in terms of acreage. In the existing cropping pattern, in the area under study (Table 2.7) which is mainly determined by the rainfall and weather conditions, winter cropped acreage is very small due to the scanty rainfall. Among the Rabi crops the oilseed is grown in less acreage by the farmers in the current situation than that of pulses. In the optimal farm plans of all three farm sizes, the oilseed crop has not been included.

In addition to aman, the other important summer crop activity included in the optimal farm plans of 4 acre and 6 acre farms is the aus paddy. But the percentage of acreage indicated by the optimal plans is slightly less that that of the existing percentage of acreage under this crop in the area. However, if we take together the acreages under aus paddy and transplanted aman paddy, as indicated in the optimal farm plans of 4 acre and 6 acre farms, we find that the subsistence food crop, i.e. paddy, dominates the cropping pattern of all the three farms under consideration. The existing farming pattern in the area also concentrates mainly on the transplanted aman paddy.
The transplanted aman paddy which is the single most important crop in the current cropping pattern covering about 72 per cent of the total cultivable area, also fully dominates the optimal plan of 2 acre farm and takes the major share in acreages in the case of the 4 acre farm and is the second important crop on the 6 acre farm. But none of the optimal farm plans had included any high yielding variety of crops which require higher amounts of cash outlay. The cropping patterns indicated by the optimal plans is, however, based on a hypothetical situation of complete absence of credit support to the farms. This crude assumption of complete non-availability of credit has been made to gauge how far the farms' own funds can exploit the income increasing potential through optimal allocation of resources, and to form a basis for subsequent comparison with situations involving alternative amounts of credit availability.

The net revenue indicated by the optimal solutions for 2, 4 and 6 acre farms are Tk. 3390, Tk. 5500 and Tk. 8710 respectively. The net revenue per cultivated acre is Tk. 1695 for 2 acres, Tk. 1375 for 4 acres and Tk. 1451 for 6 acres farm. The average size of farms for the three groups of farms in the field survey is 1.94, 4.13 and 6.28 acres respectively and the corresponding net revenue per cultivated acre in three sizes of farms is Tk. 1667, Tk. 1850 and Tk. 1777 respectively. The farm sizes are slightly different from those considered in the LP model and the direct comparison of net revenue per cultivated acre from survey and model results is therefore rough.

Figure 4.1 shows the comparative position of net revenue of the three farms in actual situations and in optimal solution without credit.

In the figure the net revenue in actual situations is represented by "a"
FIGURE 4.1
CROPPING INTENSITY AND NET REVENUE OF THE THREE FARM SIZES IN WITHOUT CREDIT SITUATION AND IN THE ACTUAL SITUATION REPORTED

A = cropping intensity in the actual situation of the farms
A' = cropping intensity in the optimal solution without credit situation
a = net revenue in actual situation
a' = net revenue in the optimal solution
and the net revenue in the optimal solution without credit situation is represented by a'. It can be observed from the figure that the net revenue in the case of the 4 and 6 acre farms is higher in the actual situation than that indicated by optimal solution in without credit situation; whereas in the case of the 2 acre farm the net revenue indicated by the optimal solution in without credit situation is slightly higher than that of the actual situation. This comparison suggests that a possible explanation is that farms in the two bigger size groups had some access to credit while the farm in the smallest size group had no credit facilities. Alternatively, or more likely, the very small farmer does obtain credit to allow for more intensive use of land (cropping intensity 126 per cent) but high non-institutional interest rates mean little increase in income.

Cropping Intensities, Resource Use, and Shadow Prices of Scarce Resources for the 3 Farms in the Optimal Solution (Situation A)

The cropping intensities, resource use and the shadow prices of scarce resources for the 3 farm sizes have been presented in Table 4.2. It can be observed from the table that the cropping intensity for the 2 acre farm is lowest, i.e. 97 per cent. It is lower than the existing average cropping intensity of 117 per cent in the area and much lower than the cropping intensity of 126 reported for 1.94 acre farm in Table 2.7. Compared with the 2 acre farm, the cropping intensities of the 4 and 6 acre farms are higher, i.e. 110 per cent and 106 per cent and are very close to the actual cropping intensities reported for similar sized farms in the area. The solutions reveal that in the case of the 2 acres farm the available land resources remain unutilised
## TABLE 4.2
CROPPING INTENSITIES, RESOURCE USE AND SHADOW PRICES OF SCARCE RESOURCES ON 2, 4 AND 6 ACRE FARMS WITHOUT CREDIT SITUATION

<table>
<thead>
<tr>
<th>Resource Code</th>
<th>Resource Description</th>
<th>Unit Availability</th>
<th>Unused</th>
<th>Used Cropping Ability</th>
<th>Shadow Cropping Ability</th>
<th>Shadow Cropping Price</th>
<th>Unit Availability</th>
<th>Unused</th>
<th>Used Cropping Ability</th>
<th>Shadow Cropping Ability</th>
<th>Shadow Cropping Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>November Land</td>
<td>2</td>
<td>0.0831</td>
<td>1.9169</td>
<td>4</td>
<td>2.7278</td>
<td>6</td>
<td>0.0831</td>
<td>1.9169</td>
<td>4</td>
<td>2.7278</td>
</tr>
<tr>
<td>52</td>
<td>December Land</td>
<td>2</td>
<td>0.0831</td>
<td>1.9169</td>
<td>4</td>
<td>2.7278</td>
<td>6</td>
<td>0.0831</td>
<td>1.9169</td>
<td>4</td>
<td>2.7278</td>
</tr>
<tr>
<td>53</td>
<td>Jan-Feb Land</td>
<td>2</td>
<td>1.9403</td>
<td>0.0597</td>
<td>4</td>
<td>2.7278</td>
<td>6</td>
<td>1.9403</td>
<td>0.0597</td>
<td>4</td>
<td>2.7278</td>
</tr>
<tr>
<td>54</td>
<td>March Land</td>
<td>2</td>
<td>1.9403</td>
<td>0.0597</td>
<td>4</td>
<td>2.7278</td>
<td>6</td>
<td>1.9403</td>
<td>0.0597</td>
<td>4</td>
<td>2.7278</td>
</tr>
<tr>
<td>55</td>
<td>April Land</td>
<td>2</td>
<td>2.000</td>
<td>-</td>
<td>4</td>
<td>5.5947</td>
<td>6</td>
<td>2.000</td>
<td>-</td>
<td>4</td>
<td>5.5947</td>
</tr>
<tr>
<td>56</td>
<td>May Land</td>
<td>2</td>
<td>2.000</td>
<td>-</td>
<td>4</td>
<td>5.5947</td>
<td>6</td>
<td>2.000</td>
<td>-</td>
<td>4</td>
<td>5.5947</td>
</tr>
<tr>
<td>57</td>
<td>June Land</td>
<td>2</td>
<td>2.000</td>
<td>-</td>
<td>4</td>
<td>5.5947</td>
<td>6</td>
<td>2.000</td>
<td>-</td>
<td>4</td>
<td>5.5947</td>
</tr>
<tr>
<td>58</td>
<td>July Land</td>
<td>2</td>
<td>0.1429</td>
<td>1.8571</td>
<td>4</td>
<td>2.8669</td>
<td>6</td>
<td>0.1429</td>
<td>1.8571</td>
<td>4</td>
<td>2.8669</td>
</tr>
<tr>
<td>59</td>
<td>Aug-Oct Land</td>
<td>2</td>
<td>0.1429</td>
<td>1.8571</td>
<td>4</td>
<td>2.7272</td>
<td>6</td>
<td>0.1429</td>
<td>1.8571</td>
<td>4</td>
<td>2.7272</td>
</tr>
</tbody>
</table>

