FARMING IN MYMENSINGH DISTRICT OF EAST PAKISTAN

bу

Mohammad Lutfar Rahman

A Thesis Submitted to the Faculty
of Agricultural Sciences in Partial Fulfillment of
the Requirements for the Degree of
MASTER OF SCIENCE IN AGRICULTURE

Major: Agricultural Economics -

Extension

Minor: Rural Sociology

Approved:

In Charge of Major Work

b 2

be morning

AMERICAN UNIVERSITY OF BEIRUT SCIENCE & AGRICULTURE LIBRARY

Chairman, Graduate Committee

American University of Beirut

Economics of Irrigation
Rahman

ACKNOWLEDGEMENTS

The author acknowledges with deep respect and gratitude to Dr. H. Ward, Professor of Agricultural Economics, American University, Beirut, for his constant advice, guidance, supervision, and suggestions received throughout the course of this study and for correction of this manuscript.

Thanks are due to Dr. J. Kincaid, Associate

Professor of Extension and Drs. H. Morsink, Associated

Professor of Rural Sociology, American University, Beirut,

for their suggestions and assistance.

He is also indebted to Dr. S. Islam, Professor of Agricultural Economics and Dr. Underwood, Advisor to the Agricultural University Mymensingh, East Pakistan, who took much interest to give some valuable advice during the time of collection of data from Mymensingh.

Sincere thanks are due to friends whose direct and indirect help and inspiration made this thesis possible.

ABSTRACT

Various nation-building departments of the Government of East Pakistan have been striving to grow more food for making Pakistan as nearly self-sufficient in staple food rice as is possible. Irrigation is one of the important factors both for increasing per acre yields of crops and for bringing new areas into crop production. Since 1951, production of boro paddy crops with irrigation pump water, has been increasing but to-date, there has been no economic analysis of dryland and irrigated farming in East Pakistan. On the basis of observation, the writer formulated the hypothesis that raising boro paddy crop with pumped water is more economical than growing other crops without irrigation. Mymensingh, one of the 19 districts of East Pakistan, was selected for this study considering its representativeness of farming in East Pakistan. Necessary information was collected from 50 dryland and 50 irrigated farms for 1963-64. The data were analyzed with due consideration to the practical situation prevailing in East Pakistan.

Analysis of the data revealed that the hypothesis may not be true universally. The hypothesis was demonstrated to be correct for small and medium sized

farms and not true for large sized farm. The following conclusions were drawn after detailed discussion of the data:

- Growing field crops under irrigation is more economical for medium and small sized irrigated farms than for medium and small sized dryland farms.
- Growing field crops under irrigation was less economical for large sized farms than for dryland farming on large sized farms.
- 3. Restricting the operating of irrigation pumps to the three and a half months of the growing season for boro paddy prevents rationalization of the cropping program to Schedule crops for double and treble cropping to enable maximum use of family labor and minimize hired labor.

The conclusions drawn suggested two categories of recommendations as follows:

- A. Improvements in the supply of water.
 - Growing crops under irrigation should be encouraged with water available to farmers whenever needed.
 - 2. Pumped irrigation water should be made available to medium and small size groups of farms throughout the year.

- 3. Supply of irrigation water should be limited to the actual requirements of various crops and farmers should be charged according to water supplied to them.
- 4. Irrigation cooperatives should be organized to keep pumps operating for the maximum possible number of days, to supply individual members according to their crops, and to educate members regarding the proper use of irrigation water.
- B. Improvements enabling farmers to make more productive use of pumped irrigation water.
 - 1. Cooperatives operating irrigation pumps should take up the functions of providing production supplies for the members on credit, marketing their produce, and establishing storage facilities.
 - The Government should make sufficient credit available through cooperatives to enable members to expand the output of their farms.
 - 3. Extension Service should strengthen its educational program for farmers and cooperative members with regard to better methods of production and cooperation.
 - 4. All agencies working with farm people should

integrate their activities at the local level in order for farm families to get the full benefit of these programs.

TABLE OF CONTENTS

			Page
LIST	OF	TABLES	
LIST	OF	FIGURES	
СНА	TER		
1,		INTRODUCTION	. 1
		Agricultural Situation in East Pakistan	1
		Purpose of the Study	3
		Selection of Mymensingh District as	
		location for the study	4
		History of irrigation in Mymensingh	
		District	5
		Reasons for developing irrigation in	
		Mymensingh District	11
		Availability of water in Mymensingh	12
		Availability of land for irrigation	
		in Mymensingh District	16
	II.	CLIMATE AND SOCIO-ECONOMIC SITUATION OF	10
		FARMS STUDIED IN MYMENSINGH DISTRICT	18
		Climate Affecting Irrigation	18
		Rainfall	
			18
		Temperature and humidity	21
		Irrigation	2.3

Population	Page
Population	23
Land tenure system	25
Fragmentation of holdings	27
Plough cattle	29
Credit	29
Low prices at harvest time	30
III. PLAN OF THE STUDY	32
Collection of Data	32
Dryland and irrigated farms	33
Size of farms	33
Situation	36
Types of soils in the District	37
Major crops grown	37
Interviews	38
Analysis of Data	40
Tabulation of data	
Analytical procedure	40
Gross returns	40
Costs	40
Interest	40
	40
Depreciation	41
Water	41
Labor	41
Seed	42
Plough cattle hire	42
Manures and chemical fertilizers	4.0

		Page
	Taxes	43
	Annual net earnings	43
	Labor earnings	43
	Interpretation of findings	43
IV.	RESULTS	44
	Analysis of Total Farm Income	49
	Crops grown and the growing period	51
	Yields of various crops per acre	56
	Value of the produce per acre in crop	59
	Analysis of Total Expenses	61
	Seeds	63
	Chemical fertilizers	65
	Animal manures	65
	Labor	67
	Plough cattle hire	71
	Water	73
	Taxes	74.
	Land rent	74
	Interest on borrowed money	75
	Depreciation of plough bullocks,	
	implements, and equipment	76
	Analysis of Interest on Invested Capital	78
	Summary	0.9

v. co	NCLUSIONS AND RECOMMENDATIONS	Page 84
	Conclusions	84
	Recommendations	87
SELECTED	BIBLIOGRAPHY	98
APPENDIX		99

LIST OF TABLES

Table		Page
1.	Area under different crops in East Pakistan and in Mymensingh District. 1957-58	
		6
2.	Number of acres of irrigated crops in East Pakistan and in Mymensingh District	7
3.	Number of irrigation pumps and areas	
	irrigated in East Pakistan and in	
	Mymensingh District. 1951-52 through 1953-54	8
4.	Number of acres irrigated by various sources	
	in East Pakistan and in Mymensingh District.	
	1957-58 through 1958-59	14
5.	Classification of land in Mymensingh	
	District. 1947-48 through 1953-54	17
6.	Monthly rainfall at the Mymensingh	
•	Agricultural Farm. 1959-60 through 1963-64	19
7.		
	Monthly maximum and minimum temperature at Mymensingh Agricultural Farm	22
0		
8.	Distribution of density of population in the thanas of Mymensingh District	0.4
	one thanks of mymensingh district	24
9.	Number and area of plots in different sizes	*
	of farms in Mymensingh District	28
10.	Proportion of farms in the three size	
	groups in the 100 farms studied and in the	
	survey area	34
11.	Number and area of dry and irrigated farms	
	for three size groups of farms	35
12.	Proportion of areas in major crops in the	
	District and on the 100 selected farms	37
13.		
10.	Calculation of per acre and farm income	
	for different size groups of farms and all dryland and all irrigated farms	45
	was dir irrigated Idims	45

Table		Page
14.	Itemized income per acre from various crops	
	in different size groups of farms and all	
	dryland and all irrigated farms	50
15.	The state of the s	
	dryland and irrigated farm including double	
	and treble cropping	52
16.	Per acre yield of various crops in	
	different size groups of farms	57
17.	Price per maund for various crops received	
	by different size groups of farms	60
18.	Calculation of per acre expenses for	
	different size groups of farms and all	
	dryland and all irrigated farms	62
19.	Value of seeds sown per acre in different	
	crops in different size groups of farms	64
20.	Total value of fertilizer applied to	
	different crops for dryland and irrigated	
	farms and by size groups	66
21.	Requirement of labor per acre of land and	
	proportion of work done by operator his	
	family members, and the labor hired	68
22.	Expenditure for hiring plough cattle for	
	the paddy crops in different size groups	
	of farms	72
23.	Beginning and ending inventory values and	
	depreciation per acre of bullocks.	
	implements and equipment	77
24.	Calculation of interest per acre on	
	invested capital for different size groups	
	of farms and all dryland and all irrigated	
	farms	80
25.	Calculation of costs of operating standard	
	size pump by Government and private	
	agencies	91

LIST OF FIGURES

Figure		Page
1.	Monthly rainfall at the Mymensingh Agricultural Farm, 1959-60 through 1963-64	20
2.	Growing periods of crops	55

INTRODUCTION

Agricultural Situation in East Pakistan

The production of food in East Pakistan is less than required to feed her population. Large amounts of foreign exchange must be spent every year for importing food grains. At its present stage of development, the country needs much of its available resources of foreign exchange to buy capital goods for rapid industrial development. Therefore, the national policy has been aimed at increasing production of food grains to make Pakistan as nearly self-sufficient in staple food rice as is possible.

The Department of Agriculture and some other semi-Governmental organizations, like the East Pakistan Water and Power Development Authority and the East Pakistan Agricultural Development Corporation, have been vested with the responsibility of launching a campaign for growing more food. These organizations have been trying to execute schemes capable of increasing per acre yields of crops through the introduction of better methods of production; e.g., use of better varieties of seeds, chemical fertilizers, plant protection measures, better cultural practices, and irrigation water.

Attempts have also been made to reclaim new land areas for crop production purposes.

Irrigation is one of the important factors both for increasing per acre yields of crops and for bringing new areas into crop production. The East Pakistan Water and Power Development Authority has begun or has planned to begin several major irrigation projects throughout the province; e.g., Kushtia Unit of the Ganges-Kobadak Project, the second Unit of the Ganges-Kobadak Project, the Khulna Multi-purpose Project, the Teesta Brarrage Project, the Tangan Irrigation Project, Brahmaputra Multi-purpose Project, the Tippera Chittagong Multi-purpose Project and the Khulna Multi-purpose Project. Such projects are designed to develop part of the non-inundated and inundated areas that occupy about 25 percent and 50 percent of the land surface, respectively.

Most of the inundated areas retain a depth of from three to six feet of water for about four months (i.e., from June through October). Within such inundated areas, there are some deeper places known as haor areas. These areas retain water at a depth of about 10 to 25 feet for much of the seven month period of May through November. The central portions of these basinlike areas retain water at levels varying from five to ten feet in depth for about five months of the year from November through April. During this period, the peripheral part

of these areas becomes dry.

Production of boro paddy crop was made possible on part of the dry areas after preparing the land through deep ploughing with tractor and mouldboard plough. After the first deep ploughing, the farmers further prepared the land using a bullock power. The areas were then planted with boro paddy transplants. Growers irrigated their boro paddy fields using irrigation water pumped from the adjacent water area in the center of the basin. Three to five irrigations were necessary during the growing period of the crop.

Since 1951, the Agricultural Extension Department has supplied tractors and irrigation pumps for use in these areas. Gradually, the demand for tractors and irrigation pumps has increased because farmers found they could harvest a bumper boro paddy crop under irrigation in areas where they could not grow any crop previously. These results gradually induced farmers in adjoining areas to demand irrigation pumps to enable them raising boro paddy under irrigation. They started to grow boro paddy in plots where other varieties of paddy and jute were grown before. As a result, the farmers changed their cropping systems.

Purpose of the Study

To-date, there has been no economic analysis of

dryland and irrigated farming in East Pakistan. The farm people using irrigation water have the impression that raising boro paddy under irrigation is more economical than raising other crops. On the basis of observations by extension personnel, the writer formulated the hypothesis that raising boro paddy crop under irrigation with pumped water is more economical than growing other crops without irrigation. Therefore, the purpose of the study was to test this hypothesis through a comparative analysis of data collected from farmers. The two groups of growers included in this study were: 1) those raising boro paddy under pumped irrigation in haor and adjoining inundated areas, and 2) farmers in similar situations, but who were not using pumped irrigation water for raising crops.

Selection of Mymensingh District as location for the study:

Mymensingh District was selected as the location for this study because it is quite representative of the whole of East Pakistan in terms of crops, soils, irrigated areas, number of pumps and in sizes of farms.

Mymensingh is one of 19 Districts of East Pakistan. It is adjacent to and north of the capital city Dacca, having rail, road and air transportation facilities to Dacca. It lies between N, 24° - 25° -15' Latitude and E, 81° -51' - 91° -20' Longitude.

Table 1 reveals that the District is fairly representative of East Pakistan with regard to areas of different crops grown. The average of seven years (1947-48 through 1953-54) total cultivated area of Mymensingh District is 14 percent of the average of the same period's total cultivated area in East Pakistan. The average irrigated area of Mymensingh District for 12 years from 1947-48 through 1958-59 is 13 percent of average irrigated area of East Pakistan for the same period. Therefore, the ratios of irrigated land to total cultivated land in both East Pakistan and Mymensingh District were nearly the same for the periods reported.

Table 2 reveals that Mymensingh is fairly representative of East Pakistan so far as the proportion of different crops under irrigation are concerned. Moreover, Table 3 shows that irrigation developed at almost the same rate in Mymensingh District as it did in all of East Pakistan.

History of irrigation in Mymensingh District:

District before 1957. Though the Department of Agriculture started in 1951-52 to experiment in some areas of East Pakistan with growing boro paddy using, pumped irrigation water, such work did not start in Mymensingh District until 1957-58. Within seven years, the number

Table 1. Area under different crop in East Pakistan and in Mymensingh District, 1957-58.1.

