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WHEAT PRODUCTION IN BANGLADESH

–SOCIO-ECONOMIC ASSESSMENT OF IMPROVED TECHNOLOGY AND IDENTIFICATION OF CONSTRAINTS TO HIGHER PRODUCTION

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- Socio-Economic Assessment of Improved Technology and Identification of Constraints it Higher Production

FINAL REPORT

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F O R E W O R D

During last decade the dramatic increase of wheat area and production has created hope to minimize food problem in Bangladesh. But the beginning of eighty's showed slow down of such rapid growth which created awareness amongst researchers and policy makers to findout the reasons thereof. The present report is expected to answer many of the quaries ralating to social and economic constraints to higher production of wheat. This report may also highlight the nature of farmers acceptance of improved technology on wheat production and its profitability. Such findings will surely help the policy makers and researchers to generate new thinking, develop appropriate technology and production procedure for large scale expansion of wheat in Bangladesh.

The researchers of the Division of Agricultural Economics and others who took part in this study deserve appreciation for their sincere effort. Financial support received from Bangladesh Agricultural Research Council is gratefully acknowledged.

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P R E F A C E

A research study entitled "Socio-Economic Assessment of Improved Wheat Technology and Identification of Constraints to its Higher Production at Farm Level" was undertaken by the Division of Agricultural Economics, BARI, in 1980-81. The study continued for three years and was completed in 1982-83. The present one is the final report of the study. The existing wheat cultivation practices, its profitability and farmers' intention towards future wheat production have been illuminated in the study. An attempt was made to asess the farmers practices compared to the recommended one and identify the constraints to its higher productivity.

The financial support for this study was provided by IDA credit through Bangladesh Agricultural Research Council which is gratefully acknowledged. Special gratitude is extended to Dr. Ekramul Ahsan, Member Director, Bangladesh Agricultural Research Council for his keen interest and encouragement to carry out the study successfully.

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Messrs S.C. Barman and S.R. Bhuiyan, Scientific Officer, Division of Agricultural Economics, were involved in the study during first year and helped in collection and analysis of data. Mr. Rafiqul Islam helped in processing farm data. Messrs Shaheen Akhtar, Ahsan Habib, Abdur Rahim, Shamsuzzaman, and Mesbahuddin collected data from the selected farmers during the survey years. Credit goes to Mr. Khurshed Alam and Mostafa Khan for neatly typing the report.

Special recognition is due to the selected farmers for their whole-hearted cooperation, without which it would not be possible to undertake such study.

Authors

SUMMARY

Agro-economic survey data on wheat production in 1980-81, 1981-82 and 1982-83 winter seasons were collected from 100 farmers each of four Upazila namely Shailkupa, Daudkandi, Modhupur and Thakurgaon in Jessore, Comilla, Tangail and Dinajpur districts respectively where wheat cultivation has been extended rapidly. The major objectives of the study were to know the existing practices of improved technology in wheat followed by the farmers, its profitability and to identify constraints to its higher production.

Number of ploughings, ladderings and time of each operation vary greatly among the farmers and locations. In Modhupur and Shailkupa the land preparation started from last week of September and first week of October as most of the farmers did not have any crop in the field during monsoon. Majority farmers in Daudkandi and Thakurgaon started land preparation after the middle of November mainly due to delay in harvest of previous amon crop. Bullocks was found to be main source of draft power for land preparation.

It was observed that about 86% of the sampled farmers used Sonalika variety seeds while the other varities like Pavon, Balaka and Tanori were not uncommon. On the average 134 kg per hectare of seed was used. The seed rate was observed lowest in Shailkupa (120 kg/ha) and highest in Daudkandi (146 kg/ha). Among the different farm size groups, highest seed rate was used by the small farm size group (138 kg/ha) compared to medium (133 kg/ha) and large (129 kg/ha) farm size groups. It was also found that the average seed rate was reduced gradually during last 3 years, the main reason for which was apprehended a scarcity and there of high price of seeds during last two years. BADC (41% of farmers) and self (37% farmers) were the major source of seed.

The farmers used both organic manures and chemical fertilizers in their wheat plots. The average quantity of organic manures of all the farmers was found 5448 kg per hectare. The average dose of fertilizer per hectare was observed to be 127 kg of urea, 129 kg of TSP and 33 kg of MP. The small farmers used more fertilizer than medium or large farmers. Daudkandi farmers used highest amount of fertilizer and Shailkupa farmers used lowest amount.

On the average of all the location and all the 3 years, it was observed that only 43% of all farmers irrigated their wheat plots. In Daudkandi all farmers and in Shailkupa 77% farmers did not apply any irrigation water. However, in Modhupur all farmers and in Thakurgaon 48% farmers applied irrigation water. In Modhupur 63% farmers irrigated wheat field thrice on standing crop and another 15% farmers irrigated four times but in Thakurgaon most of the farmers irrigated only for twice. Deep tubewell and shallow tubewell were found major source of irrigation water.

Weeding of the wheat plot was done by 47% of the total farmers. Ninety seven percent farmers in Thakurgaon and 69% farmers in Modhupur did not weeded their plot at all. In Daudkandi and Shailkupa, however, 95% and 59% farmers respectively weeded their wheat plot. Those who weeded their field, did it mostly for once only. Crop damages due to disease and insect pests were not common. It was found that only 13% of the total farmers received loan for wheat production. Harvesting started from the last week of February and continued upto the third week of April. But more than seventy five percent of the plots were harvested during the period from middle of March to middle of April and average duration of the crop in the field was 111 days.

The average number of human labour days required for wheat production was 129 mandays per hectare and out of these, 74% was supplied from farmers own family and rest 26% was supplied by hired casual labour. On the average, about 31% of the total labour was required for land preparation, 24% for harvesting and carrying, 23% for threshing and drying and 15% for weeding. Average labour required in Shailkupa was about 72 mandays per hectare, while it was as high as 174 mandays in Daudkandi. Labour requirement in Daudkandi was higher due to higher use of labour in weeding, harvesting and threshing. It was also observed that the small farm size group required about 139 mandays per hectare compared to about 122 mandays by medium farmers and large farmers. This was mainly due to intensive weeding done by the small farmers and they used more number of family labours than medium or large farmers. Draft animal was used for land preparation and threshing of wheat and on the average 36.7 animal pair days per hectare was required for above two operations.

The average yield of wheat in the sample plots was estimated to be 1636 kg/ha. The average yield was found higher in Daudkandi and lower in Shailkupa. Higher yield was obtained in the year 1982-83 compared to the previous years due to favourable weather. Small farmers were found to produce more yield compared to medium and large farmers.

Yield performance due to variation in number of ploughing, seed rate, fertilizer and other practices varied greatly among the farmers and locations. Higher yield was received by those farmers who performed 3-4 ploughings and 5-6 ladderings on their plots. On the average, slightly higher yield was obtained in the plots where seed rate was in the range of 161-175 kg per hectare. It was also observed that BADC supplied seed was found to produce lowest yield (1497 kg/ha) compared to own produced seed (1833 kg/ha).

Sonalika varity of wheat yielded 1626 kg per hectare and covered 88% wheat area whereas Balaka yielded 1818 kg/ha but covered only 3% wheat area.

Highest wheat yield was received by the group of farmers using organic manure in the range of 6000-9000 kg per hectare, Urea in the range of 101-150 kg per hectare, TSP in the range of 201-250 kg per hectare and MP in the range of 91-120 kg per hectare. On the average, the highest average yield (1759 kg/ha) was received by those who performed only one weeding on their plots. Among the irrigated farmers, average highest yield (2009 kg/ha) was obtained by the group of farmers was irrigated their plots twice. Multiple linear regression analysis showed that the yield was significantly related to human labour, animal power, quantity of Urea and MP used.

The average cost of wheat cultivation was found to be Tk. 4526 per hectare when all variable costs were included and Tk. 2158 per hectare when only cash costs were considered. The cost was higher in 1982-83 compared to 1980-81 and 1981-82 which was mainly due to the higher cost of seeds, fertilizers and irrigation. About 32% of the total variable cost was due to human labour, 26% was due to cost of manures and fertilizers, 16% was due to animal power and 15% was due to cost of seed. Highest cost was found in Daudkandi which was Tk. 5391 per hectare and lowest was found in Shailkupa (Tk. 3341/ha).

Higher cost in Daudkandi was due to the higher cost of labour, draft power and chamical fertilizers. However, when only cash costs were considered the cost per hectare was found higher in Modhupur (Tk. 3081/ha) and lower in Shailkupa (Tk. 1221/ha). Higher cash cost in Modhupur was mainly due to the cost of irrigation. Among the different farm size groups, it was observed that the total variable costs as well as cash costs were highest

for small farm size group than other farm size groups. Intensive use of human labour, high cost of draft animal and more use of chemical fertilizers were major reasons for higher cost to the small farmers.

The average gross return was Tk. 6507 per hectare. Gross margin was Tk. 1981 on full cost basis and Tk. 4349 on cash cost basis per hectare. Gross return was highest in 1982-83 (Tk.7822/ha) due to higher yield. Gross margin per day per hectare was found highest in 1982-83 which was Tk. 48.91 on cash cost basis and Tk. 26.74 on full cost basis. The average bebefit cost ratio was found 3.02 on cash cost basis and only 1.44 on full cost basis. Return analysis for different farm size groups showed that the yield and gross return was higher for small farm size group, but due to higher cost of production, gross margin was lower for this group. For the same reason, benefit cost ratio for small farm size group was also lower than medium or large farm size groups.

On the average, about 41% of the total wheat grain produced was consumed by the farmer and his family, 36% was sold immediately after harvest, 10% was sold during off season and 12% was kept for seed purpose. This disposal pattern was found different in different locations and for different farm size groups. In Shailkupa, where production was lower, the share of the total production consumed by the farmer and his family was about 70% while in Modhupur, where market was assured, the share of the total production sold immediately after harvest was about 48%. It was also found that about 50% of the total production of a small farmer was consumed by the farmer and his family while he could sale only 38% of the production. On the other land, large farmer and his family consumed about 34% of the total production and sold about 55% of it.

The price prevailed immediately after harvesting (Tk. 3.19/kg) was found lower than the price prevailed during off season (Tk. 4.06/kg). It was observed that there was a gradual increase in the price from 1980-81 to 1982-83. Average harvest price received by the farmers was found higher in Shailkupa and Modhupur while it was lower in Daudkandi and Thakurgaon.

According to the opinion of the farmer, it was observed that 87% of the total farmers were willing to increase the area or at least keep the area under wheat same in the next season. High yield, more income and home consumption were the major reasons for such decision. Comparison of actual and intended wheat area for different farm size groups show that deviation from intention was more prominant among large farmers than small or medium farmers which means small farmers are more stable and rational in making decisions.

Better yield performance of Balaka variety and its tolerance to draught proved its potentiality for acceptance by the farmers. Average yield of Sanalika variety under farmers' own managemet was found lower than the 'On farm' experimental yield. However, about 22% of the total non-irrigated plots and 4% of the irrigated plots were found to produce yield more than the corresponding 'On farm' experimental yield. Although the average seed rate applied by the farmers was less than the optimum result obtained under 'On farm' experiment, 47% of the non irrigated plots and 22% of the irrigated plots were found to apply seeds more than the quantity applied for optimum results obtained under 'On farm' experiment.

Only 34% of the total farmers planted seeds within the optimum recommended time. Due to delay in amon harvest, majority farmers planted seeds in December and January. The average quantity of chemical fertilizer applied by the farmers was much below the recommeded dose. In TSP, many farmers fairly follow the recommendations while in Urea and MP, most of them were much below the recommended level. However, in non-irrigated plots many farmers applied fertilizer more than the recommendations, but in irrigated plots this number was much less. The use of fertilizer was found to be influenced by the location.

First irrigation at the critical root initiation stage, which was recommended, was followed only by about 37% of the irrigated farmers. About 40% of the irrigated plots were applied water for thrice. Another 38% irrigated plots were irrigated for twice only.

Small farmers were found to cultivate more share (25%) of their land to wheat compared to only 19% of the cultivated land by medium farmers and 15% by the large farmers.

A number of constraints to higher production of wheat was identified. One important constraint was the difficulties in fitting wheat in the cropping system particularly after the amon rice and before aus rice. Coincidance of planting and harvesting time of wheat and rice created problems to wheat yield and resulted in artificial creation of labour peak.

Insufficient supply of institutional source of seed also acted as one constraint to wheat expansion. Scarcity of human labour at the weeding time, due to the alternative employment opportunities in other crops and development works, shortage of draft animal, and predominance of one single variety Sonalika were found other major constraints to wheat production. Similarly higher input price compared to the output price, lack of credit and lack of sufficient knowledge about the new technology were found to act against increasing wheat production. Scanty and undependable rainfall was another important problem for wheat production.

A set of recommendations has been formulated in the report. Important ones are development of short duration, draught tolerant variety which can be fitted to rice based cropping patterns without yield reduction. Ensured supply of seeds, storage of own seeds and minimum tillage were also recommended. Floor price of wheat was recommended to fix in consideration with its cost of production, price of related products etc. 'On farm' multidisciplinary research needs to be strengthened. Marketing research should get priority to ensure fair price to the farmers and proper distribution of the products.

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CHAPTER I

INTRODUCTION

1.1. Importance of the study

To meet the chronic deficit of about 1.5 millions tons of food grain per year, Bangladesh has to import rice and wheat every year to a large extent. Wheat has by now accounts for about 15 to 20 percent of all cereals when imports are taken into consideration. Moreover, rice production is supplemented by wheat production. Rapid expansion of wheat area and production in the last decade has created hope to solve food problems within a short period of time. As the figure 1 shows, the area, production and yield rate of wheat have been increasing dramatically during last decade. The production of wheat increased during the period at an average rate of 26% per year (Table 1). Of this, 17% was contributed by area expansion, while the rest 9% by yield increase. This can be compared to the rate of change in the preliberation wheat production. Annual average rate of change of wheat production during 1947-48 to 1970-71 was found 6.7% which was contributed 4.9% by area and 1.8% by the yield (Table 1). By now, wheat has acquired about 6% of the net cropped area.

The rapid growth of wheat can be attributed to a variety of factors including research, extension, effective seed supply and government intervention in pricing. However, very recently the area and yield of wheat have not increased faster than before rather it showed a declining trend. This is not only due to the fact that high yielding variety (HYV) has replaced most of the local variety area and that the scope of horizontal expansion is gradually diminishing, but there are many other factors which have caused to slow down the expansion of wheat. It is now necessary to find out the causes of such decline in the acreage of wheat and also to assess the technology of wheat which the farmers adopted.

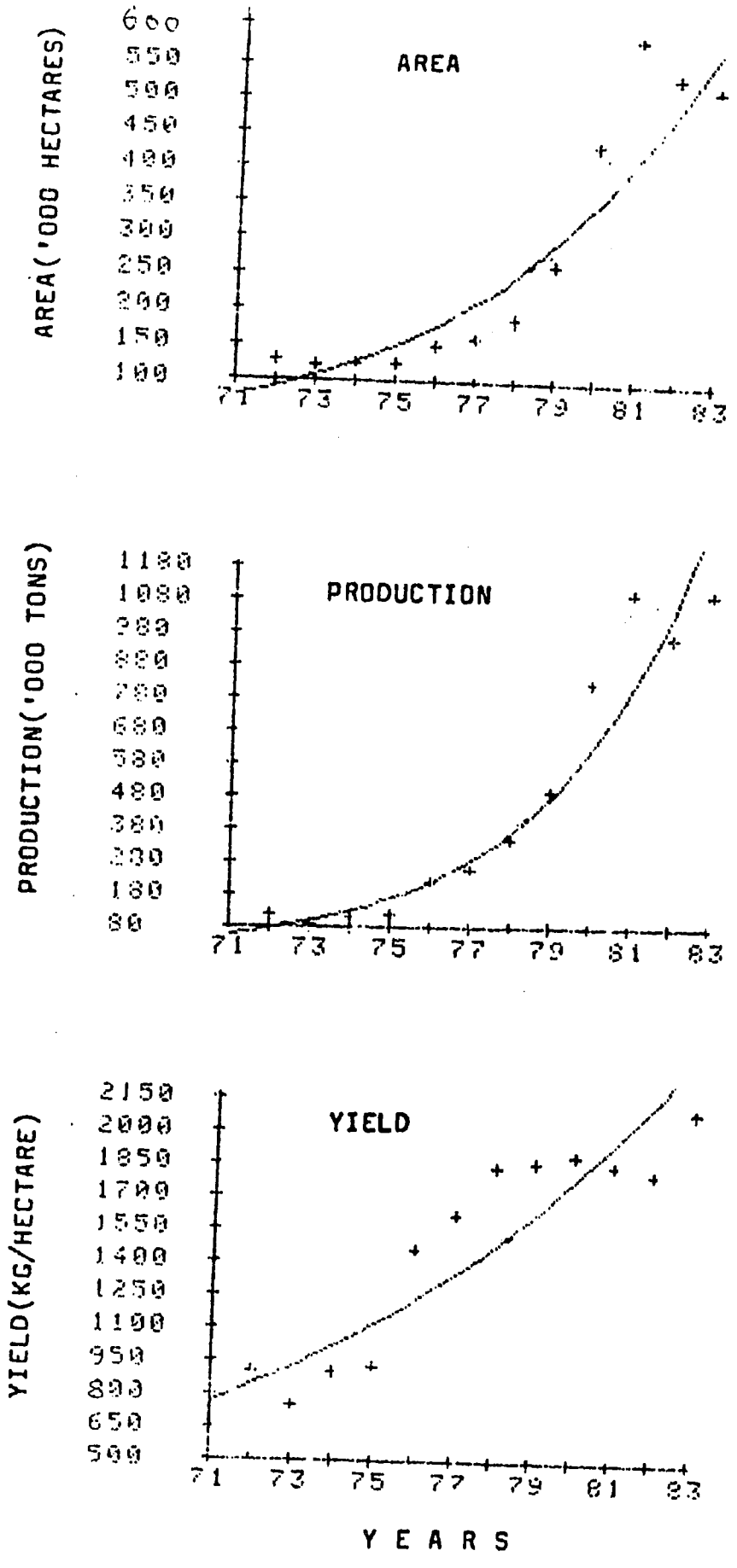

FIGURE 1 : EXPONENTIAL CURVES SHOWING AREA, PRODUCTION AND YIELD OF WHEAT IN BANGLADESH.

Table 1. Average annual rates of change of area, production and yield of wheat [1/]

Measure	Annual rate of change (percent)	
	1947-48 to 1970-71	1971-72 to 1982-83
Area	4.9	16.8
Production	6.7	26.1
Yield	1.8	9.3

[1/] The annual growth rate (g) is estimated by fitting the exponential equation :

$$Y = ae^{bx} \text{ where } g = 100 (b)$$

The equation for the period 1971-72 to 1982-83 was;

Area = 0.526 Exp (0.168x), R^2 = 0.880
Production= 0.001 Exp (0.261x), R^2 = 0.945
Yield = 1.021 Exp (0.093x), R^2 = 0.818

The equation for the period 1947-48 to 1970-71 was;

Area = 2.919 Exp (0.049x), R^2 = 0.800
Production= 0.623 Exp (0.067x), R^2 = 0.802
Yield =213.638 Exp (0.018x), R^2 = 0.540

1.2. Objectives of the study

The present study was an attempt to assess the technology of wheat from social and economic point of view and also to identify constraints to its higher production. Specifically, the present study was under taken to fulfil the following objectives :-

1. To know the ownership and utilization pattern of available resources under the possession of wheat farmers;
2. To identify the existing agronomic practices followed in wheat production by different size of farm holdings;
3. To analyze and interpret the factors responsible for change in wheat production;
4. To estimate the costs of and return from wheat cultivation;
5. To know the disposal pattern of wheat produces and farmers' intentions towards growing wheat;
6. To assess the improved technology of wheat in the context of farmers resource position;
7. To identify constraints to the higher production of wheat;
8. To suggest future research and policy guidelines for sustaining wheat production.

1.3. Design of the study

Four Upazilas namely Shailkupa, Daudkandi, Modhupur and Thakurgaon in Jessore, Comilla, Tangail and Dinajpur districts respectively, where wheat cultivation has been extended rapidly, were selected for the study (Figure 2). The areas have been selected so as to represent the major agro-ecological zone of Bangladesh and also where farmers are growing wheat in more than 6% of the net sown area of the district.

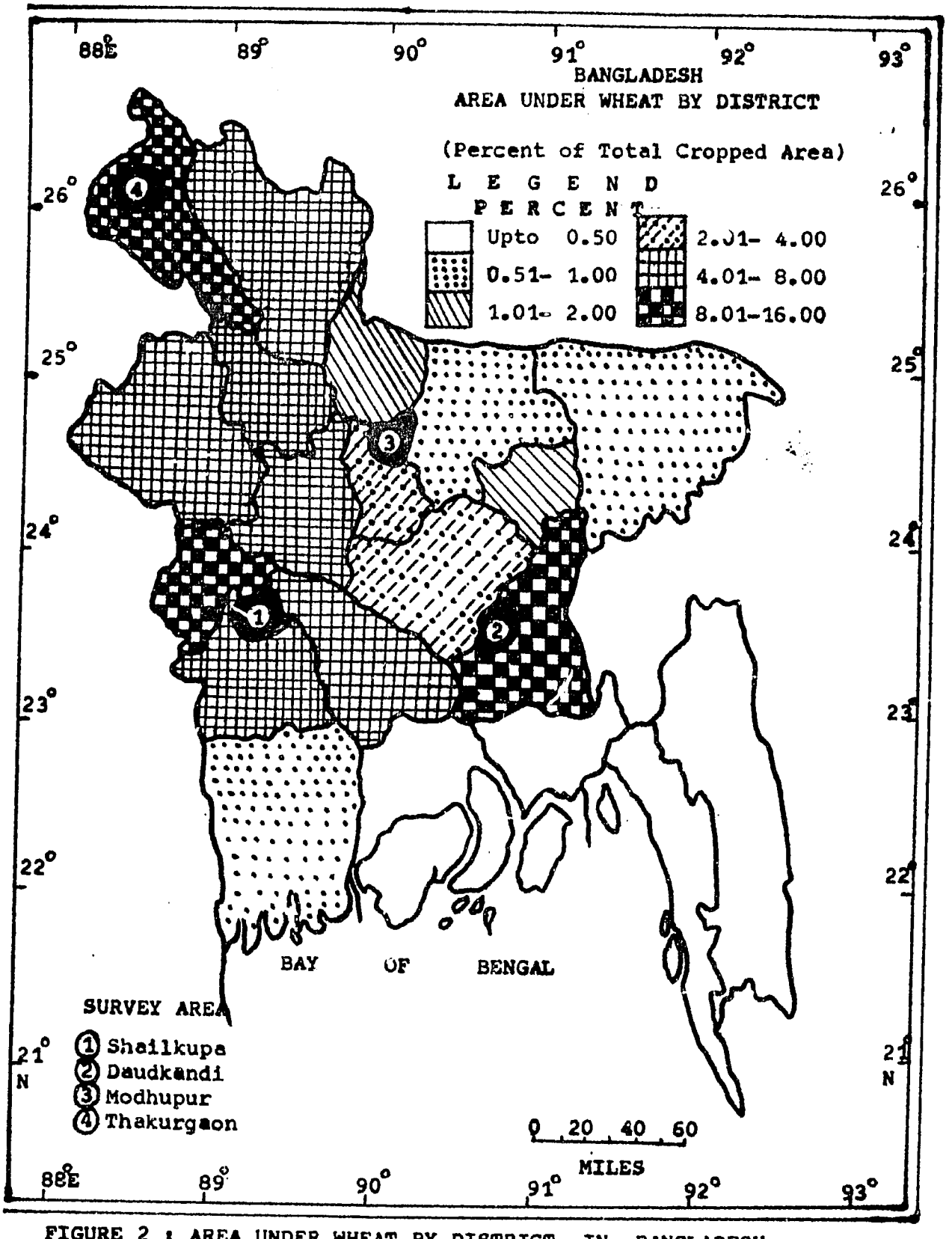

FIGURE 2 : AREA UNDER WHEAT BY DISTRICT IN BANGLADESH, (AVERAGE OF 1980-81, 1981-82 and 1982-83).

One union in each of the above upazilas were selected purposively where concentration of wheat cultivation was observed. A list of all wheat growers in each locality for the winter season of 1980-81 was collected. A sample of one hundred farmers were selected from the list at random from each location. All the selected farmers were grouped into three different groups according to the size of land holdings. Small farmers were those having land below or equal to one hectare and large farmers were having land more than two hectares. Medium farmers were those having lands between one and two hectares.

The unit of analysis chosen was one single plot of wheat of each farmer, the area of which was not less than 0.04 ha of land and from where detailed informations of the characteristics of the plot and agronomic practices followed on the plot for wheat cultivation were collected. Farmers background information including his resource position, disposal of wheat produces, intentions towards wheat cultivation and constraints to higher wheat production were also recorded with the help of a predesigned questionnaire. To collect accurate and reliable data, enumerators visited each plot and interviewed the farmers several times during the crop season.

The study period started in 1980-81 and continued for three years upto 1982-83. Same farmers were interviewed for all the three wheat seasons to alleviate any effect of particular year. In the subsequent years, if any farmer was found not to grow wheat, the causes for such behaviour were recorded and he was replaced by another farmers of the same holding group in the locality.

Due to limitations of facilities and resources, the analysis employed were relatively simple and relied heavily on tabular analysis using averages, ratios, percentages etc. Multiple linear regression equation was fitted with seven important independent variables in minicomputor HP-85 to observe the resource use efficiency of the farmer. Statistical tests like X^2 was applied

wherever necessary to verify the validity of conclusions drawn from the analysis.

1.4. Wheat cultivation in the survey districts

The four districts, Jessore, Comilla, Tangail and Dinajpur together cover about 37% of the total wheat area and produce about 34% of the total wheat production in Bangladesh.

Jessore district is situated in the western part of Bangladesh and accounts for about 6% of the nations wheat production. About 9% of its net sown area is under wheat cultivation, which is higher than national average (Table 2). The study area, which is about 240 kilometers west of Dhaka, lies within the ganges - kobadak irrigation project and the topography is relatively smooth. Soils are dark greyish brown loamy to clay soils with the clay soil predominating in the study area. The P^H of the soil is 7.0. In dry season, land preparation is difficult without irrigation. Irrigation is by canal lining method which is maintained by Bangladesh Water Development Board (BWDB). Irrigation water scheduling is mostly for rice cultivation for which farmers usually produce wheat without irrigation.

Comilla district is situated in the eastern part of Bangladesh and accounts for about 11% of the nation's total wheat production. About 14% of the net sown area of the district is devoted to wheat production. The study area, which is about 60 km east of Dhaka city is characterized by low to medium low land lying within the middle Meghna Flood Plain. Every year flood water enters the study area and wheat is cultivated after the flood water recedes. The soils are predominantly grey sandy or loamy soils of the Fuldi series making dry season ploughing easy. The P^H of the soil is 6.7. Farmers in the area grow wheat without any irrigation water.

