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PAKISTAN
WATER & POWER DEVELOPMENT AUTHORITY

AGRO-ECONOMIC BASELINE REPORT
IRRIGATION SYSTEMS REHABILITATION PROJECT-II

Watercourse Monitoring & Evaluation Directorate
Planning and Investigation Organization
Planning Division (December 1992)

P&I Publication No.386

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WATERCOURSE MONITORING & EVALUATION DIRECTORATE
PLANNING AND INVESTIGATION ORGANIZATION
PLANNING DIVISION (DECEMBER 1992)

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S U M M A R Y

Irrigation Systems Rehabilitation Project-II (ISRP-II) aims at increasing agricultural production by providing a more reliable and equitable supply of irrigation water by strengthening the capability and capacity of provincial Irrigation Departments. The project is coordinated at the Federal level by Chief Engineering Advisor, Ministry of Water and Power while the provincial Irrigation and Power Departments are responsible for its implementation. Agro-Economic evaluation of the ISRP-II was assigned to the Watercourse Monitoring and Evaluation Directorate (WM&ED), planning and Investigation Organization, WAPDA, in three provinces (NWFP, Sind and Balochistan) under an agreement signed in August 1990.

According to the study design the agro-economic evaluation covers four distributaries, two in Sind, and one each in NWFP and Balochistan. Eighteen watercourses have been selected on four distributaries, representing head, middle and tail sections.

Irrigation Water Supplies

Measurements on the eighteen selected watercourses of four distributaries (Chowky, Puran, Nagna and Nari) were undertaken as part of the agro-economic evaluation of the ISRP-II. Main purpose of this activity is to establish bench marks for studying the effect of the project improvements on the equity and reliability of irrigation supplies at watercourse and farm level. The data have been recorded with two rounds of observations during a crop season and extend as a whole, over a period of 13 months (April 1991 to April 1992) covering Kharif 1991 and Rabi 1991-92 seasons. Results, presented here under, represent pre-project conditions except for Chowky where the rehabilitation works were completed prior to the bench-mark measurements.

Chowky System

- The results of outlet discharge (measured vs designed) based on head and tail reaches of the distributary/ minor show a mixed trend. Regarding Chowky distributary, the watercourses at head and tail reaches had been drawing respectively 10 and 58 percent less than the designed discharge which shows inequitable distribution of supplies. In case of Chowky minor, inequity is applicable to middle watercourse only as the tail watercourse had actual discharge equal to the designed.

- The outlet discharge shows wide variation over time for the three watercourses of Chowky distributary (0.2-1.4 cusecs) and two watercourses of Chowky minor (0.4-1.3 cusecs). It is due to fluctuating supplies in the distributary.

- The watercourse delivery efficiency is significantly better irrespective of the ocation on the distributary/minor. The delivery efficiency of lined watercourse remained higher than the unlined by 9-10 percent in head, 7-22 percent in middle and 10 percent in tail reach.

Puran System

- In Puran distributary, head watercourse had been drawing 43 and 62 percent excess supplies (against the designed discharge) during Kharif and Rabi seasons respectively, whereas the tail watercourse received 6 and 49 percent excess supplies during the respective seasons. These results reveal excess supplies even to tail watercourse although its extent was less compared with head reach watercourse especially during Kharif season.

- The head watercourses of Puran System can be regarded as average in terms of delivery efficiency. The tail watercourse of Puran minor is typical as its command area is 3-6 feet higher than the watercourse bed level due to which lifting of water (using camels and diesel pumps) is involved.

Nagna System

- An overall view of the results shows a trend of excess withdrawals by 46-69 percent (against the designed discharge) in respect of head and tail watercourses during both the seasons. Excess supplies in the distributary not only delivered excess water to the tail watercourse but its extent was greater than the head reach watercourses.

- Results of delivery efficiency regarding head and middle reach watercourses of Nagna system can be considered better than average. However, lined watercourses had an edge over the unlined. The tail watercourse involved camel-lifting and mechanical pumping of water as its command area is 4-5 feet higher than the watercourse bed level.

Nari System

- In Sibi branch, one tail watercourse had been drawing 28 percent excess supplies during Kharif but equal to the designed discharge during Rabi season, while the other tail watercourse had been drawing 22-25 percent less than the designed discharge which shows inequity within the tail reach of the branch.

- In Kurak branch, the middle watercourse had been receiving excess supplies (against the designed discharge) by 89 percent during Kharif and 96 percent during Rabi. The flow at the tail watercourse of this branch remained almost equal to the designed discharge. This shows inequity due to excess supplies drawn by the middle watercourse.

- The delivery efficiency of watercourses in Nari system can be rated as normal. Efficiency during Rabi remained higher compared with Kharif season which is attributable to watercourse cleaning done prior to start of measurements during Rabi.

Agro-Economic Variables Before Rehabilitation

Chowky System

- The head reach of the chowky disty is dominated by high delta crops like orchards, and sugarcane occupying 30, and 12 percent of CCA, respectively. The tail reach of disty presents considerably less area under sugarcane and orchards.

- The cropping intensity on the head reach of chowky disty figures out as 169 percent which is higher by 56 percent of tail reach. On chowky minor, the cropping intensity in middle is 168 percent against 156 percent in tail.

- An equal number of owners and tenants are operating the farms and majority of them fall in 0-2.50 hectares farm size group on system basis. Two types of tenureship either owner or tenants exist on chowky minor. Fragmentation of holding appears to be a more serious problem on chowky distributary especially for holdings upto 2.50 ha.

- Watercourse cleanings have shown complete uniformity as one cleaning per season (2 per year) is being done on all watercourses irrespective of their location.

- About 97 percent farmers were not satisfied with the allocation of turn time. About 83 percent of farms have reported the missing of their irrigation turn ranging from 2 to 8 on system basis during the year.

- The majority (67 percent) of chowky disty and all respondents of chowky minor have reported the fluctuating supplies in the parent channels creating unreliability in water supplies.

- Seven farms at the tail watercourses of chowky disty, 2 farms at the middle and 12 farms at tail watercourses of chowky minor have used tubewell water for crop production. It is quite clear that the tail watercourse respondents have to supplement irrigation supplies from private tubewells as the surface supplies are not adequate and reliable.

- A declining trend of yields from head to tail watercourses for all crops except oilseeds have been recorded on chowky disty. The yields of sugarcane, maize and wheat crops have been reported more on tail watercourse compared to middle watercourse of chowky minor. The reason is that some area of the tail watercourse is abandoned and irrigation water allocated to that area is being used by the farms of upper reaches. Further tubewell water is being used by the farms of tail watercourse.

- The crop income per cropped hectare and per hectare have been recorded negative by channel reach and overall system except head reach of chowky disty. The crop income per farm works out to be Rs. 6290/= on system basis, mainly due to head reach watercourses. The livestock income have been recorded more by the farms of tail watercourses compared to the farms of head reach watercourses.

- The farms located at the tail watercourse of the chowky disty, seem to be more equipped with tubwells and tractors.

Puran System

- The orchard is a major crop at head reach of Puran minor while the area under cotton and wheat crops is almost same at head and tail watercourses.

- About 80 percent of farmers are tenants and 88 percent of tenants operate upto 7.50 hectares of holdings on system basis. It is observed that 87, 47 and 68 percent of the sample farms are in the shape of the compact block on Puran disty, Puran minor and overall system, respectively.

- Mean irrigation turn time is recorded as 0.94, 0.90 and 0.94 hours per hectare for distributary, minor and system respectively.

- Annually, nine and five main watercourse cleanings have been carried out on Puran disty and Puran minor. All the respondents have reported to be satisfied with the allocation of irrigation turn time.

- About 25 percent respondents did not miss any irrigation turn unexpectedly but 70 percent missed 3 irrigations per year due to emergency maintenance. About 76 and 24 percent farms have availed their irrigation turns when flows were below normal during Khairf and Rabi. The frequency of turns having inadequate discharge have been more on Puran minor compared to Puran disty. Not a single farmer used tubewell water for crop production.

- Relatively higher amount of nitrogenous fertilizer has been applied to cotton, sugarcane and wheat. As regards phosphatic fertilizer, a maximum dosage per hectare has been applied to Rabi vegetables followed by orchards. The potashic fertilizer has been used only for orchards and Rabi fodder.

- A declining trend of crop yields from head to tail of Puran disty for cotton, Jantar, Kharif vegetables, sugarcane, Rabi fodders and Rabi vegetables have been observed. The same trend on Puran minor for Jantar, wheat, Rabi fodder and Rabi vegetables have also been recorded.

- The average figure of crop income shows declining trend from head to tail watercourses on both channels. The mean livestock income and livestock income per hectare on system basis is Rs. 1705 and Rs. 826, respectively. The average non-farm income per farm and per hectare works out to be Rs. 790/- and Rs. 372/-.

- A slight variation have been observed for the population of livestock by channel reach. The Puran disty is ill equipped for mechanized farming.

Nagna System

- The middle reach watercourses have more area under sugarcane and orchards compared to head and tail reach watercourses. The reasons are that majority of the farms at middle watercourses are owner operated having more than 7.50 hectares holdings. Further they are socially influential and utilizing the sources at their optimum level.

- The cropping intensity at middle reach is 24 and 71 percent higher compared to head and tail reaches. Cropping intensity at tail reach is the lowest.

- On system basis, majority of the operators (57%) are tenants and second category is owners (36%). Majority of the owners and owner cum tenants have a larger holding size i.e. more than 7.50 ha. whereas majority of tenants have less than 7.5 ha. holding. About 49 percent of sample farms comprise of a single parcel.

- The average irrigation turn time on head, middle tail reach and for overall channel basis has been recorded as 0.85, 0.56, 0.99 and 0.75 Hrs./ha. respectively.