Name of crop	Area in East	Percent of net area	Area in Mymensingh District	Percent of net
	Pakistan (acres)	sown	(acres)	sown
Rice	20,234,700	97.00	2,558,900	91.80
Autumn	5,786,500	28.00	809.500	29.10
Winter	13,632,200	67.00	1,499,400	53.80
Summer	816,000	4.00	250,000	9.00
Wheat	107,322	0.52	4,900	0.18
Barley	57,400	0.30	2,000	0.08
Maize	6,680	0.04	200	0.01
Bazra	600	0.01		_
Jowar	1,320	0.01		-
Gram	136,250	0.66	4,700	0.18
Lentil	179,000	0.86	10,000	0.40
Mustard	134,500	0.65	18,800	0.70
Mung	40,500	0.20	5,300	0.20
Kheshari	261,600	1.26	18,200	0.70
Arahar	18,190	0.09	500	0.16
Other				
pulses	9,200	0.05	1,200	0.05
Cotton	51,048	0.25	48	0.01
Rape and				
Mustard	398,100	1.91	75,000	2.70
Linseed	20,000	0.10	500	0.16
Graundnut	14,300	0.07	11,800	0.43
Sesamum	123,700	0.60	8,500	0.31
Jute	1,563,619	7.50	410,495	14.73
Sunnhamp	17,745	0.09	4,400	0.16
Sugar Cane	251,800	1.21	27,000	0.97
Tobacco	106,800	0.52	8,200	0.30
Tea	76,225	0.37	-	-
Betlenut	175,215	0.84	1,305	0.05
Potato	108,101	0.52	10,330	0.38
Other	d			
vegetable	435,770	2.09	131,670	0.48
Onion	33,180	0.16	3,540	0.13
Garlic	16,470	80.0	2,555	0.10
Chill L	169,800	0.82	21,000	0.76

Source: Pakistan. Department of Agricultural Economics and Statistics, Ministry of Agriculture and Works, Government of Pakistan, Rawalpindi.

Land and Crop Statistics of Pakistan, 1960.

pp. 26-76; 133-149; 156-159.

Number of acres of irrigated crops in East Pakistan, and in Mymensingh District, 1951-52 through 1958-59. 2 Table

				1)	n tho	nusana	(In thousand acres)					
Year	Rice		Wheat	at	Barley	ley	Sugar	ugar	Other food crops	food	Other non- food crops	non-
	East Pakistan	Mymen- singh	E.P.		К.Р.	Mym. E.P. Mym.		Е.Р. Муш.	Е.Р.	Mym.	Мут. Е.Р.	Mym.
1951-52	303.0	0.09	0.6	2.1	7.0 2.4	2.4	35.0	11.0	134,0 12,0	12,0	32.0	12.0
1952-53	385.0	0.19	0.6	2.0	8.0	2.1	39.0	11.0	141.0	12,4	30.0	1.3
1953-54	389.0	61.5	0°6	2,1	0.7	2.2	40.0	11,4	143.0	11.8	29.0	1.3
1954-55	354.0	49.4	7.0	,	2.0	ı	44.0	1	70.07	0.8	12.0	1,3
1955-56	441.0	13,2	0.9	1	0.5	0.1	16.0	1	89.0	0.1	19.0	0.4
1956-57	354.0	27.0	16.0	Ĺ	0.5	ï	20.0	ı	93.0	2.6	19.0	0.4
1957-58	775.0	25,5	10.0	0.2	1,0	ı	14,0	ı	37.0	2.2	20.0	0.4
1958-59	446.0	65.3	11.0	0.1	5.0 0.1	0.1	39.0	0.1	22.0	1.8	30.0	2.0
	,											

Pakistan, Department of Agricultural Economics and Statistics Ministry of Agriculture and works, Government of Pakistan, Rawalpindi, Land and Crop Statistics of Pakistan, 1960, pp. 237-246. Source.

Number of irrigation pumps and acres irrigated, in East Pakistan and in Mymensingh District, 1951-52 through 1953-541. Table 3.

Year	Number of i gation pump	irri- mps	Area irri (acres	irrigated acres)	Number of tractors	of	Area re (ac	reclaimed (acres)
	East Pakistan	Mymen- singh	E.P.	Mym.	Е.Р.	Mym.	E.P.	Mym.
1951-52	30	ı	1,919	1	18	1	1,919	ı
1952-53	30	ı	1,895	I	30	1	2,700	1
1953-54	20	t	546	ī	35	ī	2,991	ι
1954-55	30	Ĭ	1,897	ī	25	ï	945	1
1955-56	40	1	2,658	Nil	25	1	1,595	1
1956-57	135	1	10,000	Ni1	30	1	3,000	Ē,
1957-58	541	19	29,000	516	32	Ţ	3,200	ì
1958-59	848	45	32,793	166	55	ť	5,700	ı
1959-60	1,150	26	47,370	2,866	99	က	7,332	74
1960-61	1,367	26	62,142	3,162	63	က	11,060	72
1961-62	1,950	242	100,000	6,731	115	31	000.6	1,878
1962-63	2,600	418	N.A.2	20,409	N.A.	26	N.A.	2,610
1963-64	4,100	591	N.A.	28,665	N.A.	15	N.A.	1,920

Source: East Pakistan, Agricultural Development Corporation, Dacca, Yearly Progress Report of Irrigation Division 1963-64.

^{2.} N.A. Data not available.

of irrigation pumps of two cubic feet of water per second capacity increased from 19 to 591, as shown in Table 3.

The area irrigated from these pumps, the number of tractors, and the amount of land reclaimed also increased.

The East Pakistan Agricultural Development

Corporation took over the direction of this irrigation

pump Division of the Agricultural Department in 1959-60.

The corporation bored three deep tube-wells in the

District and have since been irrigating crops success
fully.

The Pakistan Academy for Village Development also bored two tube-wells which have given good results.

The East Pakistan Water and Power Development
Authority has already completed survey work for the
Brahmaputra Multi-purpose project with the aim of irrigating about 300,000 acres of land in the District.

The District Council of Mymensingh has undertaken a program of supplying free of cost, one irrigation pump of two cubic feet of water per second capacity to each of 531 Union Councils in the District. A similar program was initiated by the writer as ex-officio member of the District Council of Chittagong. The supplying and first year's operating of 199 standard sized irrigation pumps were completed under his supervision before he entered the American University of Beirut in October, 1963.

In addition, about 40 irrigation pumps were owned by cooperatives and individual farmers in the District.

Over the past 15 years, the Agricultural Department has spent about 300,000 to 400,000 rupees per year for minor irrigation schemes. This program has emphasized work such as excavating or re-excavating channels, repairing or constructing small dams, and re-excavating silted water tanks. The program's costs have been continuously supplemented by a one-fourth contribution from its beneficiaries. Their payment has been either in cash and/or in kind (i.e., mostly in labor performed). The Third Five-year plan 1964-65 through 1969-70 provide for a continuation of this program.

The East Pakistan Water and Power Development
Authority has completed a preliminary survey of a project
for boring deep tube-wells in Mymensingh District. This
project is similar to a scheme which the authority has
completed and in which 1000 deep tube-wells were bored
for irrigation purpose in northern parts of the province.

It was disclosed by the head of the East Pakistan Agricultural Development Corporation that there is a tentative program to increase the number of pumps by about 20 percent every year in Mymensingh District until the end of the Third Five-year plan period in 1969-70.

One rupee is equivalent to 0.21 dollars and 0.65 Lebanese pounds.

Reasons for developing irrigation in Mymensingh District:

Irrigation has been developing in Mymensingh District for the following reasons;

1. Reclaiming highly inundated areas:

These areas are known as haors. They retain water at a depth varying from about 10 to 25 feet for nearly seven months. During the remaining five months, part of each haor area becomes dry and the remainder retains supply of water which is about five to ten feet deep. The use of irrigation in these areas makes possible the reclamation of the dry area so that boro paddy can be grown.

The Food and Agriculture Commission of Pakistan described these areas and the potential for bringing new land into production in a report published in 1960:

(Food and Agriculture Commission Report, 1960, pp.112-113):

In the Districts of Mymensingh, Sylhet, and Tippera (now Comilla) there is a concentration of haors and beels as explained above. Thus the area is commonly known as haor area. The total area of this low lying saucer is approximately 2,000,000 acres. Of this 700,000 acres are not available for cultivation. Boro paddy is grown on about 700,000 acres and about 100,000 acres are devoted to such crops as groundnuts, mustard, and potatoes. The remaining 500,000 acres are unproductive due to lack of irrigation although the whole area is intersected by a large number of perennial water courses involving only a low lift to bring the water up to the land.

During the First Five year plan, power irrigation, coupled with mechanized cultivation, was started by the Department of Agriculture and an area of 40,000 acres has been brought under boro paddy cultivation. If these facilities were extended and a certain canalization and drainage

added, the remaining area of about 450,000 acres could be brought into production.

Extending irrigation to new areas: 2.

There is a network of previously constructed canals and channels throughout the District for irrigation, drainage and navigational purposes. Most of these have varying degrees of accumulated silt. Re-excavation of existing waterways and construction of new ones have served to extend irrigation to new areas with water pumped from rivers. This work indirectly helps to control flooding since the re-excavated canals and channels facilitate the orderly flow of surplus floodwater off the land when most parts of the District become flooded.

3. Increased employment opportunities:

Installation of irrigation pumps in the local areas has increased the demand for labor for raising crops under irrigation and also for reclamation work. addition, some local labor is employed in repair shops and rice hauling centers which are needed to service equipment and for marketing the crop. Therefore, the development of projects for irrigation systems which use irrigation pumps helps partly to solve the problem of underemployment of labor force.

Availability of water in Mymensingh:

Various sources of water suitable for irrigation

are available in the District. Though some land areas are at convenient distances from the water sources, farm people can not irrigate sufficient cropping areas by using indiginous water lifting devices. Irrigation pumps are required to move the water from the source to the land in quantities needed for efficient and effective irrigation. Table 4 reveals numbers of acres irrigated from several water sources for the years 1947-48 through 1958-59.

Enllowing is a detailed description of some of the important water sources:

1. Rivers.— The entire district is interlaced with a dense network courses branching out of two principal rivers, i.e., the Brahmaputra (or the Jamuna) and the Meghna. The Meghna has its origin in Assam Province of India and gets its supply of water from the Garo hills. The Brahmaputra has its origin in Tibet and gets its main supply of water from Tibet, the Himalayas and India. The Old Brahmaputra, Atrai, Nagli, Lobajong, Bengi, Magra, Kugsa, and Someswari are tributaries to the Meghna and the Brahmaputra rivers. About 400 miles of these rivers are navigable through the year. These water courses can provide sufficient irrigation water, especially during the dry season from October to April to enabling a second or even a third crop to be grown in the greater parts of Mymensingh District. Water can be pumped from these

Number of areas irrigated by various sources in East Pakistan and in Mymensingh District, 1947-48 through 1958-59. Table 4.

					(In 4	(In thousand		acres					
	Government		Private	rivate Canals	Ta	Tanks	Dug	g	Other Sources	er	To	Total	Mym. Percent
Year	East Pak.	Mymen- singh	E.P.	Mym.	E.P.	Mym.	E.P.	Mym.		Mym.	E.P.	Mym.	B.P.
1947-48	1	1	22	1	16	1	Ŋ	1	338	10	381	20	18.4
1948-49	1	1	27	1	16	1	9	ı	337	65	387	9	16.8
1949-50	9	1	47	1	15	1	13	ı	324	92	405	9	16.1
1950-512	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	ı
1951-52	-	ı	32	1	29	ı	24	í	393	92	419	92	15.9
1952-53	31	1	56	1	83	1	25	ì	415	72	220	72	13.4
1953-54	24	1	56	1	34	1	25	1	429	17	269	92	13,5
1954-55	7	2	62	9	24	П	9	ı	306	44	481	51	10.8
1955-56	27	1	111	2	192	1	17	1	208	6		13	2.5
1956-57	31	7	115	Ŋ	191	ı	21	,	160	18		30	0.9
1957-58	20	6	148	4	217	1	24	ı	259	16		28	4.0
1958-59	136	10	06	14	33	1	26	1	286	44		69	12.2

1 Source: Pakistan. Department of Agricultural Economics and Statistics, Ministry of Agriculture and Works, Government of Pakistan. Land and Grop Statistics of Pakistan, p. 237, p. 247.

2 NA is equal to Data not Available.

rivers and conducted to cropped land through existing canals and channels. In some places, minor construction or reconstruction of channels or embankments may be necessary for this purpose.

The river's flood plains are inundated during the 2. monsoon (rainy season) from June to October. When the flood receeds, a large volume of water is retained in natural water reservoirs or pockets, such as swamps, beels, and haors, which are interspersed throughout the whole countryside. Some of the low-lying pockets retain water during the entire year, while others become dry during the winter season. The number of such pockets and swamps is large and they are scattered over all five Sub-Divisions of the District. Their highest concentration, however, is in the Kishorgonj and Netrokona Sub-Divisions. Swampy areas in the Kishorgonj and Netrokona Sub-Divisions cover 80.640 and 58,000 acres, respectively. The total of swampy areas in the other three Sub-Divisions is about 100,000 acres. It has been roughly estimated that, with the water now available, about 125,000 acres of land within the area which becomes dry for about five months may be irrigated with pumped irrigation water.

Other sources, i.e., wells, tanks, and springs, can supply sufficient water for irrigating large areas. However, irrigation pumps will not be required for the purpose. Farmers can obtain water for irrigation from

these sources by using other lifting devices.

Availability of land for irrigation in Mymensingh District:

Classification of land according to use is shown in Table 5. Of about 3,100,000 acres of cultivated area in the District, a belt about two miles in bredth and about 800 miles in length along the rivers can be irrigated by pumping directly from the rivers through existing and/or new small channels. An area of about 400,000 acres (about 13 percent of the cultivated area) can be irrigated in this way.

Within the swampy areas, about 125,000 acres culturable waste land, or nearly four percent of the cultivated area in the District, are available for irrigation after reclamation. As described earlier, the land may be reclaimed by giving a deep ploughing with a tractor. Irrigation water can be obtained by pumping from the adjacent swampy areas.