Table 2 : Wheat production in survey districts compared to national statistics (Average of 1980-83).

Indicators	Jessore	Comilla	Tangail	Dinajpur	Bangladesh
Wheat area (hectare)	42065	72805	18890	71029	548238
Wheat production (Matric ton)	66438	117622	38762	130812	1051707
Yield (kg/hectare)	1579	1616	2052	1842	1918
Wheat area as proportion to net sown area (%)	8.50	14.20	7.59	14.54	6.43
Wheat area as proportion to total cropped area (%)	5.79	8.33	3.92	9.91	4.18

Source : Bangladesh Bureau of Statistics.

Tangail district is situated in the central north of Bangladesh and produces about 4% of the nations' total wheat production. This district is relatively new comer to wheat production. About 8% of its net sown area is devoted to wheat production. The study area, which is about 145 km north of Dhaka city, is characterized by red Modhupur tract soil. The topography of the land is terraced and rolling with clay to clay loamy soils. Most of the lands are above flood level and are well drained, groundwater table is high and deep tubewell irrigation is widespread. The clay soil in the winter make the land preparation extremely difficult without irrigation. The P^H of the soil is 7.1. Farmers in the study area produce wheat mostly under irrigated condition.

Dinajpur district is situated in the northwest part of Bangladesh. It alone accounts for about 13% of the nations total wheat production and is one of the oldest wheat growing areas. About 15% of net sown area of the district is devoted to wheat cultivation. The land is physiographically classified as old Himalayan piedmont plain. Soils are mainly sandy loam and friable marking dry season ploughing relatively easy. Ground-water table is high and the area is covered by deep tubewell irrigation. The study area, which is about 435 km north west of Dhaka city enjoy the facility of electrically operated deep tubewell irrigation, the management of which lie with BWDB. During the period of December to May, a cool dry east monsoon blows from central Asia bringing, initially the low temperature and humidity and later on, conventional storm. Mean minimum temperature in winter falls below $50^{o}F$. The P^{H} of the soil is 6.5.

1.5. Design of the report

The present one is the final report of the study which documented the findings of the study. Second chapter of this report deals with the background information of the wheat growers regarding their family size, size of holding, resource use position and cropping intensity. Third chapter deals with the wheat area of the farmers and characteristics of the survey plot. Agronomic practices with date of each operation and input use have been presented in fourth chapter. Chapter V presents the yield of wheat and related factors affecting its yield. Costs, returns and various economic measures have been shown in Chapter VI. In the next chapter, utilization and disposal pattern of wheat produces of each farmer with its seasonal price variation and farmers' intention towards producing wheat in future have been presented. In chapter VIII conclusions have been drawn with regard to assessment of wheat technology and identification of constraints to higher wheat productions. Recommendations for future research and policy guideline have also been made in this chapter.

CHAPTER II

OWNERSHIP PATTERN AND USE OF LABOUR AND ANIMAL POWER IN THE SURVEY AREA

The status of the selected sample farmers in relation to the composition and size of farm family, ownership pattern and utilization of land, labour and animal is discussed in the present chapter. This is very likely that the resource position of a farmer would affect the crop production.

2.1. Farm size groups

When all the sampled farmers were grouped into small, medium and large size groups, it was observed that about 47 percent were of large size (Table 3). The existance of small farmers in the sample was quite high in Daudkandi (66%) and Modhupur (56%) while in Thakurgaon the number of large farmers were higher (48%).

Table 3 : Frequency distribution of sample farmers according to their sizes of farm.

Farm size group	Number of farmers in different areas				All areas	
	Shailkupa	Daudkandi	Modhupur	Thakurgaon	No.	%
Small	32	66	56	34	188	47
Medium	32	22	24	18	96	24
Large	36	12	20	48	116	29
Total	100	100	100	100	400	100

2.2. Composition and size of farm family

During the survey period, the average number of family members in the survey areas was 8.0 per farm out of which 31 percent were adult male, 28 percent adult female and 43 percent were children (Table 4). The number of family members was higher in Shailkupa (9.7) and lower in Modhupur (6.7). It was observed that the number of family members of large farms was 9.9 per farm while that of small farm was only 6.7 (Table 5). This trend of increasing the number of family members with the increase in the size of land holdings has also been observed in all the locations, as well as in all the three years. Yearwise analysis of size of family members shows that in all the 3 years average family size per farm was 8.1 (Table 6). Although there was increase in adult male and female from 1980-81 to 1982-83, there was decrease in the number of children in the last year thus keeping the number of family member as 8.1.

Table 4 : Average composition and size of farm family in different survey areas.

Survey area	Average number of each category			
	Adult male	Adult female	Children[a]	Total
Shailkupa	2.7	2.9	4.1	9.7
Daudkandi	2.4	1.8	3.7	8.0
Modhupur	2.2	1.6	3.0	6.7
Thakurgaon	2.6	2.3	2.5	7.5
All areas	2.5 (31)	2.2 (28)	3.4 (41)	8.1 (100)

Bracketed figures are the percentage of total

a. Under twelve years of age.

Table 5 : Average composition and size of farm family according to the farm size groups.

Farm size group	Average number per farm			
	Adult male	Adult female	Children	Total
Small	2.0	1.7	3.0	6.7
Medium	2.6	2.3	3.3	8.3
Large	3.1	2.9	3.9	9.9
All sizes	2.5	2.2	3.4	8.1

Table 6 : Average composition and size of farm family in different years.

Survey Year	Average number per farm			
	Adult male	Adult female	Children	Total
1980-81	2.4	2.2	3.5	8.1
1981-82	2.5	2.2	3.4	8.1
1982-83	2.6	2.3	3.2	8.1
All year	2.5	2.2	3.4	8.1

2.3. Effective family labour

The average number of adult males who worked full time in crop production was 1.7. This was 68 percent of the total adult males in the family(Table 7). The average numbers of

full time adult males working in Agricultural production was observed to be higher in Shailkupa and Thakurgaon compared to Daudkandi and Modhupur.

Table 7 : Average number of adult males worked full time in crop cultivation in different survey areas.

Survey area	Average number per farm				% of total males.
	1980-81	1981-82	1982-83	Average	
Shailkupa	2.1	1.9	1.7	1.9	70
Daudkandi	1.4	1.5	1.5	1.5	62
Modhupur	1.4	1.6	1.7	1.6	73
Thakurgaon	1.9	1.9	1.7	1.8	69
All areas	1.7	1.7	1.6	1.7	68

When the data were analysed for different farm size groups, it was found that the large farms had the higher number (1.9) of effective family labour who worked full time in crop production (Table 8). It was lower in small farms (1.6). But the small farms employed 80 percent of their total adult males in agriculture while it was only 61 percent for large farms and 65 percent for Medium farms who were engaged full time in crop production. It shows that as the size of farm increased, the percent of full time adult male workers in agriculture production dicreased.

Table 8 : Average number of adult males worked full time in crop cultivation according to the farm size groups.

Farm size group	Average number per farm				% of total males
	1980-81	1981-82	1982-83	Average	
Small	1.6	1.6	1.5	1.6	80
Medium	1.7	1.9	1.6	1.7	65
Large	1.9	1.9	1.8	1.9	61
All groups	1.7	1.7	1.6	1.7	68

The average number of permanent labour hired on monthly or yearly basis for agriculture production was 0.4 per farm (Table 9). This number was highest in Thakurgaon (0.6) and lowest in Daudkandi (0.3). This tendency to hire permanent labour was found prominent in large farms where the average number of permanent labour was about 1.0 per farm. It was lower in small farms where the average number was only 0.1 labour per farm (Table 10).

Table 9 : Permanent labours employed in crop cultivation per farm in different survey areas.

Survey area	Average number of permanent hired labour			
	1980-81	1981-82	1982-83	Average
Shailkupa	0.55	0.24	0.35	0.38
Daudkandi	0.18	0.16	0.42	0.25
Modhupur	0.43	0.40	0.36	0.40
Thakurgaon	0.70	0.50	0.51	0.57
All areas	0.46	0.33	0.41	0.40

Table 10 : Permanent labours employed in crop cultivation per farm by different farm size groups.

Farm size group	Number of permanent hired labour			
	1980-81	1981-82	1982-83	Average
Small	0.10	0.04	0.11	0.09
Medium	0.38	0.24	0.39	0.33
Large	1.07	0.95	0.86	0.96
All sizes	0.46	0.33	0.41	0.40

2.4 Land occupancy

The average land under cultivation was 1.65 hectares per farm (Table 11). The average land holdings per farm was observed to be highest at Thakurgaon (2.74 ha) and lowest in Daudkandi (1.01 ha) although cultivated land was observed to be higher in Shailkupa. It was also observed that the cultivated land area in all locations except in Shailkupa was less than the land owned. Cultivated acreage in Shailkupa was found more than the area owned due to predominate tenancy.

Table 11 : Area per farm in different survey areas (Average of 1980-83).

Survey area	Average hectares per farm		
	Land owned	Land cultivated	Cropped area
Shailkupa	1.98	2.29	3.77
Daudkandi	1.03	0.98	1.67
Modhupur	1.47	1.15	1.84
Thakurgaon	2.74	2.16	3.84
All areas	1.81	1.65	2.78

The average cultivated land per farm was observed to be highest (3.13 ha) for large farm size group compared to medium (1.5) and small (0.8 ha) farm size groups (Table 12). The average cultivated land per farm was found more in small and medium group of farms compared to land owned which may be due to the fact that the small and medium farmers cultivated more lands on sharecropped basis than the large farmers.

Table 12 : Area per farm in different farm size groups(Average of 1980-83).

Farm size group	Average hectare per farm		
	Land owned	Land cultivated	Cropped area
Small	0.60	0.80	1.46
Medium	1.45	1.50	2.53
Large	4.04	3.13	5.11
All size	1.81	1.65	2.78

2.5. Land fragmentation

The average number of plots per farm was found forteen (Table 13). This number was higher in Thakurgaon (19) and Shailkupa (18) and lower in Daudkandi (7). However, when calculated on per hectare basis, the average number of plot did not vary much. It was observed that as the size of the land holding increased, the number of plots per farm increased but the number of plots per hectare decreased (Table 14). The number of plots per farm, as observed in the study, was 24 for large farms and only 7 for small farms. Conversely, the number of plots per hectare was 10 for small and 7 for large farms (Table 14).

Table 13 : Average number of plots per farm and per cultivated hectare in different survey areas(Average of 1980-83).

Survey area	Average number of plots	
	Per farm	Per cultivated hectare
Shailkupa	18	8
Daudkandi	7	7
Modhupur	10	9
Thakurgaon	19	9
All areas	14	8

Table 14 : Average number of plots per farm and per cultivated hectare for different farm size groups (Average of 1980-83).

Farm size group	Average number of plots	
	Per farm	Per cultivated hectare
Small	8	10
Medium	13	8
Large	24	7
All sizes	14	8

The plot area was also found different in different survey areas as well as for different size of farms. The average size of the plot was estimated to be 0.12 hectare of land, which was found higher in Daudkandi (0.14 ha) and Lower in Modhupur and Thakurgaon (0.11 ha) (Table 15). However, average size of plot was found to be increased as the farm size increased (Table 16). While for the small farmers average size of plot was 0.10 ha., it was 0.13 hectare for the large farm size groups.

Table 15 : Average plot size in different survey areas.

Survey area	Polt size (hectare)			
	1980-81	1981-82	1982-83	Average
Shailkupa	0.14	0.11	0.13	0.13
Daudkandi	0.13	0.13	0.17	0.14
Modhupur	0.11	0.13	0.15	0.11
Thakurgaon	0.13	0.08	0.10	0.11
All areas	0.13	0.10	0.12	0.12

Table 16 : Average plot size for different farm size groups.

Farm size group	Polt size (hectare)			
	1980-81	1981-82	1982-83	Average
Small	0.11	0.09	0.11	0.10
Medium	0.12	0.10	0.14	0.12
Large	0.16	0.12	0.13	0.13
All sizes	0.13	0.10	0.12	0.12

2.6. Cropping intensity

The average cropping intensity for the sample farms was found 167 percent (Table 17). The cropping intensity was higher in Thakurgaon (177%) and lower in Modhupur (160%) although both the areas are covered by deep tubewell water. In Modhupur, however, due to uneven land structure, all the land, can not be cultivated in all the seasons. On the average, cropping intensity was found highest in 1980-81 (184%) and lowest (156%) in 1981-82 (Table 17). The cropping intensity was higher for small farms (182%) and lower for large (163%) group of farms (Table18), that shows small farms cultivated their land more intensively compared to other group of farms. It may be mentioned that the cropping intensity in all survey areas was observed to be substantially higher than that of the national average which was about 153 percent.

Table 17 : Cropping intensity in different survey areas.

Survey area	Cropping intensity a/			
	1980-81	1981-82	1982-83	Average
Shailkupa	171	156	165	164
Daudkandi	189	168	156	170
Modhupur	169	163	148	160
Thakurgaon	201	152	176	177
All areas	184	158	165	167

a/ Cropping intensity = $\frac{\text{Total cropped area}}{\text{Total cultivated area}} \times 100$

Table 18 : Cropping intensity in different farm size groups.

Farm size group	Cropping intensity			
	1980-81	1981-82	1982-83	Average
Small	196	169	180	182
Medium	183	161	167	169
Large	179	150	159	163
All size	184	158	165	167

2.7. Livestock ownership

The average number of draft animal per farm was found 2.3 which comprised 64 percent of the total cattle head (Table 19). Average number of cattle head was found lowest in Daudkandi out of which number of draft animal per farm was only 1.9 (Table 19). Small farms had less number of draft animal (1.7) per farm compared to medium (2.4) and large (3.3) group of farms (Table 20). Also number of milch cow and youngstock were more in large farms than medium or small farms. In fact, number of cattle head was found to increase with the increase in the size of farms. Average situation for each different years showed that the draft animal was less in 1981-82 (2.2 per farm) compared to other two years (Table 21).

Table 19 : Average number of cattle head per farm in different survey areas (Average of 1980-83).

Survey area	Average number per farms			
	Draft animal	Milch Cow	Youngstock	Total
Shailkupa	2.5	0.9	1.2	4.7
Daudkandi	1.9	0.3	0.7	2.9
Modhupur	2.4	0.3	0.8	3.5
Thakurgaon	2.4	0.7	0.6	3.7
All areas	2.3	0.5	0.8	3.6
	(64)	(14)	(22)	(100)

Bracketed figures are the percentages of total.

Table 20 : Average number of cattle head per farm by farm size groups (Average of 1980-83).

Farm size group	Average number of each category			
	Draft animal	Milch Cow	Youngstock	Total
Small	1.7	0.2	0.6	2.5
	(68)	(8)	(24)	(100)
Medium	2.4	0.5	0.8	3.7
	(65)	(14)	(22)	(100)
Large	3.3	1.0	1.2	5.5
	(60)	(18)	(22)	(100)

Bracketed figures are percentages of total.

Table 21 : Average number of cattle head per farm in different survey years.

Survey Year	Average number per farm			
	Draft animal	Milch Cow	Youngstock	Total
1980-81	2.4	0.6	0.8	3.8
1981-82	2.2	0.5	0.8	3.5
1982-83	2.3	0.5	0.9	3.7
Average	2.3	0.5	0.8	3.6

The draft animals were not evenly distributed among the farms. On the average of 3 years, it was observed that 10 percent of all farmers did not have any draft animal and 65 percent farmers had only one or two draft animals (Table 22).

Table 22 : Distribution of farms by the extent of draft power ownership in different survey areas (Average of 1980-83).

Survey area	Number of farms by number of draft animals				
	None	1-2	3-4	Above - 4	All
Shailkupa	3	68	22	7	100
Daudkandi	30	45	21	4	100
Modhupur	5	71	21	3	100
Thakurgaon	1	78	16	5	100
All areas	39	262	80	19	400
	(10)	(65)	(20)	(5)	(100)

Bracketed figures are the percentage of total farms.

Chi-squire (x^2) = 69.20 significant at the 99.90 percent confidence,level.

In Daudkandi, 30 percent farmers did not have any work animal. About 20 percent of the total small farms did not have any animal to plough and 74 percent small farmers had only one or two draft animals (Table 23). Among the large group of farmers, 37 percent farmers had 3 to 4 draft animals and 15 percent farmers had more than four draft animals.

Table 23 : Distribution of farms by the extent of draft power ownership for different farm size groups (Average of 1980-83).

Farm size group	Number of farms by number of draft animals				
	None	1-2	3-4	Above - 4	All
Small	37	139	11	1	188
Medium	1	68	26	1	96
Large	1	55	43	17	116
All sizes	39	262	80	19	400
	(10)	(65)	(20)	(5)	(100)

Bracketed figures are the percentages of total farms.
Chi-square (x^2) = 116.04 significant at the 99.90 percent confidence level.

When the number of draft animal was calculated on the basis of per unit area, it was observed that the average number of draft animal per hectare of cultivated and cropped area was 1.4 and 0.8 respectively (Table 24). This number was varied among different survey areas and farm size groups. The number of draft animal per hectare of cultivated land was higher in small farms (2.1) and lower in large farms (1.1) size group (Table 21). It indicates that the cost of keeping work animal per unit of land area was much higher for small than medium or large farms.

Table 24 : Per hectare draft animal heads according to cultivated and cropped area in different survey areas.

Survey area	Average number of draft animals per hectare							
	Cultivated land				Cropped area			
	1980-81	81-82	82-83	Average	1980-81	81-82	82-83	Average
Shailkupa	1.1	1.1	1.0	1.1	0.7	0.7	0.6	0.7
Daudkandi	2.2	1.7	1.9	1.9	1.1	1.0	1.2	1.1
Modhupur	1.5	2.1	2.0	2.1	0.9	1.3	1.4	1.3
Thakurgaon	1.2	1.3	1.0	1.1	0.6	0.8	0.6	0.6
All areas	1.5	1.4	1.3	1.4	0.8	0.9	0.8	0.8

Table 25 : Per hectare draft animal heads by cultivated and cropped area for different farm size groups.

Farm size group	Average number of draft animals per hectare							
	Cultivated land				Cropped area			
	1980-81	81-82	82-83	Average	1980-81	81-82	82-83	Average
Small	2.3	2.0	2.1	2.1	1.2	1.2	1.1	1.2
Medium	1.6	1.5	1.7	1.6	0.9	0.9	1.0	0.9
Large	1.1	1.2	0.9	1.1	0.6	0.8	0.5	0.6
All sizes	1.5	1.4	1.3	1.4	0.8	0.9	0.8	0.8

There was system of hiring out, hiring in or sharing the draft animals among the farmers. In Daudkandi on the average 21 farmers hired in draft animals from other farmers, 16 farmers shared their draft animals and 5 farmers hired out their draft animals to others for ploughing land (Table 26).

Table 26 : Percent of farmers hiring out/in and sharing draft animals in different survey areas (Average of 1980-83).

Criterion	Number of farmers				
	Shailkupa	Daudkandi	Modhupur	Thakurgaon	All area
Hired out draft animals	2	5	-	2	10
Hired in draft animals	4	21	-	1	26
Shared draft animals	1	16	-	1	18

It was obly 24 small farmers or 13% of the total small farmers who hired draft animal for ploughing land (Table 27). Howev er, another 12 farmers shared their draft animals with others. Large farmers did not taker in draft animal from other but only one large farmer was found to share his animals, with others for ploughing the land (Table 27).

Table 27 : Percent of farmers hiring out/in and sharing draft animals by different farm size groups(Average of 1980-83).

Criterion	Number of farmers			
	Small	Medium	Large	All sizes
Hired out draft animals	5	3	2	10
Hired in draft animals	24	2	-	26
Shared draft animals	12	5	1	18

It was observed from the survey result that about 59% of all the farms owned goats and/or sheeps (Table 28). The average number of such farm was higher in Thakurgaon (73%) and lower in Daudkandi (41%). The tendency to keep sheeps or goats was more among the large group of farmers (Table 29). Seventy three percent of the large farms were found to own goats/sheeps while 53 percent of the small farms and 52 percent of the medium farms owned goats/sheeps.

Table 28 : Percent of farms having goats and/or Sheep in different survey areas.

Survey area	Percent of farms having goats and/or Sheep			
	1980-81	1981-82	1982-83	Average
Shailkupa	62	64	72	66
Daudkandi	56	45	22	41
Modhupur	68	62	41	57
Thakurgaon	61	71	86	73
All areas.	62	61	55	59

Table 29 : Percent of farms having goats and/or sheep by different farm size groups.

Farm size group	Percent of farms having goats and/or sheep			
	1980-81	1981-82	1982-83	Average
Small	56	55	46	53
Medium	59	59	47	52
Large	72	72	75	73
All sizes	62	61	55	59

CHAPTER III

WHEAT AREA AND THE SURVEY PLOT

The average area under wheat cultivation in different locations and farm size groups during the period from 1980-81 to 1982-83 crop seasons and the characteristics of the survey plot were discussed in this chapter.

3.1. Area under wheat

The average wheat area per farm was found to be 0.30 hectare (Table 30). In all the survey areas wheat area was observed to be decreased during the period of 1981-82 and 1982-83 compared to 1980-81 crop season. Among the survey areas the farmers of Thakurgaon cultivated more areas of wheat (0.43 ha) compared to the farmers of other areas. From Table 31, it was found that large farms produced wheat on larger areas (0.47 ha) than the area by small (0.20 ha) or medium size farms (0.29 ha). Although small farms planted less area under wheat than medium or large farms, they produced wheat on about 25% of their total cultivated land. Medium and large farms produced wheat on 19% and 15% respectively of their cultivated land.

Table 30 : Average area under wheat cultivation per sample farm in different survey areas.

Survey area	Area under wheat cultivation (hectare)			
	1980-81	1981-82	1982-83	Average
Shailkupa	0.30	0.18	0.17	0.22
Daudkandi	0.29	0.23	0.27	0.26
Modhupur	0.38	0.27	0.23	0.29
Thakurgaon	0.60	0.28	0.39	0.43
All areas	0.39	0.24	0.26	0.30

Table 31 : Average area under wheat cultivation per sample farm by different farm size groups.

Farm size group	Area under wheat cultivation (hectare)			
	1980-81	1981-82	1982-83	Average
Small	0.24	0.17	0.18	0.20
Medium	0.39	0.24	0.28	0.29
Large	0.62	0.38	0.38	0.47
All sizes	0.39	0.24	0.26	0.30

On the average, a farmer cultivated wheat on his 2.8 plots of land (Table 32). The number of plots was also more in the year 1980-81 compared to 1981-82 and 1982-83 crop seasons. The plot number was observed to be higher in Thakurgaon compared to other areas. Large farms used more number of plots for wheat cultivation than small or medium farms (Table 33).

Table 32 : Average number of wheat plots per sample farm in different survey areas.

Survey area	Average number of wheat plots per farm			
	1980-81	1981-82	1982-83	Average
Shailkupa	3.9	2.2	2.2	2.8
Daudkandi	2.3	2.0	1.9	2.1
Modhupur	3.5	2.5	2.1	2.7
Thakurgaon	3.6	3.4	3.6	3.5
All areas	3.3	2.5	2.4	2.8

Table 33 : Average number of wheat plots per sample farm in different farm size groups.

Farm size group	Average number of wheat plots per farm			
	1980-81	1981-82	1982-83	Average
Small	2.5	2.1	1.8	2.1
Medium	3.6	2.5	2.7	2.9
Large	4.4	3.4	3.2	3.7
All sizes	3.3	2.5	2.4	2.8

3.2. Area under survey plot

It is very likely that size, tenurial status, topography of land, soil texture and cropping pattern of the survey plot would influence the production of wheat.

Average size of the survey plot of wheat was 0.11 hectare of land (Table 34). The size of survey plot was bigger in Daudkandi (0.13 ha) compared to that of other areas. The larger size of survey plot was observed in large farm size group (Table 35). On the average large farmers' survey plot size was 0.13 hectare compared to 0.09 hectare and 0.11 hectare respectively for small and medium size group of farmers. It was also observed that there was a tendency of increase in plot size from year to year during the survey period in case of small and medium farm size group but in case of large farm size group it was reverse.

Table 34 : Average size of survey plot in different survey areas.

Survey area	Average size of survey plot (ha) per farm			
	1980-81	1981-82	1982-83	Average
Shailkupa	0.07	0.10	0.09	0.09
Daudkandi	0.14	0.12	0.14	0.13
Modhupur	0.10	0.12	0.12	0.11
Thakurgaon	0.15	0.08	0.09	0.10
All areas	0.13	0.11	0.11	0.11

Table 35 : Average size of survey plot by different farm size groups.

Farm size group	Average size of survey plot (ha) per farm			
	1980-81	1981-82	1982-83	Average
Small	0.08	0.09	0.10	0.09
Medium	0.10	0.11	0.11	0.11
Large	0.15	0.13	0.13	0.13
All sizes	0.13	0.11	0.11	0.11

On the average, 90 percent of the survey plots of wheat were owned by the farmers and only 10 percent survey plots were operated under the tenural arrangement (Table 36). Tenural arrangement was observed to be more in Thakurgaon area and less in Daudkandi. Eighteen percent of the small farmers' survey plots were under share cropping system (Table 37). But for other two groups of farms, negligible number of survey plots was under share cropping systems.

Table 36 : Frequency distribution of survey plots by tenure status (Average of 1980-83).

Survey area	Number of plots by tenure status			
	Owned	Share cropped	Mortgaged	All
Shailkupa	91	9	-	100
Daudkandi	97	2	1	100
Modhupur	88	11	1	100
Thakurgaon	86	14	-	100
All areas	362	36	2	400
	(90)	(9)	(1)	(100)

Bracketed figures are the percentages of total plots.
Chi-square (x^2) = 11.43 significant at 90 percent confidence level.

Table 37 : Frequency distribution of survey plots for different farm size groups (Average of 1980-83).

Farm size group	Number of plots by tenure status			
	Owned	Share cropped	Mortgaged	All
Small	154	32	2	188
Medium	93	3	-	96
Large	115	1	-	116
All sizes	362	36	2	400
	(90)	(9)	(1)	(100)

Bracketted figures are the percentages of total plots.
Chi-square (x^2) = 30.83 significant at the 99.90 percent confidence level.

3.3. Soil texture of survey plots

According to the report of the farmers, the soil of 45 percent of the survey plots were of loamy, 25 percent were of clay and 24 percent were of sandyloam in texture (Table 38). Different survey areas represents different soil texture. In Daudkandi, loamy soil comprised 94 percent of the survey plots whereas in Modhupur, 89 percent of the survey plots were of clay texture (Table 38). In Shailkupa and Thakurgaon areas, most of the survey plots were of loamy to sandy loam soil texture.