- On an average, 4,6 and 5 cleanings of main watercourse have been done on head, middle and tail watercourses.

- All the respondents of this system were satisfied in terms of allocation of turn time. About 98 percent farmers reported missing their irrigation turns under unexpected canal closures due to the emergency maintenance. In the majority of the cases (56%) the supplies delivered were inadequate.

- Eight respondents (22 percent) of head watercourses have been using tubewell water for crop production. There was no contribution on middle and tail reaches.

- The yield of sugarcane (fresh), and cotton are significantly high at middle compared to other reaches. Except wheat the yields of all other crops are lower at the tail reach.

- Crop income per cropped hectare and crop income per hectare is much higher on middle watercourses compared to head reach. The income per cropped hectare and per hectare have been negative on the farms of tail watercourse. The livestock income have indicated a declining trend from head to tail reach. The non-farm income has been recorded more at head watercourses compared to other reaches.

Nari System

- During Kharif, Jowar (Sorghum) is the only crop planted on Sibi branch. Similarly on the middle reach of Kurak branch single crop of Jowar has been grown. On tail reach of Kurak branch sorgham is the main crop although vegetables occupy about 7 percent area. The data of Rabi season indicate that on Sibi distributary and middle of Kurak branch wheat and barley are the two major crops while vegetables occupy third place on tail reach of Kurak. Sorgham-wheat is the existing cropping pattern on this system.

- The farms have been operated by almost equal number of owners and tenants while owner cum tenants are about 8 percent. Owner cum tenants do not exist on Kurak branch and they are in minority (10 percent) on Sibi branch. All farms on middle reach watercourses are larger than 7.50 ha. While on tail reach 80 percent farms on Kurak branch are of the same size. On overall basis 83 percent farms are larger than 7.50 ha. Farms comprising of two parcels are in majority and constitute 72, 60 and 70 percent of farms on Sibi, Kurak and Nari System.

- One cleaning of the main watercourse has been carried out each season except on tail watercourses of Sibi branch, where 2 cleaning have been done during Kharif season.

- All the operators of this system have reported to be satisfied for the allocation of irrigation turn time. On an average 78, 80 and 78 percent of farms have reported missing of 4 irrigation turns annually in Sibi, Kurak and Nari system, respectively. Reasons for these closures for Kurak branch are the rains which account for 90 percent of the cases. Not a single farmer has reported use of tubewell water for crop production.

- Yields are quite low by national standards. Reachwise trend is mixed as yield of some crops is higher on tail reach of Kurak branch. The output value of Jowar and wheat crops are higher at Kuark branch compared to Sibi branch.

- The gross income and income per cropped hectare is the highest on tail of Kurak branch and lowest for Sibi tail. The gross income from livestock have been recorded to be 2 to 4 times higher on Kurak branch compared with Sibi branch. Not a single farmer has reported non-farm income on Kurak branch, while it has been reported as Rs. 6100 per farm on Sibi branch.

- More animals per farm have been recorded on Kurak compared to Sibi branch. This is reflected in terms of higher gross livestock income on Kurak branch. A slight variation in the strength of animals by channel reach on Kurak branch have been recorded. The Sibi branch is well equipped as compared to Kurak branch but middle watercourse of Kurak branch is without tractor and tractor equipment.

Chapter-I

INTRODUCTION

Background

1.01 The Indus Basin irrigation system mainly comprises the Indus River, its main tributaries, three major storage reservoirs, 19 barrages/headworks, 12 link canals, 43 canal commands and more than 89,000 watercourses. The total length of the canal system is about 0.06 million kilometers with an additional length of about 1.6 million kilometers of watercourse systems within the Chaks.

1.02 Originally, the irrigation system was designed based on the general criteria of availability of river flows, the maximum cropped area with the minimum water consumption and operation of the system at a low cost. This criteria coupled with lack of maintenance of the canal systems/subsystems and inadequate use of agricultural inputs, has affected the crop yields adversely. The variations in seasonal crop production generally, reflect the dominance of weather/exogenous factors and irrigation water availability however, the yields of the main crops remain low and uncomparable with those of other countries.

1.03 As a result of deffered maintenance most of the canals are operating with inadequate or no free board, eroded berms, narrow operating roads, deterioated outside embankments and reduced capacity of water delivering/distribution subsystems (distributaries/minors) due to sedimentation and damaged structures. Though recently a flow pattern of excessive deliveries to most of the canals has appeared due to an improved system of barrages and reservoirs but supply is still short of meeting crop water requirements especially at subsystem level.

1.04 Under the water sector policy reforms and investment priorities for the uplift of irrigated agriculture (mostly based on recommendations of RAP-1979), the rehabilitation of the irrigation and surface drainage systems was decided for due consideration. Resultantly, Irrigation System Rehabilitation Project-I (1983-87) was implemented with the financial assistance of World Bank and USAID in the four provinces. The Provincial Irrigation Departments (PIDs) executed the civil works while the Project was coordinated by Federal Coordination Cell (FCC) Ministry of Water and Power, Government of Pakistan.

Irrigation Systems Management Project-II

1.05 Irrigation Systems Management Project-II (ISM-II) or ISRP-II is the continuation of ISRP-I, as included in the Seventh Five-Year Plan (1989-93). ISRP-II will replicate the operational and institutional components of ISRP-I however, some modifications in the light of ISRP-I experience, have been envisaged to achieve greater assurance and equity in the distribution of water supplies and improved operation and maintenance of the subsystems. World Bank's Staff Appraisal Report (SAR-6991 Pak.) estimates the total cost of the Project as about 220.4 million US dollars (including GOP share of 37.1 million US dollars).

1.06 Objectives of the Project: The ultimate objective of the Project is to increase agricultural production. Detailed objectives are outlined below.

* To provide a more reliable water supply by reducing risk of failure and removing physical constraints in the irrigation network.

* To reduce crop losses resulting from rain flooding by improving the surface drainage systems.

* To provide a more equitable irrigation water supply to farmers by increasing deliveries to water deficient Chaks (Watercourse Command) mainly located in the lower reaches of distributaries and minors through a programme of silt removal and redesign of selected channels and outlets.

* To strengthen the capabilities of the PID's O&M programme to improve efficiency in system operation and ensure an adequate maintenance of installed facilities.

1.07 Project Components: As mentioned earlier, the Project will be implemented over a period of five years in all the provinces. Mainly, the implementation will provide rehabilitation of designated irrigation and drainage systems/subsystems that deteriorated because of deferred maintenance. In view of the experience of ISRP-I some modifications such as completion of required rehabilitation, redesign of subsystem where required, installation of concrete or masonry lining on selected reaches of the channels as required. In specific relation to irrigation systems' rehabilitation the main civil works include the following.

* Rehabilitation of canal banks.

* Restoration of canal prisms to their normal sections.

* Redesign of systems/subsystems having hydraulic problems.

* Lining of selected reaches.

* Modification of structures and outlets.

1.08 It is estimated that under ISM-II Project, a total canal length of about 13450 kilometers will be rehabilitated which will benefit an area of about 0.414 million hectares. Province-wise distribution of length of irrigation channels targeted to be rehabilitated and area benefited, is shown in Table 1-1.

Table 1-1

REHABILITATION OF CANAL LENGTH AND BENEFITED AREA By PROVINCE

Province	Length (Km.)	C.C.A (000' Ha.)
NWFP	650	250
Punjab	9900	970
Sind	2700	870
Balochistan	200	45
Total:	13450	4435

Source: SAR, March 1988.

Monitoring and Evaluation of the Project

1.09 In relation to canal system/subsystems rehabilitation the monitoring and evaluation (external M&E) as an integral part of the Project's implementation, is required to assess the impact of the Project main components, in achieving timely, reliable and more equitable distribution of water supplies and farmers' response to the Project improvements. Hydraulic evaluation is expected to ascertain the achievement level regarding reliability and equitable water distribution whereas farmers' responses to the Project are required to be evaluated through a process of agro-economic evaluation.

1.10 Agro-Economic Evaluation: Agro-economic evaluation of the ISRP-II Project was assigned to the Watercourse Monitoring and Evaluation Directorate (WM&ED), P&I, WAPDA, for three provinces (NWFP, Sind and Balochistan). Accordingly, an Agreement for Consulting Services for M&E was signed on 27.8.1990, between the WM&ED and FCC.

1.11 Evaluation Objectives: In veiw of the Project improvements' ultimate objective of an increased agricultural production, the overall agro-economic evaluation will concentrate on assessing the effects and impact of reliable and more equitable water supplies on agricultural and agro-economic aspects. Estimated/quantitative changes in related outcome

variables and key indicators after the improvement would reflect the magnitude and level of achievement of the effects and impact. According to the study design the agro-economic evaluation covers the watercourse from the mogha down to its command and farms within the command for estimation of the outcome variables and specific key indicators before and after the Project implementation.

1.12 Components of Evaluation: For the overall agro-economic impact evaluation the important outcome variables/key indicators in specific relationship to water-crop, have been identified to measure these quantatively, before and after the Project improvements. These are outlined below.

* Water flow rate at mogha.
* Conveyance efficiency.
* Time of irrigation per unit area.
* Number of irrigations to different crops.
* Irrigated acreage and intensity of irrigation.
* Watertable depth.
* Cropped area.
* Cropping pattern.
* Cropping intensity.
* Level of various inputs.
* Crop production/yields.
* Net income of farm.

1.13 Coverage of Evaluation: As noted earlier, WM&ED has been entrusted the agro-economic impact evaluation in NWFP, Sind and Balochistan, based on selected and predetermined distributary/ minor systems. Therefore, the evaluation activities and collection of pertinent data concentrate to the commands of these systems in the respective province. Details are given in Chapter-II. For the baseline evaluation the data collection broadly pertains to Kharif 1991 and Rabi 1991-92 seasons.