Classification of land in Mymensingh District. 1947-48 through $1953-54^{1}$. Table 5,

				(In	(In thousand	acres)			
Year	Are Total no area re- (acres)port	Area not re- ported (acres)	Fo-	Not availa- ble for culti- vation	Other culti- vated land exclud- ing current fellow	Current fellow	Net area sown	Total area culti- vated	Total area reported
1947-48	4,072.6	85.3	46.3	513.5	299.2	308.5	2,819,6	3,128.2	3,987.2
1948-49	4,072.6	85.3	46.3	500.6	305.3	444.1	2,690.9	3,135.0	3,987.2
1949-50	4,072.6	85.3	46.3	499.6	306.4	442.6	2,692.4	3,134,9	3,987.2
1950-51	4,072.6	85.3	152.8	496.1	257.8	322.4	2,758,1	3,080,5	3,987.2
1951-52	4,072,6	85.3	152.8	496.6	5 252.3	318.0	2,767.5	3,085,5	3,987.2
1952-53	4,072.6	85.3	152.8	497.0	0 251.9	248.0	2,837.5	3,085.5	3,987.2
1953-54	4,072.6	85.3	152.8	497.5	5 250.9	298.0	2,788.0	3,086.0	3,987.2

Pakistan. Ministry of Agriculture and Works, Directorate of Agricultural Economics and Statistics Government of Pakistan. Land and Crop Statistics of Pakistan, p. 8. Source:

II. CLIMATE AND SOCIO-ECONOMIC SITUATION OF FARMS STUDIED IN MYMENSINGH DISTRICT

Climate Affecting Irrigation

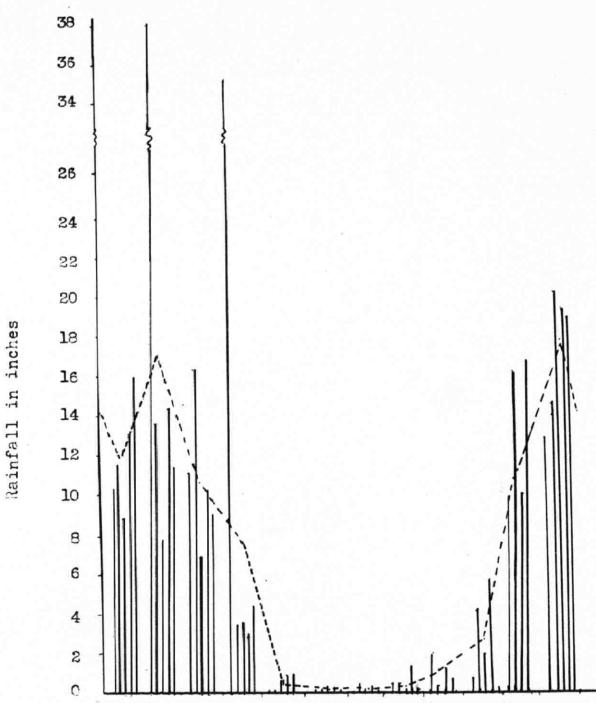
their crops to obtain high yields during the six month dry season from November through April. Various climatic conditions have various degrees of influence in determining the quantity and time of irrigation. The effects of some of the climatic conditions are described below:

Rainfall:

Monthly rainfall for five years from 1959-60 through 1963-64 at the Mymensingh District Agricultural Farm is recorded in Table 6 and Figure 1. During five months of the year, from middle of May to middle of October, there is heavy rainfall. The heavy rainfall in June, July and August causes severe flood situations in most years. The total rainfall greatly varies from year to year. The total rainfall in 1959-60 was 112.24 inches as compared to 75 inches in 1962-63. Monthly rainfall also varies greatly from year to year. This variation is shown diagramatically in Figure 1. During August 1959, the rainfall was 37.85 inches, whereas the average of rainfall in August for five years from 1959-60

Monthly rainfall at the Mymensingh Agricultural Farm, 1959-60 through 1963-641. Table 6.

Year	July Aug.	Aug.	Sept.	Sept. Oct. Nov. Dec. Jan. Feb. March April May June	lov.	Jec.	Jan.	Feb.	March	April	May	June	Yearly total
1959-60	10.40	10,40 37.85	11.21	11.21 30.97	ì	1	ī	ĵ	1.80	0.87	6.19	12,95	- 1.80 0.87 6.19 12.95 112.24
1960-61	11.63	11.63 13.90	16.52	16.52 0.20	1	ı	1	0.75	2.20	0.87	9.45	0.75 2.20 0.67 9.45 14.75	70,27
1961-62	8.95	7.85	7.00		3.52 0.76	1	0.51	0.20	0.25	- 0.51 0.20 0.25 4.29		6.04 20.08	69.45
1962-63	13.28	13.28 14.74	10,33		3.04 0.86 0.16	0,16	1	. 1	1,34	1.70	0,13	1.34 1.70 0.13 19.42	75,00
1963-64	16.06	16.06 11.48	9.21	9.21 4.67 0.86 - 0.37 1.29 0.65 5.87 16.82 18.81	0.86	1	0.37	1.29	0.65	5.87	16,82	18.81	86.09
Monthly average	12.06	17.16	10.85	8.48	0.50	0.03	0,18	0.45	1,25	2.72	11.83	17.20	12.06 17.16 10.85 8.48 0.50 0.03 0.18 0.45 1.25 2.72 11.83 17.20 82.61
Source, Mymensingh,	Mymen	singh,	East 1 Farm	Mymensingh, East Pakistan. Register of Rainfall Agricultural Farm Mymensingh. 1959-60 to 1963-64	an. singh	Regis 195	ter (of Ra	infal 963-6	1 at 1	the Go	Register of Rainfall at the Government. 1959-60 to 1963-64.	nt It



Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May June (Conseculive years of every month from left to right)

FIGURE 1. Monthly rainfall at the Mymensingh Agricultural farm, 1959-60 to 1963-64

¹ Mymensingh, East Pakistan Register of Rainfall at the Mymensingh Government Agricultural Farm 1959-60 to 1963-64.

to 1963-64 was 17.16 inches. Similar variations may be seen in October. From the middle of October through the middle of May, rainfall is very low and unevenly distributed. In 1959-60 there was no rainfall from November through February, whereas in 1963-64 only one month passed without rainfall.

The crops usually need two to five irrigations from late October to late April. During the remaining five months, crops need irrigation when there is a dry period longer than a week. Examples are: aman paddy, aman paddy seedlings, and vegetables.

Temperature and humidity:

Variations in temperature at the Mymensingh District Agricultural Farm during the year 1961-62 to 1963-64 are shown in Table 7. The maximum and minimum temperature vary from year to year and from month to month. During the dry months of the year, from October to April, temperatures remain very high. Moreover, the daily differences in maximum and minimum temperatures are very large. Humidity varies from 84 percent to 55 percent in February. Comparatively higher temperature and lower humidity during the dry months of the year increase the rate of evaporation of water and transpiration by plants resulting in a relatively higher requirement for irrigation water than in other seasons. Farmers having

Table 7. Monthly maximum and minimum temperature at Mymensingh Agricultural Farm. 1961-62 through 1963-64.

	Τ.	uly	A	ıg.	Sei	ot.	0.0	ct.	No	ov.	De	c.
Year		Mi	Ma		Ma			Mi	Ma	Mi	Ma	Mi
1961-62	106	56	110	58	116	64	110	54	102	52	NA	ΝA
1962-63	119	62	115	62	117	62	118	52	100	39	90	42
1963-64	105	72	103	75	108	74	102	68	92	58	81	57
1964-65	110	63	109	65	114	67	110	58	98	50	85	50

	1.	in.	F	eb.	Man	ch	Apr	ril	Ma	a v	Ju	ne
Year	Ma	Mi	Ma		Ma		Ma		Ma	Mi	Ma	Mi
1961-62	79	39	99	48	108	45	116	57	108	53	106	54
962-63	82	41	90	46	98	56	105	60	105	60	108	72
1963-64	90	38	96	42	104	56	105	64	103	63	102	66
1964-65	84	39	95	45	103	52	109	60	105	59	105	64

Source: Mymensingh, East Pakistan. Register of Temperature at the Mymensingh Government Agricultural Farm. 1961-62 to 1963-64.

irrigation water supplied by pumps can provide their crops with the amount of water at the intervals required for optimum growth and yield.

Socio-Economic Situation Affecting Irrigation

Socio-economic factors have great influence on the development of the irrigation schemes. The effects of several factors are described below:

Population:

Density of population in Mymensingh District is 1,103 persons per square mile. Among the Sub-Divisions, Mymensingh Sadar South has 1,246 persons per square mile and Netrokona Sub-Division has 832 persons per square mile. The density of population varies greatly among the Thanas. The number of Thanas in different groups of density of population is shown in Table 8.

Densities are very low in some Thanas due to the presence of swampy areas. Irrigation has been developing more rapidly in the swampy areas than in the densely populated areas. This spreading of irrigation is due to farmers in swampy areas harvesting a paddy crop where no paddy was grown previously. Irrigation has not developed greatly in the densely populated areas due mainly to the restriction of the supply of irrigation pumps.

Questions of settlement may arise for reclaiming

Table 8. Distribution of density of population in the Thanas of Mymensingh District, 1961.

300 - 500	of Thanas
701 - 900	1
901 - 1,100	4
1,101 - 1,300	8
7	8
	9
1,301 - 1,500	11
1,501 - 1,700	3
1,701 - 1,900	4
1,901 - 2,100	0
2,101 - 2,300	1

Source. Pakistan. Census Commissioner, Ministry of Home Affair, Karachi.

Population Census of Pakistan. 1961.

(Vol 2) pp. 116-119.

land and growing crops under irrigation in swampy areas.

Settlement of additional farmers in swampy areas will be very difficult due to high level of water during the flood season.

Also in the swampy areas, two to five irrigations are required in growing paddy crop during the dry season. This increases the requirement of labor. The demand for labor for reclamation and other works, like sowing and harvesting of paddy crops, has been met by a migration of an agricultural labor force from varying distances. Usually wages increase during such periods of high demand for labor. The full potential of irrigation development in swampy areas can not be met by this system of migratory labor. This situation means that a solution to the problem of settlement of people in these areas will need to be found.

In the densely populated areas, the farmers usually do not raise any additional crop as the result of using irrigation water. They simply change the cropping system for raising crops to avoid damage by floods. As a result, the Agricultural Development Corporation has been supplying proportionately more irrigation pumps to the swampy areas to encourage their growing paddy crop where no crops were grown before.

Land tenure system:

Development of irrigation is dependent upon land

wish to irrigate usually have to depend partly upon rented land. They often rent land from both the big farmers (with usually above 10 acres) and the very small farmers (with usually less than one acre). Land rented from the very small farmers is usually settled for by cash payment, whereas that rented from big farmers is negotiated on a share-crop basis. Because the demand for such land is high, rental payments increase abnormally. These increases cause considerably higher costs of production of irrigated crops over those not irrigated. Farmers with medium and large sized farms do not generally rent land for raising crops under irrigation.

The East Bengal (East Pakistan) State

Acquisition Act of 1950 has had some effect upon irrigation. Some of the provisions of the Act (Land Revenue
Commission Report, 1959, p. 3) related to this study are:

All rent receiving interests in all lands are to be abolished by being acquired by Government. The actual tillers of the soil will thus become direct tenants under the Government, virtually as peasant proprietors. All agricultural tenants in future will have permanent, heritable and transferable rights in their land and will be entitled to use the land in any way they like.

All khash cultivated lands of all persons in excess of 3.3 acres per family or 3.3 acres per member of the family plus the area of home stead land up to a limit of 3.3 acres are to be acquired by Government.

Nost of the unreclaimed swampy areas of the District now belong to the Government after acquisition under provisions of this Act. However, part of these areas belonged to Government prior to the passage of the act. According to Section 72 of the Act, when settling lands which have been vested in Government by acquisition, from the Zaminders (Land Lords), preference shall be given to an applicant who cultivates land himself and who holds an area of less than three acres for his whole family. It was reported by some of the farmers interviewed that the settlement has been neither properly nor promptly made. Such reports further add that the influential persons and big farmers usually manage settlement of large reclaimed and unreclaimed blocks of areas. These people often avoid intensive cropping under irrigation and even keep some areas fallow. As a result, execution of some of the irrigation schemes have become difficult in the District of Mymensingh.

Fragmentation of holdings:

The average area of plots in different size groups of farms in Mymensingh District is shown in Table 9.

Table 9. Number and area of plots in different sizes of farms in Mymensingh District 1.

Sizes of farms (acres)	Average No. of plots in each farm	Average No. of acres in each plot
Below - 2,40	4.8	0.33
2.41 - 6.40	8.4	0.51
Above - 6,40	12.0	0.89

¹ Source: Data collected from the 100 selected farms included in this study.

The average area of plots varies directly with the average area of farms. The smaller the total area of a farm, the smaller the average size of the various plots. The plots are so small in area and so scattered that it becomes very difficult for individual farmers to manage irriquation without cooperation of neighboring farmers. The water must pass through or along the edges of the holdings of numerous farmers to reach the plots of farmers at a distance from the pumps. Thus, in Mymensingh District with most of the farms relatively small, the movement of pumped water to plots distant from a pump presents many problems.

Plough cattle:

The average size and the health of plough cattle is so poor that the use of improved implements becomes difficult. Paddy crop in the irrigated areas is transplanted after puddling. Most plough cattle are quite unsuitable for proper puddling of land, an operation which requires strong bullocks.

Since there are no barns in the swampy areas, keeping of plough cattle becomes difficult. The cultivators must drive their plough cattle long distances back and forth during ploughing and harvesting seasons. This factor increases the cost of production of irrigated crops.

Credit:

Farmers need credit for production, marketing and even for family subsistance during a production season.

Lack of credit seriously affects irrigation as some of the farmers can not raise irrigated crops that require high cash expenses. At present, agencies supplying credit to the rural people are (Agricultural economist - 1961, pp. 188-189).

- a) Government. which makes loans under the land improvement Act of 1883 and the Agricultural loan Act of 1958, known as Taccavi Loans.
 - b) Institutional credit agencies
 1. Cooperatives

- 2. Agricultural Development Bank
- c) Private agencies
 - 1. Friends and relatives
 - 2. Land lords
 - 3. Village shop keeper
 - 4. Traders and factory men
 - 5. Private money lender.

