

IMPACT OF IRRIGATION ON AGRICULTURE IN KHANDAPARA OF PURI DISTRICT

**A Thesis Submitted to
The Orissa University of Agriculture and Technology
In Partial Fulfilment of the Requirements
For the Degree of
MASTER OF SCIENCE
In
Agricultural Economics.**

By
SURENDRA KUMAR PRADHAN

**Department of
Agricultural Economics
College of Agriculture.
Bhubaneswar
1974**

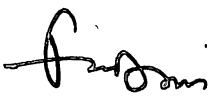
Thesis Advisor

Dr. P. K. Das

C E R T I F I C A T E

Dr. P. K. Das,
M.Sc. (Ag), Ph.D. (I.A.R.I.),
Lecturer, Department of
Agricultural Economics,
College of Agriculture, O.U.A.T.
Bhubaneswar.

Certified that the thesis entitled
"IMPACT OF IRRIGATION ON AGRICULTURE IN
KHANDAPARA OF PURI DISTRICT" submitted to the
Orissa University of Agriculture and Technology
in partial fulfilment for the award of Degree of
MASTER OF SCIENCE IN AGRICULTURE (AGRICULTURAL
ECONOMICS) embodies the results of a piece of
bonafide research work carried out by
Shri Surendra Kumar Pradhan, under my guidance
and supervision and that no part of the thesis
has been submitted for any other Degree. I further
certify that such help or source of information
as has been availed for in this connection is duly
acknowledged.


(P. K. Das) 19.8.74°

ACKNOWLEDGEMENT

The author wishes to express his profound sense of gratitude to Dr. P. K. Das, M.Sc. (Ag), Ph.D. (I.A.R.I.), Lecturer, Department of Agricultural Economics for his valuable guidance, constructive criticism, keen interest and helping attitude during the entire course of this investigation and preparation of this manuscript.

He expresses his indebtedness to Dr. B. Mishra, M.A., A.M. (Penn), Ph.D. (Uttal), Dean, College of Agriculture, for his valuable suggestions and constant encouragement.

The author is grateful to Shri H. K. Das Gupta, M.Sc. (Ag), Dip. in Statistics, Head, Department of Agricultural Economics for his valuable advice.

His thanks are also due to Dr. B. C. Hota, Dr. D. Bhuyan, Dr. S. Mohanty, Dr. L. K. Pati, Dr. D. Lenka, Shri S. C. Mallik, Shri J. P. Singh and Shri N. Chakravarty for their help and advice during the course of investigation. He also expresses his thanks to Shri R. N. Bisoi, S.D.O. (R.E.O), Khondapara and other officials for providing the necessary informations.

He is thankful to all his friends for their timely help and co-operation in manifold ways.

Lastly, the author is highly indebted to his parents for their blessings and constant encouragement to make this project a successful completion.

Dept. of Agril. Economics,
College of Agriculture,
Bhubaneswar.

Dated 19 August, 1974.

Surenada Kumar Pradhan.
(S. K. Pradhan)

CONTENTS

<u>CHAPTER</u>		<u>Page</u>
I	INTRODUCTION	
	Importance of irrigation on modern Agriculture	1
	India's irrigation potential	1
	Future programmes	1
	Irrigation potential in Orissa	1
	Irrigation potential of Khandapara area	2
	Objectives of study	2
II	REVIEW OF LITERATURE	
	Irrigation and cropping pattern	9
	Irrigation and use of chemical inputs	12
	Irrigation and farm income	13
	Irrigation and employment	18
	Benefit cost study of irrigation projects	19
III	METHODOLOGY	
	Sampling technique	24
	Sources of data	26
	Limitations	27
	Estimation of working capital	28
	Estimation of farm return	29
	Cost of production of crops	30
	Net return	31
	Percentage return on capital	32
	Employment pattern	33
	Statistical tools used	34
	Benefit cost analysis	35
	Depreciation	36
	Benefit cost criteria of investment	36
	Benefit cost ratio	36
IV	GENERAL ECONOMIC CONDITION OF SELECTED AREA	
	Agroclimatic conditions	39
	Topography	40
	Rainfall	41
	Climate	42
	Soil	43
	Socio economic condition	44
	Means of communication	45
	Medical facilities and sanitary conditions	46

Veterinary dispensary	...	46
Educational facilities and social life	...	47
Facilities for marketing and transportation	...	47
Population characteristics and occupational pattern	...	48
Distribution of population according to their nature of occupation	...	49
Distribution of farms according to size group	...	50
Tenancy	...	50
Livestock population	...	51
Land utilisation	...	51
Irrigation	...	52
Credit system	...	53

V IMPACT OF IRRIGATION

A. Irrigation and cropping pattern	...	54
Crop intensity	...	54
Cropping pattern	...	56
Distribution of area according to broad group of crops	...	60
B. Irrigation and chemical inputs	...	61
Use of fertilizer	...	62
Use of plant protection materials	...	63
C. Irrigation and labour utilisation	...	64
Per acre and per farm human labour employment	...	65
Per acre and per farm bullock labour employment	...	69
D. Irrigation and cost of cultivation	...	71
Break-up of cost of local paddy	...	71
Break-up of cost of green gram	...	75
Break-up of cost of potato	...	77
Break-up of cost of high yielding varieties of paddy (summer)	...	77
Break-up of cost of sugar cane	...	80
E. Irrigation and yield rates of different crops	...	82
Irrigation and income from farming	...	90
Gross income	...	91
Net profit	...	92
Family labour wages	...	93
Family labour income	...	95
Farm business income	...	97

F. Irrigation and regional disparities	...	97
Comparative cost and returns of different crops	...	98
Comparative position of different crops	...	99
Cost of production per quintal	...	100
Return per labour day	...	101
VI BENEFIT COST ANALYSIS		
Irrigation infrastructure	...	102
Risumitada Tubewell point	...	102
Sunamuhin minor irrigation project	...	102
Additional costs and additional benefits due to irrigation projects	...	104
Annual cost of the project	...	105
Per acre investment	...	106
Benefit cost ratio study	...	106
Rate of return to economy under different irrigation projects	...	108
Net benefit per gross cropped acre	...	108
Benefit per rupee spent on irrigation	...	110
VII SUMMARY AND CONCLUSION	...	111

LITERATURE CITED

APPENDIX

LIST OF TABLES

<u>TABLE</u>	<u>PARTICULARS</u>	<u>PAGE</u>
1.	Rainfall data of the area in different years from (1963-72)	40
2.	Location of the villages in respect of distance from the administrative headquarters.	44
3.	Situation of the villages in relation to their distance from means of communication.	45
4.	Location of the villages in relation to their distance from the hats.	47
5.	Population characteristics and number of households of the village according to 1961 census report.	48
6.	Population distribution according to nature of occupation.	49
7.	Frequency distribution of size of farms in sample villages.	50
8.	Land utilisation pattern.	51
9.	Irrigation potential of sample villages.	52
10.	Different sources nature and rate of interest of credit prevailing in the sample villages.	53
11.	Estimated crop intensity.	55
12.	Cropping pattern followed by different farms during 1972-73.	57
13.	Percentage of distribution of gross cropped area in sampled farms during 1972-73.	59
14.	Per acre value of fertilizer used.	62
15.	Per acre value of insecticides and pesticide according to source of irrigation and size group.	63
16.	Per acre human labour utilisation under different farms.	66

17.	Human labour utilisation per farm in different zones.	...	68
18.	Per acre bullock labour utilisation in different zones according to size of holding in different seasons.	...	70
19.	Per acre bullock labour utilisation according to size of holding in different zones.	...	72
20.	Itemwise cost of production of local paddy per acre in Khandapara area during 1972-73.	...	74
21.	Itemwise cost of production of greengram per acre in Khandapara area during 1972-73...	...	75.
22.	Itemwise cost of production of Potato per acre in Khandapara during 1972-73.	...	78
23.	Itemwise cost of production of H.Y. paddy (summer) per acre in Khandapara 1972-73.	...	79
24.	Itemwise cost of production of Sugarcane in Khandapara area during 1972-73.	...	81
25.	Yield of main products per acre of different crops in different areas according to size of holdings.	...	83
26.	Total cost of cultivation, gross income and profit per acre of main crops under different sources of irrigation.	...	85
27.	Rank of crops according to their per acre maximum (i) total cost of cultivation (ii) gross income (iii) net profit received by sample house holds in different region...	...	87
28.	Cost of production per quintal of some important food crops.	...	89
29.	Relative gross expenditure per acre per annum among various size groups of holding under different regions.	...	90
30.	Relative gross income per acre under different conditions of irrigation.	...	91
31.	Relative net profit per acre in different regions.	...	92

32.	Family labour wages per acre for different size of farms.	...	94
33.	Family labour income per acre and per farm in Khandapara during 1972-73.	...	96
34.	Farm business income per acre and per farm in Khandapara area during 1972-73.	...	96
35.	Input output ratio per acre in different irrigated farms.	...	99
36.	Return per labour day in different size group under different conditions of irrigation.	...	101
37.	Gross farm output and inputs.	...	104
38.	Additional benefits and costs due to canal irrigation.	...	104
39.	Per acre investment.	...	106
40.	Benefit cost ratio study:- $\frac{B}{C} = B.$	...	106
41.	Rate of return of the project $= \frac{B-C}{I} \times 100.$	...	107
42.	Net benefit per gross cropped acre.	...	108
43.	Benefit per rupee spent on irrigation during 1972-73.	...	109

CHAPTER I

INTRODUCTION

CHAPTER-I

INTRODUCTION

Importance of Irrigation on Modern Agriculture:

New strategy for agricultural development seeks to answer the question:- Can India attain self sufficiency in respect of food grains in near future ? Not many years ago the strategy seemed to hold out the promise of self sufficiency in our food front. Food grains output increased from 88.9 million tons in 1964-65 to about 108.4 million tons in 1970-71. This can not be taken as a small achievement for Indian agriculture at a time when many observers from abroad viewed India as an area destined to sink.

But, how could it happen ? Back of this agricultural output boom there were three agricultural input booms namely, high yielding varieties, inorganic fertilizers and irrigation. In other words, agricultural dynamics was brought about by the availability of these inputs. Modern agriculture is therefore distinguished by its dependence on a few of farm new inputs.

Among these three inputs irrigation seems to be a necessary condition whereas fertilizer and new seeds are taken as sufficient conditions for maximising output. Because irrigation provides the base for augmenting production.

It is now very much realised that the most important single factor determining the domain of the high yielding varieties is availability of irrigation.

The importance of irrigation needs hardly any emphasis. Irrigation helps agriculture in the following ways:

- a) It contributes directly to increased production per unit of land from a particular harvest.
- b) It makes feasible for the successive production of two or more crops on the same year from the same land.
- c) It creates a favourable condition to shift to crop that yield a larger cash return per unit of land, as it is observed that almost all the cash crops are grown on the condition of assured supplies of water.
- d) It increases the capacity of the areas to absorb productively traditional inputs like human and bullock labours, organic manures and modern inputs like fertilizers, pesticides and farm machineries.
- e) It acts as an insurance against recurring famines due to weather uncertainty which in turn stabilises agricultural production.

These are all what we say the direct benefits from irrigation the society derives. It is also alleged that irrigation input accentuates the existing regional disparities. The environmental conditions of the farmers not only influence the extent but also the nature and pattern of diffusion of a technology. Environmental conditions determine the degree of risk and uncertainty that farming would involve which in its turn would determine the intensity of crop investment and also

the pattern of input combination. Since the scope for green revolution is strictly limited to irrigated area, the income disparities are greater to-day between irrigated and unirrigated farms. In order to reduce the disparities more and more regions should be brought under irrigation. Moreover, as it is not technically and economically feasible to provide irrigation facilities through out the country, the dry land technology has to be developed on priority basis to cater the needs of dry land and unirrigated regions.

India's Irrigation Potential:-

Ever since 1951 the planning authorities at various levels had been emphasising on the expansion of irrigation capacity in India. The need for expansion of irrigation capacity is particularly important at a time when stagnation in agricultural front has created acute food crises and unprecedented rise in food price.

The net area irrigated by means of major and medium types of irrigation projects, principally canal system fed by river sources, increased from 9.7 million hectares in 1950-51 to 13.0 million hectares in 1960-61 and to 21.4 million hectares at the end of fourth plan.

Similarly the net areas irrigated by means of minor irrigation projects (excluding ground water scheme) increased from 6.4 million hectares in 1950-51 to 7.0 million hectares in 1960-61 and to 7.5 million hectares at the end of fourth plan.

In addition to the above irrigation potential developed through major medium and minor irrigation projects a substantial irrigation potential developed by tapping under ground water resources. The net area irrigated by means of tube well and other forms of ground water utilization schemes increased from 6.5 million hectares in 1950-51 to 9.2 million hectares in 1960-61 to 16.0 million hectares at the end of fourth plan.

There is plenty of rain fall in India. The annual rainfall in India represents something more than 3,000 million acre-feet of water. Of this amount about 1,000 million acre-feet are lost due to evaporation and roughly 650 million acre-feet seep in to the soil, leaving, 250 million acre feet of water to flow in to the river system. This entire surface flow is unusable due to topography, flow characteristics, climate and soil conditions. Up to 3rd Plan the utilization of the surface flow was about 160 million acre feet (i.e. about 36 percent of the usable flow and 12 percent of the total annual flow).

Out of 650 million acre feet of ground water 350 million acre feet are absorbed to the top-layers contributing to the soil moisture, so essential for plan growth. Rest 300 million acre feet percolate down in to the porous strata and represent the annual enrichment of ground water. The use of this potential was less than 20 percent of the annual enrichment up to 3rd plan. This shows that the extent of water resource in India is vast but it requires proper utilization.

Future Programmes:-

In recent years heavy emphasis has been placed upon the impounding by dam water from monsoon rains for use in dry weather and upon the use of wells to tap underground water resources. The draft out line of fifth five year plan indicates that the irrigation programme during the plan period will be based on three important objectives namely, (i) a substantial increase in the creation of irrigation potential consistent with the relevant organisational and financial capabilities, and having regard to the needs of the drought prone areas, (ii) improvement in the utilization of the created potential and efficient management of water and land through proper drainage and anti-water-logging systems for achieving maximum productivity and (iii) reduction in the imbalance between different regions which is caused due to markedly uneven distribution of irrigation projects.

Irrigation Potential in Orissa:-

Orissa lags much behind the states like Punjab, Haryana, Tamil Nadu and Andhra Pradesh so far as irrigation potential is concerned. In the year 1968-69 the net area irrigated as percentage of net sown area in case of Orissa came to 16.3, whereas the corresponding figures for Punjab, Haryana, Tamil Nadu, Andhra Pradesh and Uttar Pradesh were 58.4, 32.2, 43.2, 27.2 and 32.4, respectively. The irrigation potential created in Orissa was even lower than all India average which stood at 19.7 against Orissa's 16.3. Mainly due to the constraint of irrigation input

Orissa ranked 16 in the year 1969-70 with regard to area covered under high yielding varieties programme in cereal crops. Between 1967-68 and 1969-70 the average net income per hectare came to 1155 rupees in case of Orissa where as it was 2223 rupees for West Bengal, 1859 rupees for Punjab, 1447 rupees for Uttar Pradesh , 1367 rupees for Tamil Nadu and Haryana states. Therefore irrigation potential is considered as one of the important economic indicators to measure the progress of economic development of an agrarian state.

Orissa state receives on an average annual rainfall of 1,421 mm. which accounts 189.98 million acre feet per annum. Out of this the quantity lost as surface run-off to the areas through the net work of river system has been estimated as 77.14 million acre feet. Out of total potential available (10.72 million acre feet) about 0.25 million acre feet for irrigation of 45,900 acres is being utilised along various river basins of the state through flow system. But its use is limited as almost all rivers dry up during summer months.

Besides surface run off , some portion of water resource is lost through evaporation and transpiration. Again a part enter to the sub-soil. Leaving 25 percent evapotranspiration loss, 84.63 million acre feet penetrate in to the soil as gravitational water. From this 84.63 million acre feet the downward movement of the ground water towards the sea and capillary moisture takes away 42.32 million acre feet. Therefore only 42.31 million acre feet is available for ground water utilisation

purpose. During 1973-74 a scheme has been proposed to utilise 5.2 million acre feet of utilisable ground water in this state. The total compoundable ayacut of the stationary pumping sets comes to an area of 45,900 acres utilising 0.25 million acre feet and that of tube well comes to 19,560 acres using 0.10 million acre feet of water. Thus Orissa state is also enriched with water resource.

Irrigation Potential of Khandapara Area:

When we focus our attaintion to Khandapara area, to which the study is concerned we shall come to the conclusion that it is rich with water resources. It receives an annual rain fall of about 1,450 mm. The river Mahanadi flows by the side of this area. The tributaries Kusumi, Kuanria and Kaligiri pass through the land scape of this area which provides immense potential for irrigation. There are a few minor irrigation projects in Khandapara area. It receives 2,220 acre flow irrigation from various dams. It also avails the opportunity of lift irrigation points which command an ayacut area of 580 acres through out the year.

OBJECTIVES:-

Due to the availability of irrigation water in some areas of Khandapara, remarkable changes have occurred in the irrigated tracts of this locality. The present investigation aimed to analyse the impact of irrigation in different sectors and finally to show the feasibility of tube well irrigation and minor irrigation (Sunamuhin dam project) under study.

The objective of the study are as follows:-

- (i) To study the effect of irrigation on the cropping pattern and crop intensity.
- (ii) To study the impact of irrigation on the use of chemical inputs like fertilizer and pesticides.
- (iii) To find out effect of irrigation on human labour and bullock labour employment.
- (iv) To estimate the changes in farm costs and returns and financial status of people due to different irrigation systems.
- (v) To compare the economic feasibility of tube-well (Lift irrigation) and minor (flow) irrigation projects by cost benefit analysis.

CHAPTER II
REVIEW OF LITERATURE

CHAPTER -II

REVIEW OF LITERATURE

The review of literatures of this study is presented below according to the specific objectives of the study.

(A) Irrigation and Cropping Pattern:-

Chawla, Gill and Dhariwal in their study in district Amretsar of Punjab during 1972-73 found out that as a result of tube well irrigation significant shifts took place in cropping intensity and cropping pattern. The cropping intensity increased from 126 percent to 164 percent. Among cereals in the area under study crops like wheat and paddy gained in area to the extent of 50.90 percent and 189.10 percent, respectively, the area under barley, maize, and millets declined by 14.30 percent, 13.40 percent and 21.70 percent respectively. Pulses dwindled in area by 53.33 percent. This shows that less remunerative crops were replaced by more remunerative crops in respective seasons. In respect of non-food grains, the sown area diminished by 38.78 percent. In case of oil seeds and sugar cane, the percentage of sown areas was 36.40 and 41.40 respectively. Cotton lost in area by 42.80 percent. But the area under feeders went up by 46.10 percent. Thus the effects of tube well irrigation were pronounced on shifts in the cropping pattern. Besides, paddy and sugarcane were newly introduced by some farmers.

Sisodia in his study on Tawa project in Noshangabad district of Madhya Pradesh revealed that the intensity of cropping has increased from 91 percent under pre-project condition to 148 percent under post-project condition.

Shah revealed that Cauvery Mettur, where 85 percent of the total cropped area is irrigated, the percentage of area under food crops and non-food crops were 89.2 percent and 10.8 percent respectively during 1951. In Sarada canal districts 93.3 percent of their cropped area was under food crops and 6.7 percent was under non-food crops in 1951-56.

From the study of cauvery-Mettur Project and Sarada canal Project it was seen that the area under rice and wheat (Superior crops) was 33.6 percent of the total cropped area during 1921-26 against 36.2 percent in 1951-57 in Sarada districts. In cauvery Mettur, the area under food crops which was 70 percent in 1931 shot up to 89 percent in 1949 and area under non-food crops decreased from 30 percent to about 11 percent.

Maji and Sirohi revealed in their study during 1968-69 that the intensity of cropping in Lift Irrigated area was 15.7 percent as compare to 100 percent in unirrigated area.

Mishra revealed that the Cropping pattern in unirrigated condition was a single crop of rice in all the categories of land without a second crop where as in irrigated condition in addition to kharif paddy they grow crops like greengram, onion, chillies, cauliflower, potato and other vegetables during Robi season.

Mohapatra revealed that the Intensity of cropping of irrigated upland has been increased almost twice than that in unirrigated condition, and new cash crops replaced the extensive

and unremunerative crops like horsegram and other pulses.

Mohanty in his study on economic effect of Lift Irrigation in Puri district revealed that due to irrigation facilities the intensity of cropping has been increased nearly two times in Pipili-Bhubaneswar area. Cropping patterns have been changed and new crops like potato, summer and winter vegetables have been introduced replacing extensive pulse crops.

Patnaik revealed that the irrigation has markedly changed the cropping pattern of Sambalpur area. Remarkable change is noticed through the rapid extension of summer paddy in low land after the harvest of Kharif paddy in irrigated condition. Introduction of various crops like potato, onion, vegetables was marked in irrigated high lands.

A study on economics of lift irrigation by Dasgupta and others showed that the difference in cropping pattern in Rabi between irrigated and unirrigated components of the sample holdings is that while 100 percent of former category of land is devoted to potato cultivation, hardly 25 to 40 percent of the latter is occupied by pulse crops such as greengram, blackgram and horsegram. Rest of the unirrigated land remains idle during Rabi season due to lack of water resource. Similarly, while nothing is grown in summer without irrigation, crops like sesamum, ground-nut, cucumber and chillies are grown, under conditions of irrigation only.