Plan of the Present Report

1.14 The Baseline Report is entended to set out the information and results regarding the agro-economic and water supplies/ management aspects, derived from the data gathered during the pre-rehabilitation of the distributary/minor subsystems selected as study areas.

1.15 Besides the introduction and methodology adopted for evaluation, this report mainly deals with identified variables and key indicators in relation to the agronomic and agro-economic areas of investigations individually, for selected distributary/ minor subsystems. As regards irrigation supplies/water management an idependent chapter elaborates the relevant situations prior to the Project for the subsystems.

Chapter-II

METHODOLOGY FOR AGRO-ECONOMIC EVALUATION

2.01 This chapter deals with the design and methods adopted for agro-economic evaluation and other related areas of investigations. Mainly, it describes the data necessitated and collected to derive the pertinent information and estimates of the outcome variables and key indicators, sample design and sample selection, data analysis plan, computer application and data processing approach and institutional set-up for execution of the requisite surveys under the agro-economic impact evaluation of the ISRP-II.

Evaluation Approach

2.02 To achieve the objectives of ISRP-II it is essential to ensure more reliable and equitable distribution of water supply to the distributaries/minors and the watercourses operating in different reaches. Obviously, the rehabilitation of a distributary/minor will result into an effect of increased water supply to the watercourses especially in lower reaches on the channel. Increased water may be expected to improve the present unequitable water distribution at both the channel and watercourse level. Ultimately, the agronomic variables such as cropped area, cropping intensity, production and level of non-water inputs specifically fertilizer would undergo the changes against the pre-implementation stage charactersied with water inequity and unrelability. The measure of these changes is a main theme in the evaluation process of ISRP-II. In the light of this concept therefore, to evaluate the agro-economic impact of the Project a "before - after" evaluation approach which is more practicable under the situations has been adopted. This approach necessitates the collection of all pertinent data prior to the Project implementation. The agro-economic evaluation study thus, has been designed to be conducted in two phases i.e. baseline evaluation (pre-rehabilitation) and then post-rehabilitation evaluation, of the effects and impact indicators.

Sample Design and Sampling

2.03 Conceptually, the data needs for both the phases of evaluation concentrate to the sampling units viz; distributary/ minor, watercourse and farm. In view of this the sampling involves a three-stages sample design. The first stage covers the selection of distributaries, the second of watercourses and the third of farms. Regarding the first stage of the design it may be mentioned that the sample of distributaries is a predetermined sample as identified by USAID in the Agreement. These initially proposed and selected distributaries in the provinces (NWFP, Sind and Balochistan) are given in Table II-1.

Table II-1

PROPOSED STUDY DISTRIBUTARIES

NWFP		
Chowky Distributary	-	Maira Branch-Upper Swat Canal.
Sind		
Puran Distributary	-	Jamrao Canal-Nara Canal.
Nagna Distributary	-	Nasir Branch-Rohri Canal.
Balochistan		
Nari Main Canal	-	Nari Main Canal.

2.04 The sample selection proposal (Agreement) firstly, at distributary level involves the selection of two minors one each from about middle of the Chowky and Puran distributaries and secondly, at watercourse level it indicates to select two outlets i.e. one from head and other tail of these two distributaries. From each of the minors again two watercourses with the same distribution as in the case of the distributaries were required to be selected. For Nagna Distributary and Nari Main Canal a set of three watercourses (distributed by head, middle and tail reach) on each said channel, was required to be selected. In this way a sample of 14 watercourses was prefixed for the agro-economic evaluation.

2.05 Selection of Minors: The sampling proposal was reviewed by the WM&ED and as a first step some basic data (length, discharge, command area, number and names of minors etc.) offtaking from predetermined distributaries (Chowky and Puran) were collected. These data were used to select the minors on Chowky and Puran distributaries. The data of Nari Canal system were also collected and as a modification to the sample for this system it was proposed by WM&ED to replace Nari Main Canal as a sample channel by its Sibi and Kurak Branches. This proposal for Nari system was agreed by concerned agencies (FCC meeting of 1.7.91). The second phase of sampling frame-work construction was accomplished while collecting the data of watercourses on the distributaries and minors finalized. As a result of the review modification of proposed sample outlay and sampling procedure carried out by the WM&ED, the selection of distributaries and minors as finalized are shown in Table II-2.

Table II-2

FINALLY SELECTED STUDY CHANNELS

Province	Distributary/Minor	Parent Channel
NWFP	Chowky Disty.	Maira Branch of Upper Swat Canal.
	Chowky Minor-I	Chowky Disty.
Sind	Puran Disty.	Jamrao Canal of Nara Canal.
	Puran Minor	Puran Disty.
	Nagna Disty.	Naseer Branch of Rohri Canal.
Balochistan	Kurak Branch	Nari Canal.
	Sibi Branch	Nari Canal.

2.06 Selection of Watercourses: The method of watercourses selection involves the stratification of the watercourses by two ways i.e. firstly, by the three reaches (head, middle and tail) of selected distributary/minor and secondly, by watercourse improvement status (lined/unlined). After the consideration and imposition of stratification the selection of the watercourses from each channel was carried out through the method of randomization. As a result of the sampling procedure a total sample of 18 watercourses was selected against 14 proposed in the Agreement. The distribution of sample watercourses by selected channels, is given in Table II-3.

Table II-3

DISTRIBUTION OF SAMPLE WATERCOURSES BY SELECTED CHANNEL

Distributary/Minor	Number of Watercourses By Disty/Minor Reach			
	Head	Middle	Tail	Total
NWFP				
Chowky Disty.	1	-	2	3
Chowky Minor-I	-	1	1	2
Sub. Total:	1	1	3	5
Sind				
Puran Disty.	1	-	1	2
Puran Minor	1	-	1	2
Nagna Disty.	2	2	1	5
Sub.Total:	4	2	3	9
Balochistan				
Nari Canal				
Kurak Branch	-	1	1	2
Sibi Branch	-	-	2	2
Sub.Total:	-	1	3	4
Total:	5	4	9	18

2.07 **Sample Size and Selection of Farms**: The final stage of sample design related to sample size and selection of farms, is of quite importance because in the context of agro-economic evaluation major section of information package will be developed from the data generated at farm level. Technically, the precision of sample results is always governed by absolute, not relative, sample size. To determine the sample size of farms a developed equation (Chris Scott-Sampling for M&E, World Bank, 1985) was used as illustrated below.

$$n = K^2 R(100-R)/D^2$$

n = sample size
K = normal deviate (converted confidence level)
R = percentage rate of variance or increase in variable
D = acceptable margin of error

2.08 The ISRP-II was conceived for rehabilitation of the problem channels to ensure a more reliable and equitable water supply for achieving the ultimate objective of increased agricultural production. In view of this objective the key variable of yield was considered to estimate the value of 'R' in the above formula which is insensitive to the exact value of 'R' and a guess may suffice. However, for practical purpose for ISRP-II evaluation the value of R = 50 was used, as a safe upper limit. As regards, the value of other factors i.e. K (normal deviate) and D (margin of error) in the formula, these were considered as K = 1.96 (conversion of 95 percent confidence level with two sided interval) and D = 10 percent. Using these values, a sample size of about 96 farms per distributary system was initially worked out. This size was then adjusted and refined at the watercourse level keeping in view of load of work, available resources and permitted strength of field staff. Resultantly, s sample of 18 farms per watercourse with an equal distribution of 6 farms per watercourse reach (head, middle, tail) was finalized. However, in case of lesser number of total farms than 18 on a selected watercourse it was decided to include all the farms for data collection. The sample size of 18 farms per watercourse works out a total number of 324 farms. In actual practice due to less number of farms on some selected watercourses, a sample of 307 farms could be achieved. Table II-4 gives the distribution of number of sample farms by selected channel.

Table II-4

DISTRIBUTION OF SAMPLE FARMS BY SELECTED CHANNEL

Distributary System	Number of Sample Farms
NWFP	
Chowky Disty.	52
Chowky Minor-I	36
Sub. Total:	88
Sind	
Puran Disty.	35
Puran Minor	36
Nagna Disty.	88
Sub.Total:	159
Balochistan	
Nari Canal/	
Kurak Branch	10
Sibi Branch	50
Sub.Total:	60
Total:	307

a/ Included total farms on Kurak and Sibi Branches.

2.09 The selection of farms was accomplished while using the linear systematic sampling (LSS) technique. The farms listed on each selected watercourse were stratified by head, middle and tail reach. This was necessary to reduce the variability in the sampling strata. The LSS method (by farm size) was used because of its advantage of reducing the sampling error particularly when the variables are correlated with the farm size.

Evaluation Database

2.10 Distributary/Minor Database: For selected distributaries/minors the following data have been outlined and collected.

* Historical supplies to the channels.
* Cropped area/cropping pattern.
* Cropping intensity.

2.11 Watercourse Database: At watercourse command the data pertain to the variables given below.

* Cropped area/cropping pattern.
* Cropping intensity.
* Watertable depth.
* Flow rate below outlet.
* Delivery efficiency/conveyance losses.
* Time of irrigation per unit area.
* Rainfall.
* Inputs availability.
* Warabandi and related issues.

2.12 Farm Database: The farm level database is comparatively exhaustive and includes mainly;

* Farm physical and farm operator sociological profile.
* Farm power and associated livestock.
* Reliability of water and farmer's perception.
* Use of tubewell water.
* Area Planted/harvested.
* Inputs use and cost.
* Labour use and cost.
* Cultural operations and cost.
* Production/yield.
* Farm output.
* Farm income.

Data Collection Procedures

2.13 In general, the collection of baseline data has been carried out through two modes i.e. physical measurements and interviews. A brief description regarding the aquisition of different data is given in the following.