A taccavi loan is considered to be essentially an emergency measure in case of natural calamity, but not a relief measure. Among the above sources, the farmers can have loans at reasonable rates of interest only from the Government, cooperatives, and the Agricultural Development Bank, but the sources are able to supply less than 10 percent of the demand for credit. Interest rates for loans from other sources usually range from 30 percent to 50 percent per annum compared with five to eight percent charged by banks and cooperatives. As the irrigated farmers need comparatively more credit, this high rate of interest increases the costs of production of irrigated crops.

Low prices at harvest time:

Prices of some crops like potatoes and vegetables are very low during the harvesting season. This reduced price is partly due to the low demand by the local people and partly due to lack of storage, transportation and

other marketing facilities. Abnormally high prices for these commodities in the Urban areas are an indication of the demand. Farmers usually avoid raising potatoes and vegetables under irrigation. They devote their effort to growing paddy crop under irrigation which they need mainly for their own consumption. Thus, the farmers can not adjust their cropping system. This lack of flexibility indirectly decreases the scope of crops that would otherwise be grown under irrigation.

III. PLAN OF THE STUDY

The writer went to East Pakistan in June 1964 and collected data from a sample of 50 dryland and 50 irrigated farms in the Mymensingh District. The data were analyzed to determine annual net incomes of the irrigated and dryland farms. Conclusions were drawn about the relative economic advantages and disadvantages of irrigated as compared to dryland farming. Recommendations were presented on the basis of the conclusions.

Collection of Data

Procedure for selecting sample of respondants:

A stratified sample of two thanas out of 51 thanas was taken in the district. The sample of two thanas was representative of the district in cropping system, situation, and soil types. These two thanas were further stratified through selection of a sample of eight of their 34 unions. Due care was taken to make the samples of unions representative of the two selected thanas in cropping system, situation, and soil types. In the absence of union and thana data like temperature, humidity, and rainfall effecting irrigation and production, visual estimation and verbal reports of experienced

persons were made the basis of selecting the samples of unions and thanas. A quota of dryland and irrigated farms was fixed to each of the eight unions making a total of 50 dryland and 50 irrigated farms. Selection of farms was made at the union level on the basis of the fixed quota. Care was taken to make the selected farms representative of the district in cropping system, situation, and soil types. Data were collected from these 50 dryland and 50 irrigated farms.

Selection was made according to the criteria stated in the following sections. It was considered of vital importance to secure data from farms in the two groups that would be as nearly comparable as possible.

Dryland and irrigated farms: For individual unions, the number of selected dryland farms was the same as the number of selected irrigated farms. However, the total number of selected farms varied among unions. Selecting larger numbers from same unions than from other helped to eliminate the effect of differences among Unions in situation, type of soil, and major crops grown. Farmers irrigating at least 50 percent of their land were considered as irrigated farmers.

Size of farms: Previous to this study, an Extension specialist of the United States Aid for International

Development Mission at Mymensingh had conducted a detailed survey of two Unions in the District. His survey data were used as a basis for determining the size groups into which the 50 irrigated and 50 dryland farms to be selected for this study could be categorized.

There were about 4,000 completed interview schedules available as the result the AID specialist's former study covering all farms in the two Unions. These completed schedules were available in the District Extension office. A random sample of 100 schedules was taken from the nearly 4,000 total number. Details of size classifications revealed in the sample of schedules are shown in columns two and three of Table 10. These

Table 10. Proportion of farms in the three size groups in the 100 farms studied and in the survey area.

Size g of sam of far (acres	ples ms	Number of farms in the sample of com- pleted AID schedule	Area in the group as percent of total area in the farm	Number of farms included in this study	Area in the sample of farms se-lected for this study as percent of total area
Below	2.50	30	11.2	26	8.5
2.5	6.50	47	41.6	50	41.0
Above	6.50	23	47.2	24	50.5
Total		100	100	100	100

classifications were then made the basis for a determination of the sizes of 50 dryland and 50 irrigated farms to be selected for this study. In establishing the size groupings of farms to be included in this study, it was decided to select 50 percent of the farms in the medium size groups, leaving 26 percent and 24 percent of the farms for the small and large size groups respectively. This classification of the total number of farms surveyed in this study is shown in column four of Table 10. The percents of numbers of farms and the percents of total area for each size group are noted to be comparable to data revealed in the sample of completed schedules from the previous study by the US/AID specialist.

For making the analysis of the economics of using pumped water for irrigating crops during the dry season, the selected sample of farms included in this study was grouped into three categories according to size as shown in Table 11. A proportionately larger number of farms was

Table 11. Number and area of dry and irrigated farms for three size groups of farms.

	groups	Dryl	and farm	1 S	1	rrigated	farms
(ac	res)	Number	Total	Av. Size	Number	Total acres	Av. Size
Below	2,40	13	19.84	1.53	13	20.95	1,61
2.41	6.40	25	107.10	4.28	25	104.73	4.19
Above	6,40	12	104.31	8.69	12	153.37	12.70
Total		50	231.25		50	279.05	

included in the medium group with a view to attach more importance to this group. The idea was to correspond with a national aim to upgrade the lower income classes of farmers by increasing the average size of farm. Care was taken in data computation and interpretation of findings to avoid any influence which might result from the fact that the sample included two times as many medium size farms as either small or large sized farms. Analysis was made per acre because of differences in sizes of farms both in small, medium and large size and between dry and irrigated farms.

<u>Situation</u>: The land in the District was classified into the following four categories according to location and land use:

- 1. Flood plains 60 percent
- 2. Swamps 6 percent
- 3. Madhupur Jungle Tracts 16 percent
- 4. Isolated mounds and ridges of hills 18 percent

Selection of the farms for this study was made from the first three categories since the percentage of cultivated area in the fourth category of land was low. Thus of the 100 farms included in this study, most were in flood plain areas, several were in jungle tracts and a few in swampy areas.

Types of soils in the District: The Agricultural Chemist for the Government of East Pakistan prepared a soil map of the Mymensingh District. The physical characteristics of soils in various regions are differentiated by color.

According to this classification, there are eight types of soils in the District. They include silt loam, silt clay loam, loam, clay loam, sandy loam, loamy sand, silty clay, and clay. As far as was possible, farms were selected in the representative types of soils.

Major crops grown: The percents of the areas in major crops in the District and on the 100 farms selected for this study are shown in Table 12. The area devoted to

Table 12. Proportion of areas in major crops in the District and on the 100 selected farms.

Crop	Area in the crop in the District (acres)	Percent of total area in the crop in the District	Area in the crop in the farms studied (acres)	Percent of the total area in the selected farms
Transplante	đ			
Aman paddy	1,330,965	44.50	298.10	36.40
Aus paddy	780,322	28.50	196.82	24.00
Boro paddy	82,823	3.00	173.14	21,20
Jute	380,790	14.10	68.82	8.40
Sugar cane	15,647	0.50	2.82	0.30
Mustard	77,746	2.80	34.03	4.20
Other crops	182,213	6.60	45.10	5.50
Total	2,850,506	100.00	818.83	100.00

paddy was 80 percent of the area for all crops in the District, while the area in paddy in the selected farms was 81.6 percent of their total cropped area. The area in crop other than jute and paddy in the District was 5.9 percent of the area of all crops. For the selected farms, crops other than jute and paddy represented 10 percent of their area. In the case of jute, the area in the district was 14.1 percent of the area of all crops in the District, while the area of jute on the selected farms was only 8.4 percent of their total crop area. These variations were due to the changes in the cropping system on irrigated farms. They will be explained in the following chapters as an influence of pumped irrigation water upon the cropping pattern of the forms surveyed.

Interviews:

Questionnaires were prepared to collect information from the 50 dryland and 50 irrigated farms in three size groups (see Appendix). A period of 12 months from July 1963 to June 1964 was covered by this study.

Accuracy of findings was basically dependent upon the correctness of information collected. Accurate determination of annual net incomes in farms with pumped irrigation as compared to annual net incomes on dryland

farms was not possible without depending upon information obtained from cultivators in the villages.

Keeping accounts on farming is virtually unknown to East Pakistani farmers. Therefore, the writer found it necessary to depend upon verbal statements of the farmers. Unpleasant past experiences have created attitudes among the farm people which cause them to be skeptical of the motives of officials. They are afraid information given about their farming practices may be used to their disadvantage. They find it difficult to accept officials as friends who desire only to help. Thus, the extent to which farmers furnish correct information to Government officers is difficult to determine.

To reduce the effect of attitudinal biases, the information was collected by the writer during visits with the selected farmers. The local dress was worn and the writer introduced himself as a student. The importance of correct information and the purpose of the study were explained to the respondents. Assurance of secrecy of the information was given. No specific procedure was followed. The circumstances determined the nature of approach made. Farmers were usually given a short notice of the impending visit to avoid preconceived thinking. The questions were both direct and indirect and actual recording started at the later part of the discussion.

Analysis of Data

Tabulation of data:

The data were tabulated in six categories. They include: small dryland, medium dryland, large dryland, small irrigated, medium irrigated, and large irrigated farms. This classification was selected to provide an analytical treatment that would facilitate making comparisons between dryland and irrigated farming, both within groupings by size and for total number of farms studied.

Analytical procedure:

Gross returns: Returns was computed for all produce whether sold or consumed. In calculating the value of the produce, the amount of money actually received for the quantity of produce marketed plus the value of the quantity consumed at average market rates, was considered.

<u>Costs:</u> The following analytical procedures were used to compute costs of production:

Interest: Interest on land was calculated at five percent, the current rate of interest charged by Government Banks in East Pakistan. Interest on amounts spent for leveling the land and on invested capital was considered in determining the costs of production. 2. Depreciation: Depreciation on implements and bullocks was calculated according to standard procedure by period of service. The average value of implements was determined as follows: Beginning inventory was considered to be the value of all implements on the farm at the beginning of the year plus the value of purchase made during the year. The end inventory was considered as the value of all payments on the farm at the end of the year plus the value of these during the year. For bullocks, the same procedure was adopted. The value of bullocks sold and sacrificed during the year was added to the end value.

The value of land at the beginning and at the end of the year was obtained from the farmers. These figures were verified with the records in the local Sub-Register's office to ascertain the extent of their accuracy.

- Water: Cost for irrigation water was considered as the actual amount charged by the Agricultural Development Corporation.
- 4. Labor: Charges for hired labor were considered as the actual amount paid in cash plus the price of food supplied at average local market rate. Family labor was charged at the local market rates of labor without considering the charge against food.

 Operator's labor also was calculated by the same

- procedure. Operator's wages were included in some calculations and not in some others according to standard procedure.
- 5. Seed: Price of seed was computed at the actual amount paid for seed or as the average local market rate at the time of sowing, if the seed was the fermer's own produce.
- Plough cattle hire: Costs of hired plough cattle 6. were recorded as the actual amount spent for feeding or entertaining the participating farmers. This procedure was according to local custom and was considered as a reasonable amount since there was no direct cash payment for such services. Usually the farmers in need of hired plough cattle invite their neighbors having surplus plough cattle and manpower. Such neighboring farmers assemble at a fixed time and place and perform operations like preparation of land, transplanting, and harvesting of major crops. It is customary not to make any cash payment for such services but to feed the participating farmers with expansive food. Sometimes, farmers must spend more than what they would have to pay at the normal rates for such service.
- 7. Manure and chemical fertilizers: Animal manures were priced at the rates actually paid. Chemical fertilizers were recorded at actual prices paid. However,

it should be noted that the Agricultural Development Corporation allowed a subsidy when determining these prices.

8. Taxes: Actual amounts levied as taxes were recorded.

Annual net earnings: These earnings were calculated for each farm by deducting expenses from receipts.

Labor earnings: Labor earnings were determined by deducting interest on invested capital from annual net earnings. Wages for the farm operator were not included as expenses when determining labor earnings, i.e., the earnings for his labor and management.

Interpretation of findings:

Findings about receipts, expenses and annual net incomes were interpreted with due consideration to the situation under which the data were collected. Conclusions were drawn on the basis of such interpretation of the analyzed data. Recommendation was made as considered feasible under the existing situation.

IV. RESULT

While it is generally considered that use of pumped irrigation water during the dry season produces higher net incomes for the farmers using irrigation compared with dryland farms, the analysis of the data (Table 13) for the farms surveyed found that this is not a universal result. Analysis of data collected from irrigated and dryland farms in Mymensingh District shows that while per acre annual total receipts of irrigated farms were much greater than for dryland farms, the per acre expanses for the irrigated farms were also much greater. In the case of large farms expenses per acre increased more than receipts, resulting in a lower annual net income per acre for the irrigated farmers than for dryland farmers in this size group. In the case of the medium sized irrigated farms, receipts per acre increased more than expenses. Thus the annual net income per acre for this group of farms was higher than for dryland farmers in the same size group. For small farms, the per acre annual net income of irrigated farmers was higher than for the dryland farmers since receipts increased more than expenses. Accordingly it was necessary to analyze receipts and expenses of the various categories of farms studied to ascertain the factors which

Calculation of per acre net farm income for different size groups of farms and all dryland and all irrigated farms. Table 13.

	Small dryland farm	Small irrigated farm	Medium dryland farm	Medium irrigated farm	Large dryland farm	Large irrigated farm	All dryland farm	All irrigated farm
Total farm income for year	292,41	361.95	257,52	381,15	249,41	264,42	256,33	314.69
Total operation expense	153,35	196.261	183,382	249,37	205,25	232,78	191,03	236,18
Net farm income	139,06	165.69	73,70	131,78	44.16	31.64	65.30	78.51
Less in- terest on invested capital	97.75	115.60	09.86	93.05	85,60	78,05	92.65	86.50
Net labor income of operator	41.31	50.09	24.90	38,73	41,44	46.41	27,35	7.99
Value of family labor	51.17	18.75	60.15	23,16	35,12	26,38	44,93	24.59
Total fa- mily labor income	92.48	68,84	35,25	61.89	13,32	20.03	17,58	16.60
Market value of operator's labor	117.10	154,25	48,42	47.75	16.96	15.83	40.16	37,45

contributed to higher per acre incomes for some irrigated farms and lower income for others, relative to dryland farms.