(B) Irrigation and use of Chemical Inputs:-

Chawla, Gill and Dhariwal in their study found out that the demand for different purchased inputs such as seeds, fertilizers, insecticides increased by 39.03, 90.03 and 201.24 percent respectively as compared to unirrigated situation in the same area.

Shah revealed that the money value of input fertilizer and manures was Rs.8.27 per acre on irrigated as compared to only Rs.0.12 in unirrigated farms in Bombay.

The Madras report mentions that per acre value of fertilizer and manure was Rs.6.1 on " fully unirrigated farms as compared to Rs.7.8 on 20 percent to 30 percent irrigated farms Rs.10.6 on 45 percent to 55 percent irrigated farms and as high as Rs.23.3 on 70 percent to 80 percent irrigated farms.

Study of Dasgupta and others showed that higher yield rate is associated with assured irrigation facilities, because irrigation facilities provide scope for adopting high yielding varieties of paddy and to invest more on non-farm inputs, such as fertilizers and pesticides.

(C) Irrigation and Farm Income:-

Chawla, Gill and Dhariwal (1972-73) revealed the enhanced yields of different crops. Crops like wheat, cotton, paddy and sugarcane, showed a rise in yield per acre. Per acre gross return, variable costs and net returns over the variable costs increased by 61.79 percent, 57.81 percent and 66.72 percent respectively.

Bhati, Tewari and Singh in their study in Bisuali block of Badaun strict of Uttar Pradesh during 1969-70 showed that the incremental benefit due to irrigation was Rs.13,890 and the fixed cost variable cost and total cost for irrigating the total command area were Rs.2,966.67, Rs.1,493.19 and Rs.4,459.86 respectively. Thus one rupee investment in irrigation added Rs.3.11 net returns, which shows the bright prospects for connecting unirrigated areas into irrigated ones through tube wells in Badaun Uttar Pradesh.

Shukla in his study in Jabalpur showed that irrigation resulted in higher incomes both from the traditional and advanced farms. For example the difference between programmed incomes of the traditional unirrigated and irrigated farms was Rs.30.10 per acre. Similarly the difference in income from the advanced unirrigated and irrigated farms was Rs.202.43 per acre. In other words irrigation combined with advanced technology showed greater impact on the farm incomes. Keeping in view the cost benefit of well irrigation in this locality, it is concluded that well irrigation through electric pumps is a profitable proposition specially when combined with the advanced technology in Agriculture.

Charan in his paper described direct primary effects resulting from the west Banas irrigation project of Rajasthan. The analysis of data suggested that gross farm output in all size groups was significantly higher in the canal irrigated area as compared to that in the noncommand area. After meeting the cost of

cultivation which was higher, the farmers of the command area had greater net surplus with them. Thus the Project has largely helped in increasing agricultural production.

Krishna in his study in Tamilnadu revealed that the gross additional production has been arrived at 10.28 quintals per acre due to irrigation. After making allowance for extra cost, i.e. 45 percent, The net additional production due to irrigation has been worked out as 5.65 quintals per acre.

Sisodia in his study in Madhya Pradesh revealed that the net crop income from the project area stood at Rs.66 per acre before development where as after development it worked out to Rs.537 per acre per year. The investment in irrigation land development has a favourable rate of return and it worked out to Rs.4.90 for every rupee invested.

Shah in his study during 1955-56 in the district of Amritsar and Ferozepur in Punjab under the Farm management surveys sponsored by the Research Programme Committee concluded that both the input and output per cropped area on irrigated lands were almost double than those on unirrigated lands.

The study on Madras condition corroborates that the output values of fully irrigated holding was Rs.641, where as that of partially irrigated holdings was Rs.199 and the fully unirrigated holding Rs.96.00. The farm business income per acre was Rs.399.00, Rs.96.00 and Rs.31.00 in fully partially and unirrigated area respectively.

A comparative study of Savale on unirrigated and irrigated farms indicated that since the cropping on irrigated farms is both capital and labour intensive, the net returns from such farms are about nine times more than unirrigated farms. His study also revealed that the net returns from 7.5 acres of irrigated farms are almost equal to a 60 acre dry farm, showing a large potential for irrigation in agricultural development.

Maji and Sirohi revealed in their study in W.B. that the gross return of the farms were Rs.419.81 and Rs.1,053.22 per acre in unirrigated and irrigated areas respectively. Thus gross productivity per are in the irrigated area registered an increase of Rs.633.41 (15 percent) over that in the unirrigated area. Thus the above facts bear the testimony of intensive use of land and other resources and ought to be regarded as the impact of irrigation.

Saini using cobb-douglass function conclude that the irrigation gave the highest returns per unit of cost. Farmers response to this economic opportunity is reflected in higher expenditure on irrigation. The ratio of marginal returns to acquisition cost continued to be greater than unit in Punjab in 1956-57.

Mishra's study at Sambalpur revealed that the yield rate of kharif paddy in irrigated area was about 44 percent.

higher than the unirrigated area. The study also indicated that per acre net return in irrigated Berna and Bahal land was Rs.976.81 and Rs.497.01, respectively where as in unirrigated. Berna and Bahal land was Rs.325.26 and Rs.515.72, respectively. Thus the impact of irrigation was conspicuous in the area under study in different land types.

Mohapatra in his study in Puri District revealed that on an average early paddy gave 15.59 mds per acre in irrigated area where as 8.64 mds per acre in unirrigated area. Profit per acre in irrigated condition was about Rs.3078.63 where as in unirrigated condition it was only Rs.188.80 per annum.

Mohanty's study indicated that not only the costs of cultivation of crops were increased significantly but also the yield rates of different crops increased more than proportionately in irrigated situation. The yield rate of early paddy varied from 12-15 mds per acre in irrigated acre whereas in unirrigated area, it varied to the extent of 3 to 10 mds per acre.

Patnaik in his study at Sambalpur found out that high and medium lands were more productive under irrigated condition where as low lands were not productive under such condition. Increase in yield rates of Kharif paddy due to irrigation was about 100 percent in At land, 50 percent in 'Mal' land and 45 percent in "Berna" land. But in irrigated Bahal land kharif paddy recorded as reduction of 50 percent in the yield rate.

THIS might have been resulted due to water logging condition in low lands. In absence of good drainage system, uncontrolled flow irrigation may result such kind of adverse effect on agricultural production.

Mohapatra showed that the cost of cultivation and gross margin per acre in irrigated areas were higher than unirrigated area. The gross margin on an average worked out as Rs.3,197.80 and Rs.258.53 in irrigated and unirrigated areas, respectively.

Mohanty's study revealed that the profit per acre in irrigated and unirrigated area was in the order of Rs.903.00 and Rs.80.00 respectively.

The study of Dasgupta and others reveals that yield rate of early paddy on an average 13.94 quintal in irrigated land where as 9007 quintal in unirrigated farm. This difference in the per hectare yield can't be ascribed only to the availability water from irrigation. The other factor contributing to this difference is the residual effect of fertilisers applied to the preceding potato crop. However it may be concluded that the high productivity associated with irrigated land is the result of the positive interaction between fertilizer and water.

A study on farm Business analysis of Sambalpur district conducted by Dasgupta and others shows that the per acre yield of paddy in kharif varied from 11.62 quintals to 13.14 quintals in irrigated farm and from 6.56 quintals to 9.78 quintals in unirrigated farm.

The study also revealed that irrigated small farm earned nearly 47 percent additional profit over unirrigated small farm.

(D) Irrigation and Employment:-

Chawla and others in their Punjab study found out that, the use of hired human and bullock labour rose by 30.22 and 32.98 percent. Similarly the marginal value productivity of human and bullock labour went up by 51.14 percent and 24.38 percent respectively.

Shah's study indicated that irrigation provided work throughout the year over different seasons in Cauvery Mettur irrigation project area. Because the project has enabled farmers to take three crops in place of one crop prior to irrigation project. At times the value of labour input was as large as one third of the value of total inputs.

Report on Punjab for the year 1955-56, maintains that hired human labour charges on irrigated holding were Rs.16.75 per acre as against Rs.5.28 per acre on unirrigated holdings. The report relating to Bombay states informs that wages for hired human labour were Rs.4.11 per acre in compared to Rs.11.39 in irrigated crops. Usually the employment of annual contract labour is more on irrigated than on unirrigated holdings.

Savale's study revealed that the employment of human and bullock labour were comparatively less on dry farms. October-November was a period of intensive human labour employment, while a large part of bullock labour

was employed during June-July.

On a 20 acre dry farm, it was necessary to hire 59.-56 days human labour and 68.82 days of bullock labour. A similar size of irrigated farm has to hire human and bullock labour to the extent of 340 and 177 days, respectively. The irrigated farm could thus employ almost six times more labour and more than two times bullock labour as compared to similar size of dry farm. The intensification of irrigation facility would therefore provide opening for employment to a large part of the rural population.

(E) Benefit cost study of Irrigation Projects:-

Saini and Kundu, analysed the benefits and costs electrically operated three shallow tubewell projects installed in an area in West Bengal. The ratio of annual gross benefits and costs was found to be 5.56 and net overall benefit per unit of investment for the full useful life of the shallow tubewells have been found to be 1.69.

Singh in his study revealed that total annual cost for tube well comes to be Rs.15,503.95, Rs.17,078.86, Rs.21,105.26 and Rs.32,070.62 respectively for the tubewells installed during the First Plan, Second Plan, Third Plan and after the Third Plan period. On an average 85.0, 58.2, 57.4 and 82.8 hectares of land were irrigated during First,

Second, Third and after the Third Plan period respectively. The total direct benefits which were obtained by irrigating the crops were Rs.18,092.25, Rs.12,397.87, Rs.12,217.59 and Rs.17,623.98 during First, Second, Third and after Third Plan period, respectively. The poor benefit cost ratio is due to mounting cost and partly due to underutilisation of tubewell. The analysis shows that the net return, on an average was Rs.0.47 per rupee of capital invested.

The estimated cost benefit ratio of Punjab study made by Chawla and others worked out to 1:1.74 showing the feasibility of the installation of tube wells.

Singh and Prasad in their study during 1972-73 in four villages of Bishrampur and Hussainabad blocks of the district Palamau in Bihar showed that, taking ten years time from 1962-69 to 1977-78 and taking 10 percent and 8 percent discounting rate the ratio of total net discounted benefit to the capital costs per acre of irrigation estimated as 2.08 and 2.27 for lift irrigation and 4.43 and 4.74 for canal irrigation respectively. In the case of both the irrigation schemes, the benefit cost ratios were substantially greater than unit, but in the case of canal irrigation this ratio was relatively much higher. Both the capital cost and operating cost of canal irrigation are much lower than those of lift irrigation.

The results of this study suggested that canal irrigation must be preferred to lift irrigation where the choice between the two alternative is possible.

Shingarey and Sohoni in their study deals with the benefit cost analysis of Bor-irrigation project in Wardha district of Maharashtra. The benefit cost ratio is 1.20. The state Government had prescribed benefit cost ratio 1.5 and above for the irrigation projects. The benefit cost ratio 1.2 is expected to increase with the increase in the use of irrigation resources.

Patil in his study with soil and water conservation project in Wadhval village of Haveli taluka in Poona district of Maharashtra showed a benefit cost ratio of 1.84 taking only primary benefit into account.

Singh and Mishra have compared the estimated benefit cost ratios of various projects while they were analysing the benefit cost analysis of the Sarada canal system. The direct benefit cost ratios of Ganga canal, Sarada canal, Cauvery Mettur project and Hirakud dam were found to be 4.68, 2.67, 1.37 and 1.20 respectively. Their study has indicated that the benefit cost ratios of these projects could increase with full use of water resources.

Desai revealed that in Cauvery Mettur Project the benefit cost ratios were worked out only up to 1949-50, a period of ten years from the inception of the project 1939-40. This ratio exceeded unit in the first four years, becomes less than unit in next two years, improved in the following year and declined again below unit. Assuming that it takes about five years for irrigation system to develop in a region, one would have expect the benefits to flow at a stabilized rate after the fifth year.

Savale's study revealed that the net returns per rupee of capital invested in different sizes of irrigation farms was varying between 1.5 to 2 times as compared to dry farms. The value of shadow prices obtained from final non-basis output during programming of farm plans reveals that if other factors like labour and capital are available in plenty, addition of one acre of dry land will yield a net revenue of Rs.166 to 187 on different sizes of holding. On the other hand one more acre of irrigated land added to the holdings would added a sum of Rs.547 to 594 as net returns. A comparison of shadow prices on dry farms however reveals that the addition of one acre of dry land would add only a sum of Rs.53.82 to 74.27 on various sizes of farms.

Maji and Sirohi in their study on a electrically energized tube well project estimated that at 12 paise per unit of power charge at 5 percent, 7.5 percent and 10 percent interest rates the benefit-cost-ratio would come to 2.96, 2.34 and 2.12 respectively.

CHAPTER III
METHODOLOGY

CHAPTER - III

METHODOLOGY:

Sampling Technique:-

The sampling technique adopted for the field investigations was based on stratified random sampling. Two villages from each of the three categories namely (1) Canal irrigated, (2) tubewell irrigated as (3) unirrigated were selected for the purpose of this study. Thus, altogether six villages were included for the field investigation purposes.

From each category of villages, 15 cultivating house holds were selected by stratified random sampling, after grouping them according to size of their holding. The holdings were divided into three size groups, namely (1) below 2.5 acres, (2) 2.5 to 5 acres and (3) above 5 acres. However the maximum size of holding has been limited to 10 acres to keep the third size as homogeneous as possible. Moreover, these are few holdings which are above 10 acres size in the area and study. From each size groups of farms in each category of villages five holding were selected at random. Thus in the final stage the total holding from which data were obtained were 45 (fifteen from each category of villages).

The unirrigated villages were taken as control to estimate the impact of irrigation in crop husbandry.

The data:-

On the whole six categories of data were required for their study. These are as follows:

(i) General information about the area studied.

It includes informations pertaining the location, boundaries, physical features, climate, rainfall, soil type, irrigation facilities communication facilities, educational and sanitary facilities and market facilities prevailing in the area under study.

(ii) Resource availability and its use:

It contains information on farm size, area under irrigation and kind of irrigation used, family size, employment of the farm family, hired labour, draught animals, farm implements, cropping pattern, intensity of cropping etc. These information were required from each sampled farm.

(iii) Physical input-output data:-

Data relating to this includes the various levels of inputs used in different crops in various size groups as well as different categories of farms. Corresponding yield data were also estimated. Both the input and output levels in different situations were estimated at microlevels.

(iv) Input-Output price data:-

It includes price of various inputs used for crop production and harvest price of the various produce. Price of various farm inputs used in crop production were wage rate of hiring human labour, cost of hiring bullock labour, irrigation charges for various crops, price of manure, pesticide, insecticide etc. and rates of interest on credit.

(v) Information regarding problem of the area:-

This includes the operational and institutional problems faced by the people both in the irrigated and unirrigated farms.

(vi) Investment data:-

It includes the information relating to total capital outlay on tube well project and minor irrigation (canal) project, their ayacut area, maintenance, repair, power consumption, and lifespan of the projects.

Sources of data:-

Data relating to the characteristics of the area were obtained from the Bureau of Statistics and Economics. The data for resource use, physical input-output relation-ships and price were collected from the sample farmers. The total expenditure, maintenance and repair expenditure of Sunamuhin minor irrigation project

was obtained from Sub-divisional office(R.E.O.), Khandapara. The expenditure on tube well points, its maintenance, repair, lifespan, power consumption during the year were obtained from the office of the lift irrigation overseer, Nayagarh and from the Lift Irrigation Executive Engineer Office, Shubaneswar.

The data from the sampled farms were collected by means of survey method by the researcher himself. The interview schedules prepared for the purpose and investigations were carried out for the agricultural year 1972-73. The farmers in general, were found reluctant to give correct informations as they had apprehensions about rise of irrigation charges and were also concerned about land reform measures. However special efforts were made in this direction and by using good contacts and offices of local leaders and developing proper understanding with the farmers, these limitations of the survey method were minimised.

Limitations:-

In a sample survey, data were collected from the sample holders by direct enumeration. As most of the farmers do not maintain accounts for the day to day operations, data were furnished from the memory of respondents. These limit the degree of accuracy and reliability of data.

The most important limitation of the data was that the informations were collected for one agricultural year. Agriculture is a biological process. There are a number of uncertainties like weather uncertainty, price uncertainty and institutional uncertainty. The data for a single year, therefore may not provide a true picture of the situation. However, the year under investigation was not an abnormal year for agricultural operations. Again with a single year data, it is not possible to inform definitely the relationship between input and output. Since many environmental factors influence the production of the crop, which itself is highly subjected to seasonal variation. Even then comparision purpose the related data would serve the purpose well.

Regarding expenditure data of tube wells, expenditure on different heads were not found out. As they had used Civil - Accounting system or Revenue Accounting system which is changed to P.W.D. Accounting system now-a-days. Thus the estimated value from the project report is taken in to consideration.

As our final aim is to estimate the economic feasibility of the projects, only irrigated lands of the irrigated sampled farms has been taken in to consideration.

Care has been taken to minimise the error and enterprit the correct informations in the analysis. Due to time lag small sample size is taken which limits the degree of accuracy.

ANALYTICAL PROCEDURES USED

Estimation of Working Capital :-

Working capital, in this study comprised of cost of human labour, bullock labour, seed, manures, fertilizers, insecticides and pesticides, irrigation charges, maintenance and repair of farm building and implements and miscellaneous expenses.

The preveilling wage rate in the village for hired labour were considered and expenses of human labour was calculated taking all the human labour used in the farm. Prevalent hire charges of bullock labour imputed to find out the bullock labour charges. While for the purchased seeds, actual cost of seed purchased has been taken into account. For the home produced seeds, the value was estimated at the price preveilling at the time of sowing of the crops. Similarly the home produced menures were valued at the preveilling market price and these purchased actual price paid was accounted for. Actual expenses made for purchase of insecticides, fungicides and other plant protection materials were

further added for the computation of working capital. Actual water charges paid for the crop was taken as irrigation expenses. Expenditure made on maintenance and repair of farm buildings, farm tools and implements and the items not accounted for any of the heads as the miscellaneous expenses, were taken in to account. Following the above explained manner of evaluation of various components of working capital, the amount of working capital for the year 1972-73 for different categories of farms has been estimated.

Estimation of Farm Gross Return:-

In this study both main products and byproducts are considered for gross return of the farm and these are evaluated at the harvest price prevalent on the local markets. Here the harvest period has been taken as two months following the actual harvest months of respective crops. Since from six to eight weeks after the harvest, the farmers are expected to dispose the major portion of their produce.

Cost of Production of Crops :-

Cost of production means money cost or expenses of production of a commodity. The concept of costs used for different crops were cost A, cost B, and cost C. The item included in each were listed below .

Cost A.

- (i) Hired and permanent human labour.
- (ii) Owned and hired bullock labour.
- (iii) Seed (both farm produced and purchased)
- (iv) Manures (both farm produced and purchased)
- (v) Fertilizers.
- (vi) Plant protection materials.
- (vii) Irrigation charges and irrigation levy.
- (viii) Depreciation of dead stock.

Land revenue was not taken in this case since Government of Orissa had decided it earlier not to collect land revenue during Swatantra and Jana-Congress coalition ministry.

Cost B.

Cost A plus interest on operating expenses and rental value of land.

Cost C.

Cost B plus imputed value of family labour.

The concept of cost C is the most comprehensive. It included all costs both fixed and variable, both paid-out and imputed and thus it is a basis for comparison of costs in different size of farms. Cost-A comprised of all actual cost incurred in cash and kind by a farmer excepting the rent paid for leasing-in land. Cost-B included the

interest charges of the working capital and rental value of land in addition to cost A. The interest calculated at the prevailing rate for the half period of growth of the crop, as the money has been invested in different operations at different times. Cost-C included the imputed value of family labour and management charges with Cost-B.

Net return:-

Net return in this study was the difference between gross income and the total expenses including the interest on operational expenses, repair of implements and the depreciation of dead stock. The depreciation and repair were calculated for the farm as a whole and per acre depreciation was calculated.

Percentage return on capital:-

The percent return on capital represented the rate of earnings produced by the capital invested both fixed and working capital in the farm business.

Employment pattern:-

Taking different seasons, the employment pattern of human and bullock labour has been calculated.

Statistical tools used:-

For comparison between unirrigated, lift irrigated and flow irrigated area with size group

"Nested design" has been used to find out the significant difference between the level of human labour employment, input and output and total variable costs.

Regression analysis has been used to find out the productivity of human labour and capital in different areas. Correlation coefficient between human labour and input with output in different areas has been found out.

Benefit-Cost Analysis:-

By benefit cost ratio analysis the economic feasibility of the project has been analysed. Many economists have been analysed benefit cost analysis of projects in different manners. Some of them used depreciation method and some have used amortized formula to find out present cost and present benefit. To avoid controversies the most simplified accurate procedure of estimating Benefit-cost ratio has been used in this study. The benefit-cost ratio has been estimated as:-

$$\text{Benefit cost ratio} = \frac{B}{C} = B.$$

Where Benefit "B" = value of increased crop production due to irrigation.