### Family Labour

<table>
<thead>
<tr>
<th>Month</th>
<th>Days</th>
<th>Man Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>November F.L.</td>
<td>65</td>
<td>64</td>
</tr>
<tr>
<td>December F.L.</td>
<td>65</td>
<td>34</td>
</tr>
<tr>
<td>Jan-Feb F.L.</td>
<td>130</td>
<td>129</td>
</tr>
<tr>
<td>March F.L.</td>
<td>65</td>
<td>64</td>
</tr>
<tr>
<td>April F.L.</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>May F.L.</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>June F.L.</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>July F.L.</td>
<td>65</td>
<td>7</td>
</tr>
<tr>
<td>Aug-Oct F.L.</td>
<td>195</td>
<td>45</td>
</tr>
</tbody>
</table>

### Bullock Labour

<table>
<thead>
<tr>
<th>Month</th>
<th>Days</th>
<th>Man Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>November B.L.</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>December B.L.</td>
<td>26</td>
<td>22</td>
</tr>
<tr>
<td>Jan-Feb B.L.</td>
<td>52</td>
<td>52</td>
</tr>
<tr>
<td>March B.L.</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>April B.L.</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>May B.L.</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>June B.L.</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>July B.L.</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Aug-Oct B.L.</td>
<td>76</td>
<td>76</td>
</tr>
</tbody>
</table>

### Resource Prices

<table>
<thead>
<tr>
<th>Resource</th>
<th>Price (Taka)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>500</td>
</tr>
<tr>
<td>Potato Acreage</td>
<td>.125</td>
</tr>
<tr>
<td>Onion Acreage</td>
<td>.07</td>
</tr>
<tr>
<td>Brinjal Acreage</td>
<td>.0597</td>
</tr>
</tbody>
</table>

*F.L.* = Family Labour  
*B.L.* = Bullock Labour
in different degrees throughout all the periods. During March, April and May all the land remains fallow. In the case of the 4 and 6 acre farms land is fully utilised during the months of November and December only.

Figure 4.1 also shows the cropping intensities of the 3 farms in actual situation and in the optimal solution without credit situation. Cropping intensity in the actual situation is indicated by $A$ and the cropping intensity in the optimal solution without credit situation is indicated by $A'$. It can be observed from the figure that the cropping intensity of the 2 acre farm in actual situation is much higher than that of the optimal solution in without credit situation; whereas in the case of the 4 and 6 acre farms the difference between $A$ (cropping intensity in actual situation) and $A'$ (cropping intensity in optimal solution in without credit situation) is very small. These comparative analyses of the results of the model for the 3 farms suggest that the present model developed in this study suits the conditions of the 4 and 6 acre farm sizes in the small farm groups but does not fit adequately to explain the position of very small farms of 2 acre size. So, a separate model based on adequate information regarding the very small farms could have been more appropriate.

Since the land resources are fully utilised during the month of November, November land of both the 4 and 6 acre farms has got the shadow price of Tk. 502.73 which means that if the farms' land availability could be increased by one acre it would have gained extra revenue of Tk. 502.73. But the prevalent cost of renting in land on a yearly basis is about Tk. 750 per acre which is higher than that of the
shadow price indicated in the LP solution. Most of the family labour available to the farms remains unutilised throughout the whole year. The 2 acre farm can utilise only 17 per cent of the total available family labour whereas the 4 acre farm can utilise 32 per cent of its total available family labour and the 6 acre farm can utilise 33 per cent of its total available family labour. The higher percentage of labour utilisation by the 4 and 6 acre farms is due to the relatively large size of the farms and the more intensive use of land. Major portion of bullock labour availabilities for all the three farms also remain idle except during the month of July. The shadow price of July bullock labour for the 2 acre farm is Tk. 10, which is lower than that of the prevailing rate of Tk. 15 per day. The shadow prices of bullock labour for the month of July for the 4 and 6 acre farms are Tk. 17 and Tk. 18 respectively which are higher than the per day hiring charge of Tk. 15. The only resource which is fully utilised is the working capital, i.e. the cash availability of Tk. 500 for the 2 acre farm, Tk. 1100 for the 4 acre farm and Tk. 1600 for the 6 acre farm for the whole year. The shadow price of cash for the 2 acre farm is Tk. 6.25, whereas the cost involved in borrowing an additional amount of Tk. 1 is Tk. 1.12 according to the existing institutional lending rate. The shadow price of cash for the 4 acre and 6 acre farms is Tk. 3.92 which implies that an increased availability of cash by one Taka will increase the revenue for the 4 acre and 6 acre farms by Tk. 3.92. The results indicate that the returns per Taka invested on smaller farm is higher than on relatively larger farms. The higher shadow price of cash for all the three farms suggests that cash availability is the most binding constraint in the existing circumstances particularly for the relatively
smaller farms as indicated by the highest shadow price of cash for the 2 acre farm. This finding is consistent with the conclusions of Singh and Jha [89] and Sharma and Prasad [90] for India and of Naseun [75] for Pakistan. The results of the LP model indicate that there is a potential scope for raising the income of small farms through increased flow of production credit.

Optimal Solutions with Optimal Amount of Credit Availability (Situation B)

In the previous section we analysed the optimal solutions obtained for the three farms without any borrowing and found that cash availability was the most binding constraint to all the farms as indicated by the high shadow price of cash. Now we have introduced borrowing activity in our model to supplement the cash availability of the farms to analyse the impact of credit availability on the cropping pattern, cropping intensities and farms' incomes. It has been assumed that the farmers will borrow money until the marginal value product equals marginal cost (Tk. 12), i.e. the amount of credit at which shadow price of credit becomes zero.

It has been found from the results of the LP model solutions that the optimal credit requirements for a 2 acre farm is Tk. 950, for a 4 acre farm it is Tk. 1152 and for a 6 acre farm it is Tk. 1802, which they can utilise profitably to exploit their other resources at the given level of technology and other constraints. It is to be noted that the per acre credit requirement for the 2 acre farm is Tk. 475 which is much higher than that of the 4 acre and 6 acre farms. The results
FIGURE 4.2
NET REVENUE AND CROPPING INTENSITY OF 3 FARM SIZES WITH OPTIMAL CREDIT
of the LP solutions are presented in Tables 4.3 and 4.4 respectively. A comparison of Table 4.3 with Table 4.1 shows that there has been a significant improvement in the cropping patterns due to the optimal availability of credit to the farms. The feasible and profitable farm plan with optimal credit for the 2 acre farm includes 4 crops incorporating two HYV crops out of nine crop activities selected for the model; whereas the optimal farm plan for the 2 acre farm without credit included only two traditional crops. The number of crop activities in the optimal farm plans for the 4 acre and 6 acre farms has also increased from 4 to 7 including all the high yielding varieties and high value crops like HYV "boro" paddy, HYV potato, onion and brinjal during Rabi season and "aus" paddy and transplanted "aman" paddy during the Kharif and late Kharif seasons. The allocation of land among different crops in the new farm plans has also changed significantly. In the new optimal farm plans with optimal credit availability, the maximum land is occupied by "aus" paddy followed by transplanted "aman" and HYV "boro" paddy in all three farms.

It can be observed from Table 4.3 that with the optimal level of credit availability the net revenue of all three farms has increased substantially. The net revenue per cultivated acre with optimal availability of credit is Tk. 2313.5 on the 2 acre farm, Tk. 2149 on the 4 acre farm and Tk. 2142 on the 5 acre farm. This higher net revenue per cultivated acre for relatively smaller farms suggests that the adequate supply of credit to the smaller farms will have a more favourable impact on raising farm productivity and income.
### Table 4.3