2.14 The data pertaining to cropped area, cropping pattern, cropping intensity on watercourse command basis have been deduced through land use/crop survey mapping and physical observations. These data have been collected by Junior Agriculture Officers assisted by qualified Field Assistants. For development of land use/crop survey map, the plain-tabling is carried out by Junior Engineers (Agri.).

2.15 Agro-economic and related socio-economic data elaborated on farm level, have been collected through interviews with the sample farm operators. These data are collected by Junior Agriculture Officers exclusively. Checking is done by the Senior Research Officer.

2.16 Watercourse flow rate and conveyance efficiency data have been collected by Junior Engineers (Agri.) assisted by Field Assistants or Work Supervisors with one labourer. The water measurements are carried out using cut-throat flumes by inflow-outflow method. Deputy Director (Agri.Engg) has been responsible for checking of measurements.

2.17 Besides the above essentially required and related data mostly for the purpose of comparison have been collected from concerned secondary sources. These data include historical discharge of channels and outlets from Irrigation Department/ Alluvial Channels Observation Project (ACOP) of WAPDA, cropped area from Irrigation Department/Revenue Department and crop yields assessment data by the Statistical Wing of Agriculture Department.

Questionnaire Design

2.18 For the purpose of collection of data regarding major section of agro-economic evaluation at farm level, a specific questionnaire was designed. The questionnaire was reviewed, pretested and modified in the light of the comments by the M&E Specialist and the Consultants of the Project. The final and applied version of the questionnaire is appended here as Appendix-I.

2.19 To carry out the water flow measurements mainly regarding actual discharge of watercourses and conveyance efficiency, a data collection format appended as Appendix-II, was used.

Data Management

2.20 After collection of all the pertinent data these were checked exhaustively in the field by concerned field staff and Senior Research Officers. After removing any error and omission through verification at site, the data have been checked and edited by the Headquarters staff (Junior Agriculture Officer/ Research Officer) prior to entry on computer.

2.21 The evaluation (Baseline) data have been entered using dBASE III+ software package after structuring the different descriptive data set files, as an archive, transformation and file linkage. Afterwards the processing and analysis have been carried out using the SPSS/PC+ package.

Data Analysis

2.22 The plan of data analysis concentrates to presentation of the information regarding the outcome variables and indicators such as cropping pattern, cropping intensity, production/crop yields, farm income, watercourse discharge/conveyance efficiency etc. The Project outcome is expected to bring out the changes as effects in line with the Project's objectives including firstly, reliable water supplies to the distributary systems and secondly equitable distribution of water to the watercourses offtaking from rehabilitated systems. The analysis would lead to assess achieved extent of the objectives, reflected by changes in the magnitude of outcome variables/indicators under the influence of other independent factors/variables. As said earlier, the analysis will be based on "before and after" (Project implementation) comparison.

2.23 The evaluation analysis plan is split up into two types viz; exploratory analysis and advanced statistical analysis. The exploratory analysis will be carried out to reveal the simple structures and pattern in the data coupled with the purpose to detect errors before formal analysis, which might lead to incorrect conclusions regarding both the range and distribution of a variable and relation between variables. This part of analysis includes mostly descriptive statistics elaborating measure of central tendency, dispersion, proportions, frequency distribution, simple graphic presentations etc.

2.24 The advanced statistical analysis as mostly applicable for the final impact evaluation (before-after Project) will be carried out to complement the exploratory analysis in relation to the validity of results, interpretation and inferences. The analysis will comprise the application of the methods such as significance tests, testing of hypotheses, correlation and regression etc. However, these methods will be used keeping in view their suitable applicability in accordance with the availability and appropriation of requisite data sets.

Agro-Economic Evaluation

Institutional Setup

2.25 As noted earlier, WM&ED is conducting the agro-economic evaluation of the ISRP-II in NWFP, Sind and Balochistan. The collection of pertinent data for Chowky Distributary and Chowky Minor (NWFP) is carried out by Mardan Regional Office. On Nagna and Puran sub-systems (Sind) the data collection is the

responsibility of Hyderabad Regional Office. Similarly, for Kurak and Sibi Branches of Nari Canal (Balochistan) the collection of data is carried out by Quetta Regional Office. The technical staff as mentioned earlier, deputed for collection of all the data in the three Regional Offices, is directly supervised by the respective Senior Research Officers (Incharge of Regional Office), technically and logistically.

2.26 WM&ED functions under the administrative control of Chief Engineer, Planning and Investigation, Planning Division, WAPDA. The Project Director of the WM&ED on the overall, supervises all the administrative, financial and technical activities for the agro-economic evaluation of ISRP-II, in addition to the other projects. At Headquarters, he is assisted by a Director (Stat.) and Deputy Directors in various disciplines (Agri.Engg., Agronomy, Agri.Eco., Sociology, Statistics). The multi-disciplinary expertese available in the WM&ED, are utilized for the ISRP-II and other projects in hand, as needed in accordance with the nature, scope and objective of various projects subjected to monitoring and evaluation.

CHAPTER-III

IRRIGATION WATER SUPPLIES

3.01 This chapter describes the results of water flow below outlet (source discharge), delivery efficiency, time of irrigation per unit area and watertable depth as derived through physical measurements on the eighteen selected watercourses of four distributaries included in the programme of Irrigation Systems Rehabilitation Project. The data have been collected with two rounds of observations during a season and extend as a whole, over a period of 13 months from April 1991 to April 1992. Main purpose of this activity is to establish bench marks for studying the effect of the project improvements on the equity and reliability of irrigation supplies at watercourse and farm level.

3.02 In accordance with the Agreement, the source discharge and delivery efficiency data were collected for three farms (one each in head, middle and tail reaches) on each sample watercourse. The criterion was later on revised (August 1991) to six farms per watercourse, i.e., two in each of the three reaches.

3.03 Results based on the bench-mark data are presented in Tables III-1 to 15. Data given in these tables represent the weighted (in case of discharge and delivery efficiency) and simple (in case of time of irrigation and watertable depth) average of the reach-wise observations for the sample watercourses categorized with respect to head/middle/tail reaches of the distributary/minor. The detailed supporting data by systems are given in Annexure-3 (Tables 3.1 to 3.4) alongwith necessary identification codes (Appendix-III). The pertinent results regarding each distributary are discussed below.

I Chowky System

3.04 The results reported , in true sense, do not represent pre-project conditions as the rehabilitation works were almost completed prior to bench-mark measurements. The results for five study watercourses (3, including 1 already lined, in Chowky Distributary and 2 in Chowky Minor-I) are derived from the data collected during the transition period April-October 1991 covering Kharif 1991 crop season. These results are summarized in Tables III-1 to 4 and discussed below for the distributary and the minor separately.

Source Discharge

3.05 Chowky Distributary: The source discharge shows variation during the observation period for the head (0.3-1.3 cusecs), tail lined (0.3-1.4 cusecs) and the tail unlined (0.2-0.7 cusecs) watercourses (Table III-2). The watercourses at head and tail reaches had been drawing respectively 10 and 58 percent less than the designed discharge during the measurement period. This

indicates inequitable distribution of supplies between head and tail reach of the distributary (Table III-1). The coefficient of equity (2.14) also indicates inequitable distribution as supplies are supposed to be equitable when the coefficient approaches unity. Discharge at the two tail outlets is highly inequitable as the ratio (Qm/Qd) is 0.85 in one case and 0.21 for the other. It is quite a complex system due to wide variation in outlet discharge which requires intensive measurements to arrive at a reliable estimate of water supply at different times during the year.

3.06 **Chowky Minor-I:** The source discharge varied at the middle (0.4-0.7 cusecs) and tail (0.7-1.3 cusecs) watercourses. Variation is quite apparent in the case of tail watercourse (Table III-2). Compared with the designed discharge, average withdrawals during the observation period remained 64 percent less at the middle watercourse but equal to designed discharge in the case of tail watercourse. The coefficient of equity between middle and tail reach of the minor has been worked-out as 0.36 (Table III-1). In this case, inequity is applicable to middle reach watercourse only as the tail watercourse had actual discharge equal to the designed.

Delivery Efficiency

3.07 **Chowky Distributary:** The delivery efficiency of lined watercourse remained higher than that of the two unlined by 9-10 percent in head, 7-22 percent in middle and by 10 percent in tail reach (Table III-2). This shows that rehabilitation of distributary if combined with watercourse lining, more water can be delivered to the farms.

3.08 **Chowky Minor-I:** The results indicate delivery efficiency respectively for the head, middle and tail reaches of the middle watercourse as 83, 81 and 64 percent and the tail watercourse as 83, 84 and 70 percent. The tail reach of tail watercourse being well-maintained and shorter in length shows better results as compared with the middle watercourse (Table III-2).

Time of Irrigation per Unit Area

3.09 **Chowky Distributary:** Time of irrigation is influenced by the nucca discharge, soil texture and the field conditions, specifically soil moisture and levelness of field. The results presented in Table III-3 show higher values of irrigation time (around 6 hours and above) in different reaches of the sample watercourses which are due to extremely low field nucca and outlet discharge. Since, discharge at source is different during irrigation at head, middle and tail reaches, the time of irrigation also varies.

3.10 **Chowky Minor-I:** The tail watercourse shows an increasing trend from head to tail reach, whereas the middle watercourse behaves in a different manner giving somewhat mixed type of trend (Table III-3). Tail reach of both the watercourses shows higher irrigation time due to low supply at the field nucca resulting from the increased conveyance losses with the increase in distance.

Watertable Depth

3.11 **Chowky Distributary:** Lined watercourse shows deeper watertable (13.85-15.52 meters) as compared to the unlined (2.92-11.13 meters) at the tail of the distributary. However, waterlogging is not a problem even on the tail of tail watercourse (Table III-4). In case of further rise in watertable, tail reach of the tail unlined watercourse is likely to suffer.