Table 38 : Frequency distribution of survey plots by soil texture (Average of 1980-83).

Survey area	Number of plots by soil texture					All
	Loamy soil	Sandy soil	Clay soil	Clay loam	Sandy loam	
Shailkupa	48	1	2	1	48	100
Daudkandi	94	1	2	3	-	100
Modhupur	2	3	89	1	5	100
Thakurgaon	36	11	6	5	42	100
All areas	180	16	99	10	95	400
	(45)	(4)	(25)	(2)	(24)	(100)

Brackated figures are the percentages of total plots.
Chi-square (x^2) = 417.99 significant at the 99.90 percent confidence level.

3.4. Topography of survey plot

When the topography of land was classified into three classes, namely high (no flooding), medium high (sometimes flooding) and medium low (flooding recedes in November) land, it was observed that on the average, 29% of survey plots were high land, 43% were medium high and 28% were medium low land (Table 39). The topography of land varied from area to area. Ninetyfour percent of the Survey plots in Modhupur were high land while 84% and 78% respectively of Shailkupa and Thakurgaon areas were medium high land (Table 39). In Daudkandi, 94% survey plots were medium low land where wheat was planted after the flood water recedes.

Table 39 : Frequency distribution of survey plots by topography of land (Average of 1980-83).

Survey area	Number of plots by topography of land			
	High	Medium high	Medium low	All
Shailkupa	2	84	14	100
Daudkandi	-	6	94	100
Modhupur	94	6	-	100
Thakurgaon	19	78	3	100
All area	115	174	111	400
	(29)	(43)	(28)	(100)

Bracketed figures are the percentages of total plots.
Chi-square (x^2) = 549.56 significant at the 99.90 percent confidence level.

3.5. Cropping patterns of survey plots

A good number of cropping patterns were observed on the survey plots. During the survey periods it was observed that about 58 percent of the survey plots were under double cropped and the rest 42 percent plots were under triple cropped area. Aus rice followed by transplanted amon rice followed by wheat and broadcast amon rice followed by wheat were the two major patterns followed in 46 percent of the survey plots (Table 40).

Table 40 : Cropping pattern followed on the survey plots (Average of 1980-83).

Cropping pattern	Number of plots					
	Shail-kupa	Daud-kandi	Modhu-pur	Thakur-gaon	All areas	
					No.	%
Fallow-B.Aman-Wheat	-	91	-	-	91	23
Fallow-T.Aman-Wheat	29	-	10	20	59	15
Aus-Fallow-Wheat	-	5	62	2	69	17
Aus-T.Aman-Wheat	25	-	21	46	92	23
T.Aus-T.Aman-Wheat	41	-	-	18	59	15
Jute-Fallow-Wheat	3	4	5	2	14	3
Jute-T.Aman-Wheat	2	-	2	12	16	4
All cropping pattern	100	100	100	100	400	100

In Modhupur area where most of the land of survey plots were high, aus rice followed by wheat was the pattern followed in 62 percent of the survey plots. In Shailkupa and Thakurgaon areas where medium high land was predominant, aus or transplanted aus rice followed by transplanted amon rice followed by wheat were the most common patterns followed in the survey plots. Broadcasted amon rice followed by wheat was a pattern followed in 91 plots in Daudkandi where medium low land was predominant. This area remain inundated under water for most of the period of the year where amon rice is broadcasted. After harvesting the crop, the farmers planted wheat.

CHAPTER IV

AGRONOMIC PRACTICES FOLLOWED IN THE PRODUCTION OF WHEAT

The present chapter deals with the level of technology used and agronomic practices followed by the farmers in wheat cultivation. Variation in time of each operation as well as in input use among the different farmers and different locations have been discussed.

4.1. Land preparation

Land preparation for the wheat cultivation included ploughing, laddering and other activities required to make the soil suitable for sowing seeds.

Ploughing on the survey plot started at different period of time in different locations and for different farmers. The average of three years informations show that the date of first ploughing ranged between the last week of September in Modhupur and first week of January in Thakurgaon. Table 41 shows that more than 50% farmers started ploughing in the 3rd and 4th week of November. However, 64% farmers in Daudkandi, 51% in Shailkupa and 54% in Thakurgaon started ploughing during this period mainly because most of the farmers in these areas cultivated wheat after harvesting amon rice crop. But in Modhupur 63% farmers started ploughing their land before this period because most of the farmers did not have any crop in the field during amon season. Land preparation was late in Thakurgaon where 31% farmers started ploughing the land in the last week of December and first week of January (Table 41).

Table 41 : Frequency distribution of survey plots according to the time of first ploughing (Average of 1980-83).

Time of first ploughing		Shail-kupa	Daud-kandi	Modhu-pur	Thakur-gaon	All areas	
						No.	%
September	24 - 30	-	-	20	-	20	5
October	1 - 31	1	-	35	-	36	9
November	1 - 15	20	1	8	1	30	7
November	16 - 23	23	19	18	25	85	21
November	24 - 30	28	64	10	29	131	33
December	1 - 7	21	11	4	7	43	11
December	8 - 15	5	4	3	7	19	5
December	16 - 31	2	1	2	26	31	8
January	1 - 7	-	-	-	5	5	1
All		100	100	100	100	400	100

Ninety percent of the total farmers used bullocks alone for the land preparation (Table 42). In Daudkandi, 25% farmers used one bullock and one cow and another 7% used only cow for land preparation. In other areas most of the farmers used bullocks alone.

Table 42 : Frequency distribution of survey plots according to source of power used in land preparation (Average of 1980-83).

Survey area	Number of plots by source of power				
	Bullock	Bullock & Cow	Cow	Buffalo	All
Shailkupa	100	-	-	-	100
Daudkandi	67	25	7	1	100
Modhupur	97	-	2	1	100
Thakurgaon	97	-	1	2	100
All areas	361	25	10	4	400
	(90)	(6)	(3)	(1)	(100)

Bracketed figures are the percentages of all sources.

It was observed that the size of farms has significant effect on the kind of draft animal used. More number of small farmers were found to use cows than medium or large farms (Table 43).

Table 43 : Relation between farm size and source of power used in land preparation (Average of 1980-83).

Farm size group	Number of plots by source of power				
	Bullock	Bullock & Cow	Cow	Buffalo	All sources
Small	164	16	8	-	188
Medium	89	6	1	-	96
Large	107	4	2	3	116
All sizes	360	26	11	3	400
	(90)	(6)	(3)	(1)	(100)

Bracketed figures are the percentages of all sources.
Chi-square (x^2) = 13.50 significant at 95 percent confidence level.

Number of ploughing and number of laddering varied from farm to farm and from location to location. On the average, 58% farmers ploughed their land for 3 to 4 times (Table 44). In Daudkandi 90% farmers, in Thakurgaon 67% and in Shailkupa 62% farmers ploughed for 3-4 times while in Modhupur it was only 14% farmers who performed 3-4 ploughings (Table 44). About 68% farmers in Modhupur ploughed for 5-6 times for wheat cultivation. This was again mainly because most of the farmers in Modhupur did not produce T.Aman for which they had time to plough down their land more and more.

Table 44 : Frequency distribution of survey plots according to number of ploughings and ladderings (Average of 1980-83).

Operation/No.	Shail-kupa	Daud-kandi	Modhu-pur	Thakur-gaon	All areas	
					No.	%
Ploughings :						
3 - 4	62	90	14	67	233	58
5 - 6	30	10	68	33	141	35
7 - 8	8	-	18	-	26	7
All	100	100	100	100	400	100
Ladderings :						
3 - 4	5	15	8	67	95	24
5 - 6	25	80	32	22	159	40
7 - 8	37	4	26	11	78	19
9 - 10	15	1	19	-	35	9
11 - 12	10	-	6	-	16	4
Above 12	8	-	9	-	17	4
All	100	100	100	100	400	100

The number of laddering also varied much within the farms and locations. Although variation ranged between 3 to over 12 number of ladderings, on the average, over 80% farmers were confined it within 3-8 ladderings (Table 44). In Daudkandi, about 80% farmers concentrated the number of ladderings to 5-6 times while in Thakurgaon 67% farmers performed 3-4 ladderings and in Shailkupa 37% farmers performed 7-8 ladderings (Table 44). In Shailkupa and Modhupur the tendency to give more ladderings was observed. While 70% and 60% farmers respectively in Shailkupa and Modhupur gave ladderings for 7 times or more, the similar number was given by 5% and 11% farmers in Daudkandi and Thakurgaon respectively.

Although number of ploughing and ladderings varied for different size of farms, no significant difference was obtained even at 10% level of significance.

4.2. Sowing of seeds

About 86% of the sampled farmers produced Sonalika variety seeds although the seeds of other varieties like Pavon-76, Balaka and Tanori were not uncommon (Table 45). In Modhupur 7% farmers produced Tanori, while in other areas this variety was not available. Pavon-76 was available in all the areas but in few cases only (Table 45). Major number of farmers in all farm size groups produced Sanalika variety seeds (Table 46). Eighty percent of the small farmers, 86% of the medium farmers and 95% of the large farmers produced sonalika variety seeds. About 8% of the total farmers could not specify the name of the variety. Most of them are small farmers from Daudkandi.

Table 45 : Frequency distribution of sample farmers according to variety of seed used (Average of 1980-83).

Survey area	Number of farmers by variety of seed					
	Sonalika	Balaka	Tanori	Pavon-76	Not specified	All
Shailkupa	93	-	-	1	6	100
Daudkandi	65	8	-	4	23	100
Modhupur	87	1	7	3	2	100
Thakurgaon	99	-	-	1	-	100
All areas	344 (86)	9 (2)	7 (2)	9 (2)	31 (8)	400 (100)

Bracketed figures are the percentages of total farmers.
Chi-square (X^2) = 93.98 significant at 99.90 percent confidence level.

Table 46 : Relation between farm size and variety of seed used (Average of 1980-83).

Farm size group	Number of farmers by variety of seed					
	Sonalika	Balaka	Tanori	Pavan 76	Not specified	All
Small	151	5	3	4	25	188
Medium	83	3	2	4	4	96
Large	110	1	2	1	2	116
All size	344	9	7	9	31	400
	(86)	(2)	(2)	(2)	(8)	(100)

Bracketed figures are the percentages of total farmers.
Chi-square (x^2) = 20.37 significant at 99 percent confidence level.

Seed rate of wheat varied not only among the farms but in different locations as well as in different years. In 1980-81 the average seed rate was 143 kg/ha while in 1982-83 it was reduced to 125 kg/ha (Table 47). The average seed rate in these years was observed lowest in Shailkupa (120 kg/ha) and highest in Daudkandi (146 kg/ha) (Table 47). The average seed rate for small farm size group was found 138 kg/ha which was the highest among all farm size groups (Table 48). The seed rate was lowest for large farm size group (129 kg/ha). However, for all the farm size groups seed rate was reduced gradually during last 3 years(Table 48). The main reason behind this was apprehended a scarcity and thereof high price of seeds during last two years. This has forced the farmers to reduce seed rate.

Table 47 : Average seed rate used to the wheat plots in the different survey areas.

Survey area	Average seed rate (kg/ha)			
	1980-81	1981-82	1982-83	Average
Shailkupa	125	116	119	120
Daudkandi	164	146	133	146
Modhupur	150	147	129	141
Thakurgaon	132	121	113	123
All areas	143	134	125	134

Table 48 : Average seed rate used to the wheat plots by different farm size groups.

Farm size group	Average seed rate (kg/ha)			
	1980-81	1981-82	1982-83	Average
Small	147	138	128	138
Medium	142	133	127	133
Large	138	129	120	129
All sizes	143	134	125	134

The variation of seed rate in different locations was found significant at one percent level of significance. It ranged from below 115 kg to above 175 kg per hectare (Table 49). On the average of all locations and all the three years, 28% farmers applied seed rate between 131 to 145 kg per hectare. However, in Shailkupa, where the average seed rate was very low, 42% farmers used seed between 131 to 145 kg per hectare and 30% farmers used seed below 115 kg/ha. In Daudkandi, where average seed rate was higher, 51% farmers used seed rate between 146 to 160 kg per hectare and another 25% farmers used it between the range of 161 to 175 kg/hectare (Table 49).

Table 49 : Distribution of sample farmers according to seed rate followed (Average of 1980-83).

Survey area	Number of farmers by seed rate (kg/ha)						
	Upto 115	116-130	131-145	146-160	161-175	Above 175	All
Shailkupa	30	16	42	6	3	3	100
Daudkandi	3	4	13	51	25	4	100
Modhupur	12	8	30	19	14	17	100
Thakurgaon	42	23	27	4	1	3	100
All areas	87	51	112	80	43	27	400
	(22)	(13)	(28)	(20)	(11)	(7)	(100)

Bracketed figures are the percentages of total farmers.
Chi-square (x^2) = 200.43 significant at the 99.90 percent confidence level.

Small farmers were observed to use more seedrate than medium or large farmers. A total of 91 small farms or 48% of the small farms applied seed rate more than 145 kg per hectare while it was only 32% of the medium farms and 24% of the large farms who used seed rate above 145 kg/ha (Table 50). One of the main reasons to apply more seed rate for the small farmers was to avoid risk of poor germination.

Table 50 : Relation between farm size and seed rate (Average of 1980-83).

Farm size Group	Number of farmers by seed rate (kg/ha)						
	Upto 115	116-130	131-145	146-160	161-175	Above 175	All
Small	34	19	44	48	29	14	188
Medium	23	15	27	18	8	5	96
Large	30	17	41	14	6	8	116
All sizes	87	51	112	80	43	27	400
	(22)	(13)	(28)	(20)	(11)	(7)	(100)

Bracketed figures are the percentages of total farmers. Chi-square (X^2) = 22.69 significant at 95.00 percent confidence level.

The major source of seed was Bangladesh Agricultural Development Corporation and from the farmers own farm. Average of all areas and of 3 years show that 41% farmers used BADC supplied seed and 37% used their own seeds. The rest procured seeds either from local market or from other farmers (Table 51). In fact, BADC supplied seeds has been dominated in Madhupur, where the contract

Table 51 : Frequency distribution of sample farmers according to source of seed used (Average of 1980 - 83).

Survey area	Number of farmers by source of seed				
	Own	Other farmers	Local Market	BADC	All sources
Shailkupa	15	4	26	55	100
Daudkandi	75	9	3	14	100
Modhupur	10	1	7	82	100
Thakurgaon	50	14	22	14	100
All areas	149 (37)	28 (7)	58 (15)	165 (41)	400 (100)

Bracketed figures are the percentages of total farmers
Chi-square (X^2) = 194.69 significant at the 99.90 percent confidence level.

growers scheme was present. In Daudkandi and Thakurgoan most of the farmers used their own seeds. It was observed that all the different farm size groups follow the same trend of procurement of seeds i.e. BADC was the major source for small, medium as well as large farm size group and own stored seeds was the next source for all size farmers (Table 52).

Table 52 : Relation between farm size and source of seed used (Average of 1980-83).

Farm size group	Number of farmers by source of seed				
	Own	Other farmers	Local market	BADC	All sources
Small	68 (36)	21 (11)	25 (13)	74 (40)	188 (100)
Medium	33 (34)	4 (4)	16 (17)	43 (45)	96 (100)
Large	48 (41)	3 (3)	17 (15)	48 (41)	116 (100)
All sizes	149 (37)	27 (7)	58 (15)	165 (41)	400 (100)

Bracketed figures are the percentages of total farmers.
Chi-square (X^2) = 10.76 significant at 90 percent confidence level.

Time of sowing seeds varied from location to location. It started from the last week of October to middle of January. In Daudkandi more than 80% farmers completed sowing within the first three weeks of December (Table 53). But in Thakurgoan 31% farmers completed sowing during January. On the average, two thirds of the total farmers concentrated their sowing of wheat seeds within last week of November to third week of December (Table 53). In Daudkandi and Thakurgoan the sowing was late due to late harvest of amon rice crop.

Table 53 : Frequency distribution of survey plots according to time of seed sowing (Average of 1980-83).

Time of seed sowing	Shail-kupa	Daud-kandi	Modhu-pur	Thakur-gaon	All areas No.	All areas %
October 24- 31	-	-	5	-	5	1
November 1--15	4	-	32	-	36	9
November 16- 23	18	1	22	1	42	10
November 24- 30	25	10	10	16	61	15
December 1- 7	25	35	5	22	87	22
December 8- 15	18	25	15	7	65	16
December 16- 23	7	21	7	17	52	13
December 24- 31	2	8	3	6	19	5
January 1- 15	1	-	1	31	33	9
All	100	100	100	100	400	100

When asked about the germination of seed, 81% farmers reported that germination was good (Table 54). It was only in Thakurgaon where 60% farmers reported the germination as fair. But in other 3 locations, the germination of seed was quite good. It was observed that 84% of the small farmers had good germination of seed as opposed to 73% of the large farmers (Table 55).

Table 54 : Frequency distribution of sample farmers according to seed germination rates (Average of 1980-83).

Survey area	Number of farmers by seed germination rates			
	Good	Fair	Poor	All
Shailkupa	87	2	11	100
Daudkandi	97	3	-	100
Modhupur	100	-	-	100
Thakurgaon	39	60	-	100
All areas	323	65	12	400
	(81)	(16)	(3)	(100)

Bracketed figures are the percentage of total farmers.

Table 55 : Relation between farm size and seed germination rates (Average of 1980-83).

Farm size group	Number of farmers by seed germination rates			
	Good	Fair	Poor	All
Small	158	26	4	188
	(84)	(14)	(2)	(100)
Medium	80	11	5	96
	(83)	(11)	(6)	(100)
Large	85	28	3	116
	(73)	(24)	(3)	(100)
All sizes	323	65	12	400
	(81)	(16)	(3)	(100)

Bracketed figures are the percentages of total farmers.
Chi-square (X^2) = 9.71 significant at 95 percent confidence level.

4.3. Manures and fertilizers

The farmers used both organic manures and chemical fertilizers in their wheat plots. The average quantity of organic manures of all the farmers over 3 years was found 5448 kg per hectare (Table 56). However, this quantity was found to vary from farmers to farmers, from location to location and also from year to year.

Table 56 : Average dose of organic manure applied to the wheat plots in different survey areas.

Survey areas	Average dose of organic manure (kg/hectare)			
	1980-81	1981-82	1982-83	Average
Shailkupa	5145	8241	15765	9547
Daudkandi	929	968	221	673
Modhupur	9200	5232	5103	6356
Thakurgaon	3828	5382	10964	6418
All areas	4578	4788	6934	5448

In Shailkupa, the average quantity of organic manure used over 3 years was 9547 kg per hectare (Table 56). But the quantity increased sharply from 1980-81 when 5145 kg/ha was used to 1981-82 when 8241 kg/ha was used and from 1981-82 to 1982-83 when 15765 kg/ha was used (Table 56). In Thakurgaon also the use of organic manure increased from 3828 kg/ha in 1980-81 to 10964 kg/ha in 1982-83. But in Daudkandi and Modhupur the average use of organic manure was reduced from 929 kg/ha in 1980-81 to 221 kg/ha in 1982-83 and from 9200 kg/ha in 1980-81 to 5103 kg/ha in 1982-83 respectively (Table 56).

The use of organic manure by different farm size groups show that small farmers used less amount of organic manure than medium or large farmers did (Table 57). However, same trend of increase in organic manure use from 1980-81 to 1982-83 for all size of farms was noticed.

Table 57 : Average dose of organic manure applied to the wheat plots by different farm size groups.

Farm size group	Average dose of organic manure (kg/hectare)			
	1980-81	1981-82	1982-83	Average
Small	4161	3596	5226	4340
Medium	5249	5761	5932	5646
Large	4701	5506	9627	6689
All sizes	4578	4788	6934	5448

All the farmers did not use organic manure. It was found that 28% of the total farmers did not use organic manure at all. In Daudkandi 92% farmers did not use organic manure while in Modhupur and Thakurgaon all the farmers used it (Table 58). In Shailkupa 35 farmers used organic manure over 12000 kg/ha while this quantity was used only by 13% and 12% farmers in Thakurgaon and Modhupur respectively. However, in Thakurgaon and Modhupur 44% and 33% farmers used organic manure within the range of 3001 - 6000 kg/ha (Table 58). Performance of

Table 58 : Distribution of farmers by level of organic manure applied (Average of 1980-83).

Organic manure applied(kg/ha)	Number of farmers					
	Shailkupa	Daudkandi	Modhupur	Thakur gaon	All areas No.	All areas %
None	19	92	-	-	111	28
Upto 3000	1	-	18	9	28	7
3001-6000	8	2	33	44	87	22
6001-9000	16	3	26	14	59	15
9001-12000	21	2	11	20	54	13
Above 12000	35	1	12	13	61	15
All levels	100	100	100	100	400	100

different farm size groups show that 37% of the small farmers did not use organic manures at all while 27% of the medium farmers and 14% of the large farmers did not use it (Table 59). It was observed that as the farm size increased, the quantity of organic manure per hectare also increased. Chi-square test shows that this relationship between farm size and use of organic manure was highly significant (Table 59).

Table 59 : Relation between farm size and dose of organic manure applied (Average of 1980-83).

Organic manure applied (kg/hectare)	Number of farmers			
	Small	Medium	Large	All sizes
None	69 (37)	26 (27)	16 (14)	111 (28)
Upto 3000	15 (8)	6 (6)	7 (6)	28 (7)
3001 - 6000	35 (18)	18 (19)	34 (29)	87 (22)
6001 - 9000	26 (14)	17 (18)	16 (14)	59 (15)
9001 -12000	23 (12)	12 (12)	19 (16)	54 (13)
Above 12000	20 (11)	17 (18)	24 (21)	61 (15)
All levels	188 (100)	96 (100)	116 (100)	400 (400)

Bracketed figures are the percentages of total.
Chi-square (X^2) = 25.38 significant at the 99.90 percent confidence level.

Urea was used as nitrogeneous fertilizer. This was used both as basal dose at the time of land preparation and as top dressing on the standing crop. On the average, 127 kg of urea per hectare was applied on the wheat plot (Table 60). This quantity was lowest in Shailkupa (59 kg/ha) and highest in Daudkandi (185 kg/ha). The amount varied greatly not only from location to location but from year to year as well.

The highest amount of urea was found in 1980-81 in all the survey areas. The average amount in that year was 154 kg/ha. But it was reduced to 110 kg/ha in 1981-82 and then again increased slightly to 118kg/ha (Table 60). This trend of reduction in the use of urea in the year 1981-82 and then again increased slightly was observed in Shailkupa and Daudkandi where irrigation water was not applied. In 1981-82, due to draught situation, farmers used less quantity of urea. In 1982-83 although there was no draught but due to increase in the price of urea, farmers used quantity less than the year 1980-81 (Table 60). However, in Modhupur and Thakurgaon, where irrigation water was available, the use of urea gradually decreased from 1980-81 to 1982-83 mainly due to increase in the price of urea.

On the average of all area and all year, 59% of the total urea was used at the time of land preparation. The rest was used on the standing crop. This percent, however, was not found equal in all the year. In 1980-81, it was 68%, in 1981-82 it was 55% and in 1982-83 it was 52% of the total urea used as basal dose. Except Modhupur, in all other locations higher amount of urea was used at the time of land preparation (Table 60).

Table 60 : Quantity of Urea applied to the wheat plots in different survey areas.

Year and form	Average dose of urea (kg/ha) in survey areas				
	Shailkupa	Daudkandi	Modhupur	Thakurgaon	All areas
1980-81					
Basal	63	209	66	73	105
Topdressing	31	3	125	46	49
Total	94	212	191	119	154
1981-82					
Basal	34	112	42	42	60
Topdressing	2	43	103	41	50
Total	36	155	145	83	110
1982-83					
Basal	20	117	43	36	61
Topdressing	29	70	81	32	57
Total	49	187	124	68	118
Average					
Basal	39	144	50	53	75
Topdressing	20	41	102	40	52
Total	59	185	152	93	127

Small farmers were found to use more urea (141 kg/ha) than medium (121 kg/ha) or large farmers (114 kg/ha) (Table 61). All the groups were found to use more urea in 1980-81 than the later years. There was another change in the use of urea during this period. All the groups were found to reduce the basal dose of urea and increase topdressing since 1980-81.

Table 61 : Quantity of Urea applied to the wheat plots by different farm size groups.

Year and farm	Average dose of urea(kg/ha) by different size of farm			
	Small	Medium	Large	All sizes
1980-81				
Basal	116	99	94	105
Topdressing	53	49	45	49
Total	169	148	139	154
1981-82				
Basal	73	53	49	60
Topdressing	57	40	48	50
Total	130	93	97	110
1982-83				
Basal	65	71	48	61
Topdressing	58	58	54	57
Total	123	129	102	118
Average				
Basal	85	72	65	75
Topdressing	56	49	49	52
Total	141	121	114	127

In all, 7% farmers were found not to apply any urea in the field. It was only in Shailkupa that 27% farmers did not apply any urea. In other 3 areas all farmers applied urea (Table 62). In Daudkandi, farmers used more urea compared to other locations It was 65% farmers in Daudkandi who have applied urea within the range of 151 kg to 250 kg/hectare, Similar number of farmers in Modhupur used urea within the range of 101 kg to 200 kg/hectare, in Thakurgaon within 51 kg to 100 kg/ha and in Shailkupa below 150 kg/hectare (Table 62).

Table 62 : Distribution of farmers according to dose of urea applied in different survey areas (Average of 1980-83).

Dose of urea applied (kg/ha)	Number of farmers					
	Shail-kupa	Daud-kandi	Modhu-pur	Thakur-gaon	All areas	
					No.	%
None	27	-	-	-	27	7
Upto 50	14	-	1	5	20	5
51 - 100	36	6	13	66	121	30
101 - 150	16	16	30	13	75	19
151 - 200	4	31	33	13	81	20
201 - 250	2	34	13	2	51	13
Above 250	1	13	10	1	25	6
All doses	100	100	100	100	400	100

A significant relationship was observed between the size of farms and use of urea. More number of small farmers used higher doses of urea per hectare. For example, 50% of the small farmers used urea more than 150 kg/hectare while this quantity has been applied by 36% of the medium as well as large farmers (Table 63).

Although 93% of the total farmers applied urea, all of them did not apply it at the time of land preparation. It was 82% of the total farmers who have applied some urea as basal dose (Table 64). In Shailkupa, 44% farmers and in Modhupur 23% farmers did not apply any urea as basal dose. Only 29% of the total farmers applied urea more than 100 kg/ha as basal dose.

Table 63 : Relation between farm size and dose of urea applied to wheat plots (Average of 1980-83).