Optimal Solutions for 2, 4 and 6 Acre Farms with Optimal Credit

<table>
<thead>
<tr>
<th>Code Activity</th>
<th>Level (Acres)</th>
<th>Percentage of Total Cropped Acreage</th>
<th>Net Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>X₁ Boro Paddy (HYV)</td>
<td>0.937</td>
<td>30.60</td>
<td>2436.2</td>
</tr>
<tr>
<td>X₅ Potato</td>
<td>0.125</td>
<td>4.08</td>
<td>546.88</td>
</tr>
<tr>
<td>X₈ Aus Paddy 1.062</td>
<td>34.68</td>
<td>1083.24</td>
<td></td>
</tr>
<tr>
<td>X₉ Transplanted Aman Paddy</td>
<td>0.938</td>
<td>30.64</td>
<td>1665.88</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code Activity</th>
<th>Level (Acres)</th>
<th>Percentage of Total Cropped Acreage</th>
<th>Net Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>X₁ Boro Paddy (HYV)</td>
<td>0.709</td>
<td>11.95</td>
<td>1843.4</td>
</tr>
<tr>
<td>X₄ Pulses</td>
<td>1.319</td>
<td>22.22</td>
<td>1899.36</td>
</tr>
<tr>
<td>X₅ Potato</td>
<td>0.250</td>
<td>4.21</td>
<td>1093.75</td>
</tr>
<tr>
<td>X₆ Onion</td>
<td>0.125</td>
<td>2.10</td>
<td>300.00</td>
</tr>
<tr>
<td>X₇ Brinjal</td>
<td>0.125</td>
<td>2.10</td>
<td>200.00</td>
</tr>
<tr>
<td>X₈ Aus Paddy 1.935</td>
<td>32.60</td>
<td>1973.7</td>
<td></td>
</tr>
<tr>
<td>X₉ Transplanted Aman Paddy</td>
<td>1.473</td>
<td>24.82</td>
<td>2616.05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code Activity</th>
<th>Level (Acres)</th>
<th>Percentage of Total Cropped Acreage</th>
<th>Net Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>X₁ Boro Paddy (HYV)</td>
<td>0.827</td>
<td>9.38</td>
<td>2150.2</td>
</tr>
<tr>
<td>X₄ Pulses</td>
<td>2.147</td>
<td>24.34</td>
<td>3091.68</td>
</tr>
<tr>
<td>X₅ Potato</td>
<td>0.500</td>
<td>5.67</td>
<td>2187.5</td>
</tr>
<tr>
<td>X₆ Onion</td>
<td>0.250</td>
<td>2.83</td>
<td>600.00</td>
</tr>
<tr>
<td>X₇ Brinjal</td>
<td>0.250</td>
<td>2.83</td>
<td>400.00</td>
</tr>
<tr>
<td>X₈ Aus Paddy 2.819</td>
<td>31.97</td>
<td>2875.38</td>
<td></td>
</tr>
<tr>
<td>X₉ Transplanted Aman Paddy</td>
<td>2.026</td>
<td>22.98</td>
<td>3598.18</td>
</tr>
</tbody>
</table>

| Total | 3.062 | 100 | 4627 |
|       |       | 5.936 | 100 | 8596

| Cropping Intensity | 153% | 148% | 147% |
### TABLE 4.4
CROPPING INTENSITIES, RESOURCE USE AND SHADOW PRICES OF SCARCE RESOURCES ON 2, 4 AND 6 ACRE FARMS WITH OPTIMAL CREDIT

<table>
<thead>
<tr>
<th>Resource Code</th>
<th>Description</th>
<th>2 Acre Farm</th>
<th>4 Acre Farm</th>
<th>6 Acre Farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Acre Farm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Acre</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1 November Land</td>
<td>2 0.9375 1.0625</td>
<td>4 0.7086 3.2914</td>
<td>6 0.8270 148%</td>
<td></td>
</tr>
<tr>
<td>S2 December Land</td>
<td>2 2 1257</td>
<td>4 - 4 1113</td>
<td>6 - 6 1113</td>
<td></td>
</tr>
<tr>
<td>S3 Jan-Feb Land</td>
<td>2 0.9375 1.0625</td>
<td>4 1.4726 2.5274</td>
<td>6 2.0261</td>
<td></td>
</tr>
<tr>
<td>S4 March Land</td>
<td>2 0.9375 1.0625</td>
<td>4 1.4726 2.5274</td>
<td>6 2.0261</td>
<td></td>
</tr>
<tr>
<td>S5 April Land</td>
<td>2 2 512</td>
<td>4 1.3664 2.8488</td>
<td>6 2.0261</td>
<td></td>
</tr>
<tr>
<td>S6 May Land</td>
<td>2 0.9375 1.0625</td>
<td>4 2.0650 1.9350</td>
<td>6 3.1809</td>
<td></td>
</tr>
<tr>
<td>S7 June Land</td>
<td>2 0.9375 1.0625</td>
<td>4 2.0650 1.9350</td>
<td>6 3.1809</td>
<td></td>
</tr>
<tr>
<td>S8 July Land</td>
<td>2 2 226</td>
<td>4 0.5924 3.4076</td>
<td>6 1.1548</td>
<td></td>
</tr>
<tr>
<td>S9 Aug-Oct Land</td>
<td>2 1.0625 0.9375</td>
<td>4 2.5274 1.4726</td>
<td>6 3.9739</td>
<td></td>
</tr>
<tr>
<td>Family Labour Man days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S10 November F.L.</td>
<td>65 12 43</td>
<td>65 28</td>
<td>91 25 66</td>
<td></td>
</tr>
<tr>
<td>S11 December F.L.</td>
<td>65 65 16</td>
<td>65 - 65 11.76</td>
<td>91 - 91 11</td>
<td></td>
</tr>
<tr>
<td>S12 Jan-Feb F.L.</td>
<td>130 90 40</td>
<td>130 80 50</td>
<td>182 111 71</td>
<td></td>
</tr>
<tr>
<td>S13 March F.L.</td>
<td>65 57 8</td>
<td>65 37 28</td>
<td>91 45 46</td>
<td></td>
</tr>
<tr>
<td>S14 April F.L.</td>
<td>65 19 46</td>
<td>65 - 65 8.7</td>
<td>91 - 91 8</td>
<td></td>
</tr>
<tr>
<td>S15 May F.L.</td>
<td>65 41 24</td>
<td>65 22 43</td>
<td>91 28 63</td>
<td></td>
</tr>
<tr>
<td>S16 June F.L.</td>
<td>65 65 -</td>
<td>65 65 0</td>
<td>91 91 - 5</td>
<td></td>
</tr>
<tr>
<td>S17 July F.L.</td>
<td>65 75 40</td>
<td>65 - 65 5.8</td>
<td>91 - 91</td>
<td></td>
</tr>
<tr>
<td>S18 Aug-Oct F.L.</td>
<td>195 172 23</td>
<td>195 159 36</td>
<td>273 224 49</td>
<td></td>
</tr>
<tr>
<td>Bullock Labour Bull-ock days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S26 November B.L.</td>
<td>26 23 3</td>
<td>26 4 22</td>
<td>39 1 30</td>
<td></td>
</tr>
<tr>
<td>S27 December B.L.</td>
<td>26 7 19</td>
<td>26 10 16</td>
<td>39 20 19</td>
<td></td>
</tr>
<tr>
<td>S28 Jan-Feb B.L.</td>
<td>52 52</td>
<td>52 52</td>
<td>78 78</td>
<td></td>
</tr>
<tr>
<td>S29 March B.L.</td>
<td>26 26 3</td>
<td>26 23 3</td>
<td>39 34 4</td>
<td></td>
</tr>
<tr>
<td>S30 April B.L.</td>
<td>26 9 17</td>
<td>26 - 28(BH) 31</td>
<td>39 - 41(BH) 31</td>
<td></td>
</tr>
<tr>
<td>S31 May B.L.</td>
<td>26 23 3</td>
<td>26 22 4</td>
<td>39 33 6</td>
<td></td>
</tr>
<tr>
<td>S32 June B.L.</td>
<td>26 26 -</td>
<td>26 26 -</td>
<td>39 39 -</td>
<td></td>
</tr>
<tr>
<td>S33 July B.L.</td>
<td>26 10 16</td>
<td>26 1 25</td>
<td>39 4 35</td>
<td></td>
</tr>
<tr>
<td>S34 Aug-Oct B.L.</td>
<td>78 78 -</td>
<td>78 71 5</td>
<td>117 108 9</td>
<td></td>
</tr>
<tr>
<td>S41 Cash Taka</td>
<td>.112</td>
<td>1.12</td>
<td>1100 - 1100 1.12</td>
<td>1600 - 1600 1.12</td>
</tr>
<tr>
<td>S42 Potato Acreage</td>
<td>.125 .125 .125</td>
<td>.125 .125 .125</td>
<td>.125 .125 .125</td>
<td></td>
</tr>
<tr>
<td>S43 Onion Acreage</td>
<td>.07</td>
<td>.07</td>
<td>.25 - .25 .25</td>
<td>.25 .25 .25</td>
</tr>
<tr>
<td>S44 Brinjal Acreage</td>
<td>.07 .07</td>
<td>.125 - .125 .125</td>
<td>.25 .25 .25</td>
<td></td>
</tr>
</tbody>
</table>