Cost:-C =(i) Associated cost of additional inputs to the farmer.
 +(ii) Annual depreciation.
 +(iii) Working expenses and maintenance.
 +(iv) Average interest charged on the total outlay of the project per annum.

Depreciation:-

Depreciation in case of tube well accessories, salvage value or junk value has been taken 10 percent of the original value as directed by lift irrigation department. In case of minor irrigation project depreciation has been calculated in straight line method.

Benefit cost criteria of Investment:-

Benefit cost criterion for selection of irrigation projects can replace the traditional yard stick or which is used in United States and measure the direct financial return to the Government. So far 'r' has been used in practice, only to assist in the selection of projects and has of course never been regarded as a decisive criterion.

Benefit cost criterion is applied in United States in addition to 'r' as a test of the financial feasibility of a project.

For the application of cost-benefit analysis there are at least four possible criteria of investment i.e. $B-C$, $\frac{B-C}{I}$, $\frac{B}{C}$ and $\frac{\Delta B}{\Delta C}$. Benefit cost criterion of project evaluation may be symbolized by " " and in the above notations 'B' marginal benefits and marginal costs and I to direct investment for the project. Any of the above criteria may be used but result will not be always same. The sub-committee on benefit and costs in the United States has recommended $\frac{B}{C}$ in favour of others.

(i) If we adopt B-C and proceed to maximise it, it is obvious that this will always tend to favour a project with a largest size. Medium and small irrigation projects would under this formula be at a discount. But to overcome this limitation in the present study per acre of gross irrigated area the benefits and costs has been calculated. Thus made suitable measure for this purpose.

(ii) $\frac{\Delta B}{\Delta C} = 1$ is used to find out the scale of a project. But this is applied when a project already been selected out of the several alternatives that may be available. In reality it is not for selecting a project out of the many but a criterion for determining the size of a project that has been already qualified for investment.

(iii) $\frac{B-C}{I} =$ is in fact a formula for determining the total annual return on a particular investment to the economy as a whole irrespective of to whom these accrue.

But limitation for the application of this criterion is that I refers to the direct investment on a project and does not include the private and associated investment that may have to be incurred by cultivators and others to whom the benefits flow.

(iv) Thus the project with the highest value for $\frac{B}{C}$ is obviously the one which would come best on the principle of maximising economic welfare.

Benefit Cost ratio:- Both the financial and economic criteria have been commonly used by national and international organisations in the selection and ranking of projects. The economic analysis examines a project from the standpoint of its worth to the economy as a whole, while the financial analysis considers the profitability to the individual. The project level economic and financial analysis use benefit cost ratio, net present value (present value of future returns), and Internal rate of return. It is however a general practice to use benefit cost ratio for economic analysis. As the name implies, it is simply a ratio between the cost of the project and the sum of benefits. Benefit cost analysis involves the listing and consideration of as many effects as can be identified for all persons likely to be affected by the project. It is the rate at which benefits exceed costs. The undiscounted measures of project appraisals fail to take into consideration adequately the timing of benefits and costs. The cost-benefit analysis is generally done by two methods generally "with" and "without" or "before" and "after". The comparison of "before" and "after" the project situations being somewhat fallacious, imposes certain limitations on the project evaluation. So "with" and "without" is an extremely useful rule of thumb approach to quantify the additional

return generated by a project. The incremental net benefit of the project is the difference between net benefits "with" and "without" the project. This is the standard technique being applied to the appraisal of all production projects. Therefore we have applied with and without method in our analysis.

The direct benefits and costs can be usually identified on the basis of the project description. But difficulties mainly arise in identifying externalities costs and benefits accruing to third parties and to the society.

The costs and benefits may be (a) tangible costs and benefits; and (b) intangible costs and benefits. Tangible costs and benefits can be quantified and expressed in monetary terms. Even in tangible benefits, it may be primary, secondary and tertiary benefits. For intangible costs and benefits money value could not be assigned easily. The costs and benefits are to be valued according to estimated shadow or accounting prices. But it is an extremely difficult task in practice. The importance to be attached to intangible costs and benefits has to be largely a matter of judgement.

In simple term the benefit cost ratio is

$$\frac{B}{C} = B$$

Where, B = Sum of discounted net benefits

C = Sum of discounted capital costs.

Taking into consideration the timing of costs and benefits and by using discounting technique, benefit cost ratio can be written as:

$$\text{Benefit Cost ratio} = \sum_{t=1}^T \frac{B}{(1+i)^t} \left[\sum_{t=1}^T \frac{C}{(1+i)^t} \right]^{-1}$$

where: B= benefits in each year.

C= Costs in each year.

T= number of years, and

i= discount rate.

Rate of return to the project:-

For working at the rate of return on the investment for tubewell and minor irrigation project following formula is used.

$$\text{Rate of return per annum} = \frac{B-C}{I} \times 100$$

Where B = total benefit obtained per annum

C = Total cost per annum

I = Total investment in the project.

CHAPTER IV
GENERAL ECONOMIC CONDITION
OF THE SELECTED AREA

CHAPTER - IV

GENERAL ECONOMIC CONDITION OF THE SELECTED AREA

Prior to the analysis of the subject under review, it is worthwhile to give a brief account of the agro-climatic and socio-economic conditions of the sample villages, as well as the district under study. This will give certain back-ground information of the area under study and help in analysing the situations. Endeavour has, therefore, been made to present all relevant and significant features of the economy of the selected area and villages in this chapter.

AGROCLIMATIC CONDITION

Location of the district and the sample villages:-

The district of Puri is one of the four coastal districts of Orissa and is situated in the eastern part of Orissa. Geographically the district is located between 18.75° N to 20.30° N latitude and 84° E to 85.30° E longitude. Northern and Southern borders of Puri district are touched by Cuttack and Ganjam district, respectively. The Eastern border of this district is touched by Bay of Bengal. Boudh-Phulbani and Dhenkanal districts are situated in the western side of this district. Puri is the head quarter of this district and Bhubaneswar, the Capital of Orissa is located in this district.

TABLE-X

Rain fall data of the area in different years from (1963-72) (in mm)

No.	Years	Jan.	Feb.	Mar.	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total of the years
1.	1963	0.0	0.0	47.4	0.0	132.3	0.0	289.1	370.3	237.2	342.4	0.0	0.0	1418.70
2.	1964	0.0	21.4	10.4	47.8	82.6	212.8	478.8	345.5	299.2	80.0	2.4	0.0	1580.09
3.	1965	15.9	7.0	38.9	36.7	1.2	51.0	373.0	284.5	287.3	108.6	0.0	6.2	1210.03
4.	1966	87.6	31.8	0.0	5.0	6.3	178.6	332.1	223.0	323.5	116.5	103.3	0.0	1407.07
5.	1967	69.9	0.0	47.1	38.6	9.4	163.6	340.3	389.5	388.8	27.5	4.0	0.5	1555.02
6.	1968	33.6	57.9	80.4	11.8	9.8	278.3	322.9	138.6	333.7	533.0	87.4	0.0	1354.04
7.	1969	0.0	0.0	0.0	5.9	36.5	120.3	513.0	408.2	214.2	59.3	83.5	4.7	1445.6
8.	1970	0.0	44.0	52.5	23.1	95.7	337.7	306.0	399.0	0.0	148.3	10.8	0.0	1417.1
9.	1971	3.4	27.4	0.1	58.3	71.4	492.8	237.3	267.5	290.0	0.0	0.0	0.0	1348.2
10.	1972	0.0	31.2	0.0	4.0	3.1	66.6	272.0	463.3	431.7	117.2	1.6	0.0	1390.7

Total-	200.4	220.7	229.4	231.2	448.3	1901.7	3464.5	3289.5	2705.6	1532.8	293.0	11.4	14528.4
Average	20.04	22.07	22.94	23.12	44.83	190.17	346.45	328.94	270.56	153.28	29.3	1.14	1452.84
Percentage	1.37	1.51	1.57	1.59	3.01	13.08	23.24	22.64	18.62	10.55	2.01	0.78	(100)

Source - Bureau of statistics.

The Khandapara area which is located in the western side of the Puri district, lies between $20^{\circ}-13^{\circ}\text{N}$ and $20^{\circ}-18^{\circ}\text{N}$ latitude and between $84^{\circ}-58^{\circ}\text{E}$ to $85^{\circ}-14^{\circ}\text{E}$ longitude. Its boundaries extended up to Mahanadi river in north to Nayagarh Tahasil in south and in the west from Daspala Tahasil to Bolagada and Bhapur blocks in the eastern side.

The sample villages lies almost at the central part of the Khandapara area and nearer to Khandaparagarh.

Topography :-

As in other places there are three types of lands namely low, medium and up lands in the area under study. However Low lands of this area are less affected by water stagnation and become suitable for second crop just after the harvest of the first crop.

Western part of the Khandapara area is uneven whereas the Eastern part is somewhat plain.

Rainfall :-

The monsoon breaks from middle of May and continues up to middle of October. Table-1 which reveals rainfall from 1963 to 1972 shows an average annual rainfall of this area is 1452.84 mm. About 78 percent of the

annual rain is received during June to September. During winter season rains are occasional which accounts only about 14 percent of total rainfall in the year. Summer months receive 8 percent rainfall. 1964 received highest rainfall where as 1965 received lowest rainfall within these ten years of time.

Climate :-

This area of Puri district avails the moderate and mild climate and enjoy almost an equal temperature all the year round. The range between minimum and maximum temperature is slightly more than 13°C . The cold season lasts from December to February followed by hot season from March to May. The period between June to September is the monsoon season while October and November constitute the post monsoon period. The temperature rises continuously from March to May. The mean daily maximum temperature in the month of May is 38.0°C (100.4°F). With the arrival of monsoon by about the middle of June the temperature drops considerably. Towards the end of September this area experience a slight increase in day temperature. Afterwards both day and night temperature begins to decrease gradually till December, which is the coldest month. The mean daily minimum temperature in that month is 15.7°C (60.3°F).

Relative humidity is high in rainy season and scanty in summer. Wind is fairly strong in summer and monsoon months. The speed of wind is much less in post monsoon months and in winter.

Soils:-

There is no uniformity in the structure, texture and fertility of the soil in all the sample villages. Mainly there are three types of soils seen in the sample villages. The soils are clay, loam and sandy loam, in nature. The soils are deficient in phosphoric acid, nitrogen and humus, while the amount of potash and lime are adequate. The agriculture development is largely limited by the supply of nitrogen and humus. The soils are naturally of high inherent productivity and they are most important from the agricultural point of view. Low lands are more fertile than up lands. As minerals and organic matter washed away by surface runway from up land to low land, low land becomes fertile and gives better yield than up land. The P.H. of soil varies from 5.0 to 8.0.

SOCIO ECONOMIC CONDITION:

Location of sample villages in relation to their administrative Headquarters:-

The position of the villages in the study with respect to their distance from the police station, Block Office, Tahasil Office and Gram Panchayat Office is shown in the table below.

Table-2

Location of the villages in respect of distance from the administrative headquarters.

Name of the Villages.	Distance from (in Kms.)			
	'Police Station.	'Block Office.	'Tahasil Office.	'Grampanchayat Office.
1.Barapalli.	3.5 north east.	3.5 north east.	3.5 north east.	1.0 South east.
2.Kaithpalli.	3.0 north east.	3.0 north east.	3.0 north east.	1.5 South east.
3.Kusumitada.	3.5 north	3.5 north	3.5 north	0.5 South
4.Salajheria.	4.0 north	4.0 north	4.0 north	0.0(Own village)
5.Sahaspur.	3.0 north	3.0 north	3.0 north	1 South
6.Ranipada.	4.5 north	4.5 north	4.5 north	0.5 East.

The police station,Block Office and Tahasil Office of the above villages are in Khandeparagarh and Panchayat Office is at Saljheria except these Kainthpalli and Barapalli of which P.O. at Sikharpur.

Villages are more or less at a similar distance from Block Office thus they receive similar extension aid being the Panchayat headquarter the village Saljharla avails some privilege over other sample villages. The position of these villages with regards to their location in relation to administrative headquarters are of not much different.

Means of communication:-

The post office, Telegraphic Office, roads and rail are the chief means of communication available in the villages. The situation of the villages according to their distance from the nearest means of communication has been shown in the following table.

Table-3

Situation of the villages in relation to their distance from means of communication.

Name of the village.	Distance from in (Kms.)				
	Nearest Post Office.	Nearest Telegraph Office.	Nearest Kacha road.	Nearest Pacca road.	Nearest railway station.
1	2	3	4	5	6
1. Barapalli.	1.0	3.5	0	0	80
2. Kainthapalli.	1.5	3.0	0.5	0.5	81
3. Kusumitada.	1.0	3.5	0	1.0	80
4. Salajharla.	1.0	4.0	0	1.0	80
5. Sahaspur.	1.5	3.0	0	1.5	80
6. Ranipada.	1.0	4.5	0	1.0	80.5

The nearest Post Office of these villages is at Sikharpur and Telegraphic Office at Khandaparagarh. The villages are connected with Kacha roads to the Pacca road P.W.D. road from Khandaparagarh to Nayagarh passes by the side of Barapalli. R.E.O. road from Khandaparagarh to Itamati passes through the villages Sahaspur, Kusumitade and Saljharla. The nearest Railway Station is situated at Khurdha road, which is little bit away from this area. From the table above the distance of the villages to the communication centres indicates that all villages served equally from the communication point of view. At times in rainy season the village Kacha roads becomes in-accessible.

Medical facilities and Sanitary conditions:-

Primary health centre which is located at Khandaparagarh is about 3.5 Kms away from these villages. Like most of the rural villages of Orissa, these villages suffer from bad sanitary condition. Open latrin near the village site, cowdung pits inside the residential sides, mosquito menance, unclean ponds are the normal sights in these villages. In the summer season, most of the year people could not get drinking water.

Veterinary Dispensory:-

People of these villages also avail the animal treatment facilities at the Animal Husbandry Dispensory at Khandaparagarh.

Educational Facilities and Social life:-

Barapalli and Saljharla have three own well established upper primary schools. The students of other villages use to go to these schools. Nearest M.E.School at Sikharpur is about one and half kilometer away from these villages. Nearest High School for these sample villages are located at Khandaparagarh which is nearly 3.5 Kms away from these villages, for college education the boys of these villages go to Nayagarh college which is on an average 13 Kms. away from these villages. Kusumitada, Barapalli and Ranipada avail one village library each.

Facilities for marketing and transport:-

The villages are having no such good marketing facility. Itamati village market which is an assembling point in this area is 8 to 12 Kms. away from these villages. Thus farmers growing vegetables get a lower share of the consumers rupee as they usually sell their produce to the middlemen. The following table shows the location of the villages with respect to their distance from the hats.

Table-4

Location of the villages in relation to their distance from the hats.

Name of the village.	Distance in Kms.	
	Khandaparagarh	Itamati
1. Barapalli.	3.5	11.0
2. Kainthpalli.	3.0	11.5
3. Kusumitada.	3.5	10.0
4. Saljharla.	4.0	9.5
5. Sahaspur.	3.0	10.5
6. Ranipada	4.5	9.0

Kusumitada and Saljharla feed vegetables to the Khandapara market through out the year. During summer season truck loads of vegetables go to Itamati hat from this area. Chief means of transport are head loads, bullock cart and at times trucks.

Population Characteristics and Occupational Pattern:-

The total population of these villages along with the number of house holds are given in the following table.

TABLE-9

Population characteristics and number of households of the villages according to 1961 census report.

	Name of the village	No. of house-holds	Total popula-tion	Average size of family	Male	Female	Literate	
							M	F
1.	Barapalli	97	440	4.53	221	219	36	-
2.	Kainthpalli	71	350	4.92	163	187	17	-
3.	Kusumitada	19	87	4.57	43	44	14	-
4.	Salajharla	86	420	4.88	202	218	28	5
5.	Sahaspur	45	301	6.68	134	167	37	-
6	Ranipada	223	1117	5.00	565	552	211	18

Source -1961 Census report,Puri istrict.

This table reveales that more number of females found in Kainthpalli, Kusumitada,Saljharla and Sahspur than males..But in the male number is more in Barapalli and Ranipada.

Only in Ranipada and Saljharla educated females are found out. Persons per family is highest in Sahaspur and lowest in Barapalli.

Distribution of population according to their nature of occupation:-

The distribution of population of these six villages according to their nature of occupation are given below in the table.

TABLE -6

Population distribution accordint to nature of occupation

Name of the Village	As cultivator.		As Asnt labour		Running other services quarrying and house hold industries		Total worker	
	M	F	M	F	M	F	M	F
1. Barapalli.	105	16	4	-	-	-	126	16
2. Keinthpalli	85	4	-	-	-	-	85	4
3. Kusumitada	19	2	4	-	1	-	25	2
4. Saljharla	79	-	35	3	16	-	130	3
5. Sahaspur	86	65	-	-	-	-	86	65
6. Ranipada	331	14	38	-	-	9	369	34

Source:- 1961 Cencus report,Puri District.

This table indicates that male cultivators number is highest in Ranipada where as lowest in Kusumitada. Female cultivators are hig est in Sahaspur where as nil in saljharla highest no of agricultural labourer found in in Saljharla.

One person engaged in quarrying industries in Kusumitada. In Salajharla and Ranipada other occupational engaged people found out. Total male worker fighest in Ranipada lowest in Kusumipada and female workers more in Sahaspur.

Distribution of farms according to size groups:-

There is a wide variation in the size of farms in the sample village. The frequency distribution of the size of holding of the six villages are illustrated in the table below.

TABLE- 7

Frequency distribution of size of farms in the sample village.								
Name of the village	0-2. Ac		2.5 -5.0		5.0-10.0		Above 10 Acs	
	Frequ-ency	Per-centage	Frequ-ency	P.C	Frequ-ency	Per-centage	Frequ-ency	Per-centage
1.Barapalli	50	51.50	36	37.08	8	8.24	3	3.09
2.Kainthpalli	28	39.42	30	42.24	9	12.67	4	5.63
3.Kusumitada	7	36.84	10	52.63	2	10.52	-	-
4.Saljharia	40	46.48	26	30.21	12	13.94	6	6.97
5.Sahasput	20	44.44	18	39.99	5	11.11	2	4.44
6.Ranipada	135	60.53	50	22.42	26	11.65	11	4.93

This table reveals that highest percent of people of Ranipada under below 2.5 acre of holding where as Sahaspur having highest percentage of higher group people.

Within 2.5-5.0 group the distribution varies from 30.21 percent to 52.63 percent in different villages.

Likewise 5.0 to 10.0 Acre holding farms vary from 8.24 percent to 13.94 percent in different villages.

Tenancy:-

In all the villages tennancy is widely prevalent. There are quite a number of non-occupancy tenants. Leasing of land on crop share leasis and on contract basis prevalent in the sample villages.

Generally in local variety of paddy half of the produce is given to the owner and for high yielding variety of paddy one third of the produced given to owner. While in Capital intensive crops like sugarcane one-third of the produce is given to the owner.

Livestoke Population:-

Generally the house holds of the sample villages tame oxen, cows, He-buffalows, She-buffalows, goats and sheeps. The land less households and marginal farmers use to tame goats and sheeps in this area. But goats are preferred to sheeps by the house holds. These are of local breeds and farmers are not consious of taking any sort of care in imporved feeding, breeding and managemement system.

Land Utilisations:-

Land utilisation statistics of the sample villages given in the following table.

TABLE-8

Land utilisation pattern.

Name of the villages	Total area in acres.	Net area shown in acres.	Cultivable waste land including pastures.	Fallow land (acres)	Area not available for cultivation.	Forest area (acres)
1. Barapalli	335.65 (100)	220. (65.54)	20 (5.95)	20 (5.95)	25.65 (7.64)	50 (14.87)
2. Kainthpally	476.64 (100)	230 (48.25)	200 (41.96)	-	41.64 (8.73)	5.00 (1.04)
3. Kusumitada.	108.38 (100)	90 (83.03)	8.38 (7.7)	-	10 (9.22)	-
4. Saljharis	204.44 (100)	140 (68.46)	25 (12.22)	-	29.44 (14.40)	10 (4.89)
5. Ranipada	731.25 (100)	430 (58.80)	100.25 (19.70)	-	80.0 (10.94)	121 (16.54)
6. Sahaspur	242.04 (100)	182 (75.19)	20 (8.26)	-	30.04 (12.4)	10 (4.18)

Source - Tahasil office, Khandaparagarh.

(Numbers in parenthesis indicates the percentage).

Irrigation:-

Out of six villages under the study four villages have irrigation facility. Barapalli and Kainthpalli are under flow irrigation. Thus both the villages get canal irrigation facility during Kharif, Rabi and summer season. Kusumitade and Salajharis are villages which receive only canal irrigation during kharif but tube well irrigation during Rabi and summer season. The villages Sahaspur and Renipada are unirrigated villages.

TABLE -9

Irrigation potential of sample villages.

Name of the village.	Total cultivated area (Acre)	Kharif		Rabi		Summer		Source of irrigation.
		Area irrigated in (Acre)	Percentage	Area irrigated.	Percentage.	Area irrigated.	Percentage.	
1.Barapalli	220	200	90.90	40	22.72	50	22.72	Sunamul Minor irrigation Project.
2.Kainthpalli	230	200	86.95	45	19.56	40	17.39	-do-
3.Kusumitade	90	90	100	20	22.22	20	22.22	-do- and tube well.
4.Salajharis	140	130	92.85	80	57.14	80	57.14	-do-
5.Sahaspur	182	-	-	-	-	-	-	Unirrigated.
6.Renipada	430	-	-	-	-	-	-	-do-

Table reveals that irrigation position of Kusumitada is better during Kharif whereas for Saljharla it is better during Rabi and Summer season.