Dose of urea applied (kg/ha)	Number of farmers			
	Small	Medium	Large	All sizes
None	12 (6)	10 (10)	5 (4)	27 (7)
Upto 50	5 (3)	7 (7)	8 (7)	20 (5)
51 - 100	44 (23)	27 (28)	50 (43)	121 (30)
101 - 150	34 (18)	18 (19)	23 (20)	75 (19)
151 - 200	46 (24)	17 (18)	18 (26)	81 (20)
201 - 250	33 (18)	10 (11)	8 (7)	51 (13)
Above 250	14 (8)	7 (7)	4 (3)	25 (6)
All doses	188 (100)	96 (100)	116 (100)	400 (100)

Bracketed figures are the percentages of total.

Chi-square (X^2) = 28.61 significant at the 99.90 percent confidence level.

Table 64 : Distribution of farms according to dose of basal urea applied to wheat plots (Average of 1980-83).

Survey area	Number of farms by dose of basal urea (kg/ha)						
	None	Upto 50	51-100	101-150	151-200	Above 200	All doses
Shailkupa	44	15	28	12	1	--	100
Daudkandi	1	1	17	35	23	23	100
Modhupur	23	21	45	9	1	1	100
Thakurgaon	2	67	18	12	--	1	100
All areas	70 (18)	104 (26)	108 (27)	68 (17)	25 (6)	25 (6)	400 (100)

Bracketed figures are the percentages of total.

About 36% of the small farmers applied urea more than 100 kg/ha as basal dose while it was only 25% and 22% of the medium and large farmers who have applied this quantity as basal dose(Table-65). However, no significant relationship was found between size of farm and basal dose of urea applied.

All the farmers did not apply urea on the standing crop. It was 69% of the total farmers who have topdressed their wheat field with urea. In Shailkupa and Daudkandi, 68% and 54% of the farmers respectively did not at all topdressed their field with urea while in Modhupur all farmers and in Thakurgaon 98% farmers applied urea on the standing crop (Table 66). It was only 16% of the total farmers who topdressed their wheat field with more than 100 kg of urea per hectare.

Table 65 : Relation between farm size and dose of basal urea application (Average of 1980-83).

Farm size group	Number of farmer by dose of basal urea (kg/ha)						
	None	Upto 50	51-100	101-150	151-200	Above 200	All doses
Small	33 (18)	40 (21)	47 (25)	35 (19)	17 (9)	16 (8)	188 (100)
Medium	18 (19)	26 (27)	28 (29)	14 (15)	5 (5)	5 (5)	96 (100)
Large	19 (16)	38 (33)	33 (29)	19 (16)	3 (3)	4 (3)	116 (100)
All sizes	70 (18)	104 (26)	108 (27)	68 (17)	25 (6)	25 (6)	400 (100)

Bracketed figures are the percentages of total.
Chi-square (X^2) = 13.21 not significant at 90 percent confidence level.

Table 66 : Distribution of farms according to dose of topdressing urea (Average of 1980-83).

Survey area	Number of farms by dose of topdressing urea (kg/ha)						
	None	Upto 50	51-100	101-150	151-200	Above 200	All doses
Shailkupa	68	7	21	3	1	-	100
Daudkandi	54	3	31	9	3	-	100
Modhupur	-	5	45	30	14	6	100
Thakurgaon	2	72	24	2	-	-	100
All areas	124 (31)	87 (22)	121 (30)	44 (11)	18 (5)	6 (1)	400 (100)

Bracketed figures are the percentages of total.

A significant relationship was found between the size of farm and quantity of urea applied as topdressing. Fifty two percent of the small farmers applied urea more than 50 kg/ha as topdressing (Table 67). But it was obly 44% and 43% of the medium and large farmers respectively who have applied this quantity of urea as topdressing.

Table 67 : Relation between farm size and dose of topdressing urea (Average of 1980-83).

Farm size group	Number of farms by dose of topdressing urea (kg/ha)						
	None	Upto 50	51-100	101-150	151-200	Above 200	All doses
Small	59 (31)	32 (17)	56 (30)	26 (14)	10 (5)	5 (3)	188 (100)
Medium	36 (38)	17 (18)	28 (29)	8 (8)	6 (6)	1 (1)	96 (100)
Large	29 (25)	38 (32)	37 (32)	10 (9)	2 (2)	-	116 (100)
All sizes	124 (31)	87 (22)	121 (30)	44 (11)	18 (5)	6 (1)	400 (100)

Bracketed figures are the percentages of total.
Chi-square (X^2) = 21.00 significant at 95 percent confidence level.

Triple superphate (TSP) was used as phosphatic fertilizer. On the average, 129 kg/hectare of TSP was applied (Table 68). Higher dose of TSP was applied in Daudkandi (201 kg/ha) while lowest dose of TSP was applied in Shailkupa (64 kg/ha)(Table 68). Variation in TSP application was observed not only between the locations but from year to year. A gradual decrease in TSP application from 155 kg/ha in 1980-81 to 115 kg/ha in 1982-83 was noticed(Table-68).

Table 68 : Average dose of TSP applied to the wheat plots in different survey areas.

Survey area	Average dose of TSP (kg/ha)			
	1980-81	1981-82	1982-83	Average
Shailkupa	65	65	60	64
Daudkandi	251	155	199	201
Modhupur	139	138	116	130
Thakurgaon	151	99	41	103
All areas	155	118	115	129

Variation was also observed among different size of farmers in TSP application. On the average small farmers were found to apply higher quantity of TSP (141 kg/ha) than medium farmer (126 kg/ha) or large farmer (113 kg/ha) applied (Table 69).

All the TSP was applied at the time of land preparation. Different farmers applied it in different doses. Five percent of the total farmers did not apply TSP at all. More than 80% of the farmers in Daudkandi applied TSP at the dose of over 150 kg/ha (Table 70). This dose was applied only by 37% farmers in Modhupur, 28% in Thakurgaon and only by 6% farmers in Shailkupa (Table 70).

Table 69 : Average dose of TSP applied to the wheat plots by different farm size groups.

Farm size group	Average dose of TSP (kg/hectare)			
	1980-81	1981-82	1982-83	Average
Small	168	129	124	141
Medium	141	109	131	126
Large	147	110	95	118
All sizes	155	118	115	129

Table 70 : Distribution of farms according to level of TSP applied in different survey areas (Average of 1980-83).

Level of TSP (kg/hectare)	Number of farmers					
	Shailkupa	Daudkandi	Modhupur	Thakur-gaon	All areas	
					No.	%
None	15	1	4	1	21	5
Upto 50	10	-	2	32	44	11
51 - 100	49	1	22	20	92	23
101- 150	20	15	35	19	89	22
151- 200	4	30	20	16	70	17
201- 250	1	32	10	11	54	14
Above 250	1	21	7	1	30	8
All levels	100	100	100	100	400	100

It was observed that 44% of the small farmers applied more than 150 kg of TSP per hectare, while this quantity was applied by 37% of the medium farmers and 31% of the large farmers (Table 71). Although the small farmers were observed to apply more TSP than medium or large farmers, the difference was not found significant even at 10% level of significane.

Table 71 : Relation between farm size and level of TSP applied (Average of 1980-83).

Level of TSP (kg/hectare)	Number of farms			
	Small	Medium	Large	All sizes
None	10 (5)	6 (6)	5 (4)	21 (5)
Upto 50	16 (8)	8 (8)	20 (17)	44 (11)
51 - 100	36 (19)	23 (24)	33 (28)	92 (23)
101- 150	44 (23)	23 (24)	22 (19)	89 (22)
151- 200	35 (19)	16 (17)	19 (16)	70 (18)
201- 250	32 (17)	12 (12)	10 (9)	54 (14)
Above 250	15 (8)	8 (8)	7 (6)	30 (7)
All levels	188 (100)	96 (100)	116 (100)	400 (100)

Bracketed figures are the percentages of total.
Chi-square (X^2) = 15.14 not significant at 90 percent confidence level.

Muriate of Potash (MP) was used as potassium fertilizer. On the average, 33 kg/ha of MP was used for wheat cultivation (Table 72). This amount varied much from year to year. It was 42 kg/ha during 1980-81 and 33 kg/ha in 1982-83. However, in 1981-82, the average dose of MP was reduced to 23 kg/ha mainly due to less use in Daudkandi. Small farmers used less amount of MP (32 kg/ha) than medium (33 kg/ha) or large farmers (35 kg/ha) (Table 73). All groups of farmers used less amount of MP in 1981-82 and higher amount in 1982-83.

Table 72 : Average dose of MP applied to wheat plots in different survey areas.

Survey area	Average dose of MP (kg/hectare)			
	1980-81	1981-82	1982-83	Average
Shailkupa	14	23	44	33
Daudkandi	59	6	33	32
Modhupur	44	34	30	35
Thakurgaon	33	33	25	31
All areas	42	23	33	33

Table 73 : Average dose of MP applied to the wheat plots by different farm size groups.

Farm size group	Average dose of MP (kg/hectare)			
	1980-81	1981-82	1982-83	Average
Small	46	18	30	32
Medium	38	26	36	33
Large	41	27	35	35
All sizes	42	23	33	33

The use of MP varied much from farm to farm. Twenty three percent of the total farmers did not use any amount of MP in wheat cultivation. While another 60% farmers used less than 60 kg/ha (Table 74). Three years average data show that 42% of the Daudkandi farmers did not use MP at all. Thirty percent of the small farmers, 22% of the medium farmers and 11% large farmers did not use MP

(Table 75). On the other hand 18% small farmers, 19% medium farmers and 16% large farmers used MP over 60 kg/ha (Table 75). Most of the farmers used MP below 60 kg/ha.

Table 74 : Distribution of farms according to different levels of MP application (Average of 1980-83).

Survey area	Number of farms by level of MP application (kg/ha)						
	None	Upto 30	31-60	61-90	91-120	Above 120	All areas
Shailkupa	22	18	43	15	2	-	100
Daudkandi	42	5	26	16	5	6	100
Modhupur	23	14	41	18	2	2	100
Thakurgaon	3	42	52	3	1	1	100
All areas	90 (23)	77 (19)	162 (41)	52 (13)	10 (2)	9 (2)	400 (100)

Table 75 : Relation between farm size and the level of MP application (Average of 1980-83).

Farm size group	Number of farms by level of MP application (kg/ha)						
	None	Upto 30	31-60	61-90	91-120	Above 120	All areas
Small	56 (30)	27 (14)	71 (38)	22 (12)	4 (2)	8 (4)	188 (100)
Medium	21 (22)	19 (20)	38 (39)	16 (17)	2 (2)	-	96 (100)
Large	13 (11)	31 (27)	53 (46)	14 (12)	4 (3)	1 (1)	116 (100)
All sizes	90 (23)	77 (19)	162 (41)	52 (13)	10 (2)	9 (2)	400 (100)

Bracketed figures are the percentages of total farmers.

Chi-square (x^2) = 24.69 significant of 99 percent confidence level.

An overall view to the combined application of chemical fertilizers reveals that on the average 289 kg/ha of chemical fertilizer was used out of which 127 kg was urea, 129 kg was TSP and 33 kg MP (Table 76). This was in the ratio of 3.8 : 3.9 : 1.0 of urea, TSP and MP respectively. Daudkandi farmers used highest quantity of fertilizer (418 kg/ha) in the ratio 5.8 : 6.3 : 1.0 of urea, TSP and MP respectively. On the average, lowest quantity of fertilizer was used in Shailkupa (156 kg/ha) in the ratio 1.8 : 1.9 : 1.0 of urea, TSP and MP. Higher quantity of TSP was used in all the areas except in Modhupur where use of urea was highest (Table 76).

Table 76 : Average dose of different chemical fertilizers applied to wheat plots in different survey areas (Average of 1980-83).

Survey area	Average dose (kg/hectare)				
	Urea	TSP	MP	All types	Urea : TSP : MP
Shailkupa	59 (38)	64 (41)	33 (21)	156 (100)	1.8 : 1.9 : 1.0
Daudkandi	185 (44)	201 (48)	32 (8)	418 (100)	5.8 : 6.3 : 1.0
Modhupur	152 (48)	130 (41)	35 (11)	317 (100)	4.3 : 3.7 : 1.0
Thakurgaon	93 (41)	103 (45)	31 (14)	227 (100)	3.0 : 3.3 : 1.0
All areas	127 (44)	129 (45)	33 (11)	289 (100)	3.8 : 3.9 : 1.0

Bracketed figures are the percentages of total chemical fertilizer.

Among different size of farms, small farmers were found to use higher quantity of chemical fertilizers (314 kg/ha) in the ratio of 4.4 : 4.4 : 1.0 of urea, TSP and MP (Table 77). Lower quantity of fertilizer was used by the large farmers (267 kg/ha) in the ratio 3.2 : 3.4 : 1.0 of urea, TSP and MP (Table 77).

Table 77 : Average dose of different chemical fertilizers applied to wheat plots by different farm size groups (Average of 1980-83).

Farm size group	Average dose (kg/hectare)				
	Urea	TSP	MP	All types	Urea : TSP : MP
Small	141 (45)	141 (45)	32 (10)	314 (100)	4.4 : 4.4 : 1.0
Medium	121 (43)	126 (45)	33 (12)	280 (100)	3.7 : 3.8 : 1.0
Large	114 (43)	118 (44)	35 (13)	267 (100)	3.2 : 3.4 : 1.0
All sizes	127 (44)	129 (45)	33 (11)	289 (100)	3.8 : 3.9 : 1.0

Bracketed figures are the percentages of total chemical fertilizer.

It was mentioned earlier that 69% of the total farmers applied urea on the standing crop. Of them, 56% farmers top dressed only once and the rest 13% farmers top dressed their wheat field with urea for twice (Table 78). In Daudkandi only 46% farmers top dressed urea on the wheat plot and all of them applied it only once. In Modhupur, however, 74% applied once and the rest 26% applied twice. A significant relationship was obtained between the location and number of top dressings (Table 78).

Table 78 : Frequency distribution of sample farmers according to number of topdressing urea (Average of 1980-83).

Survey area	Number of farmers by number of topdressings			
	No topdressing	One topdressing	Two topdressings	All
Shailkupa	68	31	1	100
Daudkandi	54	46	-	100
Modhupur	-	74	26	100
Thakurgaon	2	71	27	100
All areas	124 (31)	222 (56)	54 (13)	400 (100)

Bracketed figures are the percentages of total figures.
Chi-square (x^2) = 188.04 significant at the 99.90 percent confidence level.

Among different farm size groups, 55% of the small farmers top dressed their wheat field with urea only once while another 13% small farmers top dressed twice (Table 79). But 57% of the large farmers top dressed urea only once and another 18% top dressed twice. However, this difference was not found significant.

Table 79 : Relation between farm size and number of top dressing urea (Average of 1980-83).

Farm size group	Number of farmers by number of topdressings			
	No topdressing	One topdressing	Two topdressing	All
Small	60 (32)	104 (55)	24 (13)	188 (100)
Medium	35 (37)	52 (54)	9 (9)	96 (100)
Large	29 (25)	66 (57)	21 (18)	116 (100)
All sizes	124 (31)	222 (56)	54 (13)	400 (100)

Bracketed figures are the percentages of total farmers.
Chi-square (x^2) = 6.42 not significant at 90 percent confidence level.

Timing of fertilizer application is important for higher yield. It was observed that the time of top dressing differs in different locations and among farms. Twenty seven percent of the total farmers applied urea on the standing crop 2 to 3 weeks after sowing seeds (Table 80). About 36% of the total farmers top dressed urea after 4 to 5 weeks of sowing seeds while another 37% farmers applied it 6 to 7 weeks after seedings. However, the time of application is not uniform for all locations. In Shailkupa, 23 farmers out of 31 top dressed after 6 to 7 weeks of seeding while in Daudkandi 27 out of 46 farmers top dressed within 4 to 5 weeks of sowing seeds (Table 80). In Modhupur 42 farmers top dressed with 2 to 3 weeks of sowing seeds and in Thakurgaon 53 farmers out of 98 top dressed within 6 to 7 weeks of sowing seeds (Table 80).

Table 80 : Distribution of topdressed plots according to the period between first topdressing and sowing in different survey areas (Average of 1980-83).

Survey area	Number of plots by number of weeks between first topdressing and sowing			
	2-3	4-5	6-7	All
Shailkupa	2	6	23	31
Daudkandi	13	27	6	46
Modhupur	42	37	19	98
Thakurgaon	16	29	53	98
All areas	73	99	101	273
	(27)	(36)	(37)	(100)

Bracketed figures are the percentages of total topdressed plots.

Variation was observed also among different farm size groups in the time of top dressing. Fifty three farmers out of 127 small farmers who top dressed their field, applied it within 4 and 5 weeks of sowing seeds while, 45 large farmers out of 87, applied it within 6 and 7 weeks after sowing seeds (Table 81).

Table 81 : Distribution of topdressed plots by the period between first topdressing and sowing for different farm size groups (Average of 1980-83).

Farm size group	Number of plots by number of weeks between first topdressing and sowing			
	2-3	4-5	6-7	All
Small	38 (30)	53 (42)	36 (28)	127 (100)
Medium	18 (30)	21 (36)	20 (34)	59 (100)
Large	17 (19)	25 (29)	45 (52)	87 (100)
All sizes	73 (27)	99 (36)	101 (37)	273 (100)

Bracketed figures are the percentages of total topdressed plots.

4.4. Irrigation

On the average of all the locations and all the 3 years, it was observed that only 43% of all farmers irrigated their wheat plots. In Daudkandi all farmers and in Shailkupa 77% farmers did not apply any irrigation water (Table 82). However, in Modhupur all farmers and in Thakurgaon 48% farmers applied irrigation water. In Shailkupa it was only in the first year i.e. 1980-81, 68 farmers applied irrigation, but in the next two years none of them irrigated their wheat plot.

Table 82 : Frequency distribution of survey plots according to number of irrigations (Average of 1980-83).

Survey area	Number of plots by number of irrigations					
	None	1	2	3	4	All
Shailkupa	77	5	13	4	1	100
Daudkandi	100	-	-	-	-	100
Modhupur	-	2	20	63	15	100
Thakurgaon	52	14	33	1	-	100
All areas	229	21	66	68	16	400
	(57)	(5)	(17)	(17)	(4)	(100)

Bracketed figures are the percentages of total.

In Modhupur 63% farmers irrigated wheat field thrice on the standing crop and another 15% farmers irrigated four times. But in Thakurgaon most of the farmers irrigated only for twice (Table 82).

Among different farm size groups, it was observed that 56% of the small farmers, 59% of the medium farmers and 58% of the large farmers did not irrigate their wheat field (Table 83). Those who irrigated their field were concentrated within 2 and 3 irrigations. Only 16 farmers were available who irrigated their field for four times. No significant relation was observed between the farm size and number of irrigations.

Table 83 : Relation between farm size and number of irrigations (Average of 1980-83).

Farm size group	Number of plots by number of irrigation					
	None	1	2	3	4	All
Small	105 (56)	9 (5)	32 (16)	33 (18)	9 (5)	188 (100)
Medium	57 (59)	5 (5)	14 (15)	17 (18)	3 (3)	96 (100)
Large	67 (58)	7 (6)	20 (17)	18 (16)	4 (3)	116 (100)
All sizes	229 (57)	21 (5)	66 (17)	68 (17)	16 (4)	400 (100)

Bracketed figures are the percentages of total.

It was observed that only 22 farmers, out of which 21 were from Modhupur, applied irrigation water before sowing wheat seeds to moisten the soil. Another 28 farmers, out of which 27 were from Modhupur, applied irrigation water on the same date when wheat seed was sown (Table 84). However, major number of farmers (37%) were found to irrigate their field for the first time within 3 and 4 weeks after sowing seeds.

Table 84 : Distribution of irrigated plots according to the period between first irrigation and sowing (Average of 1980-83).

Survey area	Number of plots by number of weeks between first irrigation and sowing						
	Before sowing	Same date	1-2	3-4	5-6	7-8	All
Shailkupa	-	-	2	11	9	1	23
Modhupur	21	27	26	24	1	1	100
Thakurgaon	1	1	6	28	8	4	48
All areas	22 (13)	28 (16)	34 (20)	63 (37)	18 (10)	6 (4)	171 (100)

Bracketed figures are the percentages of total irrigated plots.

Deep tubewell, shallow tubewell and canal irrigation were found major source of irrigation (Table 85). In Modhupur and Thakurgaon, deep tubewell as well as shallow tubewell were used to irrigated the wheat plot. In Shailkupa, in 1980-81 the farmers were found to irrigate wheat plot with canal water under G.K. project. But in the subsequent years, the farmers used irrigation water only for boro rice as the authority supplied water at a time when it was required for rice. Moreover, farmers were instructed to use irrigation water for rice only. Two farmers in each location of Modhupur and Thakurgaon were found to irrigate their wheat field by indigenous method of irrigation (Table 85).

Table 85 : Distribution of survey plots according to source of irrigation water.

Survey area	Number of plots by source of irrigation water						
	DTW[a]	STW[b]	LIP[c]	HTW[d]	Canal scheme	Done & swing busket	All
Shailkupa	-	-	-	-	23	-	23
Modhupur	73	25	-	-	-	2	100
Thakurgaon	41	3	1	1	-	2	48
All areas	114	28	1	1	23	4	171
	(67)	(16)	(1)	(1)	(13)	(4)	(100)

Bracketed figures are the percentages of total irrigated plots.

a. Deep Tubewell
b. Shallow Tubewell
c. Lowlift pump
d. Hand Tubewell.

About 57% of the total farmers did not irrigate the wheat plot. When asked why they did not irrigate the land, 67% farmers in Daudkandi and 59% farmers in Shailkupa gave opinion that irrigation was not needed on their wheat plots (Table 86). However, 44% farmers in Thakurgaon said that due to power failure, they could not irrigate the plot.

Table 86 : Reasons for non-irrigation of the survey plots (Average of 1980-83).

Reason	Number of farmers by reason of no irrigation				
	Shailkupa	Daudkandi	Thakurgaon	All areas	
				No.	%
Not needed	59	67	3	129	56
Water not available	18	11	-	29	13
No power for pump operation	-	14	44	58	25
Water cost too much	-	6	-	6	3
No money to buy water or rent pump	-	2	3	5	2
Other	-	-	2	2	1
All reasons	77	100	52	229	100

4.5. Weeding

Weeding of the wheat plot was done by 47% of the total farmers. Ninety seven percent farmers in Thakurgaon and 69% farmers in Modhupur did not weeded their field at all (Table 87). In Daudkandi and Shailkupa, however, 95% and 59% farmers respectively weeded their wheat plot. Those who weeded their field, did it mostly for once only. It was only 23 farmers or 6% of the total farmers who weeded their field twice. Weeding habit was found to have a significant relationship with the location (Table 87).

Table 87 : Frequency distribution of sample plots by number of weedings (Average of 1980-83).

Survey area	Number of plots by number of weeding			
	None	One weeding	Two weedings	All
Shailkupa	41	42	17	100
Daudkandi	5	91	4	100
Modhupur	69	30	1	100
Thakurgaon	97	2	1	100
All areas	212 (53)	165 (41)	23 (6)	400 (100)

Bracketed figures are the percentages of total.
Chi-square (x^2) = 218.37 significant at the 99.90 percent confidence level.

The period between the sowing of seeds and first weeding for different farms was worked out. About 50% of the farmers who weeded their wheat field were observed to perform this operation for the first time after 4 to 5 weeks and 28% farmers were observed to perform it after 6 to 7 weeks of sowing seeds (Table 88). In Daudkandi and Modhupur, majority of the farmers weeded their plots for the first time within 4 and 5 weeks after sowing seeds while in Shailkupa majority farmers did it after 6 to 7 weeks of sowing seeds.

Table 88 : Distribution of survey plots according to the period between first weeding and sowing (Average of 1980-83).

Survey area	Number of plots by number of weeks between first weeding and sowing				
	2-3	4-5	6-7	8-9	All
Shailkupa	3	25	27	4	59
Daudkandi	22	53	20	-	95
Modhupur	9	17	5	-	31
Thakurgaon	1	-	-	2	3
All areas	35 (19)	95 (50)	52 (28)	6 (3)	188 (100)

Bracketed figures are the percentages of total.

It was 52% of the small and medium size farmers and only 34% of the large farmers who per formed weeding on their wheat field. Majority farmers in all the different size groups were found to perform first weeding within 4 and 5 weeks of sowing seeds (Table 89).

Table 89 : Distribution of survey plots according to the period between first weeding and sowing (Average of 1980-83).

Farm size group	Number of plots by number of weeks between first weeding and sowing				
	2-3	4-5	6-7	8-9	All
Small	21 (22)	54 (55)	20 (20)	3 (3)	98 (100)
Medium	10 (20)	22 (44)	17 (34)	1 (2)	50 (100)
Large	4 (10)	19 (48)	15 (37)	2 (5)	40 (100)
All sizes	35 (19)	95 (50)	52 (28)	6 (3)	188 (100)

Bracketed figures are the percentages of total.
Chi-square (x^2) = 7.59 not significant at 90 percent confidence level.

The farmers who did not perform any weeding on their wheat plot, were asked why they did not perform it. The single major reason was that the weeding was not necessary on their plot (Table 90). However, in Thakurgaon, 3 farmers were available who could not perform weeding due to the labour scarcity.

Table 90 : Reasons for no weeding on the survey plots.

Reasons	Number of farmers					
	Shailkupa	Daudkandi	Modhupur	Thakurgaon	All areas	
					No.	%
Not needed	41	5	69	94	209	99
Could not get labour	-	-	-	3	3	1
All reasons	41	5	69	97	212	100

4.6. Plant protection

Crop damages due to disease and insect pests were not reported by any farmer particularly in 1981-82 and 1982-83. However, in 1980-81, thirty six farmers in Shailkupa reported wheat crop damage by insect and rat. However, a small number of farmers in Shailkupa, Daudkandi and Thakurgaon applied insecticide.

4.7. Credit used

In 1980-81, in all 79 farmers or about 20% of the total farmers received loan for wheat cultivation (Table 91). They were mostly from Thakurgaon (37%), Modhupur (22%) and Daudkandi (18%). But in the subsequent years of 1981-82 and 1982-83, the loan receiving farmers reduced to 13% and 5% of the total farmers respectively. [illegible] on the average of 3 years, it was only 13% of the total [illegible]rmers who received loan for wheat production. The rest [illegible] farmers did not receive any loan.

Table 91 : Distribut[illegible] of farmers who used credit for wheat produc[illegible]n in different years.

Survey area	Percent of farmers used credit			
	1980-81	1981-82	1982-83	Average
Shailkupa	2	-	-	1
Daudkandi	18	17	-	12
Modhupur	22	24	12	19
Thakurgaon	37	13	7	19
All areas	20	13	5	13

Among different farm size groups, it was 14% of the small, 11% of the medium and 12% of the large farmers who received loan for wheat production (Table 92). Most of the farmers in Daudkandi who received loan were from small farm size group. In Modhupur, the farmers who received loan for wheat were mostly from medium farm size group and in Thakurgaon, the farmers who received loan were mostly from large farm size group (Table 92).