F.L. = Family Labour  
B.L. = Bullock Labour  
B.H. = Bullock Hiring
Effect of Optimal Amount of Credit Availability on Resource Utilisation

The influence of credit on cropping intensities, on resource utilisation and the shadow prices of scarce resources can be observed in Table 4.4. With the optimal level of credit availability, the cropping intensities of the three farms under consideration have increased substantially. The cropping intensity of the 2 acre farm has increased from a very low level of 96 per cent to 153 per cent showing an increase of 59 per cent. The cropping intensity of the 4 acre farm has increased from 110 per cent to 148 per cent indicating an increase of 34 per cent over the previous situation without credit. The explanation for this situation may lie in the relatively larger availability of family labour and bullock labour per unit of land for the 2 acre farm. As evident from the increased cropping intensities, the land utilisation by all the three farms has substantially increased. In the case of the 2 acre farm the available land is fully occupied by crops during the months of December, April and July. The shadow price of the December land when the HYV "boro" paddy is planted is the highest, i.e. Tk. 1257 per acre followed by April and July land of Tk. 502 and Tk. 226 respectively. In the case of the 4 acre and 6 acre farms the available land is fully occupied during the month of December only and the shadow prices of December land is Tk. 1113. The implication of the higher shadow prices of December land is that the net revenue of the farms could be increased substantially if the additional land could be put under HYV boro paddy cultivation. Maximum acreage limitations placed on potato, onion and brinjal cultivation also indicated shadow prices of Tk. 1151, Tk. 609
and Tk. 58 respectively for the 4 and 6 acre farms. This implies that withdrawal of the restriction of acreage limitation on these crops will further raise the net revenues of the farms.

With the optimal amount of credit availability to the farms the family labour utilisation by all three farms has increased greatly. In situation A where there is no credit availability, the total amount of family labour utilised by the 2 acre farm is only 139 man days while the family labour availability is 780 man days, so only 17 per cent of the available family labour is utilised. But in situation B, i.e. with the optimal credit availability the total family labour utilisation increases to 289 man days raising the percentage of family labour utilisation to 37 per cent, but still 63 per cent of the available family labour remains unutilised. In the case of the 4 acre farm the family labour uses rise from 32 per cent to 45 per cent and in the case of the 6 acre farm, 52 per cent of the total available family labour is utilised when optimal amount of credit is available, while without credit availability only 33 per cent of the available family labour is used.

This trend of family labour utilisation suggests that although the production credit for crop activities raises the labour demand, yet it has only a limited role in alleviating the problem of unemployment and under-employment in the farm families because of seasonality in agricultural production and the limitation of land resources. Therefore, the alternative investment opportunities along with farming have to be explored and adequate provision of credit should be made to create subsidiary occupations for the farmers during the slack seasons. The adequate supply of credit to finance the agricultural allied activities, like poultry, cattle rearing, horticulture, farming, fishing,
small scale and cottage industries, has got potential scope for raising the small farms' incomes and creating additional job opportunities for the surplus labour in the farm sector of the economy.

Optimal Solutions with Different Levels of Credit Availability (Situation C)

In the last two sections we have examined two extreme cases - one with complete absence of credit availability and the other with optimal level of credit availability. Neither of these two situations conforms to the practical conditions in the study area or in the country as a whole. In practical situations most of the farmers, particularly the small farmers, have to borrow either from institutional sources or from the non-institutional sources or from both sources for family expenditure and production purposes. Since the access to the institutional credit for the small farmers is very limited, they have to rely mainly on exploitative non-institutional sources. In non-institutional sources of credit a farmer can borrow any amount provided he can pay the exorbitant interest. It was mentioned in Chapter 2 that the rate of interest charged by money lenders ranges from 60 to 100 per cent. In the case of institutional lending, which until now has been mainly security oriented and beset with rigid procedures and formalities, there are credit limits or ceilings to individual farmers and the credit is supplied at relatively lower interest rates of 12 per cent. The credit limit to individual farmers also varies from institution to institution according to the purposes of borrowing and the valuation of the securities offered by the farmers. Ordinarily the credit limit to individual farmers from institutions is determined by the rough estimate of per acre credit
requirements, based on the cost of production per acre for the different crops produced. In cooperative financing the credit limit depends on the amount of savings and share capital of the borrowing cooperative members. The cooperatives which finance the major portion of short term production credit, do not have any fixed credit limit on per acre basis to the farmers. However, in the recently launched Special Agricultural Credit Programme of Tk. 1000 million for the crop year 1977-78, the Government has set up a uniform credit limit of Tk. 250 per acre to the farmers for all the participating credit agencies like Bangladesh Krishi Bank and the six nationalised commercial banks.

In view of this uncertain and flexible situation of agricultural credit availability, it is felt that a sensitivity analysis on the assumption of varied amount of credit limits will provide meaningful results. Accordingly, a sensitivity analysis has been attempted for the 4 acre farm by gradually increasing the credit availability by a unit of Tk. 100 at each level up to the optimum amount of credit requirement where the MVP equals marginal cost (12 per cent) or where shadow price of credit comes down to zero. The sensitivity analysis has been made only for a 4 acre farm which is the average farm size, on the assumption that the same analysis would be applicable to the 6 acre farm but that more detailed data is required for the 2 acre farm before definite credit recommendations can be made.

The results obtained for the different levels of credit availability have been presented in Table 4.5. The impact of varied amount of credit availability on net revenue, cropping pattern, cropping intensity and resource use can be observed from this table. With the
### TABLE 4.5
**NET REVENUE, CASH OUTLAY, CROPPING INTENSITY, CROPPING PATTERN**
**AND SHADOW PRICES OF SCARCE RESOURCES ON 4 ACRE FARM WITH DIFFERENT LEVELS OF CREDIT AVAILABILITY**

<table>
<thead>
<tr>
<th></th>
<th>Without Credit</th>
<th>With Credit Limit of Tk200</th>
<th>Tk300</th>
<th>Tk400</th>
<th>Tk500</th>
<th>Tk600</th>
<th>Tk700</th>
<th>Tk800</th>
<th>Tk900</th>
<th>Tk1000</th>
<th>Tk1100</th>
<th>Tk1200</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net Revenue Tk</strong></td>
<td>5500</td>
<td>7080</td>
<td>7354</td>
<td>7607</td>
<td>7833</td>
<td>8073</td>
<td>8163</td>
<td>8288</td>
<td>8389</td>
<td>8489</td>
<td>8570</td>
<td>8596</td>
</tr>
<tr>
<td><strong>Cash Outlay Tk</strong></td>
<td>1100</td>
<td>1200</td>
<td>1500</td>
<td>1600</td>
<td>1700</td>
<td>1880</td>
<td>1900</td>
<td>2000</td>
<td>2100</td>
<td>2200</td>
<td>2525</td>
<td></td>
</tr>
<tr>
<td><strong>Cropping Intensity</strong></td>
<td>15%</td>
<td>20%</td>
<td>29%</td>
<td>37%</td>
<td>46%</td>
<td>53%</td>
<td>56%</td>
<td>58%</td>
<td>58%</td>
<td>58%</td>
<td>58%</td>
<td>58%</td>
</tr>
<tr>
<td><strong>Crop Mix</strong>&lt;br&gt;(area in acres)&lt;br&gt;X1 Boro Paddy (HYV)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Shadow Price of November Land</strong></td>
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<td><strong>Shadow Price of December Land</strong></td>
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<tr>
<td><strong>Shadow Price of April F.L.</strong></td>
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<tr>
<td><strong>Shadow Price of July F.L.</strong></td>
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<tr>
<td><strong>Shadow Price of Potato Acreage</strong></td>
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<tr>
<td><strong>Shadow Price of Onion Acreage</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Shadow Price of Brinjal Acreage</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>Shadow Price of Cash</strong></td>
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<td><strong>Shadow Price of Loan</strong></td>
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</tr>
<tr>
<td><strong>Shadow Price of November B.L.</strong></td>
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<td></td>
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<td></td>
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</tr>
</tbody>
</table>