During the year of the study, the operators of the farms studied, as a group, showed negative income per acre for their labor and management (Table 13). The extent of this loss was less for irrigated farms as a group compared to the dryland farms. This relatively smaller loss was due to their higher net farm income and lower interest on invested capital as compared to the dryland farmers. However, the comparison of operator's net labor income per acre for irrigated versus dryland farmers was not uniform for the various size groups. While the negative labor income was somewhat greater for the large irrigated farms in relation to the large dryland farms, it was much greater than for the medium sized dryland farms, the only other group to show negative operator's income. The operators of small farms had positive earnings per acre for their labor and management and the net labor income was higher for irrigated farms than for small dryland farms, though interest on their invested capital was higher. The medium size dryland farmers had negative earnings per acre due to small net farm income. This difference was due to a much higher net farm income per acre for medium irrigated farms than for the medium dryland farmers. though interest on invested capital of medium size dryland

farmers was less.

Interest on invested capital varied between dryland and irrigated farms in different size groups of farms,
as shown in Table 13. Since the per acre net labor income of operators was determined by deducting the interest
on invested capital from the net farm income, large
differences in amount of interest between dryland and
irrigated farms in different size groups greatly effected
the net labor incomes of operators. Therefore, it was
considered necessary to analyze the factors determining
the interest on invested capital. This analysis will be
discussed in a subsequent section.

Great variations were observed in the values of family labor at market rates between irrigated and dry-land farms in different size groups. In general, the per acre value of family labor was less for irrigated farms than for dryland farms because the irrigated boro crop reduced the areas of crops that could be grown during the periods when family labor was available to care for them.

Since the per acre total labor income of the family was calculated by adding the value of family labor with the net labor income of operator, the differences of value of family labor and of operator's net labor income between dryland and irrigated farms in different size groups had a great effect on the total family labor income per acre as shown in Table 13. Only in the case of

medium size groups did irrigation lead to higher total family labor income compared with dryland farms. This was due to greater increase of receipts than expenses causing much higher farm income per acre in medium size irrigated farms compared to medium size dryland farms. Interest on invested capital being roughly the same in both medium size dryland and irrigated farms, the net labor income of operator became much greater in irrigated farms compared to dryland farms in same size group. Though the value of family labor in irrigated farms in this size group was very low compared to the value of family labor in the medium dryland farms total family labor income remained higher in irrigated farms.

Value of family labor per acre was less in small irrigated farms than for small dryland farms. The irrigated boro crop reduced the areas of crops that could be grown during the periods when family labor otherwise remained unemployed. As such, the family members on small irrigated farms worked less than the family workers of small dryland farms. The above was also true in the case of medium size farms. Value of family labor per acre was lower for large farms compared to medium and small farms due to the larger area cultivated per family while the number of workers per family was about the same.

There were great variations between market values

of operator's labor and the net labor incomes of operators between all farms and different size groups of farms (Table 13). As the differences in market value of operator's labor between dryland and irrigated farms in different groups are not very high, except in small farms, use of irrigation water produce different degrees of advantage to irrigated farmers in different size groups. The operators of medium size irrigated farms came closest to realizing, for their personal labor, the market value of the number of hours they worked on each acre of their land. Thus, under the existing way of supplying irrigation water, only the medium size farmers realized material advantage from using it to increase the family labor income per acre.

Analysis of Total Farm Income

Analysis of the data for the receipts of the three size categories of dryland and irrigated farms showed that differences for the various groups (Table 14) were related primarily to:

- Crops grown and the growing period of each crop.
- Yields of various crops per acre.
- 3. Value of the output per acre of various crops.

Receipts per acre from crops were more in irrigated farms, averaging 293 rupees per acre versus 256 rupees for dryland farms. Moreover, the increase in

Itemized income per acre from various crops in different size groups of farms and all dryland and all irrigated farms. Table 14.

Paddy Transplanted Aman		T T BIII	Medium	Medium	Large	Large	A11	A11
splanted	dryland farm	irrigated farm	dry land farm	irrigated farm	dryland farm	D 4	dryland	irrigated farm
	04.80	1.1	4	7	9	P	0	0
	91.80	18	70.07	20.1	0.99		70.7	26.8
0		135,13	3,46	153,80	2,53	94.30	2.74	119.25
Broadcast Aman	1	_	1	0.6	1	6	1	8.7
Jute	43,55	-	_	6.	8		. 7	
Chilli	11,22	8	CI	2.4	8	2	5.9	2.7
Potato	9,33	0	-	5	1.		7	9.
Pulse	3,22	3	7	1.	4			9.
Vegetable	14.72	1.	N	1	3	1	9.	-
Onion	1,52	2	7	7.	7.		7	5
arlic	,	1	9.	2	3		4	2
ishi	4.79	2,68	6.	4	1.		г.	8
Tobacco	1.77	ı	8	9.	3	0.68	_	9.
ugarcane	1	1	4.	í	1.		0	0
Mustard	4.39	15,45	6.	2,45	3		-	5
Barley	1	1	ಬಿ	1	1	ı		1
Total receipts from crops	291,20	347,58	256.61	337.06	249,41	256,85	255.97	292,94
Increase in inventory bullocks	1,21	14.37	0,91	44.09		5.57	0.36	21,75
Total farm income for the year	292.41	361,95	257,52	381.15	249.41	264,42	256.33	314.69

inventory averaged 21.75 rupees per acre in irrigated farms tompared to only 0.36 rupees in dryland farms. This was mainly due to large increase in value of bullocks in the medium sized irrigated farms. This resulted in higher total farm income for the year in irrigated farms than for dryland farms. Increase in inventory was the highest in medium irrigated farms due to these farms converting paddy straw into increased weight and value of their bullocks. This higher inventory value contributed substantially to making the total farm income per acre of medium sized irrigated farms highest among the groups.

Crops grown and the growing periods

Total area of different crops grown on the three groups of farms by size and the total area in different crops for all dryland and all irrigated farms are shown in Table 15. With pumped irrigation water small farms were able to increase the total acres cropped from 34 to 41 acres to add to the incomes. However, medium sized farms reduced their total cropped area due to increase in transplanted aman paddy, aus paddy and jute crop. They could not grow these crops in some areas after harvesting horo paddy due to late supply of pumped water. However, medium sized irrigated farmers received greater income due to the much higher value of boro paddy. Irrigated large farms increased their total cropped area more than their

Area in different crops for different sized dryland and irrigated farms and all dry and irrigated farms including double and treble cropping. Table 15.

	Small dry-	Small irri-	Medium dry-	ed	Large dry-	arg	All dry-	All irri-
Crop	land	gated	land	gated	land	gated	land	gated
Paddy Transplanted								
Aman	10.21		5		5	5	51,1	1,3
Aus	15,16	7.24	73,67	14,98	53,28	32,02	142,11	54
Boro	1			72,27		9.	7.	9.4
Broadcast		0.05	1	6.49	1	10.40		16.94
Jute	4.01		17,12		13.26		34,39	63
Chilli	0.63	0,25	0,95	1.47	2,21	1.87	3.79	3.59
Potato	0.43	90.0	0.16	0.39	0.59	90.0	1,18	0.51
Pulse	1.47	0.14	7.34	2.72	7.76	3,95	16,57	6.81
Barley	1	ı	0,40	1	1	1	0.40	1
Vegetable	0.24	0.03	0.07	0.04	1.77	1	2.08	0.07
Onion	0.20	0.02	0.30	0.13	0.27	0.17	77.0	0.32
Garlic	1	ı	0.15	0,11	0,11	0.12	0.26	0.23
Mustard	0.88	2,80	9.31	4.32	7.39	9.61	17,58	16.73
Total	33.23	39.17	186.22	167.54	154.59	226.70	374.04	433.41

(Continued)

Table 15, Continued.

	Small	Small	Medium	Medium	Large		A11	A11
	dry-	irri-	dry-	irri-	dry-	irri-	dry-	irri-
Crop	land	gated	land	gated	land	gated		gated
	farm	farm	farm	farm	farm	farm	farm	farm
Tishi	69.0	0,30	1,46	0.48	1.40	0.81	3,55	1.59
Tobacco	k 0.30	1	0,32	0.17	0.49	0,31	0.84	0.48
Sunnhemp	1	1	1,77	1	ı		1.17	1
Sugar cane			0.05	1	1.16	0,31	1,21	0,31
Total	33,95	41.37	189.81	189,81 168,21 157,64 228,33	157.64	228,33	381,35	435.89

average annual income per acre.

Boro paddy is the major crop grown with pumped irrigation water. Farmers receiving facilities for irrigation grew boro paddy in plots where they previously raised aus paddy, transplanted aman paddy and broadcast aman paddy crops either singly or in rotation as a double crop. This emphasis on boro paddy on irrigated farms is partly due to the restriction of pumped irrigation water mainly to the boro paddy crop and partly due to lack of experience in growing other crops under irrigation.

After harvesting the boro paddy crop in the month of May, aus paddy can not be grown in the same field as indicated in Chart 2, because it should be planted in April to mature before the flood season from June through August. Growing periods of the various crops are shown in the chart. Aman paddy is usually grown after harvesting boro paddy. The area in aman paddy decreased on irrigated farms in relation to dryland farms. This decrease is due to the fact that after harvesting their aman paddy in December, farmers can not prepare the land in time for boro paddy. Since the farmers who were irrigating grew less aus and transplanted aman paddy, they grew some broadcast aman paddy which could be harvested just before the time for sowing boro paddy.

The area in pulses and most other minor crops decreased on irrigated farms as compared to dryland farms.

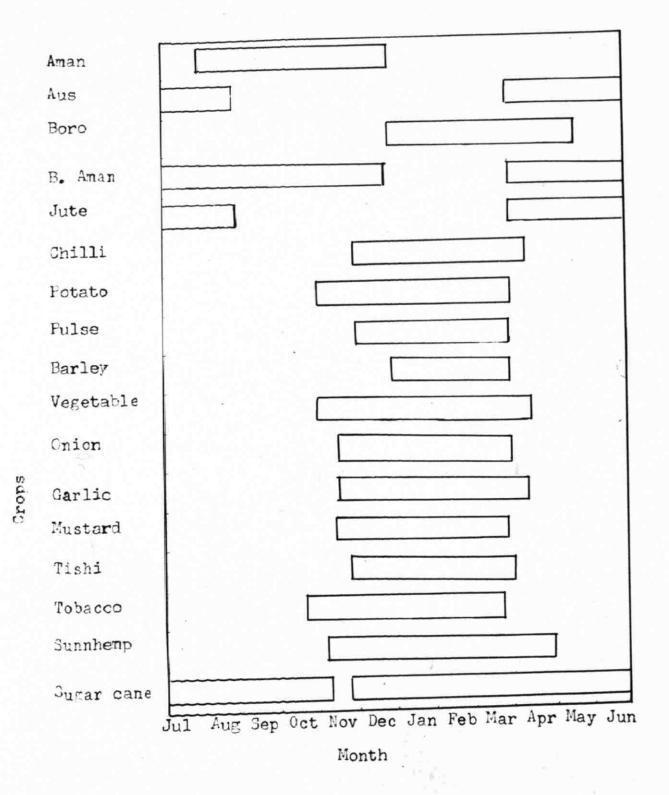


FIGURE 2. Growing periods of crops.

The requirement of labor in the irrigated boro paddy crop being very high, the irrigated farmers avoided growing crops which interfere with the labor requirement of boro paddy the more profitable crop. There was no appreciable difference among periods for growing different crops on the dryland and irrigated farms. This is partly due to the supply of irrigation water during a fixed period of about 100 days from the middle of January to the last part of April. Lack of experience of the farmers in modifying the growing periods of crops under irrigation also had some effect. Moreover, the restriction of the supply of irrigation water to mainly boro paddy reduced the possibility of farmers making adjustments in their cropping pattern which would program a sequence of crops throughout the year to produce maximum annual net earnings from 78.51 rupees.

Yields of various crops per acre:

Per acre yields of various crops for the three size groups of farms are shown in Table 16. Differences in yields make the receipts from crops different due to quantity that can be sold from each acre. The yields of aus and aman paddy generally increased on irrigated farms as compared to the dryland farms. Such increases were due mainly to larger amounts of chemical fertilizers applied to these crops by the farmers who irrigated.

Per acre yield of various crops in different size groups of farms (in Maund). Table 16.

Crop	Small dryland farm	Small irrigated farm	Medium dryland farm	Medium irrigated farm	Large dryland farm	Large irrigated farm
Paddy						
Transplanted						
Aman	17,19	18,01	15,69	19,96	13,47	16,24
Aus	10.20	10.17	8,20	11,87		12,04
Boro Broadcast	. 1	17.08	25.25	20,55	15,46	16.28
Aman	1	5.01	L	12,79		12,89
Jute	10,31	6.36	9.32	10,35	10.71	9.35
Chilli	5,96	4.00	5.16	3,13	8.24	3,61
Potato	23.64	10.09	25.01	46.67	6.65	100.00
Pulse	3,24	10,72	3,32	4.90	2,84	2,36
Vegetable	133,34	33,34	57,15	25,00	79,10	80.00
Onion	6.61	12,51	23,34	32,70	20,38	19,56
Garlic	1	1	14.17	6.82	18,19	11,26
Mustard	3,41	3.22	2,17	1.95	2.00	2,45
Tishi	5.44	19.9	2,40	3,39	2,33	6.18
Tobacco	16.67	1	5.00	7.06	5,21	5,17
Sunnhemp	gm.		gm.	ı	gm.	1
Sugar cane	gm.	1	G.M		38,80	38.71

x 1 Maund is equal to 82 pounds.

The increases were proportionately more in the larger sized farms, since they could afford to apply more chemical fertilizers.

The yields of transplanted aman paddy increased in irrigated farms due also to the residual effect of more chemical fertilizers applied to boro paddy by the irrigated farmers. Boro paddy is usually followed by transplanted aman paddy.

Among the irrigated farmers, the yield of boro paddy was the highest on medium sized farms. The abnormally high yield for boro paddy on medium sized dryland farms shown in Table 16 will be explained in the next paragraph. The medium sized irrigated farmers used greater amounts of chemical fertilizers and took better care of their fields than did the owners of the large farms.

Dryland farmers grew boro paddy without irrigation on river bank slopes. Such lands are usually more fertile than the land where the irrigated farmers grew boro paddy. Therefore, the yield in dryland farms was higher. However, these river slope areas are very small in comparison to areas in boro crop on irrigated farms.