Credit system :-

For proper utilisation of land more capital is required than its present use. With the emergence of co-operative societies the activities of unscrupulous village moneylenders are gradually decreasing. Even then the moneylenders play vital role in financing agricultural operations in this locality. The co-operative societies of this area are not so active. The interest rate charged by the societies are 10.5 percent in case of crop loans. The Khandapara branch of the United Commercial Bank also extends agricultural credit facilities to these villagers. People also use to bring loan from land development Bank for digging well for agricultural purposes. The following table brings out the clear picture of the rates of interest charged by the agencies operating in these villages.

TABLE-10

Different sources, nature and rate of interest of credit prevailing in the sample villages.

Sources	Nature of credit	Percent of interest
1. Village moneylender	Short and medium term.	25-50
2. Co-operative credit Societies.	-do-	10.5
3. Land mortgagage Bank.	Long term.	9.5
4. United Commercial Bank.	Short and medium term.	10.50

This table indicates that the highest rate of interest charged by the moneylenders.

CHAPTER V
IMPACT OF IRRIGATION

CHAPTER - V

FINDING AND DISCUSSIONS

(A) IRRIGATION AND CROPPING PATTERN:-

One of the measures to study the impact of irrigation on agriculture is to make a comparison of the size of farm business between irrigated and unirrigated farms in same area. The size of farm business is generally expressed in the forms of (i) net area sown (ii) Gross cropped area (iii) Intensity of cropping (iv) value of farm investment mostly in forms of capital inputs used (v) Total labour used (vi) farm productivity and (vii) farm returns. In this section we have given the nature of cropping pattern and crop intensity in three different situations namely unirrigated lift irrigated and canal irrigated farms. At the same time we have tried to see if there is any influence of farm size on cropping pattern and crop intensity in different conditions.

CROP INTENSITY:-

Though intensity of cropping is not an exact measure to find out the impact of irrigation, yet it will give an idea about how many times the land has been ploughed during the year.

Table 11 shows, (a) Areas farmed or net area sown (b) acres seeded or gross cropped area, and finally (c) the intensity of cropping which is derived from the earlier two, A and B.

TABLE- 11

**Estimated crop intensity in different farm situations
in various farm sizes in Khandapara during 1972-73.**

...

Particulars.	Unirrigated				Tube well irrigated				Canal irrigated			
	I 0-2.5	II 2.5-5.0	III 5.0-10	Total	I 0-2.5	II 2.5-5.0	III 5.0-10	Total	I 0-2.5	II 2.5-5.0	III 5.0-10	Total
Net area sown.	7.07	24.75	31.55	70.95	8.63	16.5	40.72	65.85	12.6	18.37	31.57	62.55
Gross cropped area.	17.15	46.0	69.75	132.90	22.37	42.0	113.77	177.15	30.3	43.95	72.20	156.45
Intensity of cropping.	187.98	184.81	187.87	189.42	242.82	254.54	279.44	269.02	240.47	239.18	260.32	250.12

The estimated figures of crop intensity reveals that the average intensity in case of unirrigated farms was 189 percent where as it came to 250 and 269 percent in canal and lift irrigated farms respectively. In other words the crop intensity was one and half times more in irrigated conditions than that of unirrigated condition. The difference between lift irrigated and canal irrigated farms with regard to crop intensity was not pronounced. So far as farm size is concerned, it is observed that it has no influence on crop intensity. As irrespective of size group they follow similar cropping pattern.

Cropping Pattern:-

The cropping pattern is the index to study the agricultural development of an area the cropping pattern of the sampled farm with respect to year under reference is presented in table -12.

The following observations can be made from table-12.

(i) While two crops were raised from the same type of land in irrigated conditions, three successive crops were taken in irrigated farms irrespective of the type of irrigation. Due to water constraint no crop is raised during summer in unirrigated farms.

(ii) The proportion of area under local variety of paddy to total cropped area varied widely from one situation to other while in case of unirrigated conditions it occupied 48.91 percent of the gross cropped area in case of tube well irrigated condition it was only 19.22 percent and for canal irrigated farms it come to 13.08 percent.

TABLE-2

Cropping pattern followed in different conditions of irrigation and percentage of area under each crop to the gross cropped area in Khandapara during 1972-73.

Unirrigated			Tube well irrigated		Canal irrigated.	
Crops	Area in percentage.		Crops	Area in percentage.	Crops	Area in percentage.
Kharif crops	Local paddy	48.91	Local paddy	19.22	Local paddy	13.08
	Ragi	2.79	Ragi	0.84		
	Jute	2.17	H.Y.V.Paddy	7.40	H.Y.V.Paddy	16.55
			Ground nut	3.90	Ground nut	2.39
	Total-	54.87	Total-	31.36	Total-	32.02
Rabi crops.	Black gram	12.55	Potato	16.59	Potato	16.10
	Green gram	16.0	Wheat	6.18	Wheat	6.13
	Horse gram	3.62	Tomato	2.96	Mustard	2.87
	Khesari	11.99	Soyabean	0.84	Winter vegetables	2.39
	Mustard	1.05	Winter Vegetable	4.82		
	Total	45.21		31.39		27.49
Summer crops			Brinjal	7.19	H.Y.V.Paddy	15.65
			Groundnut	6.13	Ground nut	10.74
			Ragi	5.80	Ragi	6.61
			Maize	2.11		
			Arum	6.35		
			Summer vegetables.	0.84		
			Total	29.42		33.11
Year round crop.			Sugar cane	5.75	Sugar cane	7.47

(iii) High yielding varieties of paddy did not find place in unirrigated farms. On tube well irrigated condition. High yielding varieties of paddy occupied 7.40 percent of the gross cropped area. But in canal irrigated condition, the same area under H.Y. varieties of paddy came to 32.11 percent (16.55 percent in Kharif and 15.56 percent in summer).

(iv) Sugar cane also did not find place in unirrigated farms. But the crop commanded 5.75 percent and 7.47 percent of the total cropped area in tube well irrigated and canal irrigated farms respectively.

(v) Potato is another crop which could be seen only in irrigated farm situations in the area under study. The proportion of area under potato was 16 percent to total cropped area in both the irrigation system.

(vi) Groundnut was also confined to irrigated conditions and this crop was grown both during Kharif and Summer months. Nearly 10 percent and 13 percent of total area under different crops was devoted to groundnut cultivation in tube well and canal irrigated farms respectively. However, the area under this crop was more in summer than Kharif.

(vii) Next to potato wheat was an important crop during in Rabi in irrigated conditions and shared little more than 6 percent of the total cropped area in both the types of irrigated farms.

TABLE-43

Percentage of distribution of gross cropped area according to broad group of crops and source of irrigation in Khandpara area during 1972-73.

Crops	Unirrigated.	Tube well irrigated.	Canal irrigated.
Food grains	68.62 (51.70)	73.65 (41.57)	90.75 (58.80)
Pulses	62.7 (46.11)	-	4.5 (2.87)
Cash crops	-	62.7 (35.39)	57.45 (36.72)
Vegetables and others.	2.93 (2.17)	40.8 (23.03)	3.75 (2.39)
Total-	134.4 (100)	177.15 (100)	156.45 (100)

(Figures in parenthesis indicate the percentage of area under different broad groups of crops).

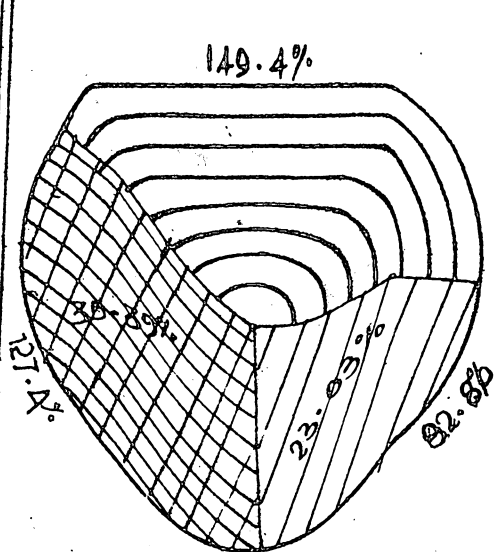
(i) Food grains = Paddy, wheat, ragi and maize.

(ii) Pulses = Black gram, Green gram, Khesari, H.gram.

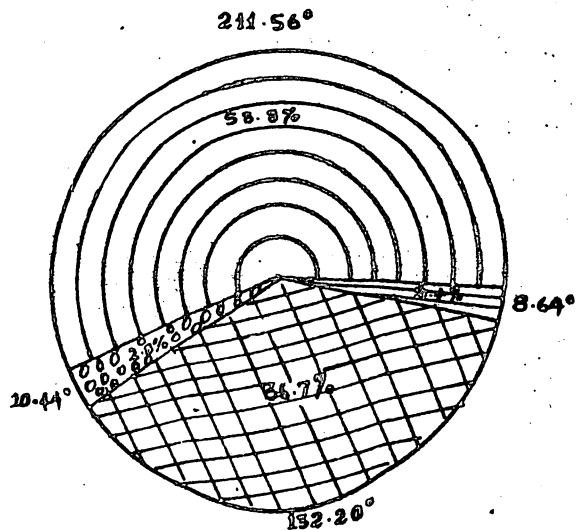
(iii) Cash crops = Sugarcane, Potato, Groundnut.

(iv) Vegetable and others = Summer and Winter Vegetables and others.

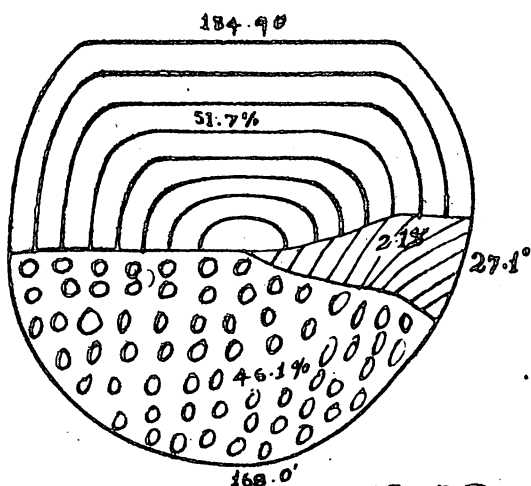
DISTRIBUTION OF CROPS



TUBE WELL-IRRIGATED
SAMPLES



CANAL IRRIGATED
SAMPLES



UNIRRIGATED SAMPLES

-  FOOD GRAIN CROPS
-  PULSE CROPS
-  CASH CROPS
-  VEGETABLE AND OTHER CROPS

(viii) In unirrigated farms different kinds of pulse crops dominated the cropping pattern in Rabi season. It is interesting to observe that almost entire sown area during Rabi was saturated with pulses in unirrigated farms. It is also equally interesting to note that pulses were completely rooted out in irrigated farms. Crops like potato and winter vegetables have replaced pulse crops in irrigated farms.

(ix) Most contrasting character of the cropping pattern study in this locality is that during summer months while the land was remaining fallow in unirrigated farms, many kinds of summer vegetables, groundnut, ragi and maize were grown in irrigated farms.

(x) In these summer months, only in canal irrigated farms the H.Y.V paddy was found to be grown in a considerable size of land.

Distribution of Area according to Broad group of Crops:-

From the table-13 it is obvious that during the year of study food grains occupied 51.70 percent, 41.57 percent and 38.80 percent in unirrigated, lift irrigated and canal irrigated samples. More percentage of cash crops and vegetables were grown in lift and canal irrigated lands. The provision of irrigation facilitated farmers to replace less remunerative pulse crops by high remunerative cash crops and vegetables.

It is a remarkable observation that more percentage of vegetables were grown in tube well irrigated area than the canal irrigated area both in Rabi and Summer seasons.

Thus we may conclude that provision of irrigation facility brought a remarkable change in cropping pattern.

(i) High yielding varieties of paddy and new crops like soyabean, wheat and maize were introduced in irrigated areas.

(ii) High remunerative cash crops and vegetables were grown in irrigated area in lieu of less remunerative pulse crops.

(iii) Irrigation facilities provided scope for triple cropping in place of double cropping which was common in this locality.

(iv) H.Y varieties of paddy were grown only in canal irrigated area during summer due to its' high water requirement where as more vegetables in tube well irrigated areas.

Since the water requirement of H.Y.V paddy is much higher than wheat, maize and vegetable crops, farmers in lift irrigated farms took up these crops in place of H.Y.V paddy for economic use of the tube well water.

(B) IRRIGATION AND CROP INPUTS:

As we know irrigation creates very favourable conditions by which high productive inputs like fertilizers and pesticides get greater scope for absorption. Attempts have been made in farming to make quantitative assessment of the effect of irrigation on the use of inputs. Keeping unirrigated as control in this experiment, two important inputs such

as fertilizers and pesticides have been considered for this approach of study. Table-14 shows the per acre distribution of the value of fertilizer use in unirrigated and irrigated condition and with respect to different farm size.

TABLE-14

Per acre value of fertilizer according to source of irrigation and size group.

Size group	(in rupees per annum)		
	Unirrigated	Lift irrigated	Canal irrigated
I	21.82	246.08	257.14
II	25.03	268.63	276.80
III	31.60	286.90	285.74
Area	26.15	263.87	273.23
Average	(100)	(1009)	(1044)

Table-14 indicates that per acre use of fertilizer was much higher in irrigated farms than unirrigated farms. In canal irrigated area, use of fertilizer was ten times higher than unirrigated area.

So far as the farm size is concerned we observed higher size farms used more fertilizer per unit of land. As a whole higher size farm used higher amount of fertilizers and the fertilizer use was proportional to farm size.

Between canal irrigated and lift irrigated farms, it is observed that, canal irrigated farms used relatively more fertilizer per acre than their counter parts in lift irrigated farms.

Use of Plant Protection Materials:

TABLE-15

Per acre value of insecticide and pesticide according to source of irrigation and size group.

Size group	(Amount in rupees per annum)		
	Un-irrigated	Lift irrigated	Canal irrigated
I	-	57.39	68.57
II	-	71.81	90.32
III	-	75.87	96.62
Area average.	-	68.32 (100)	85.08 (124.53)

Table-15 reveals that unirrigated farms did not use plant protection materials at all where as irrigated farms use Rs.57.39 to Rs.96.62 on an average in one acre of land.

Between farm sizes, bigger sized farms incurred more expenditure per acre on pesticides as compared to small farms under the same situation. However, between the two sets of irrigation systems, canal irrigated farms used more pesticides than lift irrigated farms.

The analysis of the relationship between irrigated inputs and other modern farm inputs, show that irrigation accelerated the use of fertilizers and pesticides to a considerable extent. This is only due to the nature of technology that our farmers have used for maximising their returns. As we have already said the success of our technological

break-through in agriculture lies with the interaction of water, chemical fertilizers and pesticides and biological magic seed or high yielding seed. In absence of one of these interacting factors the response to production would be seriously affected. Due to this reason farmers liked to use more and more fertilizers and pesticides under irrigation condition.

As the high yielding varieties of paddy were grown in a greater extent in canal irrigated area than tube well irrigated area, the consumption of fertilizers and pesticides were more in former than latter.

As regards the bigger farms using more money on plant protection purpose, than smaller farms per acre basis, it can be said that these farms have greater capacity to invest on productive purposes than that of smaller farms. Once they have been made to convince that the application of chemicals for crop protection result higher net return, there will be no internal cash or credit rationing.

(C) IRRIGATION AND LABOUR UTILIZATION:

Man continues to be the most important source of labour power used in the farms. The bullock labour is the second most important source of supply of labour power. However, agriculture is a seasonal industry in the sense that it does not keep those engaged in it, fully occupied

all the year round. The development of this industry will not be complete or satisfactory unless this defect is remedied. It is said that irrigation provides means to absorb greater portion of labour force and continuous employment in agricultural sector through multiple cropping, intensive methods of cultivation.

This section is devoted to study the impact of irrigation on employment in agriculture. For the purpose of present study, total bullock labour and human labour used in different crops and in different areas has been taken into consideration.

Per Acre Labour Employment:-

(i) Data in table-16 shows that the unirrigated farms on an average used 76 man days per acre per annum. Whereas tube well irrigated and canal irrigated farms used 242 days and 221 days respectively per acre per annum. Thus the labour utilisation per acre of irrigated land was more or less three times of the requirement of unirrigated farms of the same area.

(ii) It is obvious from the table that labour distribution is uneven in unirrigated areas as 80.72 percent of labour days engaged in farming only during Kharif and the remaining 19.28 percent were used during Rabi season. But in irrigated area the result was very encouraging. The estimated labour utilisation figures revealed that

TABLE-16

Per acre human labour utilisation in different zones in different seasons according to size of holding (in days)

Size of holding	Unirrigated				Tube well irrigated				Canal irrigated			
	Kharif	Rabi	Summer	Annual	Kharif	Rabi	Summer	Annual	Kharif	Rabi	Summer	Annual
I	66.05 (80.25)	16.0 (19.74)	-	82.05	80.0 (31.29)	90.43 (35.37)	85.21 (33.33)	255.64	83.67 (35.82)	92.08 (39.42)	57.79 (24.74)	230.54
II	62.66 (80.54)	13.69 (19.45)	-	76.35	77.45 (32.45)	87.09 (36.48)	77.09 (31.04)	241.63	75.59 (34.51)	85.71 (39.13)	57.73 (26.35)	219.03
III	56.98 (81.34)	14.21 (18.65)	-	70.19	73.99 (30.62)	89.61 (37.07)	74.97 (32.27)	238.57	76.95 (36.40)	61.66 (29.17)	72.77 (34.42)	214.38
Average	61.23 (80.71)	14.63 (19.28)	-	75.86 (100)	(31.45)	(36.30)	(32.21)	242.93 (320.23)	(35.57)	(35.90)	(28.50)	221.31 (291.73)

(Figures in parenthesis indicate percentage)

Analysis of variance table :-

Source of variation	Degree of freedom	S.S.	M.S.	Fs.	Remark
1. Among area	3-1 = 2	243442.86	121721.43	201.01	Highly significant
2. Among size group within area.	3(3-1)= 6	3633.23	605.53		
3. Error between observation of each holding.	9(5-1)= 36	2030.85	56.41	10.73	Significant.
Total	(45-1)= 44	249106.94			

labour load was uniformly distributed the year round 32.21 percent and 28.50 percent of the total labour were used during summer in tube well and canal irrigated areas respectively, where as during summer months not a single labour day was used for farming purpose in unirrigated area during this season due to obvious reason.

(iii) While in unirrigated condition the labour utilisation was better in Kharif than in Rabi, in irrigated condition, it was just in reverse order.

(iv) It was observed small farms utilised more labour per acre in all conditions.

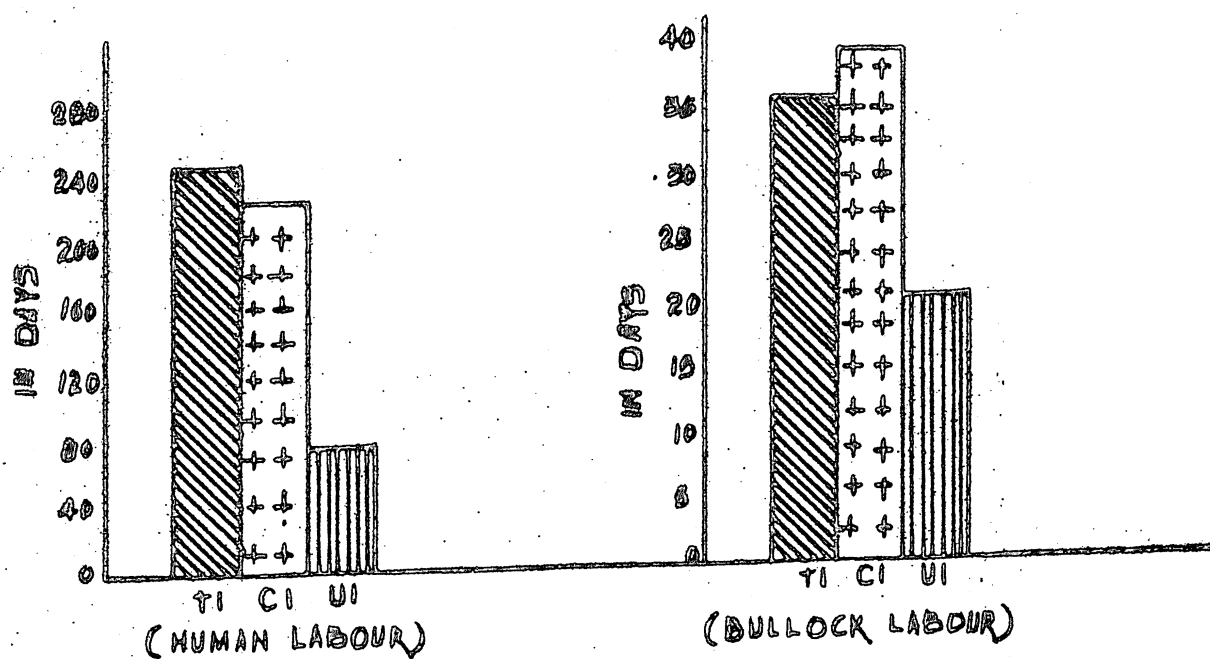
Per farm Human Labour Employment:-

This study will give a clear cut idea about total human labour days used by different size farms under different farm conditions.