**Note:** The table provides a detailed analysis of net revenue, cash outlay, cropping intensity, and shadow prices for different levels of credit availability on a 4-acre farm. The data includes specific crop mixes and their corresponding shadow prices for various resources. The table aims to illustrate the impact of credit availability on farming economics.
first dose of credit of Tk. 100, the net revenue increases by Tk. 1580 and the cropping intensity increases from 110 per cent to 120 per cent. The number of crop activities in the farm plan remains the same, i.e. 4, but the acreage under pulses and "aus" paddy increases while that of transplanted "aman" paddy decreases. When the credit availability is increased to Tk. 200 the net revenue increases by Tk. 274 from Tk. 7080 to Tk. 7354 and the cropping intensity increases from 120 to 129 per cent; the number of crop activities remains the same but the acreage under "aus" paddy and pulses increases while the acreage under transplanted "aman" declines. The same trend of increasing net revenue and cropping intensity is observed when credit availability is varied from Tk. 200 to Tk. 300. But the rate of increase in the net revenue diminishes further when credit level is increased from Tk. 300 to 400. The number of crop activities in the optimal plan increases from 5 to 7. The new crop activities included in the plan are HYV of "boro" paddy and oilseeds. Up to the credit availability of Tk. 300 no HYV crops come into the optimal plan although the net revenue and cropping intensity increases. With the credit limit enhanced from Tk. 300 to Tk. 400 HYV "boro" paddy appears in the optimal farm plan although its acreage is insignificant. With the further increase of credit availability, the HYV potato comes into the optimal farm plan and the acreage under HYV "boro" paddy and "aus" paddy continuously goes on increasing whereas the acreage under pulses and transplanted "aman" paddy declines. This finding suggests that the increased flow of credit is a precondition for the adoption of HYV cultivation by the small farmers.

With the credit limit of Tk. 500, the net revenue increases by Tk. 132 and cropping intensity increases from 146 per cent to 151 per
cent and acreage under HYV boro paddy increases from .0119 to .221 acre. At the credit availability of Tk. 600 the net revenue increases by Tk. 108 and the cropping intensity decreases from 151 per cent to 145 per cent and the acreage under HYV "boro" paddy increases from .221 acre to .435 acre. With the increased availability of credit, the shadow price of December land which is needed for HYV "boro" cultivation also increases. It can be observed from the table that within the range of credit availability of Tk. 600 to 900 the cropping intensity slightly diminishes from 145 per cent to 143 per cent. This may be explained by the fact that with increased availability of credit although the acreage under HYV crops, which need more capital, increases the acreage under traditional crops like pulses, transplanted "aman" paddy, has decreased relatively more. With the credit availability of Tk. 1000 the net revenue increased to Tk. 8489 from Tk. 8389 when the credit limit is Tk. 900. The cropping intensity again increases to 144 per cent from 143 per cent. At this level of credit availability, the HYV boro paddy acreage in the optimal plan is 0.726 acre and HYV potato occupies 0.192 acre. With the further increase of credit availability to Tk. 1100, the net revenue increases by Tk. 81 and cropping intensity increases from 144 per cent to 146 per cent. With the optimal borrowing level of Tk. 1152 the farm's net revenue rises to Tk. 8596 and the cropping intensity increases to 148 per cent and the acreage under HYV potato increases to 0.25 acre.

From the above analysis we find that the farmer's absorption power of credit with the crops and technology specified in the model is Tk. 288 per cultivated acre. The results of the sensitivity analysis
discussed above are also presented in graphical form. Figures 4.3 and 4.4 relate total net revenue product (TNRP) and marginal net revenue product (MNRP) to credit for a 4 acre farm on total farm and per acre basis respectively. At the Government's current planned level of credit of Tk. 250 per acre or Tk. 1000 for a 4 acre farm, it can be inferred from Figures 4.3 and 4.4 that the farmers may be prepared to pay an interest rate of about 100 per cent per annum. This high rate of interest more or less corresponds to the rate of interest charged by non-institutional money lenders. The results suggest that the rate of interest charged by the institutional agencies can be increased substantially from the current low level.
FIGURE 4.3
TOTAL AND MARGINAL NET REVENUE FOR 4 ACRE FARM
WITH DIFFERENT LEVELS OF CREDIT

Total Net Revenue (Tk)

Marginal Net Revenue (Tk)

Amount of Credit

100 200 300 400 500 600 700 800 900 1000 1100
FIGURE 4.4

PER ACRE TOTAL AND MARGINAL NET REVENUE WITH DIFFERENT LEVELS OF CREDIT

![Graph showing per acre total and marginal net revenue with different levels of credit.](image)
CHAPTER 5

PRODUCTION POSSIBILITIES AND RESOURCE USE WITH A NEW CROP

Addition of a New Crop - Watermelons

In this chapter an attempt will be made to examine the impact of introducing a new crop - watermelons - on resources uses, farm income, and credit requirements for the three farm sizes. In the original programming model we selected six traditional crops which are commonly grown by all the farmers, and three HYV crops, viz. HYV of "boro" paddy, HYV of wheat and HYV of potato which are being adopted by the farmers in the area gradually. During the field survey it was found that some enterprising farmers had taken up the cultivation of watermelons as a new crop in the area on an experimental basis.

From the cost and return analysis of watermelon it was observed that it could be a most promising and profitable crop for the area. Watermelon requires less water and more labour and grows in the period from the month of January to May during which most of the farmers' land and labour resources remain idle. Since watermelon is a food crop and its harvesting is done during the food shortage months of April and May it will have little marketing problems when its volume of production will increase. The area is connected with its district town and with the city of Dacca by railways and motor roads which will facilitate the marketing of watermelon to Dacca City and other regions of the country. So far, watermelon is grown only in some small areas of Chittagong and Comilla districts of Bangladesh. So when the volume
of production in the area increases it is not likely to face marketing problems. Moreover, all farmers in the area are unlikely to adopt watermelon cultivation at the initial stages. Therefore marketing of watermelons may not face any immediate problems. In view of this evidence it is felt desirable to examine the effect of diffusion of this crop in wider scale on resource uses, cropping pattern, cropping intensity, farm incomes and credit requirements.

Optimal Solutions with Watermelon as a New Crop - Without Credit Situation

The results obtained by incorporating watermelon as a new crop in our previous LP model have been presented in Tables 5.1 and 5.2. It can be observed from these tables that the 2 acre farm with its own financial resources cannot adopt watermelon cultivation. As such there is no impact on its cropping pattern, cropping intensity, resource use and net revenue as a result of the introduction of a new crop. But the optimal farm plans for the 4 and 6 acre farms, as indicated by the LP solution, have included watermelon even when there is no credit availability at all. This finding suggests that the introduction of a new technology (New Crop - Watermelons) involving higher financial outlay has bias against the very small farmers. At the initial stages of introduction of a new technology the very small farmers cannot derive the benefit due to their financial constraints whereas the relatively bigger farmers can take advantage of a new technology even without financial support from outside. In the case of the 4 acre farm, the number of crop activities included in the farm plan is 3 - pulses, transplanted aman paddy and watermelon. Brinjal and aus paddy have been
TABLE 5.1
OPTIMAL SOLUTIONS ON 2, 4 AND 6 ACRE FARMS WITH WATERMELONS -
WITHOUT CREDIT SITUATION