The yield of jute on small dryland farms was more than on the small irrigated farms due partly to application of more chemical fertilizers. However, there was no appreciable difference in yields of jute crop among

other size groups of farms.

The yield of chilli in irrigated farm, was lower than the dryland farms. Since the major operations of boro paddy and the chilli crop have to be done at the same time, the farmers who irrigated usually gave less care to the minor chilli crop.

The yield of potato was greater for irrigated farms mainly due to a better variety of seed sown by these farmers. Potato seed loans were given by the Agricultural Development Corporation. Some irrigated farmers who came in touch with the officials of the Corporation received the benefit of this program to provide a more productive variety of seed potatoes.

The areas in other minor crops were very small.

Thus, it was difficult to ascertain the causes of variations in yields among different sizes of farms for these crops.

Value of the produce per acre in crop:

Values of produce per maund for different crops on farms are shown in Table 17. These values are not proportionate to the yields per acre of different crops in different size groups of farms for the following reasons:

The higher price received by large dryland farmers for their surplus aman paddy was due to their ability to hold their harvest for sale when the price had risen seasonally. The medium sized irrigated farmers had to

Prices per maund for various crops received by different size groups of farms. Table 17.

Crop	Small dryland farm	Small irrigated farm	Medium dryland farm	Medium irrigated farm	Large dryland farm	Large irrigated farm
Paddy Transplanted						
Aman	11.86	12,61	12,20	12,00	13,45	11.99
Aus	11.79	11,73	11.81	11,85	11,68	11,70
Boro	1	12,32	10.28	10.86	10.96	10,63
Jute	20,93	20.40	20.66	19,32	18.27	21.84
Chilli	59,34	00.09	56.36	55,58	48,48	65,49
Potato	18,05	16.01	19.76	19,01	50,47	20,01
Pulse	13,51	18,01	17.76	16.58	16,28	22,63
Mustard	32,96	35,95	31,49	30,54	31,02	33,37

dispose of part of their surplus aman paddy shortly after the harvesting season to meet cash expenses of boro paddy cultivation. Therefore, they received relatively lower prices than the medium sized dryland farmers. The small irrigated farmers harvested their crop early, using family labor, and marketed some of their harvest before the prices started falling after the harvesting season was well along. As a result, they received higher prices than the small dryland farmers.

There were many fluctuations in the prices of jute during the year. It was found that farmers with different sized farms received different prices. These prices received by farmers in different size groups were determined by their respective finantial ability to store their production until the prices were favorable.

Analysis of Total Expenses

Analysis of the data revealed large differences in expenses between dryland and irrigated farms (Table 18). Total operating expenses of the irrigated farms were more than that of dryland farms. This result was true for the different size groups of farms. The increases in expenses were not proportionate to the increases in receipts. The increases in expenses were comparatively lower than the increases in receipts. As a result there were differences in net farm income. Causes of the differences in expenses

Calculation of per acre expenses for different size groups of farms and all dryland and all irrigated farms. Table 18.

	Small	Small	Medium	Medium	Large	Large	A11	A11	
	dry-	irri-	dry-	irri-	dry-	irri-	dry-	irri-	
	land	gated	land	gated	land	gated	land	gated	
	farm	farm	farm	farm	farm	farm	farm	farm	
Expenses									
Seeds	27,73	23,45	20,29	21,24	18,09	17,39	19,94	19,29	
Chemical fertilizers	ers 4.60	19,39	4.93	12,33	3,49	7.24	4,25	10.01	
Manure	1	0.91	0.61	0.07	0.61	0.29	0.56	0.25	
Value of family labor	51,17	18,75	60,15	23,16	28,12	26,38	44,93	24.59	
Hired labor	53,69	84.17	84.28	149,65	128,09	149,40	102,10	144,95	
Hire of plough cattle	0.30	8.88	1.77	2,90	2,53	0.59	1.99	2,08	
Irrigation water	1	23,79	1	25,53	1	20,12	1	22,46	
Taxes	1,06	1,01	0.73	0,95	0.88	0.94	0,83	0.94	
Land rent	8.28	8,12	7.52	7,63	7.47	7,42	7.55	7,53	
Interest on borrowed money	0,32	1,20	0.27	0.82	0.24	0.56	0.27	69.0	
Decrease in inventory of bullocks and equipment	6.20	6.59	3,27	5.09	15.73	2,45	8,61	3,33	
Total operating expenses	153,35	196.26 183.82	183,82	249,37	205.25	232.78	191,03	236,18	
									l

between irrigated and dryland farms and the variations related to different items of expenses shown in Table 18 will be discussed in this section.

Seeds:

Value of seeds sown per acre for crops by different size groups of farms are tabulated in Table 19. The small irrigated farmers financed their boro paddy cultivation by disposing of the harvest from previous crops. Therefore, they had little left to use for seeds. had to purchase seeds during the sowing season when the prices were higher than in other periods of the year. This fact also explains the higher cost of seeds for medium sized, irrigated farmers when compared to medium sized, dryland farmers. Some of the medium sized, dryland farmers obtained their supply of better varieties of seed potatoes from the Agricultural Development Corporation and therefore, their expenditure per acre for seed potatoes was higher than that of the medium sized, irrigated farmers. Large sized irrigated farmers could hold their aus paddy longer than the large, dryland farmers as they had already harvested boro paddy for consumption, They used their own production of aus seeds unlike the large sized dryland farmers who had to purchase their seeds during planting season when the prices were higher. Since most of the large sized, irrigated farmers received

Table 19, Value of seeds sown per acre in different crops in different size groups of farms in rupees.

Crop	Small dryland farm	Small irrigated farm	Medium dryland farm	Medium irrigated farm	Large dryland farm	Large irrigated farm
Transplanted					9	
Aman	10,63	11,10	10,30	11,50	6.85	9.30
Aus	16.03	18,51	15.51	16.96	16.18	13,81
Boro	i	14.18	12,86	14,83	10,31	13.67
Jute	3,50	3,53	3.74	3,33	3,61	4.51
Mustard	2,28	3.93	3,36	4.17	3,15	3.96
Pulse	5,11	7.15	7.02	9,29	7.41	8.74
Potato	130.23	133,33	181,25	135,89	133,90	200.00

Development Corporation, their expenditure per acre for seed potatoes was higher than that of the large sized, dryland farmers.

Chemical fertilizers:

The value of Chemical fertilizers applied for the different sized dryland and irrigated farms are shown in Table 20. The irrigated farmers applied more chemical fertilizers than did dryland farmers. The Agricultural Development Corporation supplied chemical fertilizers on credit to the irrigated farmers. This service enabled the irrigated farmers to apply a relatively larger quantity of chemical fertilizers than could dryland farmers. It was further observed that the extent of increase in use of chemical fertilizers has an inverse relationship with the increase in size of farms.

Animal manures:

The dryland and irrigated farmers applied animal manures in amounts costing 84 rupees and 115 rupees, respectively. The above quantities were applied in addition to the quantity of animal manures produced on their farms. Irrigating farmers had greater contact with the Government officials. Thus, they were motivated to use manures more than were dryland farmers.

Total value of fertilizer applied to different crops for dryland and irrigated farms and by size groups (in rupees). Table 20.

Crop	Small dryland farm	Small irrigated farm	Medium dryland farm	Medium irrigated farm	Large dryland farm	Large irrigated farm
Paddy						
Transplanted						
Aman	49.76	99.74	310,34	473,21	171.26	467,86
Aus	19,33	3.88	166.82	45,38	165.93	31,32
Boro	1	298.08	1	770,65	1	611,93
Jute	21,28	2,25	32,50	1.76	2,62	ı
Sugar cane			ı	ı	20,25	1
Vegetable	0.88	1	1	1	3.82	i
Mustard	1	2,25	1	18,63	1	ī
Chilli	١		0.62	,	•	1
Total	91,25	406.20	510,28	1,309,63	363,88	363,88 1,111,11

Labor:

Requirements for labor by different size groups of farms, work done by the operator and the members of his family and the amounts of hired labor required per acre of land for all the crops grown are shown in Table 21. The labor needed by the irrigated farmers was more than that needed by the dryland farmers. This high labor requirement of irrigated farmers was due to the fact that they increased their area of double and treble cropping. From December, through April, both the dryland and irrigated farmers and their family members were equally busy caring for paddy and other minor crops. However, the total area in different crops was greater on irrigated farms than on dryland farms. It was found that dryland farmers could care for standing crops by utilizing the labor of family members, and by hiring comparatively less labor than the irrigated farmers. Findings of the study showed that numbers of working members in both irrigated and dryland farm families were almost equivalent. Therefore, the higher labor requirement on irrigated farms resulted in their being forced to depend more upon hired labor than did their dryland farming neighbors. During the remaining seven months of May through November, the operators and their families in both dryland and irrigated farms could do most of the work by themselves. Thus for the year as a whole the requirement of hired labor was

Requirement of labor per acre of land and proportions of work done by the operator, his family members, and the labor hired. Table 21.

	Small dryland farm	Small Small dryland irrigated farm farm	Medium dryland farm	Medium irrigated farm	Large dryland farm	Large irrigated farm	All dryland farm	All All dryland irrigated farm
Value of family labor	51.17	18.75	60,15	23,16	28.12	26.38	44.93	24.59
Value of operators labor	117,10	154,25	48.42	47.75	16.96	16,96 15,83	40.16	37,45
Hired labor	53.69	84.17	84,28	149.65	128.09	149.40	102,10	144,95
Total	221.96	257,17	192,85	220,56		173,17 191,61	187,19	206.99

more in irrigated farms than in the dryland farms.

Had operators of irrigated farms received irrigation water during the period of May through November,
they could have adjusted the cropping system to keep them
and their family members busy during periods when they
otherwise had no work to do. During these seven months
the operators of irrigated farms, having comparatively
smaller areas in crops than the dryland farmers due to the
late harvest of boro paddy, utilized their family members
(school children and women) proportionately less than did
dryland farmers.

Increases in the requirement of labor in the irrigated farms compared with dryland farms in similar size, groups had an indirect relationship with the increase in size of farms. This finding was due to the fact that the increase in double and treble cropping in irrigated farms compared with the dryland farms in similar size groups also had an indirect relationship with the increase in size of farms. The larger sized irrigated farms did not show an increase in double and treble cropping proportional with the increase in size of farms.

The operators of small irrigated farms worked more and utilized family labor less than the operators of small dryland farms. Small irrigated farmers had less work to do than did the small dryland farmers during the seven months from May through November. Thus, they were not able

to keep their other family members busey to the same extent as could the small dryland farmers. However, the small irrigated farmers had to hire more labor than the dryland farmers during the five months from December through April to care for the boro paddy crop grown under irrigation, because of the high labor requirement of this profitable crop.

The operators of the medium sized irrigated farms could keep themselves as much occupied as the medium sized dryland farmers but they could not utilize their family members to the same extent as the dryland farmers due to less work during the seven months from May through November. Requirement of hired labor was high in medium irrigated farms due to the large area in boro paddy.

The members of the large irrigated farms remained equally engaged as the members of the large dryland farms because they had sufficient work throughout the year.

Labor constitutes a very high percent of the expenses in operating farms in East Pakistan. Though the members of families of irrigated farmers remain unemployed during some periods of the year, these farm operators depended more on hired labor than did dryland farmers. This greater dependance on hired labor was due to the restrictions in the supply of irrigation water to the boro paddy crop and also to the supply of water during a fixed

period of about four months from the middle of January through the middle of May. Had the irrigated farmers received water throughout the year, they could have grown boro paddy in December. This year around distribution would have enabled them to increase and adjust the areas in other crops and spread the utilization of family labor throughout the year. Thus, they could utilize more of the labor of the family members and depend less on hired labor. As the family members of the operators had no other employment opportunities during such periods of unemployment on their farms and as the hired labor involved cash expenses, irrigation opportunities could have made them economic gainers over dryland farmers.

Plough cattle hire:

Expenditures incurred for hiring plough cattle by farmers in the different size groups are shown for three varieties of paddy in Table 22. The small irrigated farms rented more land than did the small dryland farms. Since they did not increase their ownership of plough cattle, they spent more for hiring plough cattle than did the small dryland farmers.

The medium sized, irrigated farmers had to depend more on hired plough cattle than did the medium sized, dryland farmers. This dependence was caused by the period of preparation of land for irrigated boro paddy coinciding

Expenditures for hiring plough cattle, for the paddy crops in different size groups of farmers in rupees. Table 22.

Crop	Small dryland farm	Small irrigated farm	Medium dryland farm	Medium irrigated farm	Large dryland farm	Large irrigated farm
Aman paddy	1	52,00	106.00	230,00	162,00	45.00
Aus paddy	00*9	12,00	74,00		102,00	1
Boro paddy		122,00	1	74.00		45.00
Total	00-9	186.00	180.00	304.00	264.00	00.06

with some important operations of other major crops such as aman paddy, aus paddy and jute.

The large sized, irrigated farmers had comparatively larger areas of boro paddy grown in swampy areas than did the large sized, dryland farmers. Neighboring farmers who were invited to supply hired plough cattle avoided undertaking the long walking distances required to reach such swampy areas. However, due to decrease in the area of aus paddy the irrigated farmers required less hired labor for this major crop than did the dryland farmers. Thus, the large sized, irrigated farmers utilized less hired plough cattle than was true for the large sized, dryland farmers.

Water:

The irrigated farmers paid for irrigation water at the rate of 37 rupees per crop, per growing season. They irrigated only the boro paddy crop. Water charges per acre in different size groups of farms were not same due to disproportional areas in boro paddy. This application of water increased the costs of production of boro paddy on the irrigated farms. As the dryland farmers did not raise any boro paddy without irrigation, comparative value of the harvest of boro paddy by irrigation versus dryland farms could not be furnished. However, it may be mentioned that irrigation water is a limiting factor in

boro paddy cultivation. This profitable crop can be grown only when irrigation water is available.

Taxes:

Farmers had to pay a general tax levied by the local Government. Total amounts of local taxes were 0.83 rupees and 0.94 rupees per acre for the dryland and irrigated farms, respectively. The local Government increased the burden of taxes to the irrigated farmers because they harvested higher quantity of produce than did dryland farmers. It was further observed that the rate of increase had a direct relationship with the increase in size of farms. It seems that authorities considered paying capacities of farmers when increasing the taxes on large farms. Thus, the taxes paid by individual farmers were in effect, at least partially, a personal income tax and not simply a tax on the value of the land.