Table 92 : Distribution of farmers who used credit for wheat production in different survey areas by farm size groups (Average of 1980-83).

Farm size group	Percent of farmers used credit				
	Shail-kupa	Daud-kandi	Modhu-pur	Thakur-gaon	All areas
Small	-	6	4	4	14
Medium	1	1	8	1	11
Large	-	-	3	9	12
All sizes	1	12	19	19	13

When enquired about the different source of credit, it was observed that 9% of the total farmers received credit from bank. Other 4% loan receiving farmers borrowed from noninstitutional source like relatives, friends and other farmers (Table 93).

Table 93 : Distribution of farmers according to the source of credit in different survey areas (Average of 1980-83).

Source of credit	Number of farmers				
	Shail-kupa	Daud-kandi	Modhu-pur	Thakur-gaon	All areas (percent)
Relative/Friend	-	1	-	3	1
Bank	1	3	19	14	9
Other Farmer	-	6	-	-	2
Money lender	-	1	-	-	-
Other	-	1	-	2	1
All sources	1	12	19	19	13

In Daudkandi, most of the farmers who received loan borrowed it from noninstitutional source while in other areas it was bank from where most of the farmers borrowed.

When asked the borrowers, why they borrowed, it was found that 8% of the total farmers borrowed for purchasing fertilizer while the next requirement was to pay the water charge (Table 94). In Daudkandi and Thakurgaon, the farmers who borrowed, took it mostly for purchasing fertilizer while in Modhupur most of them received it for paying water charge.

Table 94 : Distribution of farmers according to the purpose of credit used in different survey areas (Average of 1980-83).

Purpose of credit used	Number of farmers				
	Shail-kupa	Daud-kandi	Modhu-pur	Thakur-gaon	All areas (percent)
Hire labour	-	1	1	1	1
Fertilizer purchase	1	11	6	15	8
Water purchase	-	-	12	3	4
All	1	12	19	19	13

More than 87% of the total farmers did not borrow money for wheat cultivation. They used their own capital to finance wheat cultivation. These farmers were asked to state the reasons why they did not borrow money. It was 47% of the total farmers who stated that they could not get any credit inspite of their willingness to borrow (Table 95). In Shailkupa and Modhupur 72% and 56% of the total farmers in the respective location told that they could not get any credit.

However, another 34% of the total farmers were in the opinion that credit was not needed in wheat cultivation. Major number of farmers in Daudkandi and Thakurgaon were in this group (Table 95). There were few farmers who told that they could not fulfil the minimum criteria for obtaining loan and that the interest rate was too high.

Table 95 : Reasons for not using credit for the survey plots (Average of 1980-83).

Reason	Percent of farmers by reason of No credit use				
	Shailkupa	Daudkandi	Modhupur	Thakur-gaon	All areas
Credit was not needed	26	45	25	41	34
Could not get credit	72	34	56	28	47
Interest rate was too high	-	4	-	1	1
Could not qualify for credit	-	5	-	5	3
Other	1	-	-	6	2
All reasons	99	88	81	81	87

4.8. Harvesting

In all the four locations, harvesting operation was done manually. Time of harvesting differs from farmer to farmer in different locations. It started from the last week of February when only 2% of the total farmers harvested their crop and continued upto third week of April (Table 96). In Shailkupa the harvesting operation was spread from last week of February to third week of April although 40% farmers harvested during last week of March and another 29% farmers harvested in the third week of March. In Daudkandi, the harvesting operation was concentrated within second week of March and second week of April. However, 50% farmers harvested their crop in the last week of March and another 26% farmers harvested in the first week of April. In Modhupur, harvesting of wheat was little earlier. About 33% farmers harvested in the third week of March and another 30% farmers harvested in the second week of March. In Thakurgaon, however, the harvesting of wheat was late. Ninety five percent farmers in Thakurgaon harvested their crop during the first three weeks of April (Table 96). The time of harvesting was related to the time of sowing. It was observed that late sowing in Thakurgaon resulted in late harvesting.

The duration of the crop in the field which is the period between seed sowing and harvesting was also not even for all farmers. It ranged from less than 100 days to more than 130 days (Table 97). On the average, the crop was in the field for 111 days. In Shailkupa 38% farmers harvested their crop within 101 to 110 days of sowing while in Daudkandi 54% farmers harvested within the similar period. In Modhupur, 39% farmers harvested their crop within 111 to 120 days of sowing while in Thakurgaon 25% farmers harvested the crop within the same period (Table 97). Prolonged winter was also one reason for which 39% of the Thakurgaon farmers had to keep their crop in the field for more than 120 days.

Table 96 : Frequency distribution of sample plots according to time of harvest (Average of 1980-83).

Time of harvest	Number of farmers					
	Shailkupa	Daudkandi	Modhupur	Thakur-gaon	All areas	
					No.	%
February 24-28	1	-	6	-	7	2
March 1-7	1	-	4	1	6	1
March 8-15	14	2	30	-	46	12
March 16-23	29	19	33	1	82	20
March 24-31	40	50	19	3	112	28
April 1-7	11	26	2	35	74	18
April 8-15	1	3	6	24	34	9
April 16-23	3	-	-	36	39	10
All	100	100	100	100	400	100

Table 97 : Frequency distribution of sample plots according to days required for wheat production in different survey areas (Average of 1980-83).

Survey area	Number of plots by days required for wheat production					
	Upto 100	101-110	111-120	121-130	Above 130	All
Shailkupa	15	38	30	10	7	100
Daudkandi	22	54	22	2	-	100
Modhupur	21	15	39	17	8	100
Thakurgaon	22	14	25	21	18	100
All areas	80 (20)	121 (30)	116 (29)	50 (13)	33 (8)	400 (100)

Bracketed figures are the percentages of total.

Not much difference in duration of crop was observed amongst different farm size group. Most of the farmers in small, medium or large size group harvested the crop within 101 to 120 days of sowing seeds (Table 98).

Table 98 : Frequency distribution of sample plots according to days required for wheat production in different farm size groups (Average of 1980-83).

Farm size group	Number of plots by days required for wheat production					
	Up to 100	101-110	111-120	121-130	Above 130	All
Small	37 (20)	57 (30)	58 (31)	19 (10)	17 (9)	188 (100)
Medium	20 (21)	33 (34)	25 (26)	12 (13)	6 (6)	96 (100)
Large	23 (20)	31 (27)	33 (28)	19 (16)	10 (9)	116 (100)
All sizes	80 (20)	121 (30)	116 (29)	50 (13)	33 (8)	400 (100)

Bracketed figures are the percentages of total.

4.9. Labour employment

Human labour was required from land preparation to harvesting and threshing the crop. The number of human labour days was different for different operations. The average number of human labour days required to produce, harvest and thresh wheat crop was 129 mandays per hectare (Table 99). About 31% of the total labour was required to prepare the land for wheat sowing. Harvesting operation also consumed much labour which was estimated to be 24% of the total labour requirement. Similarly threshing and drying the products consumed about 23% of the total labour requirement. Weeding operation also required appreciable number of labour which was about 15% of the total requirement (Table 99).

Table 99 : Average labour requirement for different agronomic practices of wheat cultivation (Average of 1980-83).

Operations	Per hectare labour requirement (Mandays)			
	Family	Hired	Total	Percent of Total
Land preparation	34.5 (86)	5.5 (14)	40.0 (100)	31
Seed sowing	1.7	-	1.7	1
Fertilizer application	5.7 (89)	0.7 (11)	6.4 (100)	5
Irrigation	1.9 (95)	0.1 (5)	2.0 (100)	1
Weeding	6.7 (35)	12.2 (65)	18.9 (100)	15
Harvesting and carrying	19.5 (63)	11.3 (37)	30.8 (100)	24
Threshing and drying	25.4 (87)	3.8 (13)	29.2 (100)	23
All operations	95.4 (74)	33.6 (26)	129.0 (100)	100

Bracketed figures are the percentages of total.

Out of total requirement of 129 labour mandays per hectare, about 74% labour was supplied from the farmers own family (Table 99). The rest was supplied by the hired casual labour. Particularly in the weeding and harvesting operation which needed to be completed in time, the farmers had to hire labour. In weeding 65% and in harvesting 37% of the labour required were hired.

Yearwise average labour requirement shows that the labour requirement was 131.2 mandays per hectare in 1980-81 which reduced to 129.6 mandays in 1981-82 and 125.9 mandays per hectare in 1982-83 (Table 100). This reduction was mainly due to less number of labour used in land preparation in the subsequent years.

Table 100 : Average labour requirement for different operations in different years for wheat cultivation.

Operations	Per hectare labour requirement (Mandays)			
	1980-81	1981-82	1982-83	Average
Land preparation	42.5	39.6	37.9	40.0
Seed sowing	1.8	1.7	1.7	1.7
Fertilizer application	5.0	7.6	6.6	6.4
Irrigation	2.2	1.7	2.0	2.0
Weeding	17.7	19.9	19.1	18.9
Insecticide application	0.1	-	-	-
Harvesting and carrying	31.0	32.0	29.4	30.8
Threshing and drying	30.9	27.1	29.2	29.2
All operations	131.2	129.6	125.9	129.0

Locationwise average labour requirement shows that the labour utilization was different for different locations. Average labour required in Shailkupa was 71.8 mandays per hectare, while it was as high as 173.6 mandays per hectare in Daudkandi (Table 101). Labour requirement in Daudkandi was higher due to higher use of labour in weeding, harvesting and threshing. However, in Thakurgaon, labour requirement was higher in land preparation but minimum in weeding (Table 101).

Table 101 : Average labour requirement for different operations in different survey areas for wheat cultivation (Average of 1980-83).

Operations	Per hectare labour requirement (mandays)				
	Shail-kupa	Daud-kandi	Modhu-pur	Thakur-gaon	Aver-age
Land preparation	32.9	36.5	33.4	58.6	40.0
Seed sowing	1.3	1.0	1.3	3.7	1.7
Fertilizer application	4.8	2.5	11.0	7.6	6.4
Irrigation	-	-	5.6	1.9	2.0
Weeding	1.6	55.1	10.1	0.3	18.9
Insecticide application	-	-	-	0.1	-
Harvesting & carrying	14.1	36.8	32.9	37.0	30.8
Threshing and drying	17.1	41.7	23.8	31.1	29.2
All operations	71.8	173.6	118.1	140.3	129.0

When labour utilization for different farm size groups was observed, it was found that the small farm size group required 138.6 mandays per hectare compared to 122.0 mandays by medium farmers and 121.6 mandays by large farmers (Table 102). This was mainly due to intensive weeding done by the small farmers and that they used more number of family labours than medium or large farmers.

Table 102 : Average labour requirement for different operations in different farm size groups for wheat cultivation (Average of 1980-83).

Operations	Per hectare labour requirement (Mandays)			
	Small	Medium	Large	Average
Land preparation	39.1	27.8	42.7	40.0
Seed sowing	1.6	1.5	2.0	1.7
Fertilizer application	5.6	6.4	7.4	6.4
Irrigation	2.1	1.8	1.9	2.0
Weeding	25.6	19.1	10.3	19.9
Harvesting & carrying	32.7	27.8	30.5	30.8
Threshing and drying	31.9	27.6	26.8	29.2
All operations	138.6	122.0	121.6	129.0

4.10. Draft power utilization

Draft animal was used for land preparation and threshing of wheat. On the average, these two operations required 36.7 animal pair days per hectare (Table 103). In Modhupur, all the farmers in all three years threshed wheat manually. But in other areas farmers used draft animal as well as manual labour for threshing. Farmers in Thakurgaon used higher number of animal pair days for land preparation (50.4 pair days/ha) than other areas. However, farmers were found to use both owned as well as hired draft animal. Daudkandi farmers used more number of hired draft animal (8.7) than other areas (Table 103). This was mainly because they had less number of animals of their own.

Table 103 : Average draft power required for wheat cultivation in different survey areas (Average of 1980-83).

Operations	Draft animal pairdays per hectare				
	Shail-kupa	Daud-kandi	Modhu-pur	Thakur-gaon	Average
Land preparation					
Owned	27.4	23.4	24.8	47.1	30.1
Hired	1.1	8.1	0.6	3.3	3.5
All	28.5	31.5	25.4	50.4	33.6
Threshing					
Owned	5.0	4.5	-	1.8	2.8
Hired	0.7	0.6	-	-	0.3
All	5.7	5.1	-	1.8	3.1
All operations					
Owned	32.4	27.9	24.8	48.9	32.9
Hired	1.8	8.7	0.6	3.3	3.8
All	34.2	36.6	25.4	52.2	36.7

Average utilization of draft animal was found to reduce from 39.0 pair days/ha in 1980-81 to 37.5 pair days/ha in 1981-82 and 33.5 pair days in 1982-83 (Table 104). It was mainly due to less number of ploughing in the subsequent years that the draft animal requirement was less.

Table 104 : Average draft animal required for wheat cultivation in different years.

Operations	Draft animal pairdays per hectare			
	1980-81	1981-82	1982-83	Average
Land preparation				
Owned	32.2	30.1	28.0	30.1
Hired	2.7	5.2	2.6	3.5
All	34.9	35.3	30.6	33.6
Threshing				
Owned	3.4	2.2	2.9	2.8
Hired	0.7	0.1	-	0.3
All	4.1	2.3	2.9	3.1
All operations				
Owned	35.6	32.3	30.9	32.9
Hired	3.4	5.2	2.6	3.8
All	39.0	37.5	33.5	36.7

Average draft animal requirement was found higher (38.7 pairdays/ha) in large farm size groups than other two groups (Table 105). Small farmers had less number of draft animal per farm and they had to hire animals for which they used less number of animal pair days than large farmers.

Table 105 : Average draft animal required for wheat cultivation for different farm size groups (Average of 1980-83).

Operations	Draft animal pairdays per hectare			
	Small	Medium	Large	Average
Land preparation				
Owned	26.3	31.2	34.2	30.1
Hired	6.5	0.4	1.8	3.5
All	32.8	31.6	36.0	33.6
Threshing				
Owned	2.6	3.7	2.5	2.8
Hired	0.5	0.2	0.2	0.3
All	3.1	3.9	2.7	3.1
All operations				
Owned	28.9	34.9	36.7	32.9
Hired	7.0	0.6	2.0	3.8
All	35.9	35.5	38.7	36.7

CHAPTER V

FACTORS AFFECTING YIELD OF WHEAT

In the present chapter, the yield of wheat obtained from the survey plots in different locations and in different years and role of various factors responsible for higher yield have been discussed.

5.1. Yield of Wheat

Yield of wheat was found to vary not only among farmers but from location to location and year to year. The average of all the farmers in all the four locations and in all the years was found 1636 kg per hectare. The average yield was higher in 1982-83 (1871 kg/ha) than the other two years (Table 106).

Table 106 : Average yield of wheat on sample plots in different survey areas.

Survey area	Yield (kg/hectare)			
	1980-81	1981-82	1982-83	Average
Shailkupa	886	1008	1278	1052
Daudkandi	1861	2201	1812	1949
Modhupur	1505	1406	2324	1762
Thakurgaon	1710	1299	1963	1672
All areas	1517	1512	1871	1636

The average yield was hig est in Daudkandi (1949 kg/ha) and lowest in Shailkupa (1052 kg/ha). However, in Shailkupa the yield was gradually increased from 886 kg/ha in 1980-81 to 1278 Kg/ha in 1982-83. In this location wheat was introduced recently. In the initial year, farmers were lacking the knowledge of agronomic practices. Moreover, heavey rainfall during harvesting time and irregular supply of irrigation water resulted in lower yeild in 1980-81. In Madhupur and Thakurgaon, although irrigation water was supplied, the farmers received lower yield in 1981-82 mainly due to draught situation. However, in Daudkandi, the average yield was highest in this year (2201 kg/ha) though it was rainfed. (Table 106).

The average performance of the small farmers was found better in Daudkandi (1970 kg/ha) and Thakurgaon (1705 kg/ha) while in other two areas, large farmers performed better (Table 107).

Table 107 : Average yield of wheat on sample plots in different survey areas by farm size groups (Average of 1980-83).

Farm size group	Yield (kg/hectare)				
	Shailkupa	Daudkandi	Modhupur	Thakurgaon	All area
Small	827	1970	1670	1705	1673
Medium	1094	1899	1760	1661	1586
Large	1180	1944	1899	1656	1625
All sizes	1052	1949	1762	1672	1636

A comparison between different groups of farmers in different years shows that on the average, small farmers, who do not possess more than one hectare of land, performed well. Average yield of small farmers was 1673 kg/ha which was higher than medium or large farmers (Table 108). However, in 1980-81 and 1981-82, small farmer's yield per hectare was more than other group of farmers but in 1982-83, large farmers' yield was more.

Table 108 : Average yield of wheat on sample plots by different Farm size groups.

Farm size group	Yield (kg/hectare)			
	1980-81	1981-82	1982-83	Average
Small	1546	1631	1847	1673
Medium	1517	1383	1879	1586
Large	1480	1472	1895	1625
All sizes	1517	1512	1871	1636

When all the farmers were grouped into four groups according to the yield performance, it was found that yield of 28% of the total farmers was below 1200 kg/ha (Table 109). In shailkupa 50% farmers had yield below 1200 kg/ha while only 6% farmers had yield more than 2000 kg/ha. But in Daudkandi it was reverse. Only 3% farmers had yield below 1200 kg/ha, and it was 42% farmers in Daudkandi whose yield was more than 2000 kg/ha (Table 109).

Table 109 : Distribution of Farmers according to the yield of wheat on sample plots in different survey areas(Average of 1980-83).

Yield (kg/ha)	Number of Farmers					
	Shailkupa	Daudkandi	Modhupur	Thakur-gaon	Total No.	Total %
Upto 1200 kg/ha	50	3	27	31	111	28
1201-1600 kg/ha	26	16	19	19	80	20
1601-2000 kg/ha	18	39	23	17	97	24
Above2000 kg/ha	6	42	31	33	112	28
All levels	100	100	100	100	400	100

It was observed that fifty seven small farmers or 30% of the all small farmers had yield more than 2000 kg/ha as opposed to 25% of the medium farmers and 27% of the large farmers who had yield more than 2000 kg/ha (Table 110).

Table 110 : Distribution of farmers according to the yield of wheat on sample plots in different farm size groups (Average of 1980-83).

Yield (kg/ha)	Number of farmers			
	Small	Medium	Large	Total Number
Upto 1200	47 (25)	31 (32)	33 (28)	111 (28)
1201 - 1600	34 (18)	21 (22)	25 (22)	80 (20)
1600 - 2000	50 (27)	20 (21)	27 (23)	97 (24)
Above 2000	57 (30)	24 (25)	31 (27)	112 (28)
All levels	188 (100)	96 (100)	116 (100)	400 (100)

Bracketed figures are the percentages of total.

5.2. Effect of land preparation on yield

It was observed that the average yield was higher for the farmers who had ploughed their land for 3 to 4 times(1644 kg/ha) as well as the farmers who ploughed 5 to 6 times (1643 kg/ha) (Table 111). However, this trend was not uniform for all the locations or for all the years. In Shailkupa the farmers who ploughed for 7 to 8 times received more yield than the farmers with less number of ploughings (Table 111). In Daudkandi and Modhupur farmers with 3 to 4 times ploughing received higher yield than the farmers with more number of ploughings. In Thakurgaon, the farmers with 5 to 6 times of ploughing received higher yield than the other groups. The survey plots where 3 to 4 ploughing were done covered about 55% of the total land and the plots where 5 to 6 ploughings were done covered 38% of the total land (Table 111).

Table 111 : Average yield of wheat of sample plots according to the level of ploughing in different survey areas (Average of 1980-83).

Survey area	Yield (kg/hectare) by number of ploughings			
	3 - 4	5 - 6	7 - 8	All levels
Shailkupa	998	1052	1460	1052
Daudkandi	1964	1825	-	1949
Modhupur	2070	1778	1537	1762
Thakurgaon	1644	1710	-	1672
All areas	1644 (55)	1643 (38)	1531 (7)	1636 (100)

Brackated figures are the percentage of total cultivated wheat area.

In 1980-81 and 1982-83, plots with 5 to 6 number of ploughings received higher yield, while in 1981-82, plots with 3 to 4 ploughings obtained highest yield (Table 112). Conservation of soil moisture due to less number of ploughing in 1981-82, the year of draught, might be a cause for higher yield.

Table 112 : Average yield of wheat on sample plots according to the level of ploughing in different years.

Survey year	Yield (kg/ha) by number of ploughings			
	3 - 4	5 - 6	7 - 8	All levels
1980-81	1485	1552	1460	1517
1981-82	1563	1394	1408	1512
1982-83	1869	1900	1718	1871
Average	1644	1643	1513	1636

After ploughing the land, it was levelled with the ladder. The farmers who laddered their land for 5 to 6 times received highest yield (1804 kg/ha). Increasing number of laddering did not found to have any effect on yield. The plots where laddering was done for 5 to 6 times covered about 43% of the total area (Table 113). In Shailkupa and Modhupur, however, plots with 3 to 4 ladderings produced higher yield while in Thakurgaon it was 5 to 6 ladderings which produced higher yield.

Table 113 : Average yield of wheat on sample plots according to the level of laddering in different survey areas (Average of 1980-83).

Survey area	Yield (kg/hectare) by number of laddering						
	3-4	5-6	7-8	9-10	11-12	Above-12	All levels
Shailkupa	1598	1134	1051	976	875	958	1052
Daudkandi	1792	1981	1867	2054	-	-	1949
Modhupur	2110	1746	1836	1590	2002	1601	1762
Thakurgaon	1641	1814	1533	-	-	-	1672
All areas	1703 (20)	1804 (43)	1454 (20)	1363 (9)	1386 (4)	1366 (4)	1636 (100)

Brackated figures are the percentage of total cultivated wheat area.

In different years yield behaved differently due to different number of laddorings. In 1980-81, higher yield was obtained due to 3 to 4 times of laddorings while in 1981-82 the plots with 5 to 6 laddorings gave higher yield (Table 114).

Table 114 : Average yield of wheat on sample plots according to the level of laddering in different years.

Survey Year	Yield (kg/hectare) by number of laddorings						
	3-4	5-6	7-8	9-10	11-12	Above 12	All levels
1980-81	1616	1776	1415	1159	941	1243	1517
1981-82	1350	1947	1147	1332	1437	1338	1512
1982-83	1949	1728	1989	1894	2697	2124	1871
Average	1703	1804	1454	1363	1386	1366	1636

5.3. Effect of seed rate on yield

No uniform relationship was found between the seed rate and yield. On the average of all locations and for all years, slightly higher yield was obtained (1869 kg/ha) in the plots where seed rate was in the range of 161 - 175 kg/ha than in the plots where seed rate was in the range of 146 - 160 kg/hectare (1852 kg/ha)(Table 115). The plots with seed rate in the range of 161 - 175 covered only 11% of the surveyed area while the plots with seed rate in the range of 146 - 160 kg/ha covered 22% of the surveyed area.

Table 115 : Average yield of wheat on sample plots according to the seedrate in different survey areas (Average of 1980-83).

Survey area	Yield (kg/hectare) by seedrate						
	Upto 115	116-130	131-145	146-160	161-175	Above 175	All levels
Shailkupa	848	1262	1112	1154	965	1462	1052
Daudkandi	1686	1903	1820	1934	2020	2059	1949
Modhupur	2142	1954	1568	1752	1708	1802	1762
Thakurgaon	1620	1771	1662	1855	1896	1485	1672
All areas	1422 (21)	1660 (12)	1482 (28)	1852 (22)	1869 (11)	1777 (6)	1636 (100)

Brackated figures are the percentage of total cultivated wheat area.

In Shailkupa and Daudkandi, plots with seed rate above 175 kg/ha produced highest yield while in Modhupur and Thakurgaon plots with seed rate upto 115 kg/ha and 116 - 130 kg/ha respectively produced higher yield (Table 115).

Performance of seedrate also behaved differently in different years. In 1980-81, plots with seedrate in the range of 116-130 kg/ha produced higher yield (1684 kg/ha) while in 1981-82, the plots with seed rate 161-175 kg/ha produced higher yield. In 1982-83, however, the farmers who applied seed rate above 175 kg/ha received higher yield (Table 116).

Table 116 : Average yield of wheat on sample plots according to the seedrate in different years.

Survey year	Yield (kg/hectare) by seedrate						
	Upto 115	116-130	131-145	146-160	161-175	Above 175	All levels
1980-81	1140	1684	1500	1761	1759	1667	1517
1981-82	1156	1244	1270	1917	1935	1434	1512
1982-83	2059	1982	1612	1842	2072	2328	1871
Average	1422	1660	1482	1852	1869	1777	1636

5.4. Effect of source of seeds on yield

Yield of wheat was found to vary due to variation in the source of seed. On the average of all the locations and all the three years, farmers own produced seed was found to produce highest yield (1833 kg/ha) and BADC supplied seed was found to produce lowest yield (1497 kg/ha) (Table 117). About 38% of the surveyed area was covered by the farmers own stored seeds while about 43% area was covered by BADC supplied seed.

Table 117 : Average yield of wheat on sample plots according to the source of seed in different survey areas (Average of 1980-83).

Survey area	Yield (kg/ha) by source of seed				
	Own	Farmer	Local Market	BADC	All
Shailkupa	1312	1111	977	1020	1052
Daudkandi	1954	1849	2022	1954	1949
Modhupur	2308	2643	2144	1660	1762
Thakurgaon	1633	1636	1738	1712	1672
All areas	1833 (38)	1685 (6)	1509 (13)	1497 (43)	1636 (100)

Brackated figures an the percentage of total cultivated wheat area.

Within each location, seeds purchased from the market was found to produce higher yield in Daudkandi and Thakurgaon while own stored seed was found to yield higher in Shailkupa (Table 117). However, in 1980-81 and 1981-82, on the average of all locations, farmers own stored seeds produced higher yield while in 1982-83 only BADC supplied seed was found to yield higher than other source (Table 118).

Table 118 : Average yield of wheat on sample plots according to the source of seed in different years.

Survey year	Yield (kg/hectare) by source of seed				
	Own	Farmer	Local Market	BADC	All
1980-81	1860	1674	1585	1205	1517
1981-82	1797	1183	1215	1385	1512
1982-83	1841	1940	1620	2011	1871
Average	1833	1685	1509	1497	1636

5.5. Effect of variety on yield

About 88% of the surveyed area was found to cover by Sonalika variety. The rest area was covered by Balaka, Pavon, Tanori and others. Sonalika, Tanori and Pavon variety were available in the first two years while in the third year farmers dropped pavon from all locations and introduced Balaka in Modhupur and Daudkandi. In Modhupur under irrigated condition Balaka was found to produce 3124 kg/ha while in Daudkandi under non irrigated condition this variety was found to produce 1799 kg/ha (Table 119). Although Balaka gave higher yield, it covered only 3% of the total surveyed wheat area.