<table>
<thead>
<tr>
<th>Activity</th>
<th>2 Acre Farm</th>
<th>4 Acre Farm</th>
<th>6 Acre Farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulses</td>
<td>.060</td>
<td>96.00</td>
<td>Pulses</td>
</tr>
<tr>
<td>Transplanted Aman Paddy</td>
<td>1.857</td>
<td>3298.00</td>
<td>Transplanted Aman Paddy</td>
</tr>
<tr>
<td>Watermelons</td>
<td>0.1425</td>
<td>427.5</td>
<td>Watermelons</td>
</tr>
<tr>
<td>Hiring Activities</td>
<td>-4</td>
<td></td>
<td>Hiring Activities</td>
</tr>
<tr>
<td>Total</td>
<td>1.92</td>
<td>3390.00</td>
<td>4.1425</td>
</tr>
<tr>
<td>Cropping Intensity</td>
<td>96%</td>
<td></td>
<td>104%</td>
</tr>
<tr>
<td>Resources</td>
<td>Unit</td>
<td>Available Used</td>
<td>Shadow Price</td>
</tr>
<tr>
<td>-------------------</td>
<td>------</td>
<td>----------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Land November Land</td>
<td>2</td>
<td>1.9169</td>
<td>96%</td>
</tr>
<tr>
<td>December Land</td>
<td>2</td>
<td>1.9169</td>
<td>4</td>
</tr>
<tr>
<td>Jan-Feb Land</td>
<td>2</td>
<td>0.0597</td>
<td>4</td>
</tr>
<tr>
<td>March Land</td>
<td>2</td>
<td>0.0597</td>
<td>4</td>
</tr>
<tr>
<td>April Land</td>
<td>2</td>
<td>0.0597</td>
<td>4</td>
</tr>
<tr>
<td>May Land</td>
<td>2</td>
<td>0.0597</td>
<td>4</td>
</tr>
<tr>
<td>June Land</td>
<td>2</td>
<td>0.0597</td>
<td>4</td>
</tr>
<tr>
<td>July Land</td>
<td>2</td>
<td>1.8571</td>
<td>4</td>
</tr>
<tr>
<td>Aug-Oct Land</td>
<td>2</td>
<td>1.8571</td>
<td>4</td>
</tr>
<tr>
<td>Family Labour</td>
<td>Man</td>
<td></td>
<td></td>
</tr>
<tr>
<td>November F.L.</td>
<td>65</td>
<td>1</td>
<td>65</td>
</tr>
<tr>
<td>December F.L.</td>
<td>65</td>
<td>31</td>
<td>65</td>
</tr>
<tr>
<td>Jan-Feb F.L.</td>
<td>130</td>
<td>1</td>
<td>130</td>
</tr>
<tr>
<td>March F.L.</td>
<td>65</td>
<td>1</td>
<td>65</td>
</tr>
<tr>
<td>April F.L.</td>
<td>65</td>
<td>-</td>
<td>65</td>
</tr>
<tr>
<td>May F.L.</td>
<td>65</td>
<td>-</td>
<td>65</td>
</tr>
<tr>
<td>June F.L.</td>
<td>65</td>
<td>-</td>
<td>65</td>
</tr>
<tr>
<td>July F.L.</td>
<td>65</td>
<td>58</td>
<td>65</td>
</tr>
<tr>
<td>Aug-Oct F.L.</td>
<td>195</td>
<td>45</td>
<td>195</td>
</tr>
<tr>
<td>Bullock Labour</td>
<td>Bull-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>November B.L.</td>
<td>26</td>
<td>-</td>
<td>26</td>
</tr>
<tr>
<td>December B.L.</td>
<td>26</td>
<td>4</td>
<td>26</td>
</tr>
<tr>
<td>Jan-Feb B.L.</td>
<td>52</td>
<td>-</td>
<td>52</td>
</tr>
<tr>
<td>March B.L.</td>
<td>26</td>
<td>-</td>
<td>26</td>
</tr>
<tr>
<td>April B.L.</td>
<td>26</td>
<td>-</td>
<td>26</td>
</tr>
<tr>
<td>May B.L.</td>
<td>26</td>
<td>-</td>
<td>26</td>
</tr>
<tr>
<td>June B.L.</td>
<td>26</td>
<td>-</td>
<td>26</td>
</tr>
<tr>
<td>July B.L.</td>
<td>26</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Aug-Oct B.L.</td>
<td>78</td>
<td>2</td>
<td>78</td>
</tr>
<tr>
<td>Cash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potato Acreage</td>
<td>.115</td>
<td></td>
<td>.115</td>
</tr>
<tr>
<td>Onion Acreage</td>
<td>.07</td>
<td></td>
<td>.125</td>
</tr>
<tr>
<td>Brinjal Acreage</td>
<td>.07</td>
<td></td>
<td>.125</td>
</tr>
</tbody>
</table>

F.L. = Family Labour  
B.L. = Bullock Labour  

TABLE 5.2  
CROPPING INTENSITIES, RESOURCE USE AND SHADOW PRICES OF SCARCE RESOURCES ON 2, 4 AND 6 ACRE FARMS WITH WATERMELON WITHOUT CREDIT SITUATION
replaced by watermelon. For the 6 acre farm, the number of activities included in the new farm plan is four, but here the aus paddy and brinjal have been replaced by watermelons and oilseeds. The cropping intensities for the 4 acre and 6 acre farms have declined slightly from 110 per cent and 107 per cent to 104 per cent for both. But the net revenue for the 4 acre farm has increased to Tk. 6811 due to the inclusion of watermelon, from Tk. 5500 in the similar situation but without watermelon. Similarly, the net revenue of the 6 acre farm has also increased nominally from Tk. 8710 to Tk. 9224 as a result of the introduction of a new crop.

Resource Use and Shadow Prices

It can be observed from Table 5.2 that there is no significant change in the resource utilisation due to the incorporation of the new crop, watermelon, without any credit availability. As evident from the low cropping intensities for all three farms, most of the available land resources remain fallow except during the months of November and December. As land is fully utilised by the 4 acre and 6 acre farms during the month of November, the November land has got the shadow prices of Tk. 449 per acre which is much lower than that of the existing cost of renting-in an acre of land. Therefore, we find that there is no improvement in land utilisation due to the addition of a new crop.

The family labour utilisation with the inclusion of the new crop watermelon has remained the same as it was observed in Situation A without credit in Chapter 4. More than 70 per cent of the available family labour remains unutilised during the year when there is no credit
availability. The inclusion of watermelon without credit has no favourable impact on family labour utilisation. The available bullock labour of all three farms also mostly remains unutilised during all the periods except the months of November and July. Only during the month of July is the available bullock labour fully utilised, having shadow price of Tk. 23 per day for the 4 acre and 6 acre farms. The only resource which is fully utilised by all three farms is the cash availability of Tk. 500, for the 2 acre farm, Tk. 1100 for the 4 acre farm, and Tk. 1600 for the 6 acre farm for the whole year. The shadow price of cash for the 4 acre and 6 acre farms has increased to Tk. 4.14 from 3.92 in the previous situation due to the introduction of a new crop. This implies that availability of cash has become more binding constraint to raise productivity and farm income.

The above findings suggest that mere introduction of a new crop cannot bring about any significant improvement in the resource uses and farm income of the small farmers unless it is accompanied by adequate availability of credit.