Land rent:

Under the provisions of the East Bengal (East Pakistan) State Acquisition Act of 1950, farmers are considered as direct tenants of the Government, Because the Government took over the land from the zaminders who used to collect rents from farmers. The Government fixed land rents for an indefinite period of years. This land rent includes an "Irrigation Tax" levied by the District

Council. The tax is a definite proportion of the land rent. Since the District Council tax is a fixed amount for a period of years, it has been combined with the land rant. Land rents for farms in the study totaled 1,337.25 rupees for the dryland farms and 1,339.87 rupees for the irrigated farms. Since the assessment was made as a flat rate per mauza¹, the amounts were roughly the same. The irrigated farmers had comparatively more boro paddy areas in swampy land where rent rates are lower than for average land. As a result, the total amounts of rent remained almost the same though the total area in irrigated farms was higher than the total area of the dryland farms. The payment for renting land from neighboring farmers was made in kind and was omitted from both receipts and expenses.

Interest on borrowed money:

Farmers received chemical fertilizers and seed potatoes as loan from the Agricultural Development Corporation. In addition, they received some loan from cooperatives and other sources for financing production and family maintenance. The taccavi loan received from the Government was free of interest. The Agricultural Development Corporation supplied chemical fertilizers and seed potatoes on loan mainly to the irrigated farmers and thus the total amount of loan received by the irrigated farmers was more than that received by the dryland farmers (Table 18).

^{1.} A mauza is nearly equivalent to 100 acres.

The Corporation preferred to give loans to the irrigated farmers due to the belief that they would have better paying capacity after harvesting larger quantities of boro paddy under irrigation.

Depreciation of plough bullocks, implements and equipment:

Plough bullocks used by farmers in East Pakistan are an indiginous breed generally weak in health. Their average liveweight is only about 400 pounds. Paddy straw is the main cattle food. In the absence of sufficient green fodder and other cattle feed, and sometimes in absence of enough paddy straw, the cattle suffer from malnutrition. The health and the body weight of cattle usually improves on irrigated farms because the production of paddy straw is more than on dryland farms. Table 23 reveals that the bullocks of dryland farmers as a group show depreciation in value. However, it was in the large sized, dryland farms that the substantial depreciation on bullocks occurred. These farmers maintained large numbers of plough cattle which could not be cared for as well as those of the small and medium sized dryland farmers who were able to produce slight gains in the weight of their animals.

The farmers generally use local made equipment and implements. The equipment consist of baskets, wooden rakes, spades, sickles, khurpi, and shovels. The implements include ploughs, yokes, and ladders. All equipment and

Beginning and ending inventory values and depreciation per acre of bullocks, implements and equipment. Table 23.

Value of bullocks: Beginning of year 169.66 152.03 96.58 135.34 63.43 53.72 96.96 91.38 End of year of year 170.87 166.40 97.49 179.43 69.94 59.29 91.53 113.13 Depreciation and implements: Beginning of year 20.46 21.98 11.71 14.66 7.67 5.01 10.63 9.81 End of year 0.20.46 15.39 8.44 9.57 5.33 2.56 7.45 6.48 Depreciation 6.20 6.59 3.27 5.09 2.24 2.45 3.18 3.33 Total depreciation 6.20 6.59 3.27 5.09 15.73 2.45 8.61 3.33		Small dryland farm	Small irrigated farm	Medium dryland farm	Medium irrigated farm	Large dryland farm	Large irrigated farm	All dryland farm	All irrigated farm
169.66 152.03 96.58 135.34 83.43 53.72 96.96 9 170.87 166.40 97.49 179.43 69.94 59.29 91.53 11 - - - - - 13.49 - 5.43 20.46 21.98 11.71 14.66 7.67 5.01 10.63 14.26 15.39 8.44 9.57 5.33 2.56 7.45 6.20 6.59 3.27 5.09 2.24 2.45 3.18 6.20 6.59 3.27 5.09 15.73 2.45 8.61									
170,87 166,40 97,49 179,43 69,94 59,29 91,53 11 - - - - - 5,43 - 5,43 20,46 21,98 11,71 14,66 7,67 5,01 10,63 14,26 15,39 8,44 9,57 5,33 2,56 7,45 6,20 6,59 3,27 5,09 2,24 2,45 3,18 6,20 6,59 3,27 5,09 15,73 2,45 8,61	Beginning of year	169,66		96.58	135,34	83,43	53.72	96.96	91.38
- - - - - 5.43 - - - - 5.43 - - - - 5.43 - - - - 5.43 - - - - 5.43 - - - - 5.03 - - - - 5.45 - - - - 5.45 - - - - - 5.45 - - - - - 5.45 8.61	End of year	170,87		97.49	179.43	69.94	59.29	91,53	113,13
s: ng 20.46 21.98 11.71 14.66 7.67 5.01 10.63 14.26 15.39 8.44 9.57 5.33 2.56 7.45 ion 6.20 6.59 3.27 5.09 2.24 2.45 3.18 tion 6.20 6.59 3.27 5.09 15.73 2.45 8.61	Depreciation	1	ı	ı	ι	13,49	ı	5,43	
inning year 20.46 21.98 11.71 14.66 7.67 5.01 10.63 of r 14.26 15.39 8.44 9.57 5.33 2.56 7.45 ciation 6.20 6.59 3.27 5.09 2.24 2.45 3.18 ciation 6.20 6.59 3.27 5.09 15.73 2.45 8.61	Value of equipment and implements:								
of 14.26 15.39 8.44 9.57 5.33 2.56 7.45 riation 6.20 6.59 3.27 5.09 15.73 2.45 8.61	Beginning of year	20,46		11.71	14.66	7.67	5.01	10,63	9,81
ciation 6.20 6.59 3.27 5.09 2.24 2.45 3.18 ciation 6.20 6.59 3.27 5.09 15.73 2.45 8.61	End of year	14.26		8,44	6.57	5.33	2.56	7.45	6.48
ciation 6.20 6.59 3.27 5.09 15.73 2.45 8.61	Depreciation				5.09	2.24	2,45	3,18	3.33
	Total depreciation				5.09	15,73	2,45	8,61	3,33

implements cost about 10 rupees per acre. There was no appreciable difference in the amounts of depreciation to implements and equipment per acre of land for all dryland and all irrigated farms. The depreciation was 3.18 rupees per acre in dryland farms and 3.33 rupees per acre in irrigated farms.

Total depreciation per acre for bullocks, equipment, and implements amounted to 8.61 rupees in dryland farms as against 3.33 rupees per acre in irrigated farms. The high depreciation for dryland farms was due to large depreciation of plough bullocks. For large dryland farms, the total depreciation was 15.73 rupees as against only 2.45 rupees in large irrigated farms due to very high depreciation of plough cattle. All other categories had the bullocks increase in value during the year. This increase was included in the receipts stated in Table 13.

Had the farmers received the advantage of irrigation throughout the year enabling the planning of the
cropping system to include some fodder crops, there would
have been appreciable increase in the inventory value of
plough bullocks due to the animals gaining in weight and
meat value.

Analysis of Interest on Invested Capital

Capital invested by farmers is in land, bullocks, implements, and equipment. Of the above, the investment

in land is about 80 percent of the total investment per acre (Table 24). Interest at five percent on the invested capital is about 89 rupees per acre, about 125 percent of the average net farm income and about 225 percent of the market value of operator's labor (Table 24). Due to this high interest on invested capital operators, as a group, earned negative labor income. They remained in farm operation in the absence of alternate employment opportunities. Interest per acre on irrigated farms as a group is less than that on the dryland farms. This difference is due to lower investment in land by the irrigated farmers than by the medium size and large dryland farmers. The price of land in these larger size farms had not responded as quickly to the idea of higher returns from growing crops under irrigation as in the case of the small farms.

The irrigated farmers had comparatively more land near the swampy areas where the land prices were very low before the reclamation started for growing boro paddy under irrigation. Though the land value in these areas had been rising since the beginning of the cultivation of boro paddy under irrigation, prices had not reached, by the year of this study the same level as in the dryland areas. The above is true for the large and medium sized farms. The small farmers had most of their land in the dry areas. The prices of the land of small irrigated

Calculation of interest per acre on invested capital for different size groups of farms and all dryland and all irrigated farms. Table 24.

	Small dry- land farm	Small irri- gated farm	Medium dry- land farm	Medium irri- gated farm	Large dry- land	Large irri- gated	All dry- land	All irri- gated	T.
Average value per acre in:				5					1
Land	1,767.00 2,1		1,864,40	17.20 1,864.40 1,692.80 1,632.20 1,500.40 1,749.90 1,619.40	1,632,20	1,500,40	1,749,90	1,619,40	
Bullocks	170,00	159,20	00°26	156,20	73,40	56,40	95.00	102,60	
Implements and equipment	18,00	35,60	10.60	12,00	6.40	4.20	00°6	8.00	
Interest at 5% on invest- ment per acre	in:	-							
Land	88.35	105,86	93,22	84.64	81,61	75.02	87,45	80.97	
Bullocks	8.50	7.96	4.85	7.81	3,67	2,82	4.75	5,13	
Implements and equipment	06.0	1,78	0,53	09*0	0,32	0.24	0.45	0.40	
Total	97.75	115.60	09.86	93.05	85.60	78.05	92.65	86.50	-
									١

farmers increased more than the price of the land of small dryland farmers because they obtained higher yields due to better care.

Interest on capital invested in bullocks was greater for irrigated farms as a group (5.13 rupees) than for the dryland farms (4.75 rupees). This difference existed because bullocks improved in condition and weight on the irrigated farms during the year due to better feeding. The value of bullocks and thereby the increase in interest charge was quite high for medium sized, irrigated farms compared with the medium sized, dryland farms because the numbers of their plough cattle were more suitably adjusted to their production of cattle feed.

There was no appreciable difference in the interest on investment in implements and equipment as shown in Table 24. The interest per acre was slightly less for the irrigated farms as a group than for the dry-land farms because the irrigated farmers had to depend more on hired laborers who used mostly their own equipment. In the case of small farms, the interest was more for the irrigated farms because they depended less on hired labor and had to have tools for each member of the family who worked in the fields.

Summary

The hypothesis under test in this study was that the use of pumped irrigation water during the dry season produced higher average annual net incomes for farmers using irrigation than for comparable dryland farmers. At the beginning of this chapter it was shown in Table 13 that all irrigated farmers included in the study had an average net income which amounted to 78.51 rupees per acre. Comparatively, all dryland farms were found to have had an average net income amounting to 65.30 rupees per acre.

However, when the sample of farms was classified into large, medium, and small irrigated and dryland farms, varying results were revealed. For example, for the large sized group, irrigated farms had less average net annual income per acre (31.64 rupees) than did the dryland farms (44.16 rupees). Conversely, both medium and small irrigated farms were found to have had larger average annual net incomes per acre than did their dryland counterparts. In Table 13, it was shown that medium irrigated farms had 131.78 rupees average annual net income per acre as compared to 73.70 rupees for the dryland farms in that same size group. Much the same result was found for the small irrigated and small dryland farms where average annual net incomes were 165.69 rupees and 139.06 rupees, respectively. The greater net income per

acre for the irrigated farms was found to be due to much greater profitability of the boro paddy grown with the water supplied by pumps. The large irrigated farms did not grow proportionally as much boro paddy as the smaller farms and had to hire expensive labor to produce it.

Much of this chapter was devoted to detailed analysis of factors in the income and expenses of the various classifications of farms under study. These analyses were interpreted to give an insight into why a universal pattern of advantage for irrigated over dryland farming (as expressed by average annual net income per acre) was not found for all size groups of farms.

V. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The data collected from the selected farms were analyzed, summarized in tables, and discussed in the previous chapters with due consideration to the situation prevailing in Mymensingh District of East Pakistan. On the basis of data collected it was revealed that the hypothesis, namely, the use of pumped irrigation water during the dry season produces higher annual net incomes for farmers using irrigation than for comparable dryland farmers, may not be true universally. However, for the farms included in this study, the hypothesis was demonstrated to be correct for small and medium sized farms and not true for large sized farms.

The following conclusions may be drawn on the basis of what has been discussed in previous sections.

A. Growing field crops under irrigation is more economical for medium and small sized irrigated farms than for medium and small dryland farms.

Following are some of the supporting facts:

1. Net farm income per acre was more for medium and small sized irrigated farms (131.78 rupees and 165.69 rupees, respectively) than for medium and small sized dryland farms (73.70 rupees and

- 139.06 rupees, respectively) due to much greater increase in receipts than in expenses.
- 2. Net labor income of operators per acre was more among medium and small sized irrigated farms (38.73 rupees and 50.09 rupees, respectively) than for medium and small sized dryland farms (24.90 rupees and 41.31 rupees, respectively) studied.
- 3. Total family labor (family members plus operator) per acre was greater for medium sized irrigated farms (61.89 rupees) than for same size group of dryland farms (35.25 rupees) on account of the much higher net labor income of operators of irrigated farms compared with dryland farms as mentioned in the preceding section. However, the total family labor income per acre for small irrigated farms was less than for the dryland farms because of the small amount of family labor utilized by the irrigated farms. This difference was caused by the necessity for these farms to hire outside labor.
- B. Growing field crops under irrigation was less economical for large sized farms than for dryland farming on large sized farms.
 - Following are some of the facts in support of this conclusion:
 - Net farm income per acre was less for large sized irrigated farms (31.64 rupees) than for large

sized dryland farms (44.16 rupees). This difference was due to much greater increase in expenses (from 205.25 rupees to 232.78 rupees) than the increase in receipts (from 249.41 rupees to 264.42 rupees) for irrigated farms than for dryland farms in this size group. Due to limitation of the period for irrigation water, the large farmers could not increase the area in boro paddy proportionately to the increase of area in boro paddy by the medium and small sized irrigated farms. Areas in minor crops decreased on large irrigated farms compared with large dryland farms as they were unable to use irrigation water at other times of the year. This prevented rational change of the cropping program to increase the returns from crops and spread labor requirements so that family labor could be employed for more days per year.