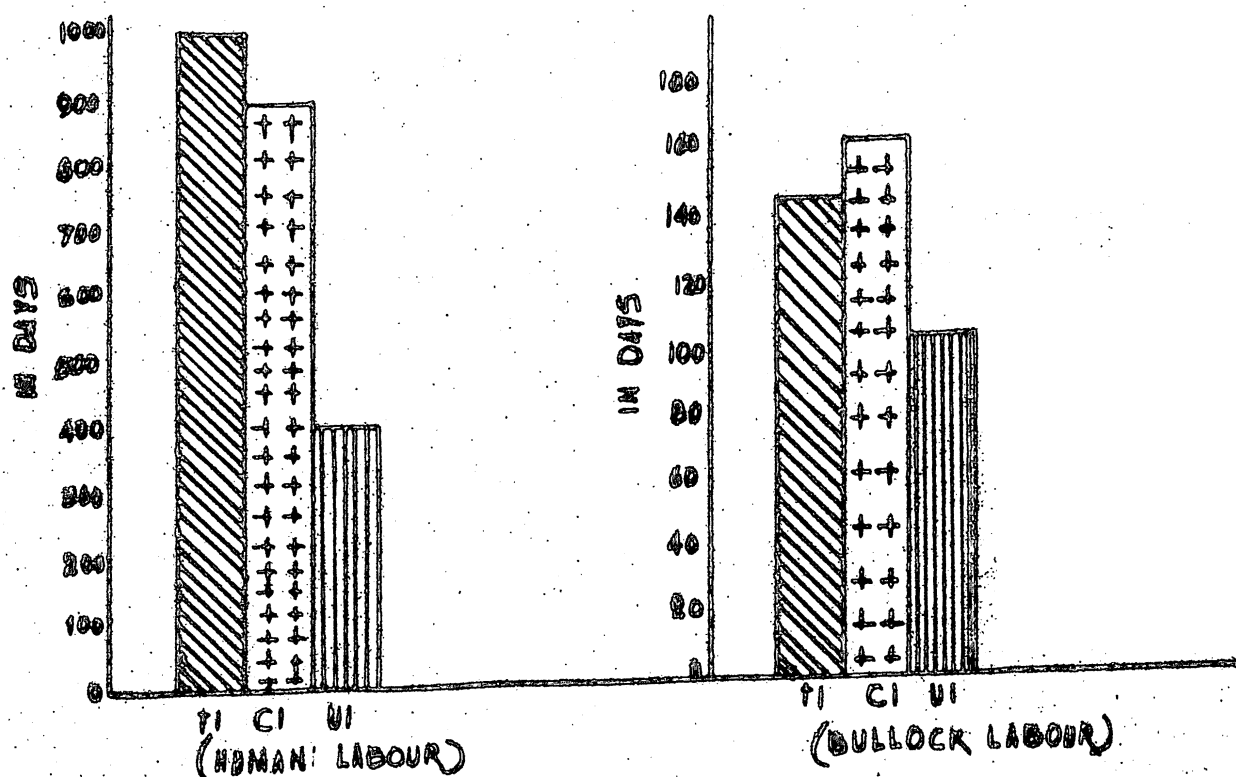
(i) It is seen that total human labour employment per farm per annum was two and half to three times larger in irrigated situations compared to same sized farms in unirrigated situations. However, the total utilisation of labour was relatively more in tube well irrigated condition than that of labour in canal irrigated condition. It was due to the higher labour absorbing capacity of vegetable crops.

(ii) Relationship between farm size and employment showed that employment was directly proportional to farm size. In other words, higher farms used more labour days and smaller farms used less labour days with more or less same units of labour per acre.

PER ACRE HUMAN LABOUR AND BULLOCK LABOUR UTILISATION



PER FARM HUMAN LABOUR AND BULLOCK LABOUR EMPLOYMENT



TI - TUBE WELL IRRIGATED FARM
 CI - CANAL IRRIGATED FARM
 UI - UN-IRRIGATED FARM

**Human labour utilisation per farm in different zones in different seasons
according to size of holding.**

Size of holding	(in days)											
	Unirrigated				Tube well irrigated.				Canal irrigated			
	Kharif	Rabi	Summer	Annual	Kharif	Rabi	Summer	Annual	Kharif	Rabi	Summer	Annual
I	130.75	32.16	-	162.91 (15.30)	152.80	172.72	162.75	488.27 (26.27)	175.70	193.36	121.35	484.13 (18.28)
II	258.15	56.40	-	314.55 (29.54)	283.46	318.74	282.14	884.34 (29.57)	308.40	349.69	235.53	893.62 (33.74)
III	470.08	117.23	-	587.28 (55.15)	501.65	607.55	508.29	1617.49 (54.09)	462.46	370.57	437.34	1270.37 (47.97)
Total	858.98	205.79	-	1064.74 (100)	937.91	1099.01	953.18	2990.10 (100)	946.56	913.62	794.22	2649.37 (47.97)
Average per farm.	289.66	68.59	-	388.28	312.63	366.33	317.72	996.70	315.52	304.54	264.74	882.70

(Parenthesis numbers indicate the percentage)

Per Acre Bullock Labour Employment:-

This portion of study will fetch us about the changed pattern of bullock labour utilisation due to irrigation.

(i) On an average 21 bullock pair days per acre were used in unirrigated area. Where as 35 and 38 bullock labour days were engaged in tube well and canal irrigated areas respectively. Thus irrigation created almost two times employment for bullock power per acre of farm land as compared to one acre of unirrigated farm land.

(ii) During Kharif employment of bullock labour per acre was almost same (i.e 17.0 days) in all the three types of farms. But in other seasons bullock labour could get hardly 3 days per acre in unirrigated land and 18 days per acre in tube well irrigated and 21 days per acre in canal irrigated lands.

(iii) It is a remarkable observation that higher size group used more bullock pair days per acre in all conditions, namely unirrigated, tube well and canal irrigated.

Per Farm Bullock Labour Employment:-

To keep a pair of bullock without much employment opportunity is uneconomical . This analysis will provide us the information regarding the employment pattern of bullock labour in different seasons and average use of bullock labour per farm.

(i) Table-19 gives the idea that on an average 102,144 and 161 bullock pair days were used by a simple family for cultivation purpose in unirrigated, lift irrigated and

TABLE-7

Per acre bullock labour utilisation in different
Zones in different seasons for all crops
according to size of holdings.

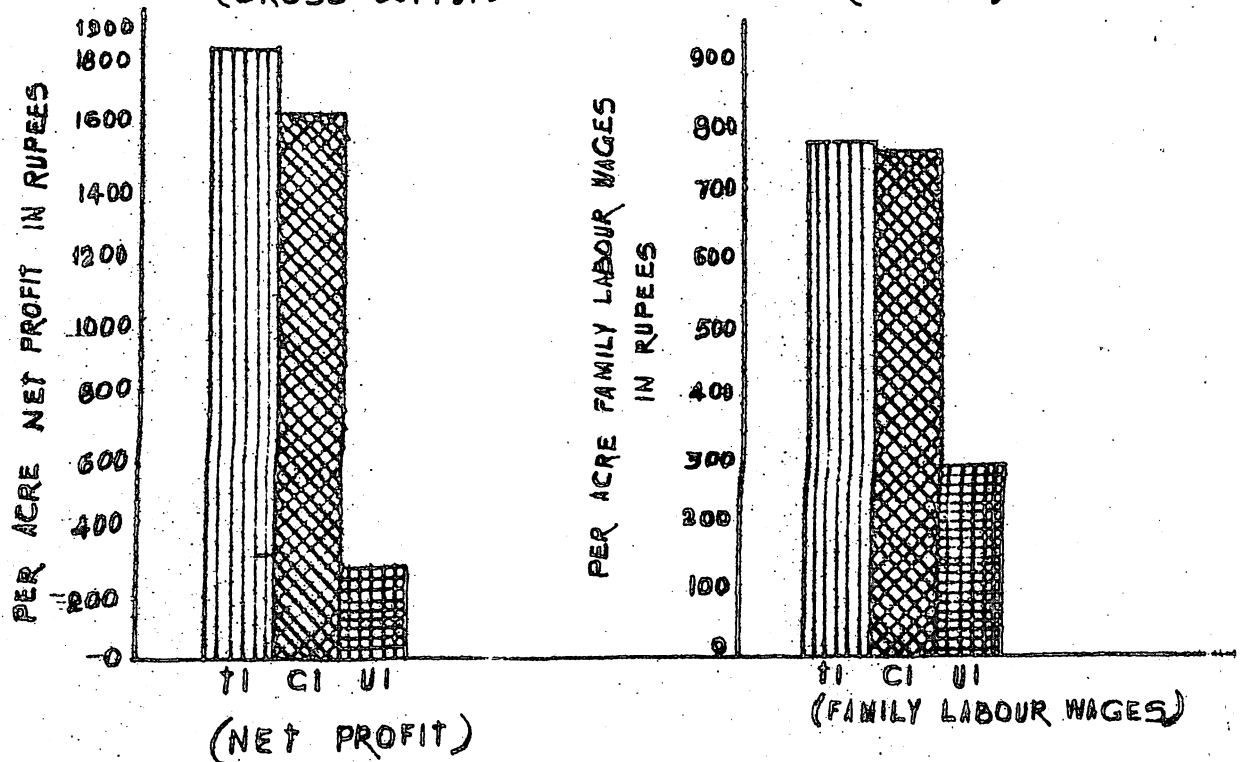
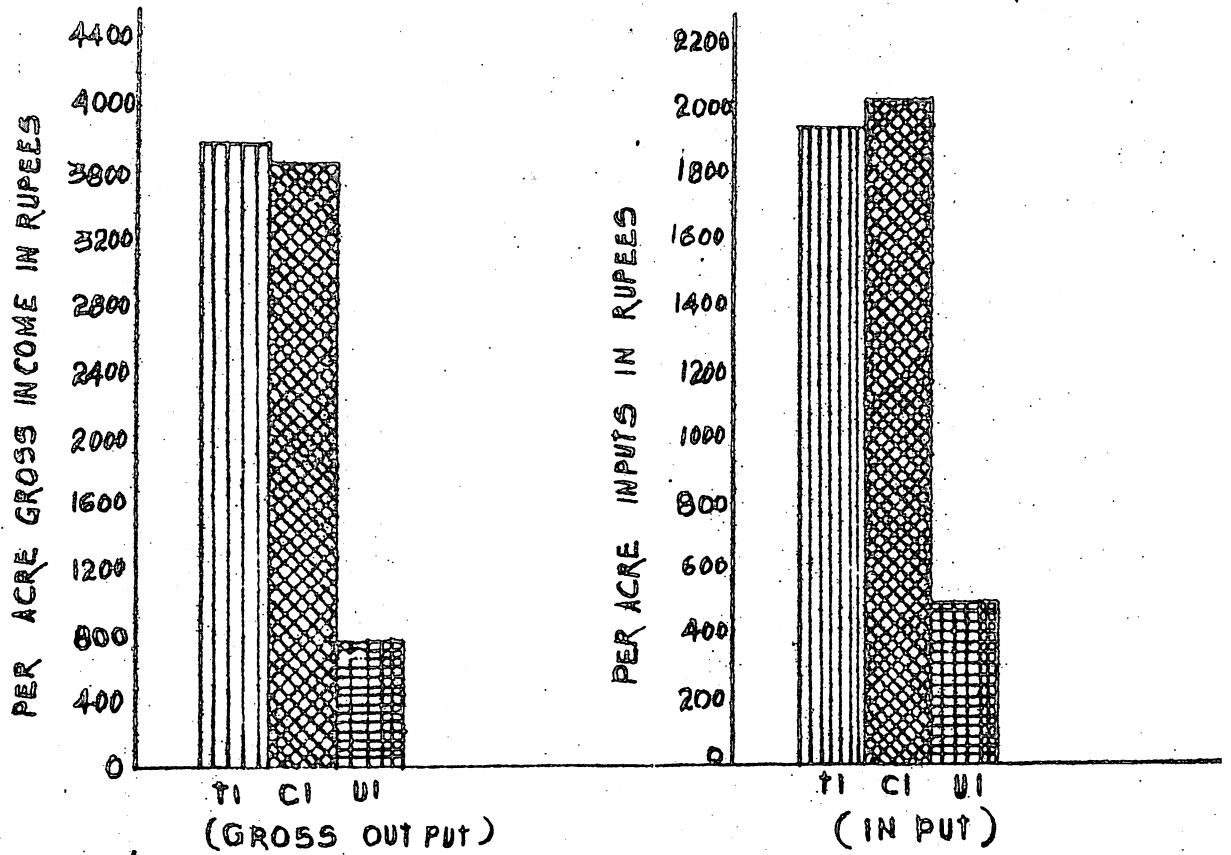
...

(in days)

Size of holding.	Unirrigated		Irrigated		Total		Unirrigated		Irrigated		Total		Unirrigated		Irrigated		Total	
	Harif.	Rabi	Summer	Total	Harif.	Rabi	Summer	Total	Harif.	Rabi	Summer	Total	Harif.	Rabi	Summer	Total	Harif.	Rabi
I	16.19 (80.02)	2.29 (19.97)	-	18.48	17.39 (89.04)	11.47 (32.34)	6.60 (18.61)	35.46	13.00 (41.41)	11.19 (33.58)	8.33 (25)	33.32	16.81 (87.79)	2.30 (12.20)	-	21.84	16.81 (86.60)	11.63 (32.24)
II	19.54 (87.79)	2.30 (12.20)	-	21.84	16.81 (86.60)	11.63 (32.24)	7.63 (21.15)	36.07	15.10 (43.22)	11.02 (31.54)	8.81 (25.22)	34.93	20.12 (89.42)	2.38 (10.57)	-	22.50	16.92 (89.44)	10.31 (30.12)
Average.	17.95 (85.72)	2.99 (14.27)	-	20.94 (100)	17.04 (88.34)	11.13 (31.57)	7.07 (20.65)	35.25	16.36 (43.29)	10.06 (26.62)	11.36 (30.06)	37.79	17.95 (85.72)	2.99 (14.27)	-	20.94 (100)	17.04 (88.34)	11.13 (31.57)

-000- -000-

PER ACRE INPUT, OUTPUT, NET PROFIT AND FAMILY LABOUR WAGES



TI - TUBE WELL IRRIGATED FARM
 CI - CANAL IRRIGATED FARM
 UI - UN IRRIGATED FARM

canal irrigated area per annum. Thus nearly one and half times more pairs of bullock power were employed in canal irrigated farms than that of unirrigated farms. It was due to the cultivation of more labour absorbing crop cultivation in canal irrigated area.

Irrigation facility extended the use of human and bullock labour many fold and created opportunity for year round employment. Thus seasonality of employment could be corrected to a great extent through the introduction of water resources in farming.

(D) COST AND RETURN OF CROPS UNDER DIFFERENT SOURCES OF IRRIGATION

(1) Local Paddy:-

Paddy (local varieties) is the only crop which is grown in all the conditions of farming during Kharif. Therefore a comparison of cost can be made conditions with reference to water supply during Kharif season.

Per acre average cost of cultivation of local varieties of paddy during Kharif has been estimated at Rs.387/- in unirrigated farm, Rs.419/- in tube well irrigated farms and Rs.429/- in canal irrigated farm. It is observed that even in case of local varieties of paddy irrigated farms put greater effort in the application of fertilizers than that of unirrigated farms. This is largely due to reduction of weather uncertainty in irrigated farm. However, in the unirrigated farm the utilisation of labour was relatively more as compared to irrigated farms. This finding appears

TABLE -19

Bullock labour utilisation for farm in different zones in different seasons
according to size of holding. (in days)

Size of hold- ing.	Un irrigated					Tube well irrigated					Canal irrigated				
	Ave- rage hold- ing. in acre.	Kharif	Rabi	Summer	Annual	Ave- rage hold- ing in acre	Kharif	Rabi	Summer	Annual	Ave- rage hold- ing in acre	Kharif	Rabi	Summer	Annual
I	2.01	34.55	8.62	-	43.17 (14.08)	1.91	33.21	21.90	12.60	67.72 (15.68)	2.1	28.98	23.49	17.49	69.97 (14.46)
II	4.12	68.14	9.47	-	77.62 (25.33)	3.66	61.52	42.56	27.92	132.01 (30.57)	4.08	61.60	44.02	23.94	142.51 (29.46)
III	8.25	165.99	19.63	-	185.62 (60.57)	6.78	114.71	69.90	47.39	232.01 (53.73)	6.01	121.34	47.95	101.86	271.17 (56.06)
Total-	14.38	268.68	37.72	-	306.41 (100)	12.45	209.50	134.36	87.91	431.74 (100)	12.19	211.92	115.46	155.29	483.65 (100)
Ave- rage.	4.79	89.56	12.57	-	102.13	4.15	69.83	48.12	29.30	143.91	4.06	70.64	38.48	51.76	161.21

(Parenthesis numbers indicate the percentage)

to be little unrealistic, because various studies indicate that irrigation creates additional capacity for absorption of labour input in farm operations. The deviation with respect to local varieties of paddy here was due to the fact that in unirrigated farms this was the only crop to be grown during Kharif and therefore the labour input, bulk of which was in the form of non-cash input was put to use more liberally in unirrigated farms than that of irrigated farms.

The break up of the cost of cultivation of local paddy shows that the human labour input was the single largest item of expenditure and accounted for 41 to 55 percent of total expenditure.

Bullock labour expenditure ranked second irrespective of size group and irrespective of irrigation source consideration. The absolute expenditure in this item by various size groups varied from Rs.110/- to Rs.131/- .

The expenditure on seed ranked third accounting almost 8 percent in different farm conditions. It was observed that large farms used a little more than the small farms though the percentage expression found to be more or less similar in all size groups.

Manure expenditure took fourth place in unirrigated and tube well irrigated condition accounting 7 and 8 percent respectively. But this expenditure took 5th place in canal

TABLE-20

Item wise cost of production of local varieties of paddy per acre in Khandapara area during 1972-73

(Amount in Rupees)

Items	Unirrigated				Tuba well irrigated				Canal irrigated			
	I	II	III	Average	I	II	III	Average	I	II	III	Average
1. Seeds	25.0	34.44	39.23	32.89 (8.49)	28.35	35.16	38.00	33.83 (8.05)	26.35	35.0	36.52	32.62 (7.60)
2. (a) Manu- res.	30.0	24.44	24.40	26.28 (6.83)	32.43	33.22	34.77	33.47 (8.40)	19.41	27.50	31.30	26.07 (6.07)
(b) Ferti- lizer.	10.50	20.50	30.91	20.63 (5.32)	20.00	28.33	36.81	28.34 (6.75)	25.00	32.50	47.39	31.63 (7.37)
3. Plant prote- ction.	-	-	-	-	-	-	-	-	-	-	-	-
4. Labour												
(a) Bullock labour.	110.0	115.0	123.39	116.13 (34.38)	108.10	124.57	131.36	121.34 (28.92)	114.70	120.0	128.78	121.16 (28.23)
(b) Human labour.	190.0	181.66	170.76	180.80 (55.62)	186.48	175.20	172.0	177.89 (42.40)	205.88	177.50	170.43	177.93 (41.40)
5. Irri- gation.	-	-	-	-	8.00	6.5	6.00	6.83 (1.70)	10.29	10.0	18.69	12.99 (3.02)
6. Misc. cost. (Repair, interest, deprecia- tion, and rental value of land).	10.33	11.27	10.30	10.63 (2.7)	13.60	14.88	24.88	17.78 (4.46)	17.64	20.0	22.60	20.08 (4.67)
	375.83	387.31	398.99	387.37 (100)	398.96	412.76	443.82	419.51 (100)	409.27	422.50	455.71	429.16 (100)

irrigated area accounting 6.7 percent. On an average it was observed that the proportion of manure expenditure was neutral to size group variation.

The fertilizer expenditure was 5 percent in unirrigated farms and tube well irrigated farms where as about 7 percent in canal irrigated farms. The trend of its use found to be more units of this input by large farms than small farms.

The expenditure on plant protection found to be nil in all the farm studied. Irrigation and miscellaneous expenditures were nominal.

(11) Greengram:-

TABLE -21

Item wide cost of production of "Greengram" per acre in Khandapara area during 1972-73

Annual expenditure on crop during 1972-73						
Items	(Amount in rupees)				T.W irrigated	Canal irrigated
	Unirrigated					
	I	II	III	Average		
1. Seeds	22.0 (17.08)	25.5 (24.21)	30.0 (24.97)	25.83 (22.51)		
2.(a)manure	-	-	-	-		
(b)Fertilizer	-	-	-	-		
3.Plant protection	-	-	-	-	Not grown	Not grown
4.Labour						
(a)Human labour	54.0 (41.92)	40.90 (38.84)	45.0 (37.45)	46.63 (40.63)		
(b) Bullock labour	32.8 (25.46)	34.54 (32.80)	38.0 (31.80)	33.78 (29.44)		
5.Irrigation	-	-	-	-		
6.Misc. cost	12.0 (9.31)	6.36 (6.03)	7.14 (5.94)	8.50 (7.40)		
Total	128.8 (100)	105.30 (100)	120.14 (100)	114.74 (100)		

Greengram occupied largest area during Rabi season in unirrigated farms.