Optimal Solutions with a New Crop - Watermelon - Optimal Credit Available

In the previous section, we analysed the impact of introducing a new crop on farms' incomes and resource uses without any credit availability. In this section we will analyse the results obtained from LP solutions by incorporating borrowing activity along with the new crop of watermelon. Tables 5.3 and 5.4 present the summary of the results obtained from the model solutions. It can be observed from Table 5.3 that the optimal borrowing, i.e. the credit absorption capacities of all three farms have remarkably increased due to the introduction of a new crop -
### TABLE 5.3

**OPTIMAL SOLUTIONS WITH A NEW CROP - WATERMELONS - OPTIMAL CREDIT SITUATION**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Level (Acres)</th>
<th>Optimal Borrowing (Tk.)</th>
<th>Net Revenue</th>
<th>Activity</th>
<th>Level (Acres)</th>
<th>Optimal Borrowing (Tk.)</th>
<th>Net Revenue</th>
<th>Activity</th>
<th>Level (Acres)</th>
<th>Optimal Borrowing (Tk.)</th>
<th>Net Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trans-</td>
<td>2</td>
<td>3552</td>
<td></td>
<td>Trans-</td>
<td>3.0645</td>
<td>5442.55</td>
<td></td>
<td>Potato</td>
<td>0.50</td>
<td></td>
<td>2187.50</td>
</tr>
<tr>
<td>planted</td>
<td></td>
<td></td>
<td></td>
<td>planted</td>
<td></td>
<td></td>
<td></td>
<td>Aus Paddy</td>
<td>0.50</td>
<td></td>
<td>500.00</td>
</tr>
<tr>
<td>Aman Paddy</td>
<td></td>
<td></td>
<td></td>
<td>Aman Paddy</td>
<td></td>
<td></td>
<td></td>
<td>Trans-</td>
<td>3.74</td>
<td></td>
<td>6645.79</td>
</tr>
<tr>
<td>Water-</td>
<td>2</td>
<td>6000</td>
<td></td>
<td>Water-</td>
<td>4.00</td>
<td>12000.00</td>
<td></td>
<td>Water-</td>
<td>5.50</td>
<td></td>
<td>16500.00</td>
</tr>
<tr>
<td>melons</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hiring</td>
<td>-1710</td>
<td></td>
<td></td>
<td>Hiring</td>
<td>-3826.55</td>
<td></td>
<td></td>
<td>Hiring</td>
<td>-5165.29</td>
<td></td>
<td></td>
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<tr>
<td>Total</td>
<td>4</td>
<td>1500</td>
<td>7842</td>
<td>7.065</td>
<td>3029</td>
<td>13616</td>
<td></td>
<td>10.24</td>
<td>4700</td>
<td>20.168</td>
<td></td>
</tr>
<tr>
<td>Cropping</td>
<td>200%</td>
<td></td>
<td></td>
<td>177%</td>
<td></td>
<td></td>
<td></td>
<td>170%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensity</td>
<td></td>
<td></td>
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</tbody>
</table>
TABLE 5.4
CROPPING INTENSITIES, RESOURCE USE AND SHADOW PRICES OF SCARCE RESOURCES ON 2, 4 AND 6 ACRE FARMS WITH WATERMELONS AND WITH OPTIMAL CREDIT

<table>
<thead>
<tr>
<th>Resources</th>
<th>Unit</th>
<th>2 Acre Farm</th>
<th>4 Acre Farm</th>
<th>6 Acre Farm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Avail-ability</td>
<td>Used</td>
<td>Shadow</td>
</tr>
<tr>
<td>Land</td>
<td>Acre</td>
<td>2 2</td>
<td>200%</td>
<td>4 3.0645</td>
</tr>
<tr>
<td>November Land</td>
<td>2 2</td>
<td>60%</td>
<td>4 3.0645</td>
<td>176%</td>
</tr>
<tr>
<td>December Land</td>
<td>2 2</td>
<td>180%</td>
<td>4 4.1781</td>
<td>166%</td>
</tr>
<tr>
<td>Jan-Feb Land</td>
<td>2 2</td>
<td>407%</td>
<td>4 4.407</td>
<td>6 4.60</td>
</tr>
<tr>
<td>March Land</td>
<td>2 2</td>
<td>1781</td>
<td>4 4.1781</td>
<td>6 4.1781</td>
</tr>
<tr>
<td>April Land</td>
<td>2 2</td>
<td>407</td>
<td>4 4.407</td>
<td>6 4.407</td>
</tr>
<tr>
<td>May Land</td>
<td>2 2</td>
<td>60</td>
<td>4 4.60</td>
<td></td>
</tr>
<tr>
<td>June Land</td>
<td>2 2</td>
<td>0.50</td>
<td>4 0.50</td>
<td></td>
</tr>
<tr>
<td>July Land</td>
<td>2 2</td>
<td>1038</td>
<td>4 3.0645</td>
<td>6 4.2419</td>
</tr>
<tr>
<td>Aug-Oct Land</td>
<td>2 2</td>
<td>3.0645</td>
<td>4 3.0645</td>
<td>6 3.7419</td>
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</tbody>
</table>

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F.L. = Family Labour
B.L. = Bullock Labour
L.H. = Labour Hiring
B.H. = Bullock Labour Hiring
watermelons. The optimal credit requirement for the 2 acre farm has increased from Tk. 950 to Tk. 1500 as a result of the inclusion of a new crop. Although the number of activities in the optimal farm plans has reduced from 4 to 2 including only transplanted aman paddy and watermelon, the cropping intensity has increased from 153 per cent in Situation B with borrowing but without watermelons to 200 per cent when there is borrowing along with watermelons. The net revenue of the 2 acre farm has also increased to Tk. 7842 from Tk. 4627. In the case of the 4 acre farm the optimal credit requirement has increased from Tk. 1152 to Tk. 3029, the cropping intensity has risen from 148 per cent to 177 per cent as a result of the inclusion of watermelon as a new crop. The net revenue has also increased from Tk. 8596 to Tk. 13 616. The optimal farm plan for the 4 acre farm also includes only two crops, viz. transplanted aman paddy and watermelon. In the case of the 6 acre farm, the optimal borrowing increases from Tk. 1802 to Tk. 4700, consequently the cropping intensity also rises from 147 per cent to 170 per cent and the net revenue increases from Tk. 12 852 to Tk. 20 168. The crop mix indicated by the optimal farm plan includes 4 crop activities where transplanted aman paddy and watermelon dominate in terms of acreage under them.

Resource Use and Shadow Prices

It can be observed from Table 5.4, that the introduction of a new crop with borrowing has brought about a substantial improvement in the resource utilisation of all three farms. In the case of the 2 acre farm, the available land has been fully utilised over the whole year
except during the month of June. January-February land, when watermelons are planted, has got the shadow price of Tk. 1781 per acre which is much higher than the existing cost involved in renting-in one acre of land for a year. For 2 acre farms the family labour utilisation has remained the same. Only 34 per cent of the available family labour has been utilised with optimal borrowing with a new crop. The available bullock labour also remains unutilised in the 2 acre farm except during the month of July when available bullock labour cannot meet the requirement and 2 bullock days have to be hired. The shadow price of July bullock labour per day is Tk. 31 which is much higher than the existing rate of Tk. 15. The higher shadow prices of land for the 2 acre farms during the months of January-February, April and July imply that land is the most binding constraint for the smaller farms to raise farm income.

Resource utilisation in the 4 and 6 acre farms has also increased to a great extent due to the availability of credit along with a new crop - watermelon. In the case of the 4 acre farm the available land is fully occupied by crops during five months due to the introduction of watermelon along with credit availability. The major portion of the available land resources is also utilised during the rest of the year except in the month of June when the entire 4 acres remains fallow. Family labour utilisation has also increased from 45 per cent to 56 per cent as a result of the introduction of watermelons. It is to be noted that the 4 acre farm has to hire labour during the peak month of July when the available family labour is quite inadequate to meet the requirements. The shadow price of July labour is Tk. 33, which is much higher than that of the prevailing wage rate of Tk. 8
per day. The utilisation of family labour has also increased to a greater extent in the case of the 6 acre farm. In the 6 acre farm 63 per cent of the total available family labour is utilised and 42 labour days are hired during the months of May and July.

These findings suggest that credit, along with a location-specific new potential crop, can bring about a significant breakthrough in the traditional agriculture.
CHAPTER 6
SUMMARY AND CONCLUSIONS

The main objective of the study was to empirically assess the role of agricultural credit in the rural development oriented strategy of economic development in Bangladesh. The Government of Bangladesh has committed itself to initiate an economic development process encompassing all aspects of rural life with topmost priority being given to agricultural development to achieve the twin objectives of food self-sufficiency and the creation of adequate employment opportunities through direct involvement of the rural peasantry, especially the small farmers. Since agricultural credit policy is an important instrument in this strategy, an attempt was made in this study to investigate the short term production credit needs of the small farmers and the impact of credit on cropping pattern, cropping intensity, farm income and resource utilisation.