C. Restricting the operating of irrigation pumps to the three and a half months of the growing season for boro paddy prevents rationalization of the cropping program to schedule crops for double and treble cropping to neable maximum use of family labor and minimizing hired labor.

Due to restriction of the supply of water to three and a half months from the middle of January to the end of April the farmers having pumped irrigation water have to follow cropping system which prevents them from increasing the areas in double and treble

crops for better utilization of family labor. Supply of irrigation water throughout the year should enable them to adjust their cropping system and thereby utilize more family labor and less hired labor. When water is available all through the year crops can be irrigated whenever needed to maintain normal growth and to obtain higher yields.

Recommendations

The conclusions drawn from data presented and the facts described in previous chapters suggest for the farms included in this study, two categories of recommendations, namely, those relating to improvements in supplying pumped irrigation water to farmers and those enabling farmers to make the most productive use of irrigation water.

- A. Improvements in the supply of irrigation water.
 - 1. Growing crops under irrigation should be encouraged with water available to farmers whenever needed.

Irrigation facilities with engine driven pumps operated when needed would enable farmers to increase the areas in double and treble crops and to grow larger areas of higher value crops.

Moreover, the crop yield per acre increases under irrigation. This increases the farm output and total farm receipts are raised more than

production expenses.

2. Pumped irrigation water should be made available to small and medium size groups of farms throughout the year.

This availability would enable farmers to increase their income by increasing the areas in double and treble crops. It would further enable them to decrease expenses through more extensive utilization of family and operator labor in a cropping pattern adjusted to avoid the occurrence of the peak labor requirements for various high net return crops at the same time. While the results of this study do not show irrigation to be more profitable than dryland for large farms, further study of the year around availability of water should be made for this size group.

3. Supply of irrigation water should be limited to the actual requirements of various crops and farmers should be charged according to water supplied to them.

The Agricultural Development Corporation should determine the amount of water required by various crops in different areas. The amount of water supplied to individual farmers should be limited to these actual requirements. Misuse of water means increased expense and usually causes yields to be lower than those achieved with the optimum quantity of water. Therefore, proper utilization of water should decrease cost of

production and increase farmer's income.

Farmers should be charged for water in proportion to the quantity supplied at the appropriate intervals for optimum plant growth. This system of charging may stimulate farmers to decrease their misuse of water. It also is an important factor in the achievement of higher crop yields.

4. Existing cooperatives should be re-organized to keep irrigation pumps operating for the maximum possible number of days, to supply individual members according to their crops and to educate members regarding the proper use of irrigation water.

Local Irrigation Committees are not properly organized to manage projects such as construction of channels for leading water to plots, collection of irrigation water charges from the beneficiaries, delivering and returning irrigation pumps, and supervising and settling disputes. Often the influential persons in the area served are the primary beneficiaries of a scheme (usually the area irrigated by a standard sized irrigation pump in a block). Therefore, maldistribution of water among farmers has occurred in many places and some have not received enough water to achieve normal yields.

Such committees should be replaced by reorganized cooperatives to supply irrigation water to their members on an equitable basis. Care should be taken to see that all farmers needing irrigation water are admitted to membership in cooperatives. Ownership and operation of pumps coupled with supervision by such cooperatives of the use of water by the members should supply water to farmers as they need it to expand the production of irrigated crops and increase yields. Cooperative personnel who are farmer-members trained as local leaders can be effective in educating other farmers regarding improved practices in growing crops under irrigation, because farmers rely more upon their neighbors who adopted practices and who give advice than they do on extension officers.

Cost data obtained from the Tejgaon power pump center regarding cost estimate for the 1963-64 season indicates that a cooperative operating a pump throughout the year to supply water as needed would be able to furnish water at a lower price than the charges paid by the farmers included in this study (Table 25). It is estimated that an irrigation cooperative would need to operate such a pump about 1,500 hours during the

Covering the operation of a standard size two cubic feet of water per second capacity pump which supplied water to irrigate 72 acres of boro paddy during 1963-64.

Table 25. Calculation of costs of operating standard size pump by Government and private agencies.

Item	Costs by A.D.C. Working 786 hours	Costs by cooperatives working 1500 hours
Fixed cost: Depreciation (7 years life)	1.070	1.070
Variable costs:		
Fu e 1	979	1.889
Oil and grease	.60	115
Spare parts	50	95
Storage & moving to field	25	15
Incidental charges	3	5
Pump operator	521	1.284
Mechanic & Assistant mechanic	48	
Administrative salaries of staff maintained by the A.D.C. for the purpose	438	# <
Supervisory & administrative staff of cooperatives		300
Total cost for the season	3.194	4.753
Cost per working day of 10 hours	40.50	31.60
Cost per acre of boro paddy (for 11 hours)	44.55	34.75

year to supply the water required by members having a total of 136 acres to irrigate. As shown in Table 25, the annual depreciation of a pump amounts to 1,070 rupees. When such a pump was operated 786 hours per year, the depreciation cost amounted to 1.36 rupees per hour. If the cooperative operates the same kind of a pump for 1.500 hours during a year, the depreciation cost per hour drops to 0.71 rupee, a saving of 0.65 rupee per hour. Since the other operating costs remain about the same per hour for operating the pump, the charges to members of an irrigation cooperative would be lower by the amount of the saving in depreciation cost per hour. Since the records of the Tejgaon Center showed that a standard size pump has to operate about 11 hours to supply the water to grow an acre of born paddy. a farmer who obtained water from a cooperative would save 7.15 rupees on the cost of water for each acre of boro paddy he grew.

B. Improvements enabling farmers to make more productive use of pumped irrigation water.

A great majority of farmers in East Pakistan are unable to get maximum benefit from pumped irri-gation water even if it is supplied when needed throughout the year because of lack of capital to pay

for improved seeds and chemical fertilizer to increase yields, lack of knowledge of improved production practices, and necessity to sell products immediately at harvest time. Thus, they need sufficient credit and proper education to enable them to use irrigation water to increase their income and improve living.

1. Cooperatives operating irrigation pumps should take up the functions of providing production supplies for the members on credit, marketing their produce, and establishing storage facilities,

Farmers can increase their yields by using improved seeds, chemical fertilizers and plant protection measures. The Agricultural Development Corporation has been supplying only a very small percent of what is actually needed by farmers. The cooperatives may arrange to supply better varieties of seeds, chemical fertilizers, and plant protection chemicals on credit to members to enable them to increase farm income by utilizing such lower cost supplies.

The farmers are not getting proper prices for their produce due to marketing difficulties.

They must dispose of their marketable produce to buyers who do not pay them reasonable prices and who take advantage of their marketing difficulties.

The cooperatives may take up the function of marketing the marketable produce of their members

and thereby enable them to increase returns from their produce.

The farmers have to dispose of their marketable produce immediately after harvesting time due to immediate need for cash and also due to insufficient storage facilities. The co-operatives may provide storage and credit enabling members to market their produce when prices rise reasonably and thereby increase their returns from crops.

2. The Government should make sufficient credit available through cooperatives to enable members to expand the output of their farms.

Although the amount of credit required by farm people is very great, the Government should attempt to provide a reasonable amount of initial capital to the above described cooperatives. In addition to the capital required for buying pumps, developing facilities to distribute water to members, buying an inventory of production supplies and improved farm equipment and making advances to members upon delivery of their products to the cooperative for marketing (both immediately and after storage) capital is required to enable cooperatives to borrow money from cooperative Banks for supplying production credit and loan to members. Farmers in East Pakistan have very small

capital resources. Thus, they need considerable capital from Government in order to capitalize their cooperatives adequately to enable the performance of various services members require to expand their production and to increase their incomes. Also, farmers require credit so they can obtain seeds of higher yielding varieties and chemical fertilizer to produce higher crop yields. They need loans to buy improved equipment to be used when following recommended production practices. They also need loans to cover the family subsistance until crops are harvested and sold after prices have risen following harvest. Without this credit farmers will not be able to prosper even with irrigation water.

Cooperatives can educate members regarding thrift and stimulate them to save through the cooperative so they can accumulate capital to get out of debt and to improve and increase the productive resources of their farms.

3. Extension Service should strengthen its educational program for farmers and cooperative members with regard to better methods of production and cooperation.

The Extension Service is virtually the only agency charged with making direct contact with the farm people. The geographical area and the

population for which one local extension worker is responsible is very large. Therefore, he should strive to approach farm people through mass media education and by personal contact. The available mass media should be utilized to create interest in farm people for adapting better methods of production and personal contact should be made to help farmers put improved practices into operation on their farms. Result demonstration have already proved to be successful in the use of better seeds, chemical fertilizers and plant protection measures.

Cooperatives have proved to be effective agencies for bringing their members into group contacts with the local extension worker. The cooperative arranges meetings and demonstrations of improved practices at which the Government Extension Agent is asked to teach recommended improved methods and practices. It also arranges for progressive members to serve as demonstrators of the recommended practices and cooperates in supplying necessary materials. Some members become volunteer teachers to show other members the new practices taught by the extension worker. In these ways cooperatives help greatly in fostering the participation of their members in the educational program of the extension workers to explain

cooperative principles and practices to the members so that they will participate more effectively in their cooperative and derive maximum benefits.

4. All agencies working with farm people should integrate their activities at the local level in order for farm families to get the full benefit of their programs.

Unless there is close cooperation among the different agencies (Agricultural Extension Department, Cooperative Department, Agricultural credit agencies, other nation-building departments and Basic Democracy) effecting the overall program for rural improvement, the desired target of higher incomes and levels of living for farm families can not be reached. Coordination at all levels - thana, district, division and provincial level - and specially at the thana level and integration of the local program with national program are required. The councils formed by officials and non-official persons at different levels may be utilized for such coordinated effort for agricultural development and rural improvement.

SELECTED BIBLIOGRAPHY

- Pakistan. Agricultural Economics Society of Pakistan, Karachi. The Agricultural Economist. 1959.
- Pakistan Directorate of Agricultural Economics and Statistics, Ministry of Food and Agriculture, Government of Pakistan, Rawalpindi. <u>Agricultural</u> <u>Statistics of Pakistan</u>, 1961.
- 3. Pakistan, Ministry of Agriculture. Karachi. Food and Agriculture Commission Report, 1960. Printed by Government Printings, Karachi.
- 4. Pakistan. Department of Agricultural Economics and Statistics, Ministry of Agriculture and Works, Government of Pakistan, Rawalpindi. Land and Crop Statistics of Pakistan, 1960.
- 5. East Pakistan. Department of Home Affairs, Government of East Pakistan, Dacca. Land Revenue Commission Report, 1959. Government Printing Press, Dacca.
- 6. Government of Pakistan, Ministry of Food and Agriculture. Pakistan Census of Agriculture, 1960. Government of Pakistan Press, Karachi.
- 7. East Pakistan. Directorate of Agriculture, Decca.
 Soil Survey Report of Mymensingh District.
 Government Printing Press. Decca.
- 8. East Pakistan, Agricultural Development Corporation, Decca. Yearly Progress Report of Irrigation Division, 1963-64

APPENDIX

American University of Beirut

School of Agriculture Division of Agricultural Economics and Sociology

Economic analysis of irrigated and dryland farming in the Mymensingh District of East Pakistan.

1.	Ide	entification	
	a)	Date of interview	1964.
	b)	Enumerator's name	
	c)	Name of interviewee	
		His position	
		Village That	an a

Ownership and periods of cropping from July 1, 1963 to June 30,1964. 2

Date of har- vesting			+ -						
Date L of of sow- ve ing							lue		
Name of 3rd crop									
Date of har- vesting									
Date of sow-									
Name of 2nd crop									
Date of har- vesting									
Date of sow- ing									
Name of 1st crop									
Area rented (acres)						17			
Area owned (acres)					,				
No. of plots				i i	1			i	

. Cost of labor from July 1, 1963 to June 30,1964.

	N.	Name of crop	crop			Name o	Name of crop	
Individuals	Hired	10	Family	у	Hired	p	Fam	Family
	No. days	Rate	No. days	Rate	No. days	Rate	No. days	Rate
Men 18 - 45 yrs.								
Men 46 above								
Women 15 - 40 yrs.								
Women 41 above								
Boys 8 - 17 yrs.								
Girls 8 - 14 yrs.								

. Cash cost from July 1, 1963 to June 30, 1964.

	 		 	 -	 	-	 _
Quantity of manure used (Mds)							
Cost of seed (Rs)							
Quantity of seed used (Mds)							
Total cost of irri- gation (Rs)							
Date of 3rd irri-gation							
Date of 2nd irri-gation							
Date of 1st irri- gation							
Plot No.							
Name of crop							

Cash cost from July 1, 1963 to June 30, 1964. (Continued)

Total cost of plough cattle (Rs)						
Plough cattle hired (days)						
Rent and tax paid (Rs)						
Cost of fertilizer used (Mds)						
Quantity of fertilizer used (Mds)						
Name of fertilizer used						y.
Cost of manure used (Rs)						
Name of crop						

Outturn and value of produce from July 1, 1963 to June 30, 1964, 5.

Total value (Rs)						
Price per maund (Rs)						
Quantity of by- products (Mds)						
Total value (Rs)						
Price per maund (Rs)						×.
Quantity of product (Mds)						
Name of crop					3	

Improvements on land from July 1, 1963 to June 30, 1964.

	 				 -	
Value of land end of year (Rs)			*			
Value of land beginning of year (Rs)						
Gost of improvement						
Nature of improvement made						
Plot No.						

Expense of depreciation of farm bullocks and equipment from July 1, 1963, to June 30, 1964.

		toof to farm	Purchase	during year	En d	End of year
	No.	Value (Rs)	No.	Value (Rs)	No.	Value (Rs)
Bullock						
Spade						
Plough						
Yoke						
Ladder						
Sickle						
Rake						
Khurpi						
Dao						
Khanto						
Basket						

Narrative of the farmer's procedures and problem in obtaining irrigation water. 8

	777			6.6		-	21		
-				C F				-	
			4-						
								-1	
						41			
						Н			
		H							
				x .					
				7					
									-
							E		
1									
	 -	 	-		 -	_	_		 _

Description of ownership and holding pattern of property. . 6