Table 119 : Average yield of wheat on sample plots according to the wheat variety in different survey areas (Average of 1980-83).

Survey area	Yield (kg/hectare) by wheat variety					
	Sonalika	Balaka	Pavon 76	Tanori 71	Not specificed	All
Shailkupa	1050	-	1169	-	982	1052
Daudkandi	1970	1799	2166	-	1785	1949
Modhupur	1806	3124	1427	1241	1832	1762
Thakurgaon	1660	-	2668	-	-	1672
All areas	1626 (88)	1818 (3)	1818 (2)	1241 (1)	1648 (6)	1636 (100)

Brackated figures are the percentage of total cultivated wheat area.

In 1980-81, farmers received higher yield from the plots where they could not specify the variety. In the second year, however, highest yield was obtained from the pavon variety. But in the third year, Sonalika was found to perform well than other varieties (Table 120). The performance of Balaka and Pavon, although cultivated on a limited scale was found better.

Table 120 : Average yield of wheat on sample plots according to the wheat variety in different years.

Survey Year	Yield (kg/ha) by wheat variety					
	Sonalika	Balaka	Pavon 76	Tanori-71	Not specifed	All
1980-81	1501	-	1615	1377	1726	1517
1981-82	1447	-	1921	1178	642	1512
1982-83	1890	1818	-	-	1731	1871
Average	1626	1818	1818	1241	1648	1636

5.6. Effect of time of sowing on yield

When all the farmers were grouped according to different time of sowing seeds, it was observed that the highest average yield was 1824 kg/ha received by the farmers who planted seeds during first fortnight of November (Table 121). However, in this period only 9% of the total farmers planted wheat seeds. Most of which were from Modhupur. During second week of December, about 16% of the farmers planted seeds and received an average yield of 1809 kg/ha. In different locations different yield due to variation in time of sowing was observed. In Shailkupa, highest average yield (1340 kg/ha) was found in the group of farmers who planted seeds during second week of December (Table 121). In Daudkandi most of the farmers planted seeds in December. Highest average yield (2053 kg/ha) was obtained by those planted during third week of December. In Modhupur, where sowing started in last week of october and continued upto middle of January, highest average yield (1956 kg/ha) was received by those who planted seed in first week of December and continued upto mid January, received highest average yield (2064 kg/ha) by those who planted seeds during last week of November. Average yield was drastically reduced when seed was sown after December.

Table 121 : Average yield of wheat according to the time of seed sowing (Average of 1980-83).

Time of seed sowing	Yield (kg/hectare)				
	Shailkupa	Daudkandi	Modhupur	Thakurgaon	All areas
October 24-31	-	-	1543	-	1543
November 1-15	1140	-	1894	1767	1824
November 16-23	949	1364	1538	1721	1314
November 24-30	962	1832	1628	2064	1508
December 1-7	919	1957	1956	1895	1669
December 8-15	1340	1950	1879	1939	1809
December 16-23	1104	2053	1828	1477	1730
December 24-31	1192	1930	1861	1371	1676
January 1-15	208	-	1495	1345	1310
All	1052	1949	1762	1672	1636

5.7. Effect of organic manure

When all the farmers were grouped according to different doses of organic manure used, it was observed that the highest yield was received by the group using organic manure in the range of 6001 to 9000 kg per hectare (1832 kg/ha) (Table 122). The plots under this group covered only 14% of the total surveyed area. However, the farmers who did not apply any organic manure also received an average yield of 1825 kg/ha (Table 122) which was very nearer to group which received highest yield. The plots under this group covered 30% of the total surveyed area. In fact, year wise analysis showed that the farmers who did not apply any manure received highest yield in 1980-81. In 1982-83, the farmers using organic manure less than 3000 kg/ha received highest yield.

Table 122 : Average yield of wheat according to the level of organic manure application.

Organic manure (kg/hectare)	Yield (kg/hectare)			
	1980-81	1981-82	1982-83	Average
None	1655	2044	1816	1825 (30)
Upto 3000	1474	1307	2646	1612 (8)
3001 - 6000	1487	1354	2094	1573 (25)
6001 - 9000	1404	1801	2222	1832 (14)
9001 - 12000	1329	1109	2005	1528 (10)
Above 12000	1477	1244	1441	1420 (13)
All levels	1517	1512	1871	1636 (100)

Brackated figures are the percentage of total cultivated wheat area.

5.8. Effect of urea on yield

When the farmers were grouped according to different rates of urea used on the survey plots, it was observed that the farmers using urea in the range of 101 kg to 150 kg per hectare received highest average yield (1829 kg/ha) (Table 123). This trend was not uniform for all locations nor for all the years. In Shailkupa, average highest yield was obtained by the group of farmers using urea above 250 kg/ha. However, this rate was available in 1980-81 only. In the subsequest years, farmers reduced their rate and none was found to apply more than 200 kg/ha of urea in Shailkupa. In Daudkandi average highest yield was obtained by the group of farmers using urea in the range of 101 to 150 kg/ha (Table 123).

Table 123 : Average yield of wheat according to the level of urea application in different survey areas (Average of 1980-83).

Survey area	Yield (kg/hectare) by level of urea (kg/ha)							
	None	Upto-50	51-100	101-150	151-200	201-250	Above 250	All level
Shailkupa	847	1040	1087	1267	1173	1241	1730	1052
Daudkandi	-	-	1938	2069	1996	1889	1850	1949
Nodhupur	-	2214	1628	1943	1638	1661	1633	1762
Thakurgaon	-	1337	1756	1656	1480	1661	1446	1672
All areas	873	1171	1553	1829	1756	1820	1763	1636
	(6)	(6)	(29)	(20)	(21)	(13)	(5)	(100)

Brackated figures are the percentage of total cultivated wheat area.

Yearwise analysis of use of urea showed that in 1980-81 highest yield was obtained by the group of farmers using 201 to 250 kg of urea per hectare while in 1981-82 highest yield was obtained by the farmers using urea more than 250 kg/ha (Table 124). In 1982-83, the farmers reduced the rate of urea and highest yield was obtained by the group of farmers using urea in the range of 101 kg to 150 kg per hectare (Table 124). It may be noted that this highest average yield (2164 kg/ha) in 1982-83 was higher than the highest average yield of 1980-81 and ~~1981 and~~ 1981-82.

Table 124 : Average yield of wheat according to the level of urea application in different years.

Survey year	Yield (kg/hectare) by level of urea (kg/ha) application							
	None	Upto 50	51-100	101-150	151-200	201-250	Above-250	All levels
1980-81	863	796	1421	1477	1569	1759	1517	1517
1981-82	780	1091	1362	1697	1845	1880	1946	1512
1982-83	968	1633	1821	2164	1999	1876	1924	1871
Average	873	1171	1553	1829	1756	1820	1763	1636

In the earlier chapter, it was shown that the average rate of urea was reduced from 1980-81 to 1982-83. But the average yield in 1982-83 was much higher than earlier years (Table 119). Probably due to the influence of other factors yield was increased in 1982-83 even with reduced rate of urea. Moreover, higher rates of urea only increased the costs rather than yield.

5.9. Effect of TSP on yield

When the farmers were grouped according to the use of TSP, it was observed that the highest yield (1819 kg/ha) was received by the group using TSP in the range of 201 to 250 kg/ha (Table 125). However, the group using 151 to 200 kg of TSP also received 1812 kg of wheat per hectare which was more economic.

Table 125 : Average yield of wheat according to the level of TSP application in different survey areas (Average of 1980-83).

Survey area	Yield (kg/hectare) by level of TSP (kg/ha) application							
	None	Upto 50	50-100	101-150	151-200	201-250	Above 250	All levels
Shailkupa	976	878	1101	1096	1364	818	586	1052
Daudkandi	2149	-	1182	2108	2005	1906	1858	1949
Modhupur	1347	1953	1935	1797	1621	1692	1571	1762
Thakurgaon	657	1790	1532	1666	1652	1726	1449	1672
All areas	1104 (4)	1522 (11)	1420 (24)	1710 (22)	1812 (18)	1819 (14)	1746 (7)	1636 (100)

Brackated figures are the percentage of total cultivated wheat area.

In different locations, however, different trend was observed. In Shailkupa highest average yield (1364 kg/ha) was received by the group using 151 to 200 kg/ha of TSP while in Daudkandi, farmers who did not use TSP at all received highest average yield (2149 kg/ha) (Table 125). The soil of Daudkandi is regularly enriched by silt deposition due to flood. Probably due to the flood effect, the soil may not require additional phosphate. However, to confirm this, agronomic research should be conducted in that locality.

Yearwise performance of TSP showed that in 1980-81 highest yield (1792 kg/ha) was obtained from the group of farmers using TSP in the range of 201 to 250 kg per hectare (Table 126). In the next year i,e. in 1981-82 highest yield (1885 kg/ha) was obtained from those using TSP more than 250 kg/ha. But in 1982-83, highest average yield (2063 kg/ha) was obtained by those using TSP in the range of 101 to 150 kg/ha. Thus due to variation in the soil and location no regular trend of response of TSP was observed. It may also happen that all the TSP applied in the field was not available to the plants.

Table 126 : Average yield of wheat according to the level of TSP application in different years.

Survey year	Yield (kg/hectare) by level of TSP (kg/ha) application							
	None	Upto 50	50-100	101-150	151-200	201-250	Above 250	All levels
1980-81	773	945	1248	1468	1781	1792	1622	1517
1981-82	1160	961	1262	1627	725	1619	1885	1512
1982-83	1313	1880	1732	2063	1878	1985	1881	1871
Average	1104	1522	1420	1710	1812	1819	1746	1636

5.10. Effect of MP on yield

When the farmers were grouped according to the use of MP it was observed that the average highest yield (1862 kg/ha) was obtained by the group using MP in the range of 91 to 120 kg/ha(Table 127). However, it was only 2% of the total surveyed area covered by this group plots. About 41% of the surveyed area was covered by the group of farmers using MP in the range of 31 to 90 kg/ha and whose average yield was only 1624 kg/ha. This yield was even lower than the yield of those farmers (1705 kg/ha) who did not use MP at all.

Table 127 : Average yield of wheat according to the level of MP application in different survey areas (Average of 1980-83).

Survey area	Yield (kg/hectare) by level of MP (kg/ha) application						
	None	Upto 30	31-60	61-90	91-120	Above-120	All levels
Shailkupa	889	987	1050	1390	1709	-	1052
Daudkandi	2068	1781	1925	1809	1763	1906	1949
Modhupur	1543	1793	1842	1785	1921	1022	1762
Thakurgaon	1252	1667	1677	1783	2427	2144	1672
All areas	1705 (21)	1532 (23)	1624 (41)	1699 (11)	1862 (2)	1774 (2)	1636 (100)

Brackated figures are the percentage of total cultivated wheat area.

In Shailkupa, three years average data showed that the highest average yield (1709 kg/ha) was obtained by the group of farmers using MP in the range of 91 to 120 kg/ha (Table 127). But in Daudkandi the highest average yield was received by those using MP in the range of 31 to 60 kg/ha. In Modhupur and Thakurgaon the highest average yield was received by those using MP in the range of 91 to 120 kg/ha (Table 127).

Yearwise analysis of MP use showed that in 1980-81 average yield of 1856 kg/ha was received by the farmers using MP above 120 kg/ha (Table 128). This was the highest yield among different groups of farmers. However, in the same year the group of farmers using MP in the range of 91 to 120 kg received 1825 kg of wheat/ha which was very nearer to the yield of higher group. Thus, although the yield of higher group (1856 kg/ha) was more than this yield, the use of upper rate of MP may not be economical. In the year 1981-82, the average yield was highest (1705 kg/ha) for those who

did not use MP at all. In fact, it was influenced by Daudkandi yield, where farmers who did not use MP at all in 1981-82 received very high yield. However, in 1982-83 the farmers using MP in the range of 91 to 120 kg/ha received highest average yield (2095 kg/ha) (Table 128).

Table 128 : Average yeid of wheat according to the level of MP application in different years.

Survey year	Yield (kg/hectare) by level of MP (kg/ha) application						
	None	Upto 30	31-60	61-90	91-120	Above 120	All levels
1980-81	1453	1205	1551	1735	1825	1856	1517
1981-82	1746	1296	1418	1370	1694	1087	1512
1982-83	1811	1999	1822	1846	2095	-	1871
Average	1705	1532	1624	1699	1862	1774	1636

From the above analysis it was revealed that MP has good response to wheat in Shailkupa, Modhupur and Thakurgaon which needs to be confirmed by conducting experiment on the farmers' field of the locality. However, in Daudkandi the requirement of MP was found much lower.

5.11. Effect of weeding on yield

About 51% of the total surveyed plots were found not to perform any weeding while in other 45% plots only one weeding was done. In the rest plots two weeding were done (Table 129). On the average of all locations and all the years, the highest average yield (1759 kg/ha) was received by those who performed only one weeding on their plots.

Table 129 : Average yield of wheat on sample plots according to the level of weeding in different survey areas (Average of 1980-83).

Survey area	Yield (kg/hectare) by level of Weeding			
	None	One weeding	Two weeding	All levels
Shailkupa	750	1131	1290	1052
Daudkandi	1906	1948	1975	1949
Modhupur	1701	1887	-	1762
Thakurgaon	1669	1660	2177	1672
All areas	1513 (51)	1759 (45)	1538 (4)	1636 (100)

Brackated figures are the percentage of total cultivated wheat area.

Except Modhupur, in all other areas highest average yield was received by those performing two weedings. In Modhupur none was available to perform more than one weeding. However, marginal difference in yield in Daudkandi due to weeding may not suggest additinal expenditure spent for it, particularly in non-irrigated situation.

Yearwise analysis showed that in 1980-81 the highest average yield (1985 kg/ha) was received by the farmers who performed two weedings while in 1981-82, the average highest yield (1827 kg/ha) was received by the farmers who performed only one weeding (Table 120). However, in the third year the farmers who did not weeded their field received highest average yield of 2056 kg/ha. In this year the average yield in all locations except Duadkandi was highest for those who did not perform any weeding. However, in Daudkandi, performance of those with two weedings was better.

Table 130 : Average yield of wheat on sample plots according to the level of weeding in different years.

Survey year	Yield (kg/hectare) by level of weeding			
	None	One weeding	Two weedings	All levels
1980-81	1409	1689	1985	1517
1981-82	1236	1827	1259	1512
1982-83	2056	1750	1633	1871
Average	1513	1759	1538	1636

5.12. Effect of irrigation on yield

In Daudkandi, farmers did not irrigate their wheat plots in any of the three years. In Shailkupa only 68 farmers irrigated wheat plots in the first year. But in the subsequent years irrigation water was not applied to the wheat field by any farmers. Hence in the analysis the effect of irrigation has been shown only for Modhupur and Thakurgaon. In Modhupur all farmers and in Thakurgaon 48% farmers applied irrigation water in their wheat fields.

Highest average yield (2009 kg/ha) was received by the group of farmers who irrigated their plots twice (Table 131). About 25% of the surveyed plot area were irrigated twice. In Modhupur, farmers who irrigated their plots twice received an average of 1794 kg/ha which was highest among all the groups. Similarly in Thakurgaon the group of farmers who irrigated their plots twice received 2132 kg/ha of wheat which was highest among all the groups (Table 131).

Table 134 : Average yield of wheat on sample plots according to the level of irrigation used in different survey areas (Average of 1980-83).

Survey area	Yield (kg/hectare) by level of irrigation					
	None	One irrigation	Two irrigations	Three irrigations	Four irrigations	All levels
Modhupur	-	1278	1794	1790	1693	1762
Thakurgaon	1390	1454	2132	1917	-	1672
All areas	1390	1434	2009	1794	1693	1722
	(24)	(7)	(25)	(36)	(8)	(100)

Brackated figures are the percentages of total cultivated wheat area.

NB. In Shailkupa only 68 farmers in the year 1980-81, irrigation was used but in the subsiquent years, no irrigation was given by any farmers. So, in the yield calculation, it was not shown and in Daudkandi no irrigation was used for wheat cultivation.

Yearwise analysis of yield showed that both in 1980-81 and 1981-82, farmers applying two irrigations received highest average yield of 1547 kg/ha and 1607 kg/ha respectively (Table 132). In 1982-83, however, highest average yield (2380 kg/ha) was received by the farmers applying three irrigations. This was influenced by the farmers of Modhupur, because none in Thakurgaon applied more than two irrigations in this year. However, marginal increase in the yield of 170 kg/ha due to one more irrigation may not suggest to invest additional expenditure in third irrigation.

Table 132 : Average yield of wheat on sample plots according to the level of irrigation used in different years.

Survey year	Yield (kg/hectare) by level of irrigation					
	None	One irrigation	Two irrigation	Three irrigation	Four irrigation	All levels
1980-81	1234	1287	1547	1401	1671	1394
1981-82	1171	1354	1607	1330	1570	1362
1982-83	1778	1456	2210	2380	2071	2025
Average	1390	1434	2009	1794	1693	1722

5.13. Effect of duration of crop on yield

To know the difference in yield due to difference in the duration of crop, all farmers were grouped into five groups according to different duration. Average of all the locations and all the three years information indicated that the farmers who kept the crop on the field for more than 130 days received highest yield of 1674 kg per hectare (Table 133). But the area of survey plots under this group was only 8% of the total surveyed area. The group to whom the duration of crop in the field was 121 to 130 days received 1669 kg/ha of yield which was very nearer to highest group.

Table 133 : Average yield of wheat on sample plots according to the duration of crop in different survey areas (Average of 1980-83).

Survey area	Yield (kg/hectare) by duration of crop (days)					
	Upto 100	101-110	111-120	121-130	Above 130	All
Shailkupa	1230	1017	1038	1005	939	1052
Daudkandi	1920	1921	1951	2220	-	1949
Modhupur	1743	1860	1837	1664	1480	1762
Thakurgaon	1327	1643	1562	1852	1983	1672
All areas	1616 (19)	1635 (30)	1615 (30)	1669 (13)	1674 (8)	1636 (100)

Brackated figures are the percentage of total cultivated wheat area.

In Shailkupa highest average yield (1230 kg/ha) was obtained by the farmers who kept the crop in the field for less than 100 days while in Daudkandi highest average yield (2220 kg/ha) was obtained by the group who kept the crop in the field for 121 to 130 days (Table 133). In the earlier chapter, it was shown that in Shailkupa 47% of the total farmers broadcasted seeds within November while in Daudkandi it was only 11% farmers who broadcasted seeds during November and the rest 89% farmers broadcasted in December.

In Modhupur, highest average yield (1860 kg/ha) was received by the farmers who kept the crop in the field for 101 to 110 days while in Thakurgaon, the farmers who kept the crop in the field for more than 130 days received highest average yield of 1983 Kg/ha (Table 133). It was shown earlier that 69% farmers in Modhupur planted their seeds within November while in Thakurgaon, 83% farmers planted the seeds in December and January. Thus, in general,

the result indicated that in Shailkupa and Modhupur where most of the farmers planted seeds early, received higher yield within short duration while in Daudkandi and Thakurgaon, where most of the farmers planted seeds late, received higher yield from longer duration plants.

Yearwise analysis of data could not show any logical behaviour mainly due to the influence of localised practices by the farmers. In 1980-81, the highest average yield of wheat (1686 kg/ha) was obtained by the group of farmers who kept the crop for less than 100 days in the field while in 1981-82, the highest average yield (1663 kg/ha) was received by the farmers who kept the crop in the field for 101 to 110 days. In 1982-83, however, highest average yield (2085 kg/ha) was received by the farmers who kept the crop in the field for more than 130 days (Table 134).

Table 134 : Average yield of wheat on sample plots according to the duration of crop in different years.

Survey year	Yield (kg/ha) by duration of crop (days)					
	Upto 100	101-110	110-120	121-130	Above 130	All
1980-81	1686	1514	1351	1546	1656	1517
1981-82	1367	1663	1515	1445	1126	1512
1982-83	2009	1654	2015	1969	2085	1871
Average	1616	1635	1615	1669	1674	1636

In a situation of farmers' management where the use of factors of production are not controlled, it is difficult to isolate the effect of any specific input. It is the combination of various factors responsible for change in the yield.

5.14. Resource utilization efficiency

The wheat yield depends upon a large number of independent factors. In mathematical notation,

$$Y = f(x) \text{ where,}$$

Y is the yield of wheat and x are the independent variables. It is difficult to quantity all the independent variables. For the sake of simplicity only major ones were considered. It was hypothesized that wheat yield at the farm level depended mainly on the farm size, human labour, animal pair days, quantity of fertilizer applied (Urea, TSP, MP) and seed rate used. An important variable which influenced wheat yield was the weather. To minimize the influenced of weather on yield of wheat, the average data for the year 1980-81, 1981-82 and 1982-83 were taken. Accordingly, a multiple linear regression equation was fitted in as follows :

$$Y = 671.514 + \underset{(1.221)}{0.050\, x_1} + \underset{(7.862)}{7.174\, x_2}^{*} - \underset{(-2.978)}{6.356\, x_3}^{*}$$

$$+ \underset{(2.485)}{1.505\, x_4}^{*} - \underset{(-.692)}{0.380\, x_5} + \underset{(3.212)}{4.209\, x_6}^{*} - \underset{(-.178)}{0.207\, x_7}$$

* Significant at one percent level of significance. Bracketed figures in the equation indicate (t) values of the estimate.

Co-efficient of multiple correlation ($R_{y.1.....7}$) = 0.632*

Co-efficient of multiple determination ($R^2_{y.1....7}$) = 0.399

$$F_{Reg} = 37.2^*$$

Where, y = yield of wheat (kg/ha)

x_1 = Farm size in hectare

x_2 = Human labour (mandays/ha)

x_3 = Animal labour (pairadys/ha)

x_4 = Urea (kg/ha)

x_5 = TSP (kg/ha)

x_6 = MP (kg/ha)

x_7 = Seed rate (kg/ha)

The regression equation thus fitted in showed that the yield was significantly related to human labour, animal labour, quantity of urea and MP used.

The co-efficient of x_i's (i = 1,2,.....7) are the partial regression co-efficient (b_1 = 0.050, b_2 = 7.174,... .....b_7 = -0.207). The value of b_2 (= 7.174) is interpreted as the expected increases in yield rate for an increase in one unit of mandays of human labour. It implies that more human labour may be used to increase the yield of wheat. Number of human labour manday can profitably be increased by performing the weeding. Earlier, it was shown that a large number of farmers in Thakurgaon, Modhupur ~~was~~ and Shailkupa did

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* Significant at one percent level of significance.

not weed their field. Possibly the farmers in these areas could increase the yield by performing weeding.

The value of b_3 = -6.356 is interpreted as the expected decrease in yield for an increase in one unit of animal pair days. This implies that excessive number of bullock labour was used in the land preparation and there is possibility to use less number of bullock labour without reducing the yield of wheat. It would also reduce the cost of production and thus increase profitability.

The value of b_4 = 1.504 is interpreted as the expected increase in yield of wheat for an increase in one unit of urea which implies that there is possibility to use more urea to increase the yield. The value of b_6 = 4.209 is interpreted as an expected increase in yield of wheat for an increase in one unit of Muriate of potash. This implies that more use of potassium fertilizer may increase the yield.

However, size of farm (b_1 = 0.050), although was found positively related to yield, the relationship was not significant. Similarly use of TSP (b_5 = -0.380) and quantity of seeds (b_7=-0.207) although seems to be used excessively, it was not significant.

Co-efficient of multiple determination (R^2_y) indicated that 40% of the variation in yield (Y) had been explained by the fitted regression equation.

Co-efficient of multiple correlation (R_y) is significant at one percent level of significance which indicated that there is positive and high association between the observed value of Y and corresponding expected value of Y.

As F value is significant at one percent level of significance, it indicated that $b_i \neq 0$

Due to limitation of time and computational facility, different forms of production functions with more number of explanatory variables could not be tested.

CHAPTER - VI

ECONOMIC PERFORMANCE OF WHEAT CULTIVATION

The present chapter describes costs of different variable inputs used per hectare in wheat cultivation on the survey plots and return received from the same plot. Efficiency in wheat production has been measured in terms of gross margin per unit of time and area, return over cash expenses, benefit-cost ratio, return to labour etc. in different locations, in different years and for different farm size groups.

6.1. Cost of production

The cost of production included all variable cost items like labour, draft power, seed, manures, chemical fertilizer, insecticides etc. used in the production of wheat. Both cash expenditure and imputed value of family owned inputs have been included in the study.

When all variable cost were included, the average cost of production of wheat cultivation over 3 years in four locations was found to be Tk. 4526 per hectare (Table 135). The cost was higher in 1982-83 compared to 1980-81 and 1981-82. It was mainly due to the higher cost of seeds, fertilizers and irrigation that the cost on the third year increased. In chapter IV, it was shown that the average seed rate used in the third year was lower (125 kg/ha) than that in the first year (143 kg/ha). Even then the cost of seed was higher in the third year due to the increase in the price of seed. Similarly, the quantity of urea, TSP and MP were used less in the third year than the first year, but the cost was higher in the third year due to the increase in price of fertilizer.

Table 135 : Average cost of wheat cultivation in different years.

Cost items	Cost per hectare of wheat cultivation (Tk)				
	1980-81	1981-82	1982-83	Average	Percent
Labour :					
Family	1177	925	1070	1060	
Hired	516	378	311	402	
All	1693	1303	1381	1462	32
Draft power :					
Family	627	718	547	629	
Hired	94	115	58	89	
All	721	833	605	718	16
Seed :					
Own	188	225	383	266	
Purchased	341	427	545	438	
All	529	652	928	704	15
Organic manures: (all owned)	194	252	361	270	
Chemical fertilizer:					
Urea	454	454	484	464	
TSP	376	364	386	376	
MP	86	55	101	81	
All	916	873	971	921	
All manures and fertilizer :	1110	1125	1332	1191	26
Pesticides	3	-	-	1	
Irrigation	230	281	410	307	7
Interest on credit :	18	17	6	14	
Interest on operating cost :	126	124	138	129	3
Total variable cost :					
Full-cost-basis	4430	4335	4800	4526	100
Cash-cost-basis	2100	2074	2295	2158	48

Total variable cost per hectare in the second year (1981-82) was lower than in the first or third year purely due to the lower cost of labour. Although in the second year, slightly less number of labour was used (129.6 mandays/ha) compared to that in the first year (131.2 mandays/ha), the cost was much lower than in the first year mainly due to the reduced wage rate. It was striking to note that while the price of almost all other purchased inputs increased in the second and third year, the wage rate of labour actually reduced.