The table -21 reveals the break up of the cost of cultivation of this crop for each size of holding.

It is an interesting observation that only the unirrigated farms cultivate this crop and the cost of cultivation of this crop varied from Rs.105/- to Rs.129/- in different size of farms.

The expenditure on human labour accounted 38 to 40 percent in different size groups. Bullock labour expenditure was about 30 percent of total cost of cultivation. Seed expenses was 23 percent of the total cost of production.

Thus these inference can be drawn from the above observations.

(i) In case of green gram human labour expenses occupied first place estimating more than one third of the total expenses.

(ii) Large size farms expensed more for seeds and bullock labour whereas small farms accounted more for human labour.

(iii) Fertilizer, manures and pesticides were not used for raising this crop.

(iv) Tube well irrigated farms and canal irrigated farms did not grow this crop due to its low productivity. The unirrigated farms had grown this crop with the retained moisture of the soil after the harvest of Kharif crop.

(iii) POTATO:-

Potato was found to be grown only in irrigated farms.

(i) One of the important and exceptional characteristics of this crop was marked that seed expenses were highest among all the items of expenditure in potato cultivation irrespective of size groups and irrigation system. In all other crops we have observed that the human labour expenditure ranked first in their respective cost structures.

(ii) In case of potato, human labour expenses ranked second position followed by fertilizer and plant protection material.

(iii) The average total cost in canal irrigated farms for this crop was more than that of tube well irrigated farms due to the fact that canal irrigated farms during rabi season growing less number of crops than tube well irrigated farms thus diverting more attention towards potato crop

(iv) HIGH YIELDING VARIETIES OF PADDY (Summer):-

As we know high yielding varieties is widely grown in irrigated in summer season due to its non-photo-synthetic nature. But we have already seen in the cropping pattern study that in Khandapara area the H.Y.V of paddy was not grown in tube well irrigated farms during summer. Only it was grown in canal irrigated farm in the area under investigation since the farmers of tube well irrigated farms liked to invest in summer vegetable cultivation in place of H.Y.V paddy with an expectation of higher return.

TABLE - 22

Item wise cost of production of potato per acre in Khandapara area during 1972-73

Items	Unirrigated	Canal irrigated				Lift irrigated			
		I	II	III	Average	I	II	III	Average
1. Seeds		550.0	562.94	562.75	571.89 (44.42)	540.00	562.21	570.0	557.40 (43.85)
2.(a)Manures		40.0	45.0	51.72	47.24 (3.75)	40.00	43.97	45.0	44.65 (3.51)
(b)Fertilizers.		120.0	122.35	143.79	128.37 (10.63)	140.00	156.35	183.33	159.82 (12.57)
3.Plant protection.	not grown.	50.0	58.62	73.44	60.42 (4.80)	844.00	45.97	45.0	44.32 (3.48)
4.Labour									
(a)Human labour		360.5	331.76	341.37	344.37 (26.55)	353.00	320.47	315.0	335.49 (26.39)
(b)Bullock labour.		60.0	64.5	65.84	63.45 (4.76)	57.60	68.63	65.00	59.07 (1.64)
5.Irrigation		24.0	26.82	25.86	25.56 (1.55)	31.00	33.22	43.33	34.18 (2.68)
6.Misc.Cost. (Repair, interest, depreciation and rental value etc.)		36.0	35.29	52.93	41.74 (3.95)	36.00	25.83	36.66	36.16 (2.84)
		1240.5	1229.48	1326.86	1283.04 (100)	1241.60	1256.65	1293.22	1271.09 (100)

Coming to the expenditure analysis, it was found out that human labour expenditure, ranked first position accounting for 35 percent of the total cost. In various size of farms it varied from 34 to 38 percent.

Fertilizer expenditure ranked second accounting 20 percent of the total cost. Bullock labour expenditure came next to the fertilizer, accounting almost 17 percent. Insecticide and pesticides materials accounted to be 8 percent of the total cost.

TABLE-23

Item wise cost of production of H.V.paddy (summer) per acre in Khandepara area 1972-73

Items	(Amount in rupees)				Lift irrigated.	Unirrigated
	I	II	III	Average		
1. Seeds	26.33 (3.60)	32.0 (4.26)	32.92 (4.44)	30.41 (4.10)		
2(a) Manures	49.00 (6.52)	48.0 (6.40)	42.46 (6.06)	46.82 (6.30)		
(b) Fertilizers	133.33 (18.43)	152.00 (20.27)	155.40 (20.90)	145.11 (19.87)		
3. Plant protection	57.66 (8.21)	60.00 (8.00)	60.00 (8.36)	59.22 (8.22)		
4. Labour					Not grown	Not grown
(b) Human labour	277.00 (38.32)	256.00 (33.81)	265.00 (35.53)	269.00 (35.49)		
(b) Bullock labour	120.00 (16.58)	129.60 (17.28)	132.00 (18.39)	129.20 (17.41)		
5. Irrigation	23.33 (3.22)	24.50 (3.20)	23.07 (3.21)	23.46 (3.21)		
5. Misc. cost (Repair, interest, depreciation and rental value etc.)	36.66 (5.06)	30.00 (4.33)	37.61 (5.84)	34.42 (4.45)		
	723.33 (100)	739.60 (100)	737.69 (100)	733.53 (100)		

(v) SUGAR CANE (Year round crop)

Per acre estimated cost of cultivation of sugar cane with its break up has been shown in table-24. It appears that the cost of cultivation not only varied from one farm size to other but also varied from one irrigation condition to the other.

The estimated figures of the total cost of cultivation of sugar cane were Rs.1592/- and Rs.1674/- in lift irrigated and flow irrigated condition respectively. In other words, the investment in sugarcane cultivation was more in flow irrigated farms than that of tube well irrigated farms.

The break up of cost components indicates that there was significant difference in the expenditure on fertilizer between flow and lift irrigated farms (Rs.246/- in lift irrigated farm and Rs.277/- in canal irrigated farm). The irrigation expenditure was also higher in canal irrigated farms compared to lift irrigated farms (Rs.64/- in lift irrigated farm and Rs.81/- in canal irrigated farm). In case of seed, pesticides, human labour and bullock labour the expenditure was almost same in both the irrigated situations.

From investigation it was cleared that the farms in canal irrigated area took much interest in sugar cane cultivation than the farmers in lift irrigated area. In lift irrigated area most of the sample farmers were concentrating their efforts towards vegetable cultivation at the cost of other crops.

TR - 604

TABLE 24

Item wise cost of production of Sugarcane in Khandapara area during 1972-73
(Amount in Rupees)

Items	Unirrigated			Lift irrigated			Canal irrigated			Average	I	II	III	Average
	I	II	III	I	II	III	I	II	III					
1. Seeds	155 (9.91)	160 (10.41)	160.71 (9.86)	160.24 (10.06)	160 (9.97)	161.11 (9.29)	160 (9.97)	160 (9.50)	161.11 (9.29)	160.37 (9.57)				
2. (a) Manures	120 (7.43)	110 (7.16)	107.14 (6.57)	112.38 (7.05)	120 (7.48)	155.55 (8.97)	120 (7.48)	120 (7.13)	155.55 (8.97)	131.85 (7.87)				
(b) Fertilizers.	250 (15.49)	220 (14.32)	267.85 (16.44)	245.25 (15.44)	240 (14.96)	305.55 (17.62)	240 (14.96)	285.71 (16.97)	305.55 (17.62)	277.08 (16.54)				
3. Plant protection.	40 (2.97)	40 (2.60)	51.78 (3.17)	43.92 (2.75)	40 (2.49)	50.55 (3.10)	40 (2.49)	43.14 (2.59)	50.55 (3.10)	44.56 (2.66)				
4. Labour (a) Human labour.	785 (48.34)	750 (48.82)	772.14 (47.02)	770.17 (48.39)	785 (48.62)	781.33 (45.19)	785 (48.62)	780 (46.34)	781.33 (45.19)	781.11 (46.65)				
(b) Bullock labour	120 (7.43)	120 (7.81)	127.85 (8.23)	119.28 (7.48)	108 (6.73)	120.66 (6.73)	108 (6.73)	116 (7.13)	120.66 (6.73)	114.86 (6.86)				
5. Irrigation	66.66 (4.13)	64 (4.16)	62.50 (3.83)	64.38 (4.04)	80 (4.98)	83.33 (4.86)	80 (4.98)	80 (4.75)	83.33 (4.86)	81.11 (4.84)				
6. Misc. cost (Repair, interest, depreciation and rental value etc.)	76.66 (4.75)	72 (4.68)	78.57 (4.82)	75.74 (4.75)	71 (4.73)	55.22 (4.26)	71 (4.73)	97 (5.55)	55.22 (4.26)	83.40 (4.98)				
	1613.32 (100)	1536 (100)	1628.54 (100)	1592.60 (100)	1604 (100)	1733.30 (100)	1604 (100)	1682.85 (100)	1733.30 (100)	1674.36 (100)				

(Figures in parenthesis indicate the percentage).

Irrigation and Yield of different crops:-

In farm business analysis, productivity per unit area is considered as one of the important measures of farm efficiency. Due to its usefulness in farm business decision, productivity of land is widely used in farm economics studies.

Productivity relating to other crops could not be compared as the cropping pattern between irrigated and unirrigated conditions were not common excepting local paddy.

Table-25 indicates that while yield rate of local paddy was varying from 7.3 to 8.85 quintals per acre in unirrigated area, it was varying from 9.03 to 11.00 quintals per acre in irrigated areas. However between irrigated farm flow irrigation performed better than lift irrigated conditions. From this it can be concluded that irrigation input has a positive influence on the productivity of land.

It was further observed that Kharif H.Y. Paddy, Groundnut and Wheat gave better yield in tube well irrigation than canal irrigated area. But sugar cane and Potato gave better yield in canal irrigated area.

Large size farms observed to be receiving higher yield than small farms in all conditions.

TABLE- 25

Yield of main products per acre of different crops in different areas according to size of holding (Yield in Quintals)

Size group	Unirrigated				Lift irrigated				Canal irrigated			
	I	II	III	Average	I	II	III	Average	I	II	III	Average
1. Local Paddy	7.3	8.4	8.85	8.18	9.03	9.25	9.98	9.42	9.11	10.06	11.00	10.59
2. H.Y.V. Paddy (Kharif)	-	-	-	-	15.8	16.2	16.5	16.16	14.0	18.0	19.66	17.22
3. H.Y.V. Paddy (Summer)	-	-	-	-	-	-	-	-	20.1	20.65	22.5	21.08
4. Green gram	1.85	1.94	2.10	1.93	-	-	-	-	-	-	-	-
5. Black gram	1.60	2.36	2.46	2.14	-	-	-	-	-	-	-	-
6. Ground nut (Kharif)	-	-	-	-	-	-	9.03	9.03	-	-	-	-
7. Groundnut (Summer)	-	-	-	-	-	9.20	8.72	8.96	-	-	-	-
8. Potato	-	-	-	-	48.05	51.50	53.52	51.02	50.0	52.72	53.74	52.15
9. Sugarcane	-	-	-	-	35.0	36.66	39.20	36.95	32.81	39.88	41.00	37.89
10. Wheat	-	-	-	-	8.2	8.50	8.44	8.38	7.33	7.35	8.34	7.67

Comparative cost and returns of different crops:-

Table-26 given a comparative basis to show a clear cut idea about the crops grown in different farm conditions under the study. The table shows the per acre total cost of cultivation, gross income, net profit for all most all crops grown by the sampled farms.

Only local paddy was grown in all the sampled farms. It was observed that not only its total cost of cultivation was lowest in unirrigated area but also gross returns and net profits were lower than tube well and canal irrigated farms. The net profit per acre was Rs.218/-, Rs.251/- and Rs.310/- in unirrigated area, tubewell irrigated area and canal irrigated area farms respectively.

Excluding local varieties of paddy ragi, khesari, blackgram and green gram were grown in unirrigated farms of which total cost of cultivation varied from Rs.951/- to Rs.342/- giving a net profit lowest in khesari estimating Rs.140/- to highest in ragi accounting Rs.219/-.

In tubewell irrigated area sugarcane, groundnut, H.V.V. Paddy, wheat, ragi etc. were grown, the total cost of cultivation of which varied from lowest in ragi (Rs.340/-) to highest in sugarcane (Rs.1593/-). Excluding ragi and local paddy these crops fetch gross income to farmers more than Rs.900/- up to Rs.3926/- in different crops as shown in the Table-26. Highest net profit Rs.2335/- per acre was obtained from sugarcane. Even in some crops like summer and winter

TABLE-26

Total cost of cultivation, gross income and profit per acre of main crops under different sources of irrigation.

...

(Amount in rupees)

Crops.	Unirrigated			Tube well irrigated			Canal irrigated		
	T.C.C.	G.I.	N.P.	T.C.C.	G.I.	N.P.	T.C.C.	G.I.	N.P.
Local paddy	387.37	605.25	217.88	419.51	670.73	251.22	455.71	765.25	309.54
H.Y.V. Paddy (Kharif)	-	-	-	603.28	1114.38	511.10	606.89	1190.95	584.06
H.Y.V. Paddy (Summer)	-	-	-	-	-	-	733.53	1407.30	673.77
Wheat	-	-	-	470.41	904.10	433.69	472.81	800.00	327.19
Sugarcane.	-	-	-	1592.60	3926.46	2335.29	1674.36	4073.07	2398.71
Groundnut (Kharif)	-	-	-	493.54	1207.52	713.98	508.00	1180.00	672.00
Groundnut (Summer)	-	-	-	-	-	-	499.55	1125.0	625.45
Ragi	342.60	552.00	219.40	340.00	565.00	225.00	339.42	543.16	203.74
Khesari	97.28	237.51	140.23	-	-	-	-	-	-
Potato	-	-	-	1258.98	2135.50	876.57	1271.09	2185.85	914.76
Winter Vegetables.	-	-	-	624.03	1631.57	1007.54	664.0	1440.00	776.00
Summer Vegetables.	-	-	-	703.00	1750.00	1047.00	-	-	-
Black gram	94.75	253.80	159.05	-	-	-	-	-	-
Green gram	114.74	295.00	180.26	-	-	-	-	-	-

T.C.C. - Total cost of cultivation.

G.I. - Gross Income.

N.P. - Net Profit.

vegetables the net profits were more than total cost of cultivation of the crops. The lowest net profit per acre of ragi was even higher than the highest net profit of local paddy under unirrigated farms. This shows the clear cut difference of crops under unirrigated and tubewell irrigated farms.

Under canal irrigation the total cost of cultivation per acre varied ranging lowest Rs.456/- for local paddy to Rs.1674/- for sugarcane. The gross income to H.Y.V.paddy(Kharif), H.Y.V.Paddy(Summer), wheat, sugarcane, ground nut, potato, winter vegetables, and local paddy were Rs.1190/-, Rs.1407/-, Rs.800/-, Rs.4073/-, Rs.1180/-, Rs.2185/-, Rs.1440/- and Rs.765/- respectively. These are much more higher than any crop grown under unirrigated condition. The net profit per acre of any crop observed much more higher than the unirrigated farm crops.

Therefore these estimates help us to conclude that not only capital intensive crops were grown in irrigated area but also these crops fetch higher gross return and more net profit per acre to farmers. Thus impact of irrigation observed that, it replaced less remunerative crops and introduced highly remunerative crops in irrigation farms.

-Comparative position of different crops:-

Table-27 shows the rank of the crops grown by sampled house holds according to maximum per acre total cost of cultivation, gross income and net profit to crops.

This table has been derived from the Table-26 from this table in a birds eye-view one can know the position of the crop, under which it has been analysed.

As the table shows, local paddy carried highest rank in unirrigated farms where as ninth rank in canal irrigated farms in each respect of our study. Its rank in lift irrigated farms became XIII for total cost of cultivation, XV for gross income and XVI for net profit.

Sugar cane found to be in First rank under both canal and tube well irrigated farms. This showed that the total cost of cultivation of this crop highest and gross income and net profit received from this crop were highest.

In all these respect potato ranked Second under both tube well and canal irrigated farms.

Other crops could not hold the same rank in all respects. Their position can be observed easily from the table. Ragi and local paddy were less remunerative crops under tube well and canal irrigated farms.

-Irrigation and cost of production per quintal of some of important crops:-

The over leaf Table-2B reveals that the cost of production per quintal of paddy (local) under irrigated and unirrigated condition had significant difference. The cost of production was less per quintal in irrigated farms. The production from same unit of land was also more in irrigated area. So indirectly by reducing the cost of production per quintal it helps to check

the rise of price in the market. The cost of production in case of other crops were also much more lower then the prevailing market price. Therefore irrigation indirectly can help to bring down the price in the market.

TABLE-28

Cost of production per quintal of some important food crops.

Crops.	Source of irrigation	Yield per Ac. (in Quintal)	Total cost of production (in Rs.)	Cost of production per quintal (in Rs.)
1. Local Paddy.	U.I.	8.15	404.37	49.53
	T.W.I.	9.42	438.51	46.56
	C.I.	10.59	450.16	42.58
2. H.Y. Paddy (Kharif).	T.W.I.	16.16	651.28	40.33
	C.I.	17.22	657.89	38.24
3. H.Y.V. Paddy (summer)	C.I.	21.08	775.53	36.79
4. Sugarcane.	T.W.	36.95	1702.60	48.10
	C.I.	37.89	1788.36	51.19
5. Potato.	T.W.	51.02	1379.09	26.92
	C.I.	52.15	1387.04	26.60
6. G. Gram.	U.I.	1.93	123.74	64.45
7. B. Gram.	U.I.	2.14	113.35	48.24
8. G. Nut.	T.W.	9.20	498.72	54.25
	C.I.	8.29	519.78	62.76
9. Wheat.	T.W.	8.38	487.51	58.13
	C.I.	7.67	488.81	63.64

T.W. = Tube well irrigated.
C.I. = Canal irrigated.
U.I. = Un irrigated.

(E): IRRIGATION AND INCOME FROM FARMING:-

MEASURES OF FARM PROFITS:

Gross Expenditure:-

Gross expenditure for crop production or total cost of cultivation per acre will give an idea about the influence of irrigation in changing investment pattern in different conditions of farming.

TABLE-29

Relative Gross Expenditure per acre per annum among various size groups of holding under different region.

...

Size group	(Amount in rupees)		
	Unirrigated	T.W. irrigated.	Canal irrigated.
I	462.31	1889.73	1937.97
II	493.39	1890.97	2009.97
III	515.93	1989.36	2060.81
Average	490.54 (100)	1923.35 (392.08)	2002.91 (408.30)

Analysis of Variance:-

Source of variation.	D.F.	S.S.	M.S.	F.S.
1. Among areas.	2	19835642	9917821	280.17 **
2. Among size groups within the area.	6	212391	35398	2.85 *
3. Error between observation of each holding.	36	642628	16184	
Total.	44	20990661		

$$F_{0.05}(2,6) = 3.14$$

$$F_{0.05}(6,36) = 2.36$$

** Highly significant

* Significant.

Table-29 indicates the higher expenditure in irrigated farms. This might be due to two reasons:-

(i) Adoption of more remunerative crops and (ii) Higher crop intensity. Since the high yielding varieties of paddy were grown in canal irrigated farms the cost of cultivation was higher in these farms compared to tubewell irrigated farms where the high yielding varieties of paddy were not grown during summer. In irrigated farms the cost was almost four times than that of unirrigated farms.

Gross Income:-

Gross income is one of the measure to study farm efficiency. Gross income varies with price fluctuations and weather incertainty. Gross income analysis is done with a view to study the influence of irrigation for changing income.

TABLE-30

Relative gross income per acre under different conditions of irrigation.

(Amount in rupees)

Size group	Unirrigated	T.W.irrigated.	Canal irrigated.
I	695.28	3598.26	3488.69
II	761.51	3710.31	3607.83
III	799.31	3931.36	3824.89
average.	752.22 (100)	3746.46 (498.05)	3607.13 (479.53)

Analysis of variance:-

Source of variation.	D.F.	S.S.	M.S.	F.S.	
1.Among areas.	2	86764239	43382119	294.70	**
2.Among size group within area.	6	883216	147202	6.54	*
3.Error between observation of each holding.	36	809935	22498		
Total.	44	88457391			

** Highly significant

* Significant.

Table-30 reveals that there is wide difference between gross income of farms under unirrigated and irrigated conditions. The gross income of tube well farms were highest accounting for Rs.3746/- per acre. In case of canal irrigated farms the gross income was Rs.3607/- per acre where as in unirrigated farms it was Rs.752/- per acre. Thus due to provision of irrigation facility gross income per acre increased by more than four times. The analysis of variance conforms this finding.

Net Profit:-

"Per acre net profit" is one of the true indicator to measure the farm efficiency. However the net profit of a farm is not static. It is influenced by the rise of price and bumper harvest owing to favourable monsoon. For sample region, the result may be described as a standard measurement of their annual income as the year under study was a normal year.

TABLE-31

Relative net profit per acre in different regions.

Size group.	(Amount in rupees)		
	Unirrigated.	T.W.irrigated.	Canal irrigated.
I	232.97	1708.53	1550.72
II	268.12	1819.34	1597.86
III	383.96	1942.00	1764.08
Average.	261.68 (100)	1823.29 (696.76)	1637.88 (625.90)

Analysis of variance :-

Source of variation.	D.F.	S.S.	M.S.	F ₀	
1.Among areas.	2	23770846	11885423	76.45	**
2.Among size groups within area.	6	932684	155447	64.90	*
3.Error between observation of each holding.	36	86215	2394		
Total.	44	24789745			

** Highly significant

* Significant.