Table III-1

COMPARISON BETWEEN MEASURED AND DESIGNED DISCHARGES

KHARIF 1991

CHOWKY SYSTEM

Watercourse	Outlet Discharge (Cusecs)		Percent Variation of Measured from Designed Discharge	Qm / Qd
	Designed (Qd)	Measured (Qm)		
Chowky Distributary				
Head	0.98	0.88	- 10	0.90
Tail				
Lined	0.92	0.78	- 15	0.85
Unlined	1.89	0.40	- 79	0.21
Mean	1.41	0.59	- 58	0.42
C.E. a/	-	-	-	2.14
Chowky Minor-I				
Middle	1.45	0.52	- 64	0.36
Tail	0.95	0.95	0	1.00
C.E. a/	-	-	-	0.36

a/ Coefficient of Equity = $\dfrac{(Qm/Qd)_{head\ or\ middle}}{(Qm/Qd)_{tail}}$

Table III-2

REACH-WISE DELIVERY EFFICIENCY OF MAIN WATERCOURSE
KHARIF 1991

CHOWKY SYSTEM

CHOWKY DISTRIBUTARY

Water-course Reach	Head Watercourse			Tail Watercourses					
	Unlined			Lined			Unlined		
	Distance From Source (Meters)	Discharge At Source (Cusecs)	Effi-ciency (%)	Distance From Source (Meters)	Discharge At Source (Cusecs)	Effi-ciency (%)	Distance From Source (Meters)	Discharge At Source (Cusecs)	Effi-ciency (%)
Head	820	0.34	85	295	0.61	94	668	0.22	84
Middle	1105	1.33	64	553	1.41	86	1502	0.33	79
Tail	1502	0.45	64	768	0.27	74	1908	0.66	74

CHOWKY MINOR-I

Watercourse Reach	Middle Watercourse			Tail Watercourse		
	Unlined			Unlined		
	Distance From Source (Meters)	Discharge At Source (Cusecs)	Effi-ciency (%)	Distance From Source (Meters)	Discharge At Source (Cusecs)	Effi-ciency (%)
Head	462	0.65	83	161	1.26	83
Middle	808	0.60	81	360	0.84	84
Tail	1155	0.40	64	670	0.71	70

Table III-3

TIME OF IRRIGATION PER UNIT AREA
KHARIF 1991

CHOWKY SYSTEM

CHOWKY DISTRIBUTARY

(Hours/Acre)

Watercourse Reach	Head Watercourses	Tail Watercourses	
	Unlined	Lined	Unlined
Head	8.00	6.09	6.96
Middle	4.40	6.30	8.82
Tail	6.97	3.02	6.22

CHOWKY MINOR-1

(Hours/Acre)

Watercourse Reach	Middle Watercourse	Tail Watercourse
	Unlined	Unlined
Head	6.36	3.57
Middle	5.96	5.77
Tail	8.91	9.83

3.12 <u>Chowky Minor-I:</u> Watertable in the command of tail watercourse remained shallow (1.85- 2.43 meters) as compared to the middle watercourse (6.50-8.23 meters). In case of tail watercourse, the depth to watertable remained minimum at the tail (1.85 meters) and maximum at the head (2.43 meters) reach (Table III-4). Although, watertable has not exposed any danger of waterlogging so far but there is very little margin in case the watertable rises further.

Table III-4

WATER TABLE DEPTH

KHARIF 1991

CHOWKY SYSTEM

CHOWKY DISTRIBUTARY

(Meters)

Watercourse Reach	Head Watercourse	Tail Watercourses	
	Unlined	Lined	Unlined
Head	8.23	15.52	11.13
Middle	8.84	15.22	4.93
Tail	8.23	13.85	2.92

CHOWKY MINOR-I

(Meters)

Watercourse Reach	Middle Watercourse	Tail Watercourse
	Unlined	Unlined
Head	8.23	2.43
Middle	6.50	2.23
Tail	8.23	1.85

II Puran System

3.13 This system is represented by four watercourses, off-taking two each from Puran Distributary and Puran Minor. The results presented in Tables III-5 to 8 are based on the data collected during the period July 1991-March 1992, covering two crop seasons, i.e. Kharif 1991 and Rabi 1991-92. As rehabilitation work could not be completed in time, data collection schedule was extended to cover Rabi 1991-92.

Source Discharge

3.14 **Puran Distributary:** Variation in outlet discharge of tail watercourse is more conspicuous during Rabi season (1.0-1.7 cusecs). Head watercourse does not involve large variation in outlet discharge during the observation period (Table III-6). The head watercourse is more privileged because of excess supplies during both the seasons (43 percent during Kharif and 62 percent during Rabi), compared with the tail watercourse with 6 and 49 percent excess discharge during Kharif and Rabi, respectively. Thus, inequity is more prominent during Kharif season (Table III-5).

3.15 **Puran Minor:** The source discharge at the head watercourse varied slightly (1.7-2.0 cusecs) during Kharif but remained almost constant (2.0 cusecs) during Rabi season. In case of tail watercourse, the outlet discharge varied (1.8-2.5 cusecs) during Kharif and remained constant (2.2 cusecs) during Rabi season (Table III-6). Also, the head watercourse was observed drawing excess water than its designed discharge by 53 percent during Kharif and 73 percent during Rabi season (Table III-5).As designed

Table III-5

COMPARISON BETWEEN MEASURED AND DESIGNED DISCHARGES

PURAN SYSTEM

Water-course	Outlet Discharge (Cusecs)			Percent Variation of Measured from Designed Discharge		Qm / Qd	
	Designed (Qd)	Measured (Qm)					
		Kharif 1991	Rabi 1991-92	Kharif 1991	Rabi 1991-92	Kharif 1991	Rabi 1991-92
Puran *Disty*.							
Head	1.75	2.51	2.83	43	62	1.43	1.62
Tail	0.94	1.00	1.40	6	49	1.06	1.49
C.E.	-	-	-	-	-	1.35	1.09
Puran Minor							
Head	1.18	1.80	2.04	53	73	1.53	1.73
Tail	N.A.a/	2.03	2.23	-	-	-	-

a/ Not Available with the Irrigation Department.

discharge was not available for tail watercourse, no such comparison could be made.

Delivery Efficiency

3.16 **Puran Distributary:** The delivery efficiency of head watercourse, in its head, middle and tail reaches, is worked-out as 73,55 and 58 percent respectively, during Kharif and 78, 65 and 64 percent during Rabi season (Table III-6). Low delivery efficiency of head watercourse in middle reach is due to higher elevation of the fields being irrigated directly from the main watercourse. In terms of delivery efficiency, it can be regarded as an average watercourse.

3.17 Regarding tail watercourse, the command area is located 3-6 feet higher than the watercourse bed level. The fields are irrigated by lifting water at different points on the main watercourse, using camels in head reach and diesel pumps of varying capacity in middle and tail reaches, thus giving an extra cost to the farmers. Water from the outlet flows under gravity upto the lifting point and under pressure onwards upto the fields. The discharge at farm nucca is dependent on the type of water-lifting source and further the capacity in case the source is mechanical. So, working-out conveyance efficiency of the watercourse under such a peculiar condition makes no sense. However, to represent the existing conditions, water supply at farm nucca has been computed and presented in Table III-6. Results obtained during the two crop seasons show water supply at the farm nucca with camel-lifting (0.3 cusec) in head reach and mechanical pumping (0.7-1.1 cusecs) in middle and tail reaches of the watercourse.

3.18 **Puran Minor:** The delivery efficiency of head watercourse works-out as 77, 76 and 52 percent during Kharif and 82, 74 and 60 percent during Rabi season, respectively, for the head, middle and tail reaches (Table III-6). It is low for Kharif season.

3.19 The service area of tail watercourse starts from a point located 1174 meters below the outlet on the main watercourse. As such, reach-wise division of this watercourse (main) has been carried-out by excluding the blind length (1174 meters). The delivery efficiency of this watercourse in its head, middle and tail reaches, is worked-out as 66, 63 and 69 percent, respectively, during Kharif and 67, 67 and 62 percent during Rabi season (Table III-6). Seasonal efficiencies are comparable but low for the upper reaches.

Time of Irrigation per Unit Area

3.20 **Puran Distributary:** An overall view of the results regarding head watercourse is that time of irrigation increases from head to tail in both the crop seasons. It is a reflection of inequity at watercourse command level. The tail watercourse shows higher values of irrigation time in head reach mainly because of low capacity of camel-lifting practised in that reach (Table III-7). It represents very peculiar conditions.

Table III-6

REACH-WISE DELIVERY EFFICIENCY OF MAIN WATERCOURSE

PURAN SYSTEM

PURAN DISTRIBUTARY

Water-course Reach	Head Watercourse						Tail Watercourse					
	Unlined						Unlined					
	Distance From Source (Meters)		Discharge At Source (Cusecs)		Effi-ciency (%)		Distance From Source (Meters)		Discharge (Cusecs) At Source		Discharge (Cusecs) At Farm Nucca(after water-lifting)	
	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92
Head	823	568	2.60	2.85	73	78	556	556	0.89	1.00	0.30 a/	0.30 a/
Middle	1657	1158	2.34	2.75	55	65	1387	1258	1.13	1.66	0.87 b/	1.12 b/
Tail	2265	1706	2.58	2.93	58	64	1991	1991	0.99	1.38	0.65 b/	0.87 b/

PURAN MINOR

Water-course Reach	Head Watercourse						Tail Watercourse					
	Unlined						Unlined					
	Distance From Source (Meters)		Discharge At Source (Cusecs)		Effi-ciency (%)		Distance c/ From Source (Meters)		Discharge At Source (Cusecs)		Effi-ciency (%)	
	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92
Head	441	358	1.75	2.00	77	82	1174+ 712	1174+ 712	1.79	2.19	66	67
Middle	858	889	1.70	2.08	76	74	1174+ 1435	1174+ 1474	2.45	2.15	63	67
Tail	1304	1279	1.95	2.02	52	60	1174+ 2239	1174+ 2092	1.97	2.15	69	62

a/ Involves lifting of water using camels.

b/ Water lifting is done by diesel pumps.

c/ The service area starts beyond a distance of 1174 meters (main water-course) from the outlet. So, reach-wise division of the watercourse has been carried-out beyond its blind length (1174 m).