Human labour constituted about 32% of the total variable cost (Table 135). However, 73% of this labour cost was due to the imputed value of the family supplied labour. Next important cost item was manures and fertilizers which constituted about 26% of the total variable cost. About 77% of this cost was purchased on cash. Seed and draft power constituted respectively 15% and 16% of the total variable cost (Table 135). In all, Tk. 2158 per hectare or 48% of the total variable cost was spent in cash. Chemical fertilizer constituted about 43% of the cash cost which was the major cash requirement. Next cash requirement was for purchasing seeds which constituted 20% of the cash cost. Although human labour cost was highest in the total variable cost, due to the intensive use of family labour, it constituted only 19% of the cash costs which was spent to pay to the hired labour.

Cost of cultivation varied significantly among different locations. Highest cost was found in Daudkandi which was Tk. 5391 per hectare and lowest was found in Shailkupa (Tk. 3341/ha) (Table 136). The average cost in Modhupur was Tk. 5019/ha which was nearer to the cost in Daudkandi and the average cost in Thakurgaon was Tk. 3941/ha which was nearer to that in Shailkupa. Higher cost in Daudkandi was due to the higher cost of labour, draft power and chemical fertilizers. However, when only cash

Table 136 : Average cost of wheat cultivation in different survey areas (Average of 1980-83).

Cost items	Cost per hectare (Tk)				
	Shail-kupa	Daud-kandi	Modhupur	Thakur-gaon	Average
Labour :					
Family	862	1279	861	1202	1060
Hired	71	748	377	319	402
All	933	2027	1238	1521	1462
Draft power :					
Family	761	837	468	422	629
Hired	21	261	11	26	89
All	782	1098	479	448	718
Seed :					
Own	75	448	95	416	266
Purchased	627	196	636	335	438
All	702	644	731	751	704
Organic manure (all owned) :	343	41	307	344	270
Chemical fertilizer :					
Urea	207	725	540	305	464
TSP	208	602	355	277	376
MP	86	83	83	72	81
All	501	1410	978	652	921
All manures and fertilizers :	844	1451	1285	996	1191
Pesticides	1	1	-	3	1
Irrigation	-	-	1079	120	307
Interest on credit :	6	13	22	15	14
Interest on operation cost :	73	157	185	87	129
Total variable cost:					
Full-cost-basis	3341	5391	5019	3941	4526
Cash-cost-basis	1221	2616	3081	1455	2158

costs were considered, the cost per hectare was found higher in Modhupur (Tk. 3081/ha) and lower in Shailkupa (Tk. 1221/ha) (Table 136). Higher cash cost in Modhupur was mainly due to the cost of irrigation which was Tk. 1079/ha (Table 136). In Shailkupa and Daudkandi, the cost of irrigation was nil. Although labour cost was higher in Daudkandi, 63% of this cost was due to the imputed value of family labour.

When cost of wheat cultivation of different farm size groups were compared, it was observed that the total variable costs as well as cash variable costs were highest for small farm size group than other farm size groups. It was Tk. 4717/ha and Tk. 2368/ha as total variable cost and cash variable cost respectively for small farmers (Table 137). Intensive use of human labour, high cost of draft animal and more use of chemical fertilizers were major reasons for higher cost to the small farmers.

6.2. Returns from wheat production

Average yield of wheat grain and straw per hectare in different years, in different locations and for different farm size groups and price received by the farmers formed the basis of return. The average gross return was Tk. 6507 per hectare and gross margin was Tk. 1981 on full cost basis (Table 138). Gross return was highest in 1982-83 (Tk. 7822/ha) due to higher yield. Gross return was found lowest in 1980-81 (Tk. 4722/ha). Although yield was higher in this year than 1981-82, but due to lower price of grain, return was lower.

Gross margin per day per hectare was found highest in 1982-83 which was Tk. 48.91 on cash cost basis and Tk. 26.74 on full cost basis. Similarly benefit-cost ratio was higher in 1982-83 and lower in 1980-81 (Table 138). The average benefit cost ratio was found 3.02 on cash cost basis and only 1.44 on full cost basis. To measure the efficiency of labour, returns

Table 137 : Average cost of wheat cultivation for different farm size groups.

Cost item	Cost of wheat per hectare (Tk)			
	Small	Medium	Large	Average
Labour :				
Family	1137	1027	986	1060
Hired	446	339	442	402
All	1583	1366	1428	1462
Draft power :				
Family	587	771	580	629
Hired	190	9	17	89
All	777	780	597	718
Seed :				
Owned	270	233	284	266
Purchased	421	465	440	438
All	691	698	724	704
Organic manure (All owned) :	198	251	306	270
Chemical fertilizer :				
Urea	522	443	407	464
TSP	411	371	334	376
MP	75	84	87	81
All	1008	898	828	921
All manures & Fertilizer :	1206	1149	1134	1191
Pesticide	1	1	1	1
Irrigation	302	314	309	307
Interest on credit :	15	11	15	14
Interest on operating cost :	142	122	122	129
Total variable cost :				
Full-cost-basis	4717	4441	4330	4526
Cash-cost-basis	2368	2026	2037	2158

Table 138 : Cost, return and income measures of wheat cultivation in different years.

Parameters	Survey year			
	1980-81	1981-82	1982-83	Average
Cost of Production (Tk/ha) :				
Full-cost basis	4430	4335	4800	4526
Cash-cost basis	2100	2074	2295	2158
Cost of Production (Tk/kg) :				
Full-cost basis	2.92	2.87	2.57	2.77
Cash-cost basis	1.38	1.37	1.23	1.32
Grain yield (kg/ha) :	1517	1512	1871	1636
Grain price (Tk/kg) :	2.89	4.30	3.90	3.70
Returns from the grain (Tk/ha):	4384	6502	7297	6053
Straw yield (kg/ha) :	1692	1652	2098	1818
Straw price (Tk/kg) :	0.20	0.29	0.25	0.25
Returns from straw (Tk/kg) :	338	479	525	454
Gross return (Tk/ha) :	4722	6981	7822	6507
Gross margin (Tk/ha) :				
Full-cost basis	292	2646	3022	1981
Cash-cost basis	2622	4907	5527	4349
Gross margin (Tk/ha/day) :				
Full-cost basis	2.63	24.50	26.74	17.85
Cash-cost basis	23.62	45.44	48.91	39.18
Benefit/cost ratio :				
Full-cost basis	1.07	1.61	1.63	1.44
Cash-cost basis	2.25	3.37	3.41	3.02
Returns to labour (Tk/day) :	15.13	30.47	34.97	26.69

to labour was calculated. It was found that the average returns to labour per manday was Tk. 26.69 which was again higher in 1982-83 and lower in 1980-81 (Table 138).

Although cost per hectare was highest in Daudkandi (Tk. 5391/ha), the cost per kg of wheat was highest in Shailkupa (Tk. 3.18/ha) due to its lower yield (Table 139). Again the cost per kg of wheat on cash cost basis was highest in Modhupur (Tk. 1.75/kg) due to its high cash cost. Yield was highest in Daudkandi, but the gross return was highest in Modhupur (Tk. 7714/ha) due to higher price (Tk. 4.11/kg) received by the farmer. However, gross margin on full cost basis was higher in Modhupur (Tk. 2695/ha), but the gross margin on cash cost basis was higher in Thakurgaon (Tk. 4843/ha) due to lower cash cost (Table 139). Benefit-cost ratio was also highest in Thakurgaon due to lower cost.

Return analysis for different farm size groups show that the yield and gross return was higher for small farm size group, but due to higher cost of production, gross margin was lower for this group (Table 140). For the same reason, benefit-cost ratio for small-farmer was also lower than medium or large farm size groups. On the other hand, large farmers received higher gross margin and higher benefit-cost ratio than other farm size groups, due to its lower cost of production (Table 140).

However, profitability is not the only criteria for measurement of efficiency. Farmers at the subsistence level are interested to produce wheat primarily for consumption. In the next chapter, disposal pattern of wheat produce for different groups of farmers will show that small farmers consume major share of their produce and hence profitability may not be very important to them.

Table 139 : Cost, return and income measures of wheat cultivation in different survey areas (Average of 1980-83).

Parameters	Locations				
	Shail-kupa	Daud-kandi	Modha-pur	Thakur-gaon	All areas
Cost of Production (Tk/ha) :					
Full-cost basis	3341	5391	5019	3941	4526
Cash-cost basis	1221	2616	3081	1455	2158
Cost of Production (Tk/kg) :					
Full-cost basis	3.18	2.77	2.85	2.36	2.77
Cash-cost basis	1.16	1.32	1.75	0.87	1.32
Grain yield (kg/ha) :	1052	1949	1762	1672	1636
Grain ~~yield~~ Price (Tk/kg) (kg/ha) :	3.77	3.35	4.11	3.50	3.70
Return from grain (Tk/ha) :	3966	6529	7242	5852	6053
Straw yield (kg/ha) :	1335	2154	1888	1786	1818
Return from straw (Tk/ha) :	334	538	472	446	454
Gross return (Tk/ha) :	4300	7067	7714	6298	6507
Gross margin (Tk/ha) :					
Full-cost basis	959	1676	2695	2357	1981
Cash-cost basis	3079	4451	4633	4843	4349
Gross margin (Tk/ha/day) :					
Full-cost basis	8.64	15.81	23.64	20.86	17.85
Cash-cost basis	27.74	41.99	40.64	42.86	39.18
Benefit/cost ratio :					
Full-cost basis	1.29	1.31	1.54	1.60	1.44
Cash-cost basis	3.52	2.70	2.50	4.33	3.02
Return to labour (Tk/day) :	26.35	21.33	33.30	27.64	26.69

Table 140 : Cost, return and income measures of wheat cultivation for different farm size groups.

Parameters	Farm size groups			
	Small	Medium	Large	All size
Cost of production (Tk/ha):				
Full-cost basis	4714	4441	4330	4526
Cash-cost basis	2358	2026	2037	2158
Cost of production (Tk/kg):				
Full-cost basis	2.82	2.80	2.66	2.77
Cash-cost basis	1.42	1.28	1.25	1.32
Grain yield (kg/ha) :	1673	1586	1625	1636
Grain price (Tk/kg) :	3.69	3.72	3.67	3.70
Return from grain (Tk/ha):	6173	5900	5964	6053
Straw yield (Kg/ha) :	1913	1790	1717	1818
Return from straw (kg/ha) :	478	448	429	454
Gross return (Tk/ha) :	6651	6348	6393	6507
Gross margin (Tk/ha) :				
Full-cost basis	1934	1907	2063	1981
Cash-cost basis	4283	4322	4356	4349
Gross margin (Tk/ha/day) :				
Full-cost basis	17.42	17.18	18.59	17.85
Cash-cost basis	38.59	38.94	39.24	39.18
Benefit cost ratio :				
Full-cost basis	1.41	1.43	1.48	1.44
Cash-cost basis	2.81	3.13	3.14	3.02
Return to labour (Tk/day) :	25.38	26.83	28.71	26.69

CHAPTER - VII

DISPOSAL OF WHEAT CROP AND FARMERS' INTENTIONS TO WHEAT CULTIVATION

In this chapter, the pattern of disposition of wheat crop and its by product in different years, in different locations and by different farm size groups have been discussed. Moreover, farmers' intentions towards future wheat cultivation are also discussed.

7.1. Disposal of wheat crop

On the average, 41.4% of the total wheat grain produced was consumed by the farmers and his family. The share of total production for consumption reduced in 1982-83 (38.8%) when the production was higher and increased in 1981-82 (43.6%) when the productions was lower (Table 141). On the other hand, share of total production sold immediately after harvesting increased in 1982-83. Share of production kept for seed also reduced from 14.3% in 1980-81 to 9.7% in 1982-83 (Table 141).

Table 141 : Disposal pattern of wheat grain in different years.

Survey year	Percent of wheat grain			
	Consumed	Sold at harvest time	Sold later in the year	Used as seeds
1980-81	42.0	32.3	11.4	14.3
1981-82	43.6	35.9	8.7	11.8
1982-83	38.8	41.4	10.1	9.7
Average	41.4	36.2	10.3	12.1

Disposal pattern of wheat was found different in different locations depending on the total production. In shailkupa where production was lower, the share of the total production (Average of 3 years) consumed by the farmer and his family was 69.8% while in Modhupur where market was assured, this share of consumption was only 33.5% of the total production (Table 142). For the same reason, in Modhupur, the share of total production sold immediately after harvesting was 48.3% which was highest among all the location. Earlier in chapter IV, it was observed that most of the Modhupur farmers were supplied with institutional source of seed while in Daudkandi most of them used their own seed. For this reason, Modhupur farmers kept only 7.3% of their production as seed for the next year (Table 142).

Table 142 : Disposal pattern of wheat in different survey areas (Average of 1980-83).

Survey area	Percent of total wheat grain			
	Consumed	Sold at harvest time	Sold later in the year	Used as seed
Shailkupa	69.8	11.5	5.0	13.7
Daudkandi	44.1	29.7	8.0	18.2
Madhupur	33.5	48.3	10.9	7.3
Thakurgaon	35.5	41.1	13.4	10.0
All areas	41.4	36.2	10.3	12.1

Different farm size groups were found to dispose off their products in different way depending on their need for cash, consumption nature and quantity produced. Three years average information indicated that about 50% of the total production of a small farmer was consumed by the farmer and his family while he could sale only 37.7% of the production (Table 143). On the

Table 143 : Disposal pattern of wheat grain by different farm size groups.

Farm size group	Percent of total wheat grain			
	Consumed	Sold at harvest time	Sold later in the year	Used as seeds
Small	49.8	30.1	7.6	12.5
Medium	45.4	31.8	9.3	13.5
Large	34.3	41.6	12.9	11.2
Average	41.4	36.2	10.3	12.1

other hand, large farmer and his family consumed about 34% of the total production and sold 54.5% of it. This shows that the increase in the wheat price would benefit large farmers more because of higher share of sale while subsidy on input price would benefit small farmers more because of his large share of consumption.

About 56% of thd total wheat straw was used as fuel and 38% was used for housing and fencing (Table 144). Wheat straw was used as animal feed in small quantity in all the locations except in Modhupur. In Daudkandi about 8% of the total wheat straw was used as animal feed while in other areas it was negligible (Table 144). Wheat straw was found to be sold by the farmers, although in small quantity, in all the locations except in Shailkupa. On the average 4% of the straw was sold (Table 144).

Table 144 : Disposal pattern of by-product of wheat in different survey areas (Average of 1980-83).

Survey area	% total by-product of wheat			
	Sold	Used as fuel	Used as animal feed	Housing & fencing
Shailkupa	-	76.9	0.5	22.6
Daudkandi	7.2	59.5	8.3	25.0
Modhupur	9.3	20.9	-	69.8
Thakurgaon	2.2	58.5	0.1	39.2
All area	4.0	56.4	2.0	37.6

All the farm size groups were observed to use wheat straw in two major uses - as fuel and for housing and fencing. Although all farmers were found to use major share of wheat straw as fuel and next for housing and fencing, small farmers were inclined to use it for housing and fencing more than medium and large farmers. While small farmers used 42% of wheat straw for this purpose, medium and large farmers used 34% and 37% respectively of their wheat straw production for this purpose (Table 145).

Table 145 : Disposal pattern of by-product of wheat for different farm size groups.

Farm size group	% total by-product of wheat			
	Sold	Used as fuel	Used as animal feed	Housing & fencing
Small	2.8	53.5	1.9	41.8
Medium	3.2	60.4	2.7	33.7
Large	5.3	56.5	1.6	36.6
All sizes	4.0	56.4	2.0	37.6

7.2. Seasonal price variation

Price of wheat grain at farmers level was found to vary from location to location, year to year as well as within a year in different seasons. The price prevailed immediately after harvesting was found lower than the price prevailed before harvesting. On the average, the price of wheat was Tk. 3.19/kg immediately after harvesting which increased 27% to Tk. 4.06/kg at the pre-harvesting period (Table 146). However, the rate of increase of price from harvest price was found highest in 1981-82 when the price increased 37% during off season. The difference was minimum in 1982-83 when only 17% increase in the price of wheat from harvest season to off season was observed (Table 146).

Moreover, there was a gradual increase in the price from 1980-81 to 1982-83. While in 1980-81, the average harvest price was found Tk. 2.71/kg, it increased 42% to Tk. 3.85/kg in 1982-83 (Table 146). Similarly offseason price also increased 27% from Tk. 3.54/kg in 1980-81 to Tk. 4.49/kg in 1982-83.

Table 146 : Post harvest and preharvest price in different years.

Survey year	Price of wheat (Tk/kg)			Price increase (%)
	Post harvest	Pre-harvest	Average	
1980-81	2.71	3.54	3.12	31
1981-82	3.02	4.14	3.58	37
1982-83	3.85	4.49	4.17	17
Average	3.19	4.06	3.62	27

Average harvest price received by the farmers was found higher in Shailkupa (Tk. 3.60/kg) and Modhupur (Tk. 3.33/kg) while it was lower in Daudkandi (Tk. 2.89/kg) and Thakurgaon (Tk. 2.94/kg) (Table 147). This price in all the locations except in Modhupur was observed to increase at the same rate. In Modhupur, the price difference between harvest season and off season was minimum (14%) mainly due to the seed procurement programme of BADC where higher price was offered to the farmers at harvest time.

Table 147 : Post harvest and pre-havest price in different survey areas.

Survey area	Price of wheat (Tk/kg)			Price increase (%)
	Post harvest	Pre-harvest	Average	
Shailkupa	3.60	4.75	4.18	32
Daudkandi	2.89	3.82	3.36	32
Modhupur	3.33	3.81	3.37	14
Thakurgaon	2.94	3.84	3.39	31
Average	3.19	4.06	3.62	27

7.3. Farmers' intentions towards wheat cultivation

To know the farmers' intentions towards growing wheat in future, opinion was taken from them. On the average, it was observed that 87% of the total farmers were willing to increase the area or at least keep the area under wheat same in the next year (Table 148). The trend of taking more and more land under wheat increased from 78% farmers in 1980-81 to 86% in 1981-82 and 96% in 1982-83. High yield was the major reason for which 40% of the total farmers preferred to increase their area under wheat. High income and home consumption were the other major reasons for which many farmers were inclined towards growing more and more wheat (Table 148).

Table 148 : Reasons for cultivating more area or at least keep the same area under wheat in different years.

Reasons	Percent of total farmers			
	1980-81	1981-82	1982-83	Average
High yield	39	39	43	40
High income	9	16	21	16
Home consumption	19	22	17	19
Easy to grow	11	9	15	12
Total	78	86	96	87

Although the average yield of wheat in Shailkupa was lower (1052 kg/ha) than other locations, 60% of the total respondant in that area preferred to increase or at least keep the area under wheat same for its high yield (Table 149). It signifies that the yield of wheat in that locality is fairly high compared to the other competitive crops. In Thakurgaon, 43% respondant preferred wheat cultivation for their home consumption. In Daudkandi, however, 43% respondant preferred to grow wheat cultivation for its higher yield and another 15% farmers preferred it for home consumption (Table 149). The analysis revealed that in Daudkandi only 74% respondants were in favour of increasing the area (or keeping the area same) of wheat in the next year, although average yield was highest in this area compared to other areas. This indicates that wheat in Daudkandi has to face competition with other crops to occupy the land.

Table 149 : Reasons for cultivating more area or at least keep the area under wheat same in different survey areas (Average of 1980-83).

Reasons	Percent of total Farmers				
	Shailkupa	Daudkandi	Modhupur	Thakurgaon	Average
High yield	60	43	57	-	40
High income	2	11	22	27	16
Home consumption	2	15	17	43	19
Easy to grow	17	5	-	25	12
Total	81	74	96	95	87

While 87% of the total respondants reported that they would either increase area or keep the same area under wheat next year, other 13% respondants reported that they would reduce the wheat area in the next year (Table 150). On the average, 10% of the total farmers reported poor yield as the major cause for taking decision to reduce the area. However, in 1980-81, this cause of poor yield was reported by 19% farmers and gradually it was reduced to 10% in 1981-82 and only 2% farmers in 1982-83 (Table 150). The result indicated that the farmers are getting more and more familiar with the wheat cultivation and yield is also increasing. A small number of farmers reported high input costs and nonavailability of needed inputs as other reasons for reducing their wheat area. The share of this group of reluctant farmers, however, gradually decreased from 22% in 1980-81 to only 4% in 1982-83 (Table 150).

Table 150 : Reasons for cultivating less area or none under wheat in the next year in different years.

Reasons	Percent of total farmers			
	1980-81	1981-82	1982-83	Average
Poor yield	19	10	2	10
High input costs	1	3	2	2
Could not get needed inputs	2	1	-	1
Total	22	14	4	13

Out of 26 farmers in Daudkandi who reported to reduce area under wheat in the next year, 19 farmers showed poor yield as the major reason. Similarly in Shailkupa, 17 out of 19 farmers reported poor yield as the major reason for reducing the area under wheat (Table 151). In Daudkandi and Thakurgaon, high input costs and nonavailability of inputs were reported by few farmers as the major causes for reducing the area under wheat (Table 151).

Table 151 : Reasons for cultivating less area or none under wheat in the next year in different survey areas (Average of 1980-83).

Reasons	Percent of total farmers				
	Shailkupa	Daudkandi	Modhupur	Thakur-gaon	Average
Poor yield	17	19	4	1	10
High input costs	2	4	-	2	2
Could not get needed inputs	-	3	-	2	1
Total	19	26	4	5	13

The farmers were asked how much land they intend to cultivate under wheat in the next year. Table 152 shows a comparison between wheat area, a farmer actually planted and wheat area, he intended to plant in the next year. In 1980-81, an average farmer planted 0.39 ha of land under wheat cultivation and intended to reduce his area to 0.36 ha in 1981-82. But due to several constraints he could not plant his intended area and actually planted 0.24 ha only under wheat. However, he wanted to plant 0.26 ha under wheat in 1982-83. In 1982-83, the farmer planted the same area of 0.26 ha and after observing the favourable performance, intended to increase his area to 0.29 ha of land under wheat cultivation (Table 152). This shows that the farmers decision cannot be implemented always due to several factors beyond his control. In 1981-82, the farmer could not plant the wheat area as intended in the earlier year mainly due to draught situation. As such, the farmer intended to plant approximately same area under wheat in the next year i.e. 1982-83. But the favourable climate in 1982-83 helped to plant area under wheat more than the farmer intended in Thakurgaon and Daudkandi while the average farmer in Shailkupa and Modhupur could not even plant the area they intended.

Table 152 : Area under wheat proposed to be cultivated in the next year in different survey areas.

Survey area	Wheat area per farm (hectare)					
	1980-81		1981-82		1982-83	
	Present	Proposed in the next year	Present	Proposed in the next year	Present	Proposed in the next year
Shailkupa	0.30	0.25	0.18	0.25	0.17	0.21
Daudkandi	0.29	0.24	0.23	0.24	0.27	0.26
Modhupur	0.38	0.38	0.27	0.28	0.23	0.28
Thakurgaon	0.60	0.58	0.28	0.28	0.39	0.41
Average	0.39	0.36	0.24	0.26	0.26	0.29

This information also tells that after a set back in 1981-82, the farmer could not regain the position of 1980-81 interms of area under wheat even with the favourable weather in 1982-83.

Comparison of actual and intended wheat area for different farm size groups show that deviation from intention was more prominant among large farmers than small or medium farmers. In 1980-81, an average small farmer planted 0.24 ha under wheat and wanted to plant the same area in 1981-82 (Table 153). But in 1981-82, due to bad weather, he had to reduce wheat area to 0.17 ha only. However, in 1982-83, he planted 0.18 ha under which he intended. In the next year, he wants to increase his area gradually. But in case of large farmers, an average large farmer drastically reduced his area under wheat to 0.38 ha in 1981-82. This was much below his intention of 0.57 ha. In 1982-83 he planted 0.38 ha under wheat although he earlier intended to plant 0.42 ha (Table 153). It shows that small farmers are more stable and rational in making decisions.

Table 153 : Area under wheat proposed to be cultivated in the next year by different farm size groups.

Farm size group	Wheat area per farm (hectare)					
	1980-81		1981-82		1982-83	
	Present	Proposed in the next year	Present	Proposed in the next year	Present	Proposed in the next year
Small	0.24	0.24	0.17	0.18	0.18	0.20
Medium	0.39	0.36	0.24	0.26	0.28	0.29
Large	0.62	0.57	0.38	0.42	0.38	0.43
Average	0.39	0.36	0.24	0.26	0.26	0.29

When the farmers were asked what steps they would take in the next year to increase the yield of wheat, 67% of them were in the opinion that use of more fertilizers will increase yield (Table 154). Another 16% farmers thought use of better quality seeds would increase the wheat yield. However, these opinions also differ in diffeent years and in different locations. In 1980-81, on the average 72% farmers were in favour of increasing yield by using more fertilizers (Table 154). In 1981-82, the average quantity of fertilizer used in wheat plot was less than that of 1980-81 and the performance was also not good. This led to the belief that using more fertilizer would increase the yield situation and in 1981-82, 75% farmers were in the same opinion. But in 1982-83, after receiving good production, only 52% of the farmers retained in the same opinion. The share of farmers who believed that use of better quality seeds would increase the wheat yield, increased from 12% in 1981-82 to 19% in 1982-83 (Table 154). Another group comprising 15% of the total farmers in 1982-83 were in the opinion that weed control would increase the yield of wheat.

Table 154 : Steps to be taken to get better yield of wheat reported in different years.

Steps	Percent of farmers			
	1980-81	1981-82	1982-83	Average
Use of more fertilizers	72	75	52	67
Use of more irrigation water	4	6	12	7
Use of better quality seeds	18	12	19	16
Weed control	-	-	15	5
Pest control	2	-	1	1
Could not specify	4	7	1	4
Total	100	100	100	100

In 3 locations namely Shailkupa, Daudkand and Modhupur, most of the farmers were in favour of using more and more fertilizer for increasing wheat yield (Table 155). But in Thakurgaon, 45% farmers were in favour of using better quality seeds for increasing wheat yield. That use of more irrigation water would increase the wheat yield have been reported by 14% farmers in Modhupur and Thakurgaon, the area where the farmers were already enjoying irrigation facility (Table 155). They referred to the proper management and timely supply of irrigation water. In Shailkupa and Daudkandi, farmers were not in favour of using irrigation water for wheat cultivation.

Table 155 : Steps to be taken to get better yield of wheat by the farmers in different survey areas (Average of 1980-83).

Steps	Percent of farmers				
	Shail-kupa	Daud-kandi	Modhu-pur	Thakur-gaon	Average
Use of more fertilizers	79	78	77	34	67
Use of more irrigation water	-	1	14	14	7
Use of better quality seeds	11	-	9	45	16
Weed control	-	20	-	-	5
Pest control	1	1	-	2	1
Could not specify	9	-	-	5	4
Total	100	100	100	100	100

CHAPTER VIII

CONCLUSIONS AND RECOMMENDATIONS

In the light of discussions in earlier chapters, conclusions with regard to assessment of improved technology of wheat production and constraints towards its higher production have been drawn in this chapter. Moreover, few recommendations on research priorities of wheat and its policy guidelines have been made.