This sort of study warrants a well thought out intensive field survey for collection of adequate and accurate data and information regarding farm management, crop production and farm assets. Due to the limitation of time and other constraints, the study had to be carried out with the inadequate data from a field survey conducted by the author along with his colleagues of the Agricultural Credit Department of the Bangladesh Bank, to prepare an Area Development Project in a "Barind" area of Rajshahi district of Bangladesh. Further necessary information was collected through correspondence with the relevant institutions and agricultural experts of Bangladesh. From the
report of the field survey which covered about 100 farms of different size groups, three typical small farms of 2, 4 and 6 acres holding were selected for this study. From the input/output coefficients of crop production of these farms, a linear programming model was developed and used to assess the credit requirements and to predict the impact of credit on cropping pattern, cropping intensity, farm income and labour utilisation. A sensitivity analysis was attempted for the 4 acre farm which approximates the average farm size of the area, by parametrically varying the credit availability from Tk. 100 to the optimum amount of utilisation to show the impact of different levels of credit availability. A further analysis was made by introducing a new crop, namely watermelons, in the model without credit and with credit availability to show the impact of a new crop on production possibilities and resource uses.

The study revealed that the paucity of working capital, i.e. cash was the most binding constraint to exploiting the available resources for crop production by the small farmers. The adequate flow of institutional credit could contribute substantially to raising cropping intensities and to bringing about changes in the crop mixes of the farms in favour of the adoption of high value HYV crops.

The study revealed that the credit requirement per acre for the relatively smaller farms is much higher than that of the relatively larger farms. The 2 acre farm could optimally utilise a credit amount of Tk. 475 per acre while the per acre credit need for the 4 acre farm was Tk. 288 and for the 6 acre farm it was Tk. 300. It was found in the study that the increased availability of credit
is the precondition for the adoption of HYV crops by the small farmers in the area. From the sensitivity analysis it was observed that the HYV of "boro" paddy appeared in the optimal farm plan with the credit availability of Tk. 400 and upwards in the case of the 4 acre farm. The share of acreages under HYV crops in the farm plan increased with the increased availability of credit and reached their maximum at the optimal borrowing level.

The study also revealed that the new technology has bias against the very small farmers. New technology involving higher financial outlay cannot benefit the smallest group of farmers because of their financial and other constraints to adopt it. Therefore, there is a need for search for an appropriate new technology which will be neutral to scale. Alternatively, special treatment should be provided for the very small farmers when recommending a new technology which is not fully neutral to scale and which requires higher financial outlay than the existing technology.

Although the study revealed that the adequate availability of credit had positive effects on both family labour use and also on labour hiring during peak periods, yet more than 50 per cent of the available family labour of all three farms considered in the study remained unused throughout the whole year, even at the optimal levels of credit availability. So it follows that provision of credit merely for crop production is only a partial solution to the need for improvement in the rural employment situation.

This study showed that with the existing cropping system and practices the cropping intensity and farm income could not be
increased to a desired extent unless some new crops of short duration, adaptable to the agro-climatic and soil conditions of the area, could be developed for cultivation during the period when both land and human labour remain idle. It was observed that the introduction of watermelon, along with adequate credit availability, could provide a potential scope for raising remarkably the cropping intensity, farm income and the extent of resource utilisation.

Risk and uncertainty attendant with different types of crops in different degrees could not be incorporated in the model although they influence greatly the farmers' behaviour and decisions. Moreover, the area under study with its special features and the small size of the sampling cannot be considered as representative of the whole of Bangladesh, nor even the district as a whole. As such it would not be appropriate to derive any policy implications out of the findings of the study for the country as a whole. However, from the analysis carried out in the study, the following policy implications emerge:

1. The study has shown that production credit is the key factor in raising cropping intensity and farm income and the credit requirement per acre is much higher than that of the per acre credit ceiling of Tk. 250 fixed for the institutional credit agencies in the 1,000 million Taka credit programme. It is therefore suggested that per acre credit limit should be enhanced differently for different regions based on realistic area-wise assessment of credit requirements instead of a uniform one.
(2) Since the relatively smaller farms' per acre credit requirement is higher than that of medium farms, the credit limit may be fixed in accordance with the size of holding favouring the smaller farms.

(3) The institutional credit agencies may take up area studies using budgeting and programming techniques where feasible to provide profitable rational farm plans along with credit, for productive and efficient allocation of farm resources by the farmers.

(4) The study revealed that farm credit for crop activities has a limited role in creating additional employment opportunities for the surplus family labourers of the small farms. So, a comprehensive rural credit programme of term financing to exploit the alternative investment opportunities in agricultural allied activities, like poultry, duckery, cattle raising, pond fishery, small trading of farm products, and for non-farm activities like small scale and cottage industries, should be evolved to ameliorate the poor economic conditions of the small farmers.

The rate of return on investment of additional working capital is much higher than that of the prevailing subsidised rate of interest of the institutional credit agencies.
There is a great demand for institutional credit in the rural areas. But the credit agencies cannot deliver adequate credit at the existing low rate of interest which just covers the administrative and supervision costs involved in agricultural credit programme, but does not provide any reasonable margin to procure funds and deposits to increase the volume of their loanable funds. As a result, the small farmers have to borrow from the money lenders at an exorbitant rate of interest due to the non-availability or inadequate availability of institutional credit. At the currently planned level of Tk. 250 per acre, the farmers may be willing to pay an interest rate of 100 per cent per annum provided adequate supplies of improved seeds, fertilizers, pesticides and irrigation water are available to them. In order to enable the credit institutions to procure more loanable funds through deposit mobilisation, the present low rate of interest of the credit agencies should be suitably enhanced so that the volume of agricultural credit supply can be increased to meet the increasing demand and thus to check the exploitation of the money lenders.

The agricultural credit programme in Bangladesh suffers very badly due to the huge overdue loans and loan default problems of credit institutions whereas this study indicated a higher return on credit utilisation by the farmers. An empirical study to investigate objectively the causes of low repayment, loan default and to identify the delinquents and the reasons for non-repayment is vital. The study should also examine the supply of inputs. It may be that the required inputs like improved seeds, fertilizers, pesticides and irrigation water are not available to the farmers in adequate quantities and at the right time and place, and as a result the credit secured for those purposes may be diverted to non-productive purposes.
The existing institutional rural credit structures in the country generally favour the large farmers by-passing the genuine credit needs of the small farmers. But there are no broad-based studies to indicate the relative share of the distribution of institutional credit among the different size groups of farmers. Therefore a comprehensive survey or study is needed to find out the relative share of institutional credit among different groups of farmers and to investigate the causes of the failure of the existing credit institutions to reach the small farmers.

There is a need for a more detailed investigation as to the credit requirement, its impact on farm income, capital formation, using dynamic programming with more accurate and adequate data from a comprehensive survey.

To exploit the double and triple cropping potentials, area specific agronomic research is essential to develop some short duration "Rabi" crops and for shortening the growing season of transplanted "aman" paddy. Zonal and area-wise studies should also be conducted to identify the alternative investment opportunities for term financing by the credit agencies. The model developed in the present study could not explain the position of the very small farms regarding the resource use and credit requirements and its impact on farm income and cropping intensity adequately. As such, a separate study is needed exclusively for the smallest group of farmers with adequate data and relevant information for specific credit recommendations for this category of farmers.


43. _______ (1973). Statistical Digest of Bangladesh, No. 9, Dacca.


56. __________. Some Aspects of Rural Capital Formation in East Pakistan, Bureau of Economic Research, Dacca University, Dacca.


67. Letter from Mr L. Rahman, Bangladesh Agricultural University, Mymensing, April 1977.

68. Letter from Mr A. Aziz Khan, Deputy Director, BARD, Comilla, 10 May 1977.


95. _______ (1977), 11 January.


100. _______ (1974). Agricultural Credit Situation in Bangladesh, Dacca.


## APPENDIX A

### INPUT-OUTPUT MATRIX

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