3.21 **Puran Minor:** The time of irrigation has an increasing trend from head to tail reach during both the seasons. In case of tail watercourse, the head reach shows higher irrigation time due to low nucca discharge and the field conditions (soil moisture and levelness of field) prevailing at the time of measurements (Table III-7).

Table III-7

TIME OF IRRIGATION PER UNIT AREA

PURAN SYSTEM

PURAN DISTRIBUTARY

(Hours/Acre)

Watercourse Reach	Head Watercourse		Tail Watercourse	
	Kharif 1991	Rabi 1991-92	Kharif 1991	Rabi 1991-92
Head	2.55	2.13	6.00	7.00
Middle	2.82	3.45	2.93	3.42
Tail	3.53	3.82	2.96	2.97

PURAN MINOR

(Hours/Acre)

Watercourse Reach	Head Watercourse		Tail Watercourse	
	Kharif 1991	Rabi 1991-92	Kharif 1991	Rabi 1991-92
Head	2.95	3.49	5.41	4.72
Middle	3.21	3.22	3.34	2.32
Tail	4.09	3.94	3.20	3.29

Watertable Depth

3.22 **Puran Distributary:** Watertable in the command of head watercourse was observed as 4.55 meters during Kharif and 5.06-5.69 meters during Rabi season. In case of tail watercourse, the watertable remained at a deeper level (9.10 meters) during both the seasons (Table III-8). There is neither a problem of waterlogging on the study watercourses, nor any significant contribution to crop water requirements.

3.23 **Puran Minor:** Watertable at the head watercourse remained within the range of 1.66-1.92 meters during the observation period showing some improvement during Rabi season. However, tail watercourse shows some reach-wise variation of 1.31-1.36 meters during Kharif and 1.58-1.82 meters during Rabi (Table III-8). Kharif crops, especially deep-rooted on tail watercourse, are likely to suffer in growth and production.

Table III-8

WATER TABLE DEPTH

P U R A N S Y S T E M

PURAN DISTRIBUTARY

(Meters)

Watercourse Reach	Head Watercourses		Tail Watercourse	
	Kharif 1991	Rabi 1991-92	Kharif 1991	Rabi 1991-92
Head	4.55	5.69	9.10	9.10
Middle	4.55	5.06	9.10	9.10
Tail	4.55	5.06	9.10	9.10

PURAN MINOR

(Meters)

Watercourse Reach	Head Watercourses		Tail Watercourse	
	Kharif 1991	Rabi 1991-92	Kharif 1991	Rabi 1991-92
Head	1.66	1.81	1.31	1.82
Middle	1.66	1.92	1.36	1.58
Tail	1.62	1.92	1.36	1.82

III Nagna System

3.24 Five watercourses (with two already lined under some other programme) off-taking from Nagna Distributary have been studied. The results as derived from the data collected during the period June 1991-March 1992 (Kharif 1991 and Rabi 1991-92) are presented in Tables III-9 to 12.

Source Discharge

3.25 An overall view of the results indicate slight variation in source discharge of the sample watercourses during the observation period (Table III-10). Watercourses in head and tail reach of the distributary had been drawing excess supplies than their designed discharge by 49-57 percent during Kharif and 46-69 percent during Rabi season. The coefficients (0.95 for Kharif and 0.86 for Rabi) indicate some inequity between the head and tail reach of the distributary (Table III-9).

Table III-9

COMPARISON BETWEEN MEASURED AND DESIGNED DISCHARGES

NAGNA SYSTEM

Watercourse	Outlet Discharge (Cusecs)			Percent Variation of Measured from Designed Discharge		Qm / Qd	
	Designed (Qd)	Measured (Qm)					
		Kharif 1991	Rabi 1991-92	Kharif 1991	Rabi 1991-92	Kharif 1991	Rabi 1991-92
Nagna Disty							
Head							
Lined	1.69	2.57	2.43	52	44	1.52	1.44
Unlined	1.03	1.50	1.52	46	48	1.46	1.48
Mean	1.36	2.03	1.98	49	46	1.49	1.46
Middle							
Lined	3.04	2.91	2.84	-4	-7	0.96	0.93
Unlined	1.85	3.74	3.50	102	89	2.02	1.89
Mean	2.44	3.32	3.17	36	30	1.36	1.30
Tail	1.34	2.11	2.27	57	69	1.57	1.69
C.E.	-	-	-	-	-	0.95	0.86

Delivery Efficiency

3.26 Compared with the unlined, the delivery efficiency of lined watercourses remained higher during the observation period (Table III-10). The difference is low (only 2 percent) in the case of head lined and unlined watercourses when compared for Rabi

season. Its reason is good head-reach efficiency (88 percent) achieved by the head (unlined) watercourse as a result of silt removal and proper maintenance.

3.27 Delivery efficiency during the two seasons remained comparatively high in tail reach of head lined and low in middle reach of middle unlined watercourse. It is due to low (in case of head lined watercourse) and high (in case of middle unlined watercourse) elevation of the sample fields which were being irrigated directly from the main watercourse.

3.28 The tail watercourse of this system runs from its head to tail with the bed level about 4-5 feet below ground surface. To provide irrigation to the highly-elevated fields, water is lifted at various places on the main watercourse using camels and diesel pumps in head reach and only diesel pumps in middle and tail reaches, thus giving an extra cost to the farmers. As mentioned earlier (para 3.17), working-out the delivery efficiency of this watercourse under such peculiar conditions makes no sense. However, the existing water supply at farm nucca has been worked-out and presented in Table III-10. Results during the two crop seasons show water supply of 1.4-1.5 cusecs in head reach (with animal-lifting and mechanical pumping) and 1.8-1.9 cusecs in middle and tail reaches (with mechanical pumping).

Time of Irrigation per Unit Area

3.29 While looking at the results (Table III-11), an increasing trend from head to tail reach can be observed during both the seasons, except for some deviations mostly in middle reach, reasons of which mainly pertain to field nucca discharge and the field conditions (soil moisture and levelness of field). Also, the time of irrigation has increased during Rabi compared with Kharif season. Results clearly show that the tail farmers are at a great disadvantage compared with head farmers in terms of time of irrigation per unit area.

Watertable Depth

3.30 Watertable at the two head watercourses remained shallow (1.63-2.12 meters) during the observation period, as compared with the middle (1.90-3.00 meters) and tail (4.30-4.50 meters) watercourses. Watertable fluctuations during the two seasons (Kharif and Rabi) are prominent in head watercourses with the lined (1.85-2.12 meters) and unlined (1.63-1.82 meters). Regarding middle watercourses, the watertable was observed relatively deeper at the unlined (3.00 meters), as compared with the lined (1.90-2.12 meters) watercourses (Table III-12). In case of further rise of watertable, head watercourse farmers are likely to hit first by waterlogging.

Table III-10

REACH-WISE DELIVERY EFFICIENCY OF MAIN WATERCOURSE

M A G N A S Y S T E M

Water-course Reach	Head Watercourses												Tail Watercourse					
	Lined						Unlined						Unlined					
	Distance From Source (Meters)		Discharge At Source (Cusecs)		Effi-ciency (%)		Distance From Source (Meters)		Discharge At Source (Cusecs)		Effi-ciency (%)		Distance From Source (Meters)		Discharge (Cusecs) At Source		Discharge (Cusecs) At Farm Nucca (after water lifting)	
	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92
Head	536	329	2.58	2.44	85	90	579	538	1.50	1.55	77	88	481	487	2.08	2.28	a/ 1.40	a/ 1.51
Middle	1509	1509	2.65	2.40	76	67	1219	1240	1.50	1.55	67	67	-	b/ 1304	-	2.30	-	c/ 1.92
Tail	2221	2221	2.48	2.40	76	78	1853	1687	1.49	1.45	56	51	b/ 1304	b/ 1304	2.15	2.13	c/ 1.83	c/ 1.80

Water-course Reach	Middle Watercourses											
	Lined						Unlined					
	Distance From Source (Meters)		Discharge At Source (Cusecs)		Effi-ciency (%)		Distance From Source (Meters)		Discharge At Source (Cusecs)		Effi-ciency (%)	
	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92	Kh 91	R 91-92
Head	1046	355	2.94	2.88	88	93	974	974	3.89	3.52	83	79
Middle	2036	2036	2.85	2.80	74	65	1637	1637	3.65	3.40	60	57
Tail	3090	2870	2.95	2.80	68	66	2824	2840	3.69	3.50	75	71

a/ Involves lifting of water using canel and diesel pumps.

b/ Farms in middle and tail reaches are irrigated from the same nucca located at a distance of 1304 meters on main watercourse.

c/ Involves waterlifting through diesel pumps.