The Table-31 reveals that there exists wide difference between farms of different regions. The test of significance also reveals that there is significant difference between farms of unirrigated, tube well irrigated and canal irrigated farms from the table it is clear that the net profit per acre was about Rs.1823/- in tube well irrigated farms Rs.1637/- in canal irrigated farms and only Rs.262/- in unirrigated farms. The highest net profit in tube well irrigated farms might be due to controlled irrigation and growing up of remunerative vegetable crop in these farms. Thus irrigation had great impact to increase net profit per acre which was around seven times than the unirrigated farms. The statistical analysis has also confirmed the significance of variation between irrigated and unirrigated farms and between two sets of irrigation. Irrespective of conditions of irrigation large farms received more net profit. Due to interaction of manure, fertilizer and cropping pattern the higher size farms received highest net profit.

(iv) Family labour wages:-

The Table-32 shows that the family labour wages could increase by 268.76 percent in tube well irrigated farms and 257.59 percent in canal irrigated farms over the family labour wages in the unirrigated farms.

Irrespective of conditions of irrigation family labour wages were highest in lower size group where as bullock labour

TABLE-32

Family labour wages per acre for different size of farms.

Size group	Unirrigated		Tube well irrigated		Canal irrigated	
	Human labour	Bullock labour	Human labour	Bullock labour	Human labour	Bullock labour
I	240.57	63.0	303.57	706.95	138.0	844.95
II	192.08	68.0	280.08	625.89	145.0	770.89
III	168.15	108.0	276.15	540.69	180.0	720.69
Total	600.80	236.00	859.80	1873.53	433.00	2306.53
Average	200.23	85.33	287.06	624.51	144.33	768.84
			(100)			(268.76)
						(257.59)

(Number in parenthesis indicate percentage)

wages were lowest in this size group. This might be due to more concentration of family labour in their small patch of land by small farmers and the bullock labour use in large size holding was more as they tamed more pairs of bullock than smaller size farms.

(v) Family labour income:-

Family labour income provide an indication of extent of utilisation of family labour(bullock and human labour) of the family. Per acre family labour income used as a measure of farm efficiency.

Table-33 revealed that per acre family labour income in irrigated farms almost four times than unirrigated farms. It was around Rs.2588/- under tube well irrigated farms and Rs.2375/- in canal irrigated farms where as only Rs.588/- in unirrigated farms. It was higher under irrigated farms due to the year round employment of family members in the farm, operations, greater intensity of cropping and introduction of labour intensive crops.

Per farm family labour income found out more than three times under irrigated farms than unirrigated farms. It was highest per farm under lift irrigated condition accounting Rs.10,784/-. It increased in all conditions as the farm size increased. Thus irrigation increased family labour income to a great extent.

TABLE- 33

Family labour income per acre and per farm in Khandapara area during 1972-73.
(Amount in Rupees)

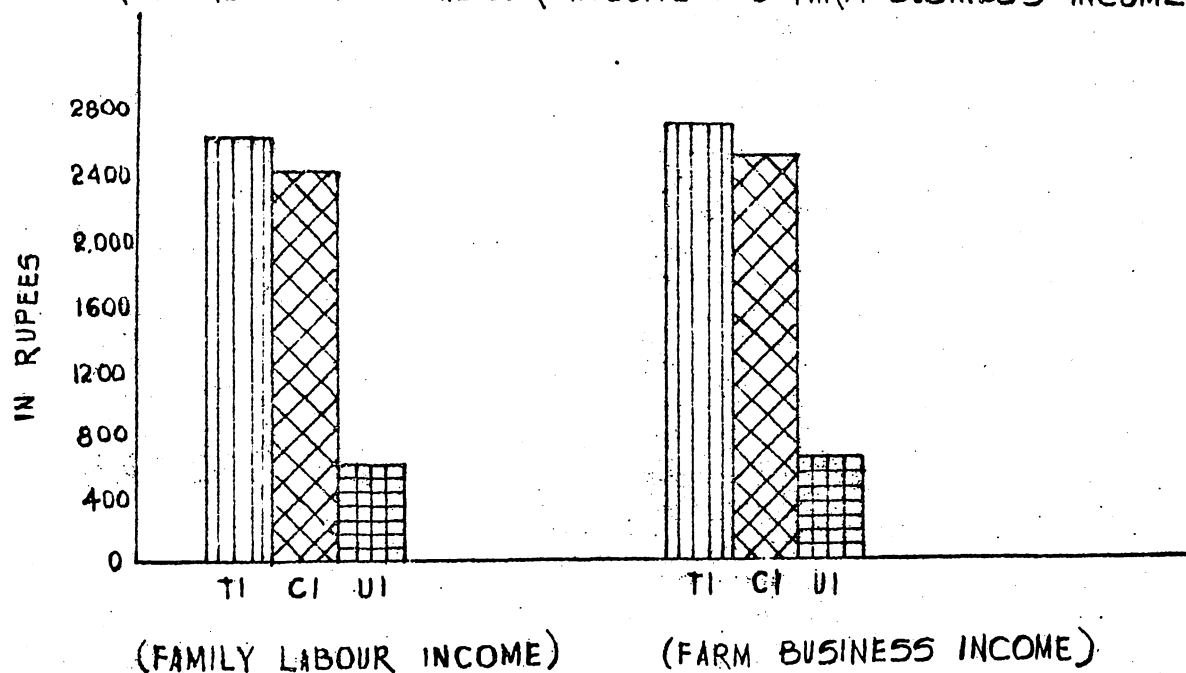
Size group	Unirrigated		Tubewell irrigated		Canal irrigated	
	Per acre	Per farm	per acre	per farm	per acre	per farm
I	536.54	1072.41	2525.48	4819.84	2270.84	4768.76
II	548.20	2258.58	2590.23	9480.24	2373.45	9683.67
III	680.11	5610.90	2662.69	18053.03	2480.28	14906.48
Average	582.28 (100)	2960.63 (100)	2585.00 (440.67)	10784.37 (361.81)	2374.85 (404.38)	9786.30 (328.32)

TABLE- 34

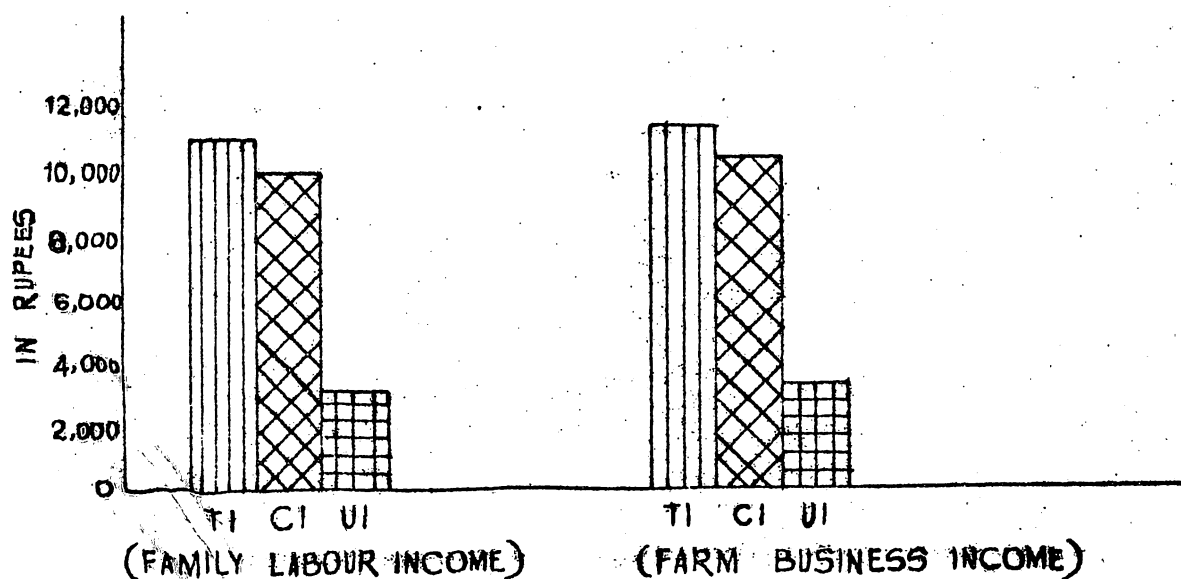
Farm business income per acre and per farm in Khandapara area during 1972-73.
(Amount in Rupees)

Size group	Unirrigated		Tubewell irrigated		Canal irrigated	
	per acre	per farm	per acre	per farm	per acre	per farm
I	545.66	1096.77	2561.59	4892.63	2339.17	4912.25
II	566.39	2333.52	2644.68	9679.52	2453.73	10011.21
III	700.77	5781.35	2720.60	18445.66	2549.11	15320.15
Average	604.27 (100)	3070.54 (100)	2642.29 (437.26)	11005.93 (358.43)	2447.33 (405.00)	10081.20 (328.32)

PER ACRE FAMILY LABOUR INCOME AND FARM BUSINESS INCOME



PER FARM FAMILY LABOUR INCOME AND FARM BUSINESS INCOME



TI - TUBE WELL IRRIGATED FARM

CI - CANAL IRRIGATED FARM

UI - UN IRRIGATED FARM

(vi) Farm business income:-

Farm business income is a measure of farm profit which includes interest on working capital together with family labour income.

Table-34 reveals that the farm business income per acre in irrigated farms was almost four times than that of unirrigated farms. It was due to similar cause, as the net profit and family labour income were more.

Due to irrigation facility farm business income in irrigated area on an average increased more than three and half times than that of the unirrigated area. Thus it conferred that the irrigation facility increased the economic condition of the people to a great extent and it was higher under lift irrigated farms than the flow irrigated farms.

-Irrigation and Regional Disparities:-

The study further brought out that irrigation input acts as a catalyst in accentuating the already existing disparities of income between regions. The disparities in income between irrigated and unirrigated regions is complex of several imbalances. The imbalances can be seen with respect to productivity of land, productivity of labour as well as productivity of capital. The favourable points that we have so far noticed in this study of the irrigation economics such as (i) high crop intensity (ii) inclusion of high value crops in the cropping pattern (iii) intensive use of labour and

capital inputs (iv) timely operations and finally (v) reduction of weather uncertainties to a considerable extent influence the factor productivities to increase in irrigated farms which accentuates regional imbalances. From table-34 it can be seen that the provision of irrigation facility in one farm or other would increase the net product of the farm by seven to eight times. One should not be confused mere irrigation influences the farm return to this extent, but this happens due to strong and positive interaction among irrigation, fertilizer and high yielding seeds, while they are used combinidly. Since irrigation stands as a pre-condition for the use of fertilizer and high yielding seeds, the income disparities would therefore largely mean as an affect of irrigation.

Farm management studies conducted in India during fifties and early sixties did not show the income disparities to such a large extent between irrigated and unirrigated areas. The impact of irrigation was mainly visualised through the reduction of weather uncertainty and consequent increase in crop yield or farm income. There was not much difference in the use of crop inputs between irrigated and unirrigated farms. Therefore the impact of irrigation was not so conspicuous. However, during late sixties the introduction of high yielding varieties programme and inter related strategic factors in our farming system made a significant impact only under irrigated condition. In absence of dry or unirrigated land technology,

the creation of irrigation potential in a few regions unfortunately accentuated the problem of regional disparities.

From the point of view of regional disparities it does not mean that irrigation should be given less priority. Rather to make a break through in subsistence rice economy to commercialised rice economy irrigation potential has to be geated up. But at the same time, efforts should be directed towards improving the dry land technology and creating supplementary occupations like dairy, poultry, piggery etc. in the unirrigated tracts.

TABLE-35

Input output ratio per acre in different irrigated farms.

Size group.	I	II	III	Average.
<u>Unirrigated:</u>				
Input.	462.31	493.39	515.93	490.54
Output.	695.28	761.51	799.81	752.22
Ratio.	1:1.50	1:1.54	1:1.55	1:1.53
<u>Tube well irrigated:</u>				
Input.	1889.73	1890.97	1989.36	1923.25
Output.	3598.26	3710.31	3931.36	3746.46
Ratio.	1:1.90	1: 1.96	1:1.97	1:1.94
<u>Canal Irrigated:</u>				
Input.	1937.97	2009.97	2060.81	2002.91
Output.	3488.69	3607.83	3824.89	3607.13
Ratio.	1:1.80	1:1.79	1:1.85	1:1.80

Input output relations of different farms:-

The above Table-35 illustrates the nature of distribution of input output per acre among different size groups and shows the extent of net profit per acre.

It is seen that both the input, output per acre and input output ratio are maximum in tubewell irrigated farms. It is 1:1.94 in tubewell irrigated farms where as only 1:1.53 in unirrigated farms. The higher input output ratio might be due to the high productivity of irrigated land coupled with high raised remunerative crops under such condition.

It is also seen that irrespective of conditions of irrigation higher size group achieved higher input output ratio. It was due to the more and better use of factors of production by higher size farms.

Irrigation and return to human labour:-

Return per human labour day as estimated in the above Table-36 confirms as that impact of irrigation increased the average return to labour. It was observed that while only Rs.6/- was the return per labour under unirrigated condition it was more than Rs.10/- in both the irrigated conditions. However, average return to labour day in tubewell irrigated area was maximum. Return to labour day was found to be positively correlated with the size of farm.

TABLE- 36

Return per labour day in different size groups under different conditions of irrigation

(Amount in Rupees)

Size group	Farm situations	Gross return per acre	T.V.C. of all inputs except human labour.	Gross revenue due to labour	Total labour days per acre in days	Return per labour day.
I	Unirrigated	695.28	219.16	476.12	81.05	5.87
II	-do-	761.51	264.34	497.17	76.35	6.51
III	-do-	799.81	305.36	494.45	70.19	7.03
Average	-do-	752.22	262.96	489.26	75.86	6.44
I	Tube well irrigated.	3598.26	1174.02	2424.24	238.57	10.16
II	-do-	3710.31	1166.08	2544.23	241.63	10.52
III	-do-	3931.36	1222.44	2708.92	255.64	10.59
Average	-do-	3746.46	1194.57	2551.89	242.93	10.50
I	Canal irrigated.	3488.69	1246.35	2242.34	230.54	9.72
II	-do-	3607.83	1352.88	2254.95	219.03	10.29
III	-do-	3824.89	1417.67	2407.22	214.38	11.22
Average	-do-	3607.13	1338.98	2268.15	221.31	10.24

CHAPTER VI
BENEFIT COST ANALYSIS

CHAPTER - VI

BENEFIT COST ANALYSIS

IRRIGATION INFRASTRUCTURE:

Kusumitada tube well point was energised during nearly part of 1968. The total expenditure for the establishment of the point was Rs.10,260/-. Though the planned potential of this point was to command an ayacut area of 30 acres actually it commands an area of 20 acres of land through out the year. It is one of the representative tube well points of Khandapara area.

Sunamuhin minor irrigation project :-

This is the biggest minor irrigation project in Khandapara area. It's construction work was completed within 1966. It was put to operation during 1966-67 agricultural year. The total expenditure in this project was about Rs.16,27,800/-. The ayacut area of the project is about 1600 acres during Kharif season and 300 acres during Rabi season and Summer seasons. The potential area of this project is fully utilised.

Benefit cost analysis :-

In this section we have planned to study the economic significance of minor irrigation projects, including ground water exploitation schemes by means of benefit cost analysis. However, only direct costs and direct benefits relating to these irrigation projects have been taken into consideration and no indirect costs as well as indirect

benefits have been taken into account while assessing the benefit cost ratio. The indirect costs and benefits have been eliminated from this study with a view to make the analysis as realistic as possible. Because during the course of investigation it was observed that the irrigation projects have been utilized only for the purposes of crop husbandry and not for any other uses. Moreover, there is no such plans to utilise water resources in other fields both agriculture and non-agriculture in near future.

In order to carry out this analysis 'with' and 'without' approach was followed instead of 'before' and 'after' approach since the former is considered as superior method over the latter. Moreover, there was no benchmark survey for the present irrigated area to go for the second method of evaluation.

Benefit cost analysis has been worked out separately for tubewell irrigation projects and canal irrigation project in order to compare the relative efficiency of these productive schemes. In case of Kusumitade lift irrigation point two sets of estimates have been made, one for the utilised capacity of the project and the other for the full potential of the project, since it is expected that the project resource will be fully utilised soon.

Primary direct benefits:-

The primary benefit of irrigation has been estimated in terms of additional output obtained from land due to assured water supply. For this estimation, the unirrigated farm productivity has been taken as "control".

The additional benefit and additional costs due to irrigation projects are given in the following tables:-

TABLE-37

Gross farm output and inputs: (T.W. irrigation project)

OUTPUT

(i) With tube well irrigation for 20 acres "R"	77,024/-
(ii) Without tubewell irrigation. --- "R"	15,044/-
(iii) Additional output due to tubewell irrigation	
or	
Additional benefit B= (R-R') ...	61,980/-

INPUT

(i) With tubewell irrigation 'T'	39,010.80
(ii) Without tubewell irrigation ... "T" ...	9,810.80
(iii) Additional input due to tubewell irrigation A=(T-T') ...	29,200.00

TABLE-38

Additional benefit and costs due to canal irrigation (Sunamahi M.I.P)

OUTPUT

(i) With canal irrigation kharif (1600 acres) ...	25,18,400/-
(ii) With canal irrigation Rabi & Summer for (300 acres) ...	6,33,939/-
Total, R	31,52,339/-
(i) Without canal irrigation kharif (1600 acres)	10,33,200/-
(ii) Without canal irrigation Rabi & Summer (300 Ac)	55,941/-
Total "R" ...	10,89,141/-
Additional benefit =B= (R-"R") ...	20,63,198/-

INPUT

(i) With canal irrigation kharif (1600 Ac.) ...	11,66,464/-
(ii) With canal irrigation Rabi & Summer (300 Ac.)	3,54,221/-
Total "T" ...	15,20,685/-
(i) Without canal irrigation Kharif (1600 Ac.)	6,21,520/-
(ii) Without canal irrigation Rabi & Summer (300 Ac.)	3,087/-
Total "T'" ...	6,24,607/-
Additional input A=(T-T')	8,96,178/-

Annual cost of the projects:-

Annual cost to the project includes both the variable costs and fixed costs of the project fixed cost includes depreciation, interest, repair and maintenance etc. of the project where as variable cost includes the cost of consumed electricity and operational expenses.

Cost structure of Sunamuhin minor irrigation project during 1972-73.

Fixed cost:-

(i) Annual depreciation @ 4 percent	...	Rs. 65,112/-
(ii) Interest on total cost of the project at @ 9 percent on average capital (16,27,800)		Rs. 73,251/-
(iii) Staff pay and project repair	...	Rs. 35,000/-
	F =	Rs. 1,73,363/-

Variable cost:-

(iv) Maintenance for irrigation system *V* =	Rs. 3,200/-
Total *C* =	Rs. 1,76,563/-

Cost structure of Kusumitada tube well point during 1972-73.

Fixed cost:-

(i) Tube well	...	Rs. 244.48
(ii) Centrifugal pump.	...	Rs. 448.75
(iii) Electrical wiring.	...	Rs. 149.50
(iv) Distribution system...	...	Rs. 598.00
	F =	Rs. 1,440.73

Variable cost:-

(v) Cost of electricity consumption.	...	Rs. 907.65
(vi) Operation cost (One operator for one pump)	...	Rs. 2100.00
	V =	Rs. 3007.65

Total cost 'C' = F + V = Rs. 4,448.38
say... Rs. 4,450.00

* Details of cost structure and expenditure given in Appendix-II.

TABLE-39

Per Acre investment:- (Amount in rupees)

Kind of irrigation project.	Total investment in the project. (in rupees)	Gross cropped area during the year (in acre)	Invest/Acre. (in rupees)
1. (a) Tube well irrigation (Kusumitada)	10,260	90	114.00
(b) -do-	10,260	60	171.00
2. Sunamshin minor Irrigation Project.	16,27,800	2,200	739.90

The findings per acre in case of flow irrigation project investment was Rs.740/- while it came to Rs.17.00 in case of lift irrigation project with its actual utilisation capacity at present level. Had the lift irrigation point been fully utilised to its potential the investment per acre would have fallen from Rs.17.00 to Rs.114.00 only. From the investment point of view for a economically backward state like ours, tube well irrigation scheme seems to be more desirable than minor irrigation projects.

TABLE -40

Benefit cost ratio study :- $\frac{B}{C} = B$

Kind of irrigation project.	(Amount in rupees)						B/C ratio
	Total additional output due to irrigation from farming 'B'	Total additional cost due to irrigation for farming. 'A'	Amount fixed cost 'P'	Annual variable cost 'V'	Total cost A+P+V=C		
1. Tube well with 20 Ac. ayacut.	61,980	29,200	1440.73	3007.65	33648.38	1.841	
2. Tube well (when 30 Ac. ayacut.	92,970	43,800	1440.73	3,462	48702.00	1.908	
3. Minor irrigation project (Sunamshin)	20,93,198	8,96,178	173363	3,300	20,72,741	1.951	

Of course the investment criteria is not the only criteria to judge the merit of a project. As such, the investment decision does not rest on the size of investment alone. As we know large size out lay might be associated with large scale operation resulting large scale economy the estimation of Benefit cost is therefore considered more useful tool among decision making indicators than many others. Keeping this in view benefit cost ratios, were estimated. Table-40 presents the estimated values of benefit cost ratios. Under this condition the minor irrigation project made a $\frac{B}{C}$ ratio of 1.95 and the lift irrigation project made a ratio of 1.84 for the utilised capacity and another $\frac{B}{C}$ ratio of 1.91 for the full capacity of the project. It may be concluded that the economic benefit is slightly more in minor irrigation project than lift irrigation project under the given condition. However, since the $\frac{B}{C}$ ratio for these two projects were fairly close to each other, other decision criteria should be considered in this situation to judge the superiority of one with respect to other.