8.1. Assessment of improved technology

Improved technology of wheat production has been assessed from agronomic, economic and social point of view. 'On farm' research results have been compared to the farmers' practices on the use of seeds, fertilizers, irrigation water, pesticides and intercultural operations. Acceptability of this technology by different groups of farm holdings, employment generation by the technology and its utilization pattern have also been discussed.

8.1.1. Seed of wheat

All the farmers were found to produce high yielding variety of wheat. Only one variety - sonalika was found to be produced by about 86% of the total farmers. Other varieties like Balaka, Pavan-76 and Tanori-71 were also found. The performance of Balaka and Pavon was found better than other varieties. However, Balaka was found in Daudkandi and Modhupur only while Pavon was available in all the four areas. These two varieties covered only 3% and 2.3% of the sample plot area. The potentiality of Balaka for large scale expansion is very high due to its draught tolerance nature. In Daudkandi, under non-irrigated condition, Balaka produced on average of 1799 kg/ha while in Modhupur under irrigated condition, it produced as high as 3124 kg/ha.

Research conducted on the farmers field on varietal performance in different locations showed that the average yield of Sonalika variety from the 'On farm' trial plots in all the three years from 1980-81 to 1982-83 were higher than the corresponding average yield of wheat under farmers' own management (Figure 3). The average yield of 3 years data from all the locations in research plots was 2052 kg/ha for Sonalika variety under non-irrigated condition. In the survey areas, about 22% of the non-irrigated plots had yield more than 2000 kg/ha. The average yield in irrigated plots of all locations in 3 years on the research plots was 2618 kg/ha. However, it was found that only 4% of the irrigated plots in the survey areas had yield more than this figure. Hence, it can be said that although the average yield at farmers level was below that of research yield, several farmers received yield higher than the research yield.

'On farm' research on seed rate in three years from 1980-81 to 1982-83 in different locations showed that on the average, 160 kg/ha under irrigated condition and 140 kg/ha of seeds under non-irrigated condition produced highest profitable yield. In the survey areas, the farmers were found to use an average rate of 134 kg/ha of seeds. This has gradually reduced from 143 kg in 1980-1981 to 125 kg in 1982-83 per hectare. However, 22% of the farmers who applied irrigation was found to apply seeds rate exceeding 160 kg/ha and most of them planted wheat late season. Similarly, 47% of the non-irrigated farmers in the survey areas were found to apply seed rate exceeding 140 kg/ha. Thus fairly a large number of farmers have exceeded the recommended seed rate. In chapter V, it was observed that the farmers could reduce the quantity of seeds slightly without reducing the yield. However, there were many farmers who used seed rate much below the recommended rate for which the average yield was low. To reduce the large variation in seed use between farmers, proper communiation is needed.

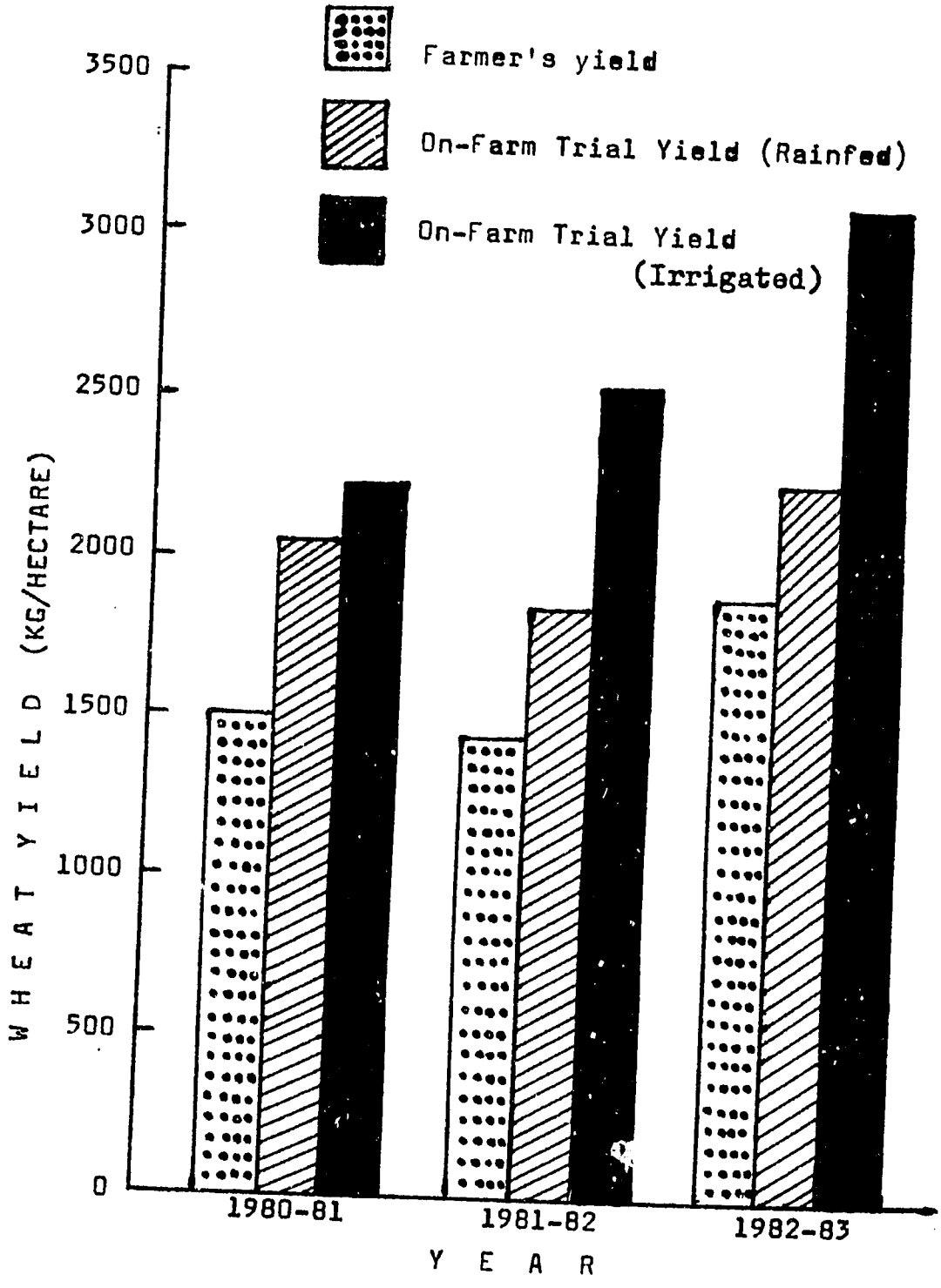

FIGURE 3 : COMPARISON OF FARMER'S YIELD WITH ON-FARM TRIAL YIELD OF WHEAT (VARIETY - SONALIKA) IN DIFFERENT YEARS.

Wheat research centre of BARI has recommended that to get optimum level of yield, the seeds should be sown within the month of November. It was found that only 34% of the total farmers planted seeds during this period of time. Majority (56%) farmers planted seeds during the month of December. In fact about 80% of the farmers produced wheat only after harvesting monsoon rice. It became very difficult to sow seeds of wheat within November after harvesting rice. Development of short duration variety which can be planted in December without yield reduction would solve this problem.

8.1.2. Chemical fertilizer

Farmers used Urea as nitrogenous fertilizer, TSP as phosphatic fertilizer and MP as potassium fertilizer. Research on the farmers' field in different locations in 3 years from 1980-81 to 1982-83 indicated that under irrigated condition, 100 kg of N/ha, 60 kg of P/ha and 40 kg of K/ha would increase the yield most profitably. However, in 1982-83 a research conducted under irrigated condition with 30 kg of Sulphur per hectare in addition to the above rate gave most profitable yield. The farmers did not use any sulphur in the study areas. On the average, the farmers applied 60 kg of N/ha, 60 kg of P/ha and 20 kg of K/ha.

Wheat research centre recommended fertilizer at the rate of 140-180 kg/ha of urea and 100-130 kg/ha of TSP under irrigated (1-2 irrigation) condition. In addition, for Barind tract, 50-60 kg/ha of MP was suggested. It was found that among the irrigated farmers, 15% farmers applied urea, 37% farmers used

TSP and only 3% farmers used MP more than the recommended dose. Thus it was observed that while in TSP, many farmers fairly follow the recommendations, in case of urea and MP, most of the farmers were much below the recommendation level.

Under rainfed condtion, the recommendation was 100-130 kg of urea/ha, 100-130 kg of TSP/ha and 40-50 kg of MP/ha (Only for Barind tract). It was observed that 37% of the non-irrigated farmers applied urea, 43% farmers applied TSP and 38% farmers applied MP more than the recommendation.

Thus it was observed, while most of the farmers did not follow the balanced dose of fertilizer, a large number used fairly high dose of TSP and lower dose of urea and MP than recommendations. The use of fertilizer was again found to be influenced by the location, Most of the Daudkandi farmers were found to apply more of urea and TSP while in other areas most of the farmers were below recommendation level.

8.1.3. Irrigation

It was only 43% of the total farmers who irrigated their wheat plots. In Daudkandi, farmers did not irrigate the wheat plots. The area remained inundated under water during monsoon season when most of the farmers cultivated deep water rice. After the water receded in October/November and when the rice crop harvested, farmers planted wheat seeds. Usually irrigation was not necessary for wheat for such medium low land where sufficient residual soil moisture was available. In Shailkupa, although irrigation was provided through G.K. canal irrigation project, the water was released for rice cultivation. The farmers had to shift their wheat cultivation in non-irrigated area. In Modhupur, however, all the farmers received deep tube-well irrigation water. In Thakurgaon about 52% of the farmers could not irrigate wheat field. The present discussion will base on the information from irrigated farms only.

Research findings recommend to apply first irrigation after 17-21 days of seed germination depending on the moisture condition of the soil. It was observed that in 37% of the total irrigated plots, farmers applied first irrigation after 3-4 weeks of seed sowing, which closely followed the recommendation. A small number of farmers were found to apply first irrigation even after 7-8 weeks of seed sowing. Three irrigations at different stages of plant growth has been recommended-1st at (CRI) critical root initiat ;; stage, 2nd before heading stage and 3rd at grain filling stage. It may go up to five irrigations depending on soil and water condition and if facilities can be provided. However, in the survey areas none was found to apply five irrigations. About 40% of the irrigated farmers irrigated their wheat plots for 3 times. Most of these farmers were from Modhupur. Another 38% farmers irrigated their field for twice only. It was observed that highest average yield was received (2009 kg/ha) from the plots which were irrigated for two times only. About 25% of the total survey plot area were put under two irrigations.

8.1.4. Weeding

Weeding was performed by 47% of the total farmers. Normally 1 to 2 weedings are suggested for wheat cultivation. It was observed that 88% of the farmers who weeded their field performed it only for once and the rest for twice. Recommendation is given for performing first weeding at the early stage, immediately after first irrigation, usually after 3 weeks of sowing seeds. In the study area, only 19% of the farmers who weeded their fields performed it 2-3 weeks after sowing seeds. However, another 50% of the farmers who weeded their fields, performed it 4 to 5 weeks after sowing seeds. Thus in case of weeding, very little farmers were found to follow recommendations. There might be two reasons for delay in weeding. Infestation of weeds may not be serious to warrant the situation and secondly, due to labour shortage, weeding may be delayed. The later problem was serious in some locations even to the extent of stop weeding for few farmers in Thakurgaon.

8.1.5. Plant protection

Wheat in the survey areas had been relatively disease and insect free. No such incidence of disease and insect attack has been reported nor any farmer sprayed insecticide on the field. However, rat problem was severe in Daudkandi which caused some losses. The farmers did not apply any rodenticide against rat attack. Loss due to rat attack could not be ascertained.

8.1.6. Post harvest operations

Threshing of wheat was done manually. In Modhupur, it was mostly done by hand while in other areas both manual labour and bullocks were used. Threshing of wheat was a problem to the farmers because it took longer time and hence more labour hours compared to rice. Pedal thresher, designed by BARI and other organizations were not available at farmers' level. In Modhupur, however, few threshers were supplied by BADC for threshing wheat.

8.1.7. Size of farm holding

It was hypothesized that improved technology of wheat may have some adverse effect on income distribution of farmers. In tabular analysis it was observed that on the average, small farmers received better yield of wheat compared to large farmers. But their gross margin was less due to higher cost associated with production. The cost was higher to the small farmers due to the intensive use of labour and other farm inputs. But in multiple linear regression analysis, no significant association was observed among the wheat yield and size of farm holding. However, on the average small farmers were found to devote more share (25%) of their cultivated land to wheat compared to only 19% by medium farmers and 15% by large farmers.

8.1.8. Disposal pattern

More than 46% of the wheat was produced for market. Small farmers were found to consume relatively major share of their own produce (50%) compared to that by large farmers. This phenomenon may guide the policy makers that subsidy on input .. price rather than subsidy on price of product whould benefit more to the subsistence farmer. Wheat straw is being used as many countries including India and Pakistan as cattle feed, in Bangladesh it has not yet gain the popularity. However, it has an ample scope to use as cattle feed and if its industrial use like that in paper industry can be promoted and if it can be lifted from the farm gate, wheat production would be much more profitable.

8.1.9. Employment generation

On the average, 129 mandays per hectare of labour was required for wheat cultivation. These mandays were spread over a period of 3-4 months. Major part of the labour was required for land preparation, harvesting, threshing and weeding. Land preparation and threshing which were mostly performed by the family labour created 'On farm' employment while weeding and harvesting which required hired casual labour created employment for the agricultural labour in the locality.

8.2. Identification of constraints

Constraints to higher production of wheat at farmers level have been identified from agronomic, economic and social point of view. This section of the report heavily relied on the discussions made earlier as well as informal meetings with the farmers.

8.2.1. Cropping systems

Wheat cultivation is a component of complex cropping systems followed by the farmers. In 80% of the wheat plots, the previous crop was monsoon rice, after harvesting of which wheat was produced. In low lying land of Daudkandi, it was broadcasted amon rice while in other areas it was transplanted amon rice. Harvesting period of rice ranged from November to December. Obviously, late harvesting of rice resulted in late planting of wheat for which yield tend to decrease gradually. Similarly in more than 60% of the survey plots, the succeeding crops were summer rice and jute, Planting of these crops started in March and April which coincided with the time of harvesting of wheat. The coincidence of planting and harvesting of wheat and rice created problems to wheat yield and resulted in artificial creation of labour peak. Development of early variety of amon rice and/or short duration variety of wheat would solve the problem to a great extent. Moreover, reduction in the turn-around period between amon rice and wheat by way of reducing land preparation for wheat would also be helpful to solve the problem.

8.2.2. Seed supply

Procurement of seeds was a problem to the farmers which resulted delay in planting and reduced the area of planting. Majority farmers purchased seeds from BADC. Only 37% of the total farmers had their own seeds. In 1982-83, inability to supply sufficient seeds by BADC and increase in the price of seeds resulted in lowering the seed rate per hectare and reducing the area planted. Demand for seed depends among many other factors on previous years' harvest conditions, favourable weather, demand for consumption through previous rice production etc. Input supply agency need to make a decision well in advance as to how much seed will be demanded in the next season.

Otherwise, only due to inability of the agency to supply timely seeds, the planting area will be reduced. However, if the farmers can store their own seeds, the problem of seed supply will be reduced. But this requires to develop lowcost and appropriate storage containers which suits the economic condition of the farmers Farmers also require eduction through extansion survice to use improve lowcost storage technigure.

8.2.3. Irrigation

Irrigation was not a major problem for Daudkandi or Shailkupa where majority farmers told that irrigation was not necessary for wheat cultivation. In Shailkupa, water schedule at present was designed for rice cultivation. As such irrigation water was not released at the critical growth period of wheat. In Thakurgaon, frequent breakdown of electricity caused about 44% of the wheat plots to remain non-irrigated within the deep-tubewell command area. Through proper care and management of tubewells in Thakurgaon and proper planning, management and farmers organization in Shailkupa, it is possible to improve upon the current situation.

8.2.4. Human labour

Supply of human labour became a constraint to wheat production during peak period. During weeding time of wheat crops harvesting of other rabi crops, employment of Agricultural labours for development activities and planting of boro rice required more labour for which weeding of wheat field delayed. Moreover, wheat threshing required more labour compared to rice at a time when jute and summer rice planting started. However, staggering of planting time may solve the problem partly.

8.2.5. Draft power

Draft power was a major problem particularly for the small farmers. More number of ploughings not only increased the cost, it exposed the soil and reduced available soil moisture. In Chapter V, regression line showed that the draft power was used excessively and probably it could be reduced without affecting the yield. Minimum tillage practice should be developed in specific areas to reduce the draft power constraint.

8.2.6. Seed variety

Sonalika was the single major variety available in the survey areas. Due to its better adaptability, good yield and white grain colour farmers preferred this variety to others. Its susceptability to rust disease may eventually make this variety unsuitable for commercial cultivation. However, Balaka veriety has started to became popular among the farmers. Similarly other disease resiestant short duration variety suitable for rainfed condition need to be released to the growers very soon. Otherwise sudden breakdown of Sonalika variety will bring disastour to wheat production in the country.

8.2.7. Threshing

Threshing of wheat appears to be a problem to wheat production but not a major one at this moment. Wheat threshing required more number of labour and complete dry day. If harvesting is delayed e.g. in April, there is every possibility of sky remaining cloudy cousing difficulties in threshing. However, for the small holders planting smaller area under wheat, it may not be a problem, but as the area and production increase, the problem, of wheat threshing, in terms of increased labour and animal power requirement will most likely to constrain wheat production.

8.2.8. Plant protection

Wheat is relatively disease free uptil now. The major pest which caused a problem to the farmers was rat. During winter season, as the field remains relatively dry, rats caused a great problem for the wheat farmer. Rat control campaign or growing awareness of the farming community may reduce the problem.

8.2.9. Input and output price

Price of wheat seeds has increased largely during last 3 years period resulting increase in cost and decrease in the seed rate used. Fertilizer price has also increased during this period. Although this is not specific to wheat, it has reduced the rate of fertilizer application in 1982-83 compared to 1980-81. Similarly irrigation cost also increased to a great extent. On the otherhand, price of wheat has not increased by that rate. Actually growers received less farmgate price in 1982-83 compared to 1980-81. However, the market price of wheat was increased over last three years. But this rate of increase was not as fast as in the input price. Moreover, as has been stated earlier in this chapter, the subsistence farmers who produced wheat mostly for consumption, would be benefited most if the subsidy on input is increased rather than subsidy on output price.

Farmers in Thakurgaon and Daudkandi were not happy with the price of wheat they received. Due to higher production in these areas and inefficient market structure, farm gate price was lower.

8.2.10. Knowledge

Lack of knowledge and skill of the new technology of wheat was found to be a major constraint towards higher yield. A good number of farmers were found to apply higher dose of fertilizer, high seed rate and intensive tillage operations. These had not only increased cost, but reduced profitability to a great extent. Moreover, timing of each operation was not followed as per recommendation by most of the farmers. Agricultural extension and education will play vital role in this regard.

8.2.11. Credit

Although financial stringency may not be specific to wheat cultivation, the results indicated that 87% of the total farmers did not receive any credit for wheat and more than half of them could not get it from any source inspite of their willingness. The results also showed that the credit was necessary mostly for purchasing fertilizer and paying water charge. Production of wheat will very likely be increased if soft credit for cash inputs can be provided.

8.2.12. Soil and climate

Soil and climatic constraints are given parameters which cannot be overcomed in a short period of time. In four study areas, different soils were available. In Daudkandi, the flood prone area, most of the soil was loamy in nature and with the residual soil moisture, yield was very high. In Shailkupa and Thakurgaon, most of the soil was loamy and sandy loam. But in Modhupur major area was belong to clay soil. Land preparation in this area was difficult and inspite of high irrigation and fertilizer use, yield was poorer than in Daudkandi.

The most important climatic constraint in wheat production is the rainfall during planting and growing season. In general, there is very scanty and undependable rainfall drops during the period from November to March. The result showed, in 1982-83, there were 5 rainy days evenly distributed in the five months of November to March in Shailkupa and Daudkandi. But in the previous year of 1981-82, there was very little rainfall during this period. Early rain in the second week of December 1981, in fact, delayed land preparation and many farmers dropped wheat cultivation in that season. The occurance of poor rain has been reflected on the yield.

Under rainfed wheat cultivation, rainfall constraint will continue to prevail unless any arrangement to forecast weather can be made beforehand. In this way, this constraint can only be avoided. However, provision of irrigation will definitely improve the situation. But, as envisaged from the present trend, there is every possibility to shift wheat area to marginal land leaving irrigated land for rice cultivation. This will again require motivation to the farmer and endeavour to make wheat profitable enough to offset rice cultivation.

8.3. Recommendations

Few recommendations based on the findings of the survey have been chalked out for the researchers and policy makers. These are as follows.

a. The rate of change of production of wheat as envisaged in last ten years can not maintain its speed in future unless yield improvement through intensification of wheat cultivation is made with the introduction of new varieties and improved cultural practices. It is necessary that the Sonalika variety should be replaced gradually by new varieties which needs to be draught tolerent, short duration and disease resistant.

To fit into the farmers cropping system the variety should be developed which can be planted in late December without affecting the yield. Wheat research centre already released new four varieties of wheat which fulfil most of the above characters. However, this needs to be evaluated at farmers level.

b. The results showed that there exists a large variation in cultural practices, time of operation, input use etc. among the farmers departing from the recommended practices. Appropriate location specific recommendation with strong extension services is highly needed. For this, extension and research will have to work together on farmers field.

c. Supply of seeds should be ensured at right time and at right place. Requirements of seeds should ascertained much ahead of time and a buffer stock of sufficient quantity of seed should be maintained annually. To do this, necessary risks and probable natural calamities needs to be considered.

Simultaneously, seed storage at farmers level should be encouraged and appropriate storage containers with proper methods should be provided to the farmers.

d. The results indicated that the farmers provide intensive land ploughing which can easily be reduced without affecting yield. Minimum tillage technology should be developed and encouraged to the farmers which on one hand will conserve available soil moisture, reduce draft power requirements and on the other hand reduce the cost of cultivation.

e. As the production will increase further, threshing by hand and bullock will become difficult because of its high labour and dry weather requirement. Low cost thresher should be provided to the farmers in a large scale. However, as on today, threshing is not a great problem particularly for the small farmers.

f. Under rainfed condition, farmers decision to grow wheat or not depends mainly on rainfall occurance at the right moment. If the farmers could be informed earlier about the possibility of occurance of rainfall in different time during the growth period of wheat, they could take appropriate action before hand. For this, an integrated index of at least 80% dependable rainfall with available soil moisture should be extablished at 7 day intervals for the planting season of wheat.

g. Floor price of wheat should be fixed in consideration with its cost of production, price of rice (instead of paddy) and other related commodities etc. The price should be declared before planting starts to so that farmers can take decision accordingly,

h. 'On farm' research of component technology of wheat as on cropping systems incorporating wheat and intercropping of other compatible crops with wheat should be strengthened. The result must be analyzed from economic point of view.

i. All 'On farm' research on management practices should be multidisciplinary involving agronomist, economist and other related disciplines.

j. As production increases and import reduces, marketing of wheat will be important. Marketing research should get priority which will identify the necessary intervention needed in the marketing of wheat to ensure fair price to the farmers and proper distribution of the products.

Appendix I. Area of wheat grown in Bangladesh, 1947/48 to 1982/83.

Year	HYV	Local	Total
	hectare		
1947/48			34,318
1948/49			38,486
1949/50			39,013
1950/51			37,839
1951/52			38,770
1952/53			39,660
1953/54			39,781
1954/55			41,643
1955/56			38,203
1956/57			53,956
1957/58			43,424
1958/59			39,862
1959/60			55,807
1960/61			56,576
1961/62			58,843
1962/63			73,735
1963/64			57,386
1964/65			53,460
1965/66			54,958
1966/67			72,825
1967/68			77,760
1968/69			117,230
1969/70			119,885
1970/71			125,996
1971/72			127,260
1972/73	21,592	98,543	120,135
1973/74	29,253	94,185	123,438
1974/75	33,021	93,017	126,038
1975/76	88,133	61,971	150,104
1976/77	116,497	43,551	160,049
1977/78	157,515	31,425	188,940
1978/79	236,002	28,754	264,756
1979/80	410,734	22,491	433,225
1980/81	571,540	19,682	591,222
1981/82	516,550	17,545	534,095
1982/83	498,290	21,120	519,410

Source : Bangladesh Bureau of Statistics.

Appendix II. Production of wheat grown in Bangladesh, 1947/48 to 1982/83.

Year	HYV	Local	Total
	metric tons		
1947/48			19,915
1948/49			18,848
1949/50			22,993
1950/51			20,423
1951/52			23,166
1952/53			24,385
1953/54			24,080
1954/55			26,620
1955/56			22,556
1956/57			23,776
1957/58			22,744
1958/59			25,503
1959/60			29,161
1960/61			32,920
1961/62			39,621
1962/63			45,158
1963/64			34,983
1964/65			34,688
1965/66			35,663
1966/67			59,317
1967/68			58,824
1968/69			93,695
1969/70			104,963
1970/71			111,642
1971/72			115,195
1972/73	24,305	66,658	90,963
1973/74	41,610	69,319	110,924
1974/75	47,276	69,438	116,713
1975/76	172,677	45,497	218,174
1976/77	229,139	30,317	259,456
1977/78	324,948	23,048	347,996
1978/79	473,748	20,282	494,030
1979/80	804,046	18,660	822,706
1980/81	1076,754	15,759	1092,513
1981/82	952,950	14,490	967,440
1982/83	1075,400	20,025	1095,425

Source : Bangladesh Bureau of Statistics.

Appendix III. Average yield of wheat grown in Bangladesh, 1947/48 to 1982/83.

Year	HYV	Local	Total
	Kilogram per hectare		
1947/48			580
1948/49			490
1949/50			589
1950/51			540
1951/52			598
1952/53			615
1953/54			605
1954/55			639
1955/56			590
1956/57			441
1957/58			524
1958/59			640
1959/60			523
1960/61			582
1961/62			673
1962/63			612
1963/64			610
1964/65			649
1965/66			649
1966/67			815
1967/68			756
1968/69			799
1969/70			876
1970/71			886
1971/72			904
1972/73	1,126	676	757
1973/74	1,422	736	899
1974/75	1,432	747	926
1975/76	1,959	734	1,453
1976/77	1,967	696	1,621
1977/78	2,063	733	1,842
1978/79	2,007	705	1,866
1979/80	1,958	830	1,899
1980/81	1,884	801	1,848
1981/82	1,845	826	1,811
1982/83	2,158	948	2,109

Source : Bangladesh Bureau of Statistics.