Table III-11

TIME OF IRRIGATION PER UNIT AREA

NAGNA SYSTEM

(Hours/Acre)

Water-course Reach	Head Watercourses				Middle Watercourses				Tail Watercourse	
	Lined		Unlined		Lined		Unlined		Unlined	
	Kharif 1991	Rabi 91-92	Kharif 1991	Rabi 91-92	Kharif 1991	Rabi 91-92	Kharif 1991	Rabi 91-92	Kharif 1991	Rabi 91-92
Head	2.15	3.93	1.06	2.28	1.44	2.46	1.15	2.08	3.96	4.30
Middle	1.93	2.54	1.47	3.55	2.29	3.33	1.54	1.65	-	3.47
Tail	4.58	5.69	3.07	3.64	2.46	3.43	1.23	3.04	3.45	5.13

Table III-12

WATER TABLE DEPTH

N A G N A S Y S T E M

(Meters)

Water-course Reach	Head Watercourses				Middle Watercourses				Tail Watercourse	
	Lined		Unlined		Lined		Unlined		Unlined	
	Kharif 1991	Rabi 91-92	Kharif 1991	Rabi 91-92	Kharif 1991	Rabi 91-92	Kharif 1991	Rabi 91-92	Kharif 1991	Rabi 91-92
Head	1.85	1.98	1.82	1.63	1.90	2.06	3.00	3.00	4.50	4.37
Middle	1.90	2.12	1.82	1.63	1.90	2.12	3.00	3.00	4.50	4.30
Tail	1.90	2.12	1.82	1.63	1.90	2.07	3.00	3.00	4.50	4.50

IV Nari System

3.31 This system is markedly different from canal-irrigated areas of Punjab and Sind as small portion of the commanded area is cropped in a crop season which is usually confined to one or two reaches. This system is represented by four study watercourses off-taking two each from Sibi and Kurak branches. The results presented in Tables III-13 to 15 are based on the data collected during the period June 1991-April 1992 covering Kharif 1991 and Rabi 1991-92 seasons. Observation period was extended to cover Rabi 1991-92 as rehabilitation works were not taken up in time.

3.32 As the cropped area served by watercourses in Nari system is changed from season to season, the criterion has been adopted with some modifications. Length of each watercourse was equally divided into three reaches by including the blind length, as, with the shifting of the cropped area, the watercourse length also changes from season to season. The condition to cover 6 farms per watercourse has been fulfilled even if the entire cropped area was confined to single reach.

Source Discharge

3.33 **Sibi Branch:** The two study watercourses bifurcate into two branches immediately below the outlet. Water from outlet is allowed to flow into the two branches simultaneously all the time. So, comparatively larger branches, i.e. left branch of watercourse OT-6 and right branch of watercourse OT-7, were selected. It is added that no watercourse off-takes from head or middle reach of the distributary.

3.34 The outlet discharge of the two tail watercourses (OT-6 and OT-7) shows a variation of 3-4 cusecs during Kharif and 2.4-3.4 cusecs during Rabi seasons, indicating that irrigation supplies at the two watercourses remained low during Rabi as compared with Kharif season (Table III-14). Compared with the designed discharge, withdrawals during the observation period remained 22-25 percent less at the tail watercourse OT-6 and higher (by 28 percent during Kharif) at the other tail watercourse OT-7 (Table III-13). Thus, one tail watercourse had been drawing excess water at the cost of other tail watercourse.

3.35 **Kurak Branch:** The tail watercourse bifurcates into two branches at a distance of about 30 meters below the outlet. Water from the outlet is allowed to flow into the two branches at the same time. So, the right branch, being comparatively larger, was selected for measurements.

3.36 The source discharge of the middle watercourse remained at 1.4 cusecs during both the seasons. However, the outlet discharge of tail watercourse shows variation of 0.9-1.5 cusecs during Kharif and remained at 1.3 cusecs during Rabi season (Table III-14). Also, the middle watercourse had been drawing 89-96 percent excess (against its designed discharge) during the observation period. The coefficient of equity works-out as 1.99 (Kharif) and 1.96 (Rabi)

which indicates the inequitable distribution of supplies between the middle and tail reach of Kurak branch (Table III-13). Tail watercourse received almost equal to designed discharge but the inequity has resulted from excess supplies drawn by the middle watercourse.

Table III-13

COMPARISON BETWEEN MEASURED AND DESIGNED DISCHARGES

NARI SYSTEM

Water-course	Outlet Discharge (Cusecs)			Percent Variation of Measured from Designed Discharge		Qm / Qd	
		Measured (Qm)					
	Designed (Qd)	Kharif 1991	Rabi 1991-92	Kharif 1991	Rabi 1991-92	Kharif 1991	Rabi 1991-92
Sibi Branch							
Tail							
(OT-6)	4.51	3.54	3.37	- 22	- 25	0.78	0.75
(OT-7)	2.35	3.00	2.35	28	0	1.28	1.00
Kurak Branch							
Middle	0.74	1.40	1.45	89	96	1.89	1.96
Tail	1.33	1.26	1.33	- 5	0	0.95	1.00
C.E.	-	-	-	-	-	1.99	1.96

Delivery Efficiency

3.37 **Sibi Branch:** The delivery efficiency measurements at the watercourse OT-6 were restricted to head and tail reaches during Kharif and only tail reach during Rabi season. At the watercourse OT-7, the measurements were confined to tail reach during Kharif and middle reach during Rabi season. In other reaches, observations could not be taken as no area was cropped on those reaches. The delivery efficiency of watercourse OT-6 has been worked-out as 77 and 70 percent in head and tail reaches respectively, during Kharif and 76 percent in tail reach during Rabi season. Achievement of good tail-reach efficiency (76 percent) during Rabi season is due to watercourse cleaning carried-out in October 1991 (just before

Rabi season). Results regarding watercourse OT-7 show delivery efficiency of 71 percent in tail reach during Kharif and 81 percent in middle reach during Rabi season (Table III-14).

3.38 **Kurak Branch:** The delivery efficiency measurements at the middle watercourse were confined to middle reach during Kharif and tail reach during Rabi season. At the tail watercourse, the observations were recorded for all the three reaches during Kharif but restricted to only tail reach during Rabi season due to non-existence of crops in the other two reaches. Delivery efficiency of middle watercourse is worked-out as 71 percent in middle reach during Kharif and 81 percent in tail reach during Rabi season. Achievement of good tail-reach efficiency (81 percent) during Rabi season is attributable to the watercourse cleaning done (in October 1991) prior to the start of measurements during Rabi season. The delivery efficiency of tail watercourse works-out as 88, 82 and 68 percent, respectively, in its head, middle and tail reaches during Kharif and 78 percent in the tail reach during Rabi season (Table III-14). These efficiencies can be rated as normal.

Time of Irrigation per Unit Area

3.39 **Sibi Branch:** Results regarding Sibi Branch watercourses are constrained due to restricted cropped area (mostly confined to single reach) that too had been shifting from one reach to the other on seasonal basis. As a result, observations could not be taken for the un-cropped reaches of the watercourse. On the basis of the data collected, the results show time of irrigation for watercourse OT-6 as 3.95 and 1.55 hours per acre in head and tail reaches, respectively, during Kharif and 1.55 hours per acre in tail reach during Rabi season. In head reach, more time has been consumed due to unlevel field conditions and high application rates. Similarly, in case of watercourse OT-7, observations were restricted to tail reach (2.51 hours per acre) during Kharif and middle reach (1.60 hours per acre) during Rabi season (Table III-15). Middle and tail reach differences are understandable in this case.

3.40 **Kurak Branch:** Results in respect of watercourses under Kurak Branch are facing similar type of situation due to the reasons as explained earlier under Sibi branch. Observations at the middle watercourse were confined to middle reach (2.39 hours per acre) during Kharif and tail reach (3.63 hours per acre) during Rabi season (Table III-15). Regarding tail watercourse, results during Kharif season indicate an increasing trend from head to tail reach while during Rabi season, observations were restricted to only tail reach (4.18 hours per acre). Increase in irrigation time from head to tail is usual as discharge at field nucca decreases due to increased conveyance losses with the increase in distance.

Watertable Depth

3.41 Command area of the sample watercourses was underlain by deep watertable mostly below 9 meters for Sibi and 11 meters in the case of Kurak branch watercourses.

Table III-14

REACH-WISE DELIVERY EFFICIENCY OF MAIN WATERCOURSE

N A R I S Y S T E M

S I D I B R A N C H

Watercourse Reach	Tail Watercourses															
	Unlined (OT-6)								Unlined (OT-7)							
	Distance From Source (Meters)		Discharge (Cusecs) Source		Discharge (Cusecs) Bifurcation		Efficiency (%)		Distance From Source (Meters)		Discharge (Cusecs) Source		Discharge (Cusecs) Bifurcation		Efficiency (%)	
	Kh-91	R 91-92	Kh-91	R 91-92	Kh-91	R 91-92	Kh-91	R 91-92	Kh-91	R 91-92	Kh-91	R 91-92	Kh-91	R 91-92	Kh-91	R 91-92
Head	778	a/	3.08	a/	1.50	a/	77	a/	a/	a/	a/	a/	a/	a/	a/	a/
Middle	a/	a/	a/	a/	a/	a/	a/	a/	a/	6143	a/	2.35	a/	1.59	a/	81
Tail	8020	11440	4.00	3.37	2.30	1.65	70	76	9081	a/	3.00	a/	1.48	a/	71	a/

K U R A K B R A N C H

Watercourse Reach	Middle Watercourse						Tail Watercourse							
	Unlined						Unlined							
	Distance From Source (Meters)		Discharge at Source (Cusecs)		Efficiency (%)		Distance From Source (Meters)		Discharge (Cusecs) Source		Discharge (Cusecs) Bifurcation		Efficiency (%)	
	Kh-91	R 91-92	Kh-91	R 91-92	Kh-91	R 91-92	Kh-91	R 91-92	Kh-91	R 91-92	Kh-91	R 91-92	Kh-91	R 91-92
Head	a/	a/	a/	a/	a/	a/	820	a/	0.92	a/	0.78	a/	88	a/
Middle	3677	a/	1.40	a/	71	a/	1296	a/	1.48	a/	1.10	a/	82	a/
Tail	a/	5875	a/	1.45	a/	81	2645	2117	1.25	1.33	0.85	0.88	68	78

a/ Observations could not be taken due to non-existance of farms in the reach.

Table III-15

TIME OF IRRIGATION PER UNIT AREA

NARI SYSTEM

(Hours/Acre)

Water-course Reach	SIBI BRANCH				KURAK BRANCH			
	Tail Watercourses				Middle Watercourse		Tail Watercourse	
	Unlined (OT-6)		Unlined (OT-7)		Unlined		Unlined	
	Kharif 1991	Rabi 91-92	Kharif 1991	Rabi 91-92	Kharif 1991	Rabi 91-92	Kharif 1991	Rabi 91-92
Head	3.95	a/	a/	a/	a/	a/	2.09	a/
Middle	a/	a/	a/	1.60	2.39	a/	3.36	a/
Tail	1.55	1.55	2.51	a/	a/	3.63	4.55	4.18

a/ Observations could not be taken due to non-existance of farms in the reach.

Chapter-IV

AGRO-ECONOMIC CONDITIONS

CHOWKY SYSTEM

4.01 This Chapter presents the information and results regarding the agro-economic conditions of the baseline study of one of the four distributary systems. The agro-economic baseline data package and results derived thereof, consist of two types of compiled presentation. The first relates to watercourse commands and the second concentrates to farms. The prominent indicators of Watercourse command level are cropped area, cropping pattern, and cropping intensities, which have been collected for two crop seasons (Kharif-90 and Rabi 90-91).

Results at Watercourse Command Level

Cropping Pattern and Cropping Intensities

4.02 It is postulated that the increased and ensured irrigation supplies with the improvement in reliability and equity in irrigation water supply will bring favourable changes in cropping pattern and cropping intensity. The positive shifts in Cropping pattern and cropping intensity is expected through increase in cropped area as a result of additional supplies. The incremental cropped area generated by the project developments is to be recorded in the context of concept to evaluate the changes. For these reasons a Baseline for cropping pattern and cropping intensity has been established.

4.03 The crop survey data at watercourse command level have been gathered through physical observation and mapping as one of the components of the agro-economic impact study. As mentioned earlier, due to delayed commencement of the evaluation study the field data collection could be started in February, 1991 on this system, consequently the crop acreage data for Kharif-90 could not be physically measured and therefore the same have been obtained from the Provincial Irrigation Department. However, the said data for Rabi 1990-91 was recorded through physical measurements (Plain Table mapping techniques).

4.04 Cropping pattern: The cropping pattern shows the farm progressiveness in relation to the extent to which the cultivated area is put under different crops on priority basis. Cropping pattern reflects the particular agro-climatic zone and the water supply situation. Other factors which influence farmer's choices of cropping patterns are degree of control of irrigation supplies, home consumption need, soil conditions, farm size and tenure status, market demand and location of market. Broadly, chowky system represents wheat-maize cropping pattern.

4.05 The cropping pattern by channel (Chowky Disty, and Minor-I) reach is shown in Table IV-1 and Figure IV-1 to IV-4, whereas the detailed information by watercourse is given in Annexure-4, Table 4.1. The data manifest that the head reach of Chowky Disty is dominated by orchards, maize and sugarcane, occupying 30, 27 and 12 percent of CCA, respectively. The tail reach of disty, presents considerably, less area specifically, under sugarcane (3.36 percent) and orchards (9.71 percent) compared with head reach. Whereas wheat area in tail reach is significantly higher against that in the head reach of the distributary. The reduced share of crop acreage specifically, of the high delta crops (sugarcane and orchards), in the tail reach reflects the inequitable irrigation water supply at lower reach. Further the increase of area under wheat at tail watercourses is due to the land available which is restricted at head because of presence of perennial crops (orchards & sugarcane).

4.06 Chowky Minor-I's results reveal that though the sugarcane area at tail reach is higher by a difference of 10.4 percent but cropped area of all other crops is less as compared with that of middle reach. The other feature is that probably due to less reliability of supplies at tail reach there is no area under orchards.

Table IV-1

CROPPING PATTERN BY CHANNEL REACH

CHOWKY SYSTEM

Season/Crops	Chowky Disty a/			Chowky Mr-1 b/			Overall Chowky System
	Head	Tail	Over all	Middle	Tail	Over all	
Kharif-90							
Sugarcane	12.15	3.36	5.05	21.13	31.57	25.64	12.58
Orchards	30.39	9.71	13.70	11.02	-	6.25	10.97
Tobbacco	23.84	0.49	5.00	9.06	-	5.14	5.05
Maize	27.07	21.19	22.33	29.39	27.23	28.45	24.57
Fodder	0.70	1.61	1.43	1.35	1.70	1.50	1.49
Minor Crops	5.73	5.73	5.58	2.51	4.65	3.44	4.80
Sub Total:	99.13	42.09	53.09	74.46	65.15	70.42	59.47
Rabi 90-91							
Wheat	20.54	44.45	39.82	47.55	40.74	44.60	41.57
Fodder	6.44	4.91	5.21	7.22	12.80	9.63	6.82
Sugarcane	12.15	3.36	5.05	21.13	31.56	25.64	12.58
Orchards	30.39	9.71	13.70	11.02	-	6.25	10.98
Minor Crops	0.22	8.33	6.76	6.21	5.91	6.08	6.51
Sub Total:	69.74	70.76	70.54	93.13	91.01	92.20	78.46
Grand Total:	168.87	112.85	123.63	167.59	156.16	162.62	137.93

a/ One sample watercourse in head and two in tail reach.
b/ Two sample watercourses i.e. one each in middle and tail reach.

4.07 Cropping Intensity: Cropping Intensity is defined as sum of cropped area for Kharif and Rabi as percent of Culturable Commanded Area. One of the major objective of ISR-project is to improve the equity and reliability in irrigation water supplies through rehabilitation of Channels. The enhancement of irrigation supplies may help in increasing the cropped area, especially of high delta crops.

4.08 A summary of the cropping intensity for 5 sample watercourses representing for different channel reaches and overall system is given in Table IV-2 and shown in Figures IV-5 & IV-6.

4.09 The cropping intensity information reveals that on Chowky Disty the head reach (one watercourse) figures out annual cropping intensity as about 169 percent which is higher by a difference of about 56 percent than of tail reach (2 watercourses) of the disty. AS the Kharif intensities for head and tail reaches widely differ whereas these are comparable for Rabi season, inequity is most dominant during Kharif season only. On Chowky Minor-I the cropping intensity in middle is about 168 percent against 156 percent in tail and this narrow margin reflects equitable water supply upto tail reach of the minor. Compared with chowky distributary, water supply situation at the tail of Minor-I is much better.

Table IV-2

CROPPING INTENSITY BY CHANNEL REACH
CHOWKY SYSTEM
(1990-91)

Season	Head	Middle	Tail	Overall For Channel
Chowky Disty				
Kharif	99.13	-	42.09	53.09
Rabi	69.74	-	70.76	70.54
Annual	168.87	-	112.85	123.63
Chowky Minor-I				
Kharif	-	74.46	65.15	70.42
Rabi	-	93.13	91.01	92.22
Annual	-	167.59	156.16	162.64

Percent of CCA.

4.10 Cropping Intensity of Lined and Unlined Watercourses: As earlier explained, the watercourse sample also represents the improvement with lining for Chowky System. Due to control over conveyance losses on lined watercourses their agricultural performance is likely to be better than the unlined watercourses, an added advantage under ISM-II Project. The baseline results regarding cropping intensity

Cropping Pattern By Channel Reach
Chowky Distributary
Kharif - 1990

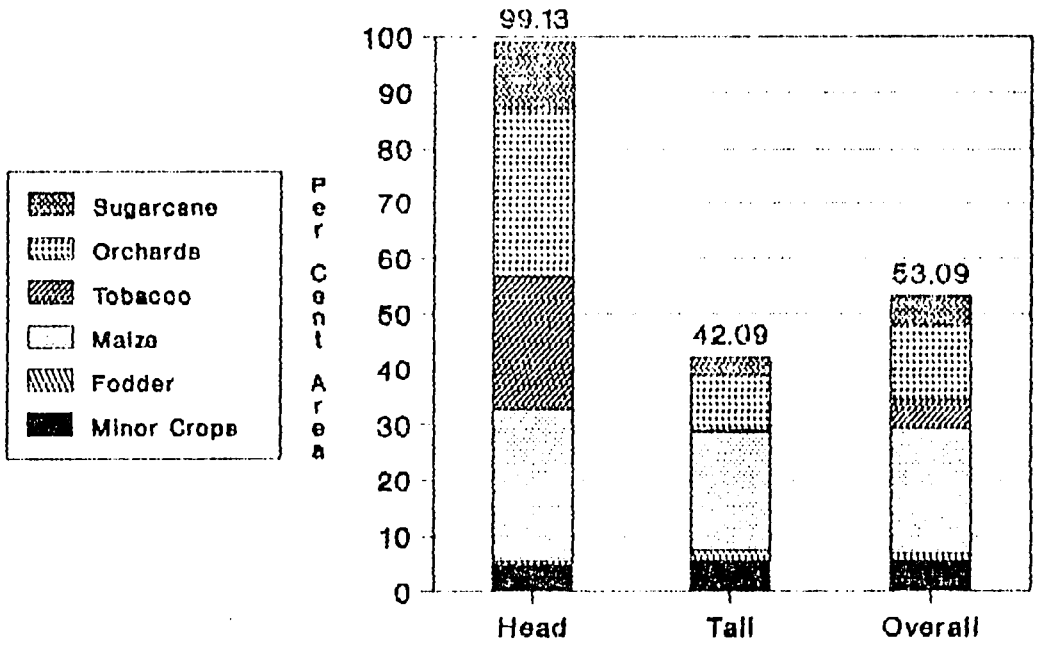


Figure IV-