TABLE -41

Rate of return of the project = $\frac{B-C}{I} \times 100$

Kind of Project.	Total investment	Total additional benefit from farming 'B'	(Amount in rupees)	
			Total cost including additional cost of farming 'C'	Rate of return $\frac{B-C}{I} \times 100$ (in percentage.)
1. Tube well	10,260	61,980	33,648.38	276.13
2. M. I. Project	16,27,800	20,96,178	10,72,741	62.87

I = Total investment in the project.

Rate of return is one of the important measure of efficiency in business analysis of any kind agriculture or non-agriculture.

Rate of return to the economy :-

It appears from table that return on the investment on tube well project worked out as 276 percent and it was only 62.87 percent in the case of minor irrigation project. It was considered appropriate at this stage to assess the rates of return in different situations of the study. This shows that the rate of return is much higher in lift irrigation system than the other one.

TABLE -42

Net benefit per gross cropped acre- (B-C)

(Amount in rupees)

Kind of irrigation project.	Total additional benefit.	Benefit/acre of gross crop production.	Total cost including annual project cost.	Cost/acre of gross cropped area.	Net benefit/Acre (B-C) (in Rupees)
1. Tube well (60 Ac.)	61,980	1,033.00	3308.38	560.80	472.20
2. Minor Irrigation (22,000 Ac.)	2096,128	952.80	1072741	487.60	465.20

Net benefit per gross cropped acre:-

It is seen in the Table-42 that the benefit per gross cropped annum in case of tube well irrigations is more than the canal irrigation system. From this point of view tube well irrigation system should be preferred to minor irrigation.

TABLE-63

Benefit per rupee spent on irrigation during 1972-73. (Amount in rupees)

Kind of irrigation project.	Total additi- onal output due to irrigation from cultivation (B-3-B')	Total additi- onal cost due to irri- gation for funding (A-R-R')	Annual fixed cost of the project (C)	Annual variable cost of the project (V)	Annual total cost of the project (C+V+W)	Net benefit due to irrigation (B-(A+G'))	Benefit for Rupees spent on irrigation during year of 1972-73. B-(A+G')
1. Tube well irrigation (20 acre ayacut)	61,980	29,200	1,440.73	3,007.65	4,448.38	28,331.62	6.36
2. Tube well (30 acre ayacut)	92,970	43,800	1,440.73	3,462.00	4,902.73	44,267.27	9.97
3. Minor irrigation (Sumbharin)	20,96,178	8,96,178	173,363	3,200.00	1,76,563.00	10,23,437.00	5.79

Benefit per rupee spent on irrigation per annum:-

The Table-43 shows the benefit per rupee spent for irrigation. It has been found out that in existing commanding area of the tube well (Kusumitada T.W.) irrigation benefit per rupee is higher (6.36) than the minor irrigation (Sunamuhin M.I.) system. Therefore we may conclude that the tube well irrigation promised more benefit per rupees spent than prevailing flow irrigation system in Khandapara area.

CHAPTER VII
SUMMARY AND CONCLUSION

CHAPTER - VII

SUMMARY AND CONCLUSION

In view of the importance of irrigation in the agricultural economy of the state, the impact of irrigation in agriculture was under taken to find out the effect of irrigation on the cropping pattern and crop intensity, on the use of chemical inputs, extent of adoption of H.Y. Varieties, human and bullock labour employment and farm income. The study also envisaged the benefit cost analysis of irrigation projects.

Sunamuhin minor irrigation project and Kusumitada lift irrigation (tube well) project of Khandapara Tahasil under Puri district were considered for the purpose of this study. Barapalli and Kainthpalli villages covered by minor irrigation project, Kusumitada and Salajharis villages covered by lift irrigation projects and Ranipada and Sahaspur villages which were not having any facilities were selected on stratified random basis for the purpose of the study. Under this experimental design while first four villages constituted two different subgroups of irrigation-input, the last two villages constituted as control to study the impact of two types of irrigation namely flow and tube well irrigation.

The farms within the six selected villages were stratified according to three size groups, namely size group-I (less than 2.5 acres), size group-II (2.5 to 5.0 acres) and size group-III (5.0 to 10.0 acres). Five farms from each

size group of three different sets of villages were selected on random basis . Thus a total number of fortyfive farms (15 under flow irrigation 15 under tube well irrigation and 15 without irrigation) were studied. The data relates to 1972-73 and the data were collected by survey method from the selected house holds.

The flowing inferences were drawn from the study.

(I) Irrigation and Cropping Patterns:-

Provision of irrigation facility brought a remarkable change in cropping pattern. H.Y.varieties of paddy and new crops like soyabean, wheat,maize were introduced in the irrigated areas.

High remunerative cash crops and vegetables were grown extensively in irrigated farms. Provision of irrigation changed the double cropping pattern to tripple cropping pattern . In canal irrigated farms H.Y.varieties of paddy were grown in summer due to its irrigation facilities . In the tube well irrigated farms more vegetables were grown during summer for economic use of tube well water.

(II) Irrigation and Input use.

Irrigation facility increased the fertilizer use almet ten times per acre. Irrigation facility enhanced pesticide use due to assured return from crops. Canal irrigated farms were found using more fertilizer and pesticide per acre than tube well irrigated farms due to cultivation

of H.Y.varieties of paddy in larger areas.

Large farms used more money for plant protection and fertilizer than small farms due to their greater investment capacity.

(III) Irrigation and labour utilisation:

Irrigation provision increased the human labour employment more than three times and bullock labour employment almost two times per acre due to adoption of tripple cropping pattern. In tube well irrigated farms the human labour utilisation was more than the canal irrigated farms as they were using labour intensive crops compared to flow irrigated farms. But bullock labour employment was more under canal irrigated farms due to more area under high yielding varieties of paddy in this area than tube well irrigated area.

Per farm human labour employment increased two and half to three times where as bullock labour use increased by 150 percent due to irrigation facilities.

Irrespective of irrigation condition small farms found to be using more of human labour and less of bullock labour per acre due to obvious reasons .

On the whole irrigation facility extended the use of human and bullock labour many fold and created opportunity for year round employment due to adoption of multiple cropping in irrigated farms.

(IV) Irrigation and cost of cultivation.

From cost break up of local paddy, it was observed that cost of cultivation increased to a greater extent (from Rs.387/- in unirrigated area to Rs.429/- in canal and Rs.419/- in tube well irrigated farms) in case of irrigated farms compared to unirrigated farms. Labour and fertilizer expenditure were increased due to growing of capital and labour intensive crops in irrigated farms. Cost structure analysis of local paddy, green gram, sugar cane, potato, H.Y.varieties paddy(summer) showed that except potato for all other crops human labour expenditure was highest and only for potato seed expenditure was highest among cost structure. Expenditure on fertilizer constituted second major items of cost in majority of the cases in irrigated situation.

(V) Irrigation and yield rates:

Yield rate of local paddy was increased due to assured supply of water through the reduction of uncertainty, timely operation and package of practices.

Large farms observed receiving higher yield than small farms due to more use of productive inputs in all conditions.

(VI) Irrigation and income from farming:

Net profit from irrigated farms was almost seven times larger than un irrigated farms. In tube well irrigated farms the net profit was highest due to cultivation of more profitable vegetable crops.

Family labour wages increased by 268.76 percent in tube well irrigated farms and 257.59 percent in canal irrigated farms. This was due to labour intensive operation followed in the irrigated farms.

Farm business income and family labour income increased almost four times in irrigated farms over unirrigated farms due to the year round employment, adoption of tripple cropping pattern and cultivation of more remunerative crops.

(VII) Irrigation and Disparities:

The gap between small holdings and large holdings was widened due to irrigation facility. At the same time regional disparities were widened between irrigated and unirrigated areas as the new technology is highly responsible for using water resource.

Cost of production per quintal of different crops was less in the case of irrigated farms compared to unirrigated farms even though total cost of cultivation per acre was more in irrigated farms. This was due to higher productivity of irrigated farms.

Input output ratio in unirrigated farms was 1:1.53 whereas 1:1.94 in tube well irrigated farms and 1:1.80 in canal irrigated farms. It confirms the relative more productivity of capital in irrigated farms.

Return per human labour day was maximum in tube well irrigated farms amounting 10.50 rupees. It was observed to be increasing with the increase in size of holding. The disguised employment of small farms is the cause of their minimum returns.

(VIII) Benefit cost analysis :

It was found out that per acre net investment of Kusumitada tube well was much lower than the Sunamuhin minor irrigation project (Rs.114/- in case of tube well and Rs.739/- in case of Sunamuhin minor irrigation project) This finding favours for investing more in tube well irrigation in our condition where capital investment is limited.

Benefit-cost ratio found out to be 1.95 case of Sunamuhin minor irrigation where as 1.84 in case of Kusumitada tube well irrigation. However direct costs and direct benefits have been taken in to consideration.

Rate of return to the economy in case of tube well was 276 percent where as in case of Sunamuhin minor irrigation it was 62.87 percent. This shows that the rate return is more in case of tube well irrigation than flow irrigation. This result favours tube well irrigation.

Again the net benefit per gross cropped area was found to be highest in case of tube well, which indicates the relative merits of tube well irrigation in our agriculture.

Benefit per rupee spent during 1972-73 was estimated as 6.36 in case of Kusumitada tube well project and 5.79 in case of Sunakuhin minor irrigation. Thus tube well irrigation found to be better than that of flow irrigation in all respect. In a backward state like ours where capital investment is a major constraint the desirability of exploiting ground water resources by means of small capital

outlay projects, of which gestation period is less, can not be lost sight of while planning for agricultural development.

From this study it may be concluded that the economies of irrigated farms is a sharp contrast to the economies of rainfed farms . The use of water resource has not only created a favourable condition for the adoption of H.V.varities of crops particularly paddy but also enhanced considerably the intensity of cropping in the area under investigation. As it has been observed irrigation facilities provided scope for both labour and capital intensive operations in farming. The extent of use of cretical e hemical inputs of very higher productive value was significantly increased in irrigated situation as compared to their counter parts in unirrigated situation. Same was the case with respective labour utilisation.

From the point of view of the efficiency of resource use, farm productivity and net return . The irrigation programmes have become the turning point in agriculture development strategy. The estimated benefit cost ratio was found to be roughly two and this was a better testimony to our minor irrigation projects under operation. The benefit cost ratio can still be higher if the illiterate farmers well armed the salient features of water management technology, which very much lacks in the area under study.

The study however revealed that regional disparities in income accentuates due to irrigation

facilities in one region and no such facility in other region.

In view of above findings the following suggestions were made:-

- (i) Top priority should be given to development of irrigation potential wherever possible.
- (ii) Efforts should not only be directed towards improving dry farming technology but also creating supplementary occupations in the unirrigated tracts, specially for the small farms.
- (iii) To avert the unavoidable growing disparities of income suitable measures ought to be introduced.
- (iv) Much attention should be given to supply of tangible inputs like quality seeds, fertilizers, pesticides in-order to derive full benefits of irrigation.
- (v) Much more attention should also be given towards intangible inputs such as soil and water management, selection of crops, timeliness of operation and proper allocation of resources. Infact many studies have indicated that returns from non monetary inputs are no less than the returns from monetary inputs.
- (vi) As the various efficiency measures show that tube well irrigation project is superior to other forms of minor irrigation project, the ground water resource survey has to be intensified and under the feasible conditions such type of low cost but quick recovery projects should be given priority in agricultural development policy formulation.

LITERATURE CITED

LITERATURE CITED:

- Anonymous:-** Evaluation of major irrigation projects-some case studies-1964. Programme evaluation organisation planning commission Government of India.
- _____ Project evaluation report. Programme evaluation organisation planning commission Government of India.
- Bashir, A.Desai-** Economics of irrigation and water rates under cauvery Mettur project- Agric. Eco. Res. centre, University of Madras.
- Bhati, J.P.; Tiwari, R.N. and Singh, L.R.-** Benefit cost analysis of irrigation projects- Methodological issues with reference to tube well. Ind. J. Agric. Eco. 28(4) : 284. Oct.-Dec. 1973.
- Charan, A.S.-** Direct primary benefits and costs of an irrigation project-empirical study of the West Benas project in Rajasthan. Ind. J. Agric. Eco. 28(4): 236. Oct.-Dec. 1973.
- Chawla, J.S., Gill, S.S. and Dhariwal, S.S.-** Benefit cost analysis of Agriculture project- A case study in district Amritsar- Ind. J. Agric. Eco. 28(4): 233. Oct.-Dec.-1973.
- Clark, Colin.-** The Economics of irrigation-1967.
- Harold, H. Mann.-** The economics results and possibilities of irrigation- Ind. J. Agric. Eco. 13(2): 1-6. April- June- 1958.
- Krishna, G.R.-** Estimation of economic benefit due to irrigation project in Tamil Nadu- Ind. J. Agric. Eco. 28(4): 240. Oct.-Dec.-1973.
- Maji, C.C. and Sirahi, A.S.-** A case study on the financial feasibility of electrically operated deep tube well in Illambazar development block in West Bengal- Ind. J. Agric. Eco. 24(4): 181-190. Oct.-Dec.-1968.
- Mishra, Shridhar-** A comparative study of minor sources of irrigation in Uttar Pradesh-1970.
- Moorti, T.V. and Mellor, John W.-** A comparative study of costs and benefits of irrigation from State and private tube well in Uttar Pradesh. Ind. J. Agric. Eco. 28(4): 181-189. Oct.-Dec. 1973.

- Mukhopadhyay, A.-** Benefit cost analysis of alternative tube well irrigation projects in Nadia District of West Bengal- Ind. J.Agric. Eco. 28(4):189-196 Oct.-Dec.1973.
- Patil, S.M.-** Benefit cost analysis of Agricultural projects. Ind. J.Agric. Eco. 28(4): 242. Oct.-Dec. 1973.
- Rawat, P.L.-** Technological transformation of Agriculture in Uttar Pradesh-1970.
- Sain, K and Kundu, S.N.-** Benefit cost evaluation of shallow tubewell irrigation in West Bengal- A case study-Ind. J. Agric. Eco.-28(4): 231. Oct.-Dec.1973.
- Sastri, V.K. and Somayagulu, D.S.-** Components of crop output in India- Ind. J.Agric.Eco.11(4):183-191.Oct.Dec.-1966.
- Savele, R.S.-** Intensive development approach to Agricultural development: Role of irrigation and cropping pattern in agricultural development-Ind.J.Agric. Eco.11(4):96-104, conference number 1966.
- Shah, S.M.-** Cropping pattern in relation to irrigation Ind. J.Agric. Eco. 18(1): 154-160, Jan.-Mar.1963.
- Shukla, V.P.-** Well irrigation, its costs and benefits in Jabalpur district of Madhya Pradesh-Ind. J.Agric.Eco. 28(4):235. Oct.-Dec.1973.
- Singarey, M.K. and Sohoni D.K.-** Benefit cost analysis of agricultural projects. Ind. J. Agric. Eco. 28(4):236.Oct.-Dec.1973.
- Singh, B. and Mishra S.-** Benefit cost analysis of the Sarada Canal system-1965.
- Singh M.L. and Prasad P.K.-** Evaluation of irrigation schemes in Palaman district(Bihar)- A case study Ind.J.Agric. Eco. 28(4): 235.Oct.-Dec.1973.
- Singh, R.P.-** Benefit cost analysis of tube well irrigation in Deoria U.P. Ind.J. Agric. Eco.-28(4):231.Oct.-Dec.1973.
- Sisodia, J.S.-** Benefit cost analysis of land development programme in Tawa Pilot project, Madhya Pradesh. Ind. J.Agric. Eco.-28(4):242-Oct.-Dec.1973.
- Snedecor, W.George & Cochran William G.-** Statistical methods.

APPENDIX

" Appendix"-I.

:NESTED DESIGN:

Computations:-

1. Grand total = $\sum^a \sum^b \sum^n y$
2. Sum of the squared observations = $\sum^a \sum^b \sum^n y^2$
3. Sum of the squared subgroup totals, divided by the sample size of the subgroups = $\frac{\sum^a \sum^b \sum^n y^2}{n}$
4. Sum of the squared group totals divided by the sample size of the groups = $\frac{\sum^a \sum^b (\sum^n y)^2}{nb}$
5. Grand totals squared and divided by the total sample size correction term CT = $\frac{(\sum^a \sum^b \sum^n y)^2}{nba}$
6. S.S.Total = $\sum^a \sum^b \sum^n y^2 - CT = \text{Quantity } 2 - CT(5)$
7. S.S.groups = $\left[\sum^a \frac{(\sum^b \sum^n y)^2}{nb} \right] - \left[\frac{(\sum^a \sum^b \sum^n y)^2}{nba} \right] = \text{Qua. 4} - CT(5)$
8. S.S.subgroup (Subgroups within groups)

$$= \left[\frac{\sum^a \sum^b (\sum^n y)^2}{n} \right] - \left[\frac{\sum^a (\sum^b \sum^n y)^2}{nb} \right]$$

$$= \text{Qt. 3} - \text{Qt. 4} = \dots$$
9. S.S.within (within subgroups, error S.S.)

$$= \left[\sum^a \sum^b \sum^n y^2 \right] - \left[\frac{\sum^a \sum^b (\sum^n y)^2}{n} \right]$$

$$= \text{Qt 2} - \text{Qt 3} = \dots$$

Analysis of Variance:-

Source of variation	df	S.S.	M.S.
$\bar{Y}_A - \bar{Y}$ Among groups	$a-1$	7	$\frac{7}{a-1}$
$\bar{Y}_B - \bar{Y}_A$ Among subgroups within groups	$a(b-1)$	8	$\frac{8}{a(b-1)}$
$Y - \bar{Y}_B$ within subgroups	$ab(n-1)$	9	$\frac{9}{ab(n-1)}$
$Y - \bar{Y}$ total	$abn - 1$	6	

"Appendix"-II.

Detail cost structure of Kusumitada tubewell point.

Depth of T.W.= 110 ft.

(A)	a) Cost of drilling 100' @ Rs.4.45/ft.	445.00
	b) Cost of drilling 100'-120 @Rs.5.06/ft.	101.00
2.	Cost of 4" dia (M.S.) 85' @ Rs.14/ft.	1190.00
3.	Cost of 4" dia strainer 25' @ Rs.5/ft.	125.00
4.	Cost of 4" dia check valve & other G.I. fittings:- L.S.	400.00
5.	Cost of transportation of materials L.S.	300.00
	Total...	2,561.00
(B)	Cost of one 5 H.P.centrifugal pump coupled to 5 H.P.electric motor with all fittings & accessories:-	2,500.00
(C)	Cost of electric connection including internal wiring:-	1,000.00
(D)	Distribution system.	
i)	Cost of one delivery tank 4'x4'	600.00
ii)	Cost of one pump chamber 6'x6'	600.00
iii)	Cost of 800' brick lined channel at rate of 3.50/ft.	1,200.00
iv)	Contingencies and other unforeseen items.	2,800.00
		<u>Rs.4,000.00</u>
		200.00
	Grand total.	Rs.7,461.00
		<u>Rs.2,800.00</u>
		Rs.10,261.00
	say...	Rs.10,260.00

Fixed cost:- (Depreciation + interest + repair and maintenance)

a) Tube well:-

- i) Cost of Tube well Rs. 2,560/-
life assumed = 25 years.
- ii) Depreciation/annum = $\frac{2560-256}{25} = 92.16$
- iii) Interest on average capital/annum. $\frac{2560+256}{2} \times \frac{9}{10} = 126.72$
- iv) Maintenance at the rate of 1 percent. = $\frac{25.60}{244.48}$

b) Cost of centrifugal pump life assumed 10 years, = 2500/-

- ii) Depreciation/annum $\frac{2500-250}{10} = 225.00$
- iii) Interest on average capital/annum = $\frac{2500+250}{2} \times \frac{9}{10} = 123.75$
- iv) Maintenance @ Rs. 4 of initial cost/annum. $\frac{100.00}{448.75}$

c) i) Cost of electrical wiring life = 15 years = 1,000.00

- ii) Depreciation/annum. $\frac{1000-100}{15} = 60.00$
- iii) Interest on capital/annum = $\frac{1000+100}{2} \times \frac{9}{10} = 49.50$
- iv) Maintenance 4 percent. $\frac{40.00}{149.50}$

d) Cost of distribution system = 15 years = Rs. 4,000.00

- ii) Depreciation/annum = $\frac{4000-400}{15} = 240.00$
- iii) Interest on average capital/annum = $\frac{4000+400}{2} \times \frac{9}{10} = 198.00$
- iv) Maintenance 4 percent of initial cost/annum. $\frac{160.00}{598.00}$

Total cost/annum = Rs. 244.48 + 448.75 + 149.50 + 598.00 = Rs. 1440.73

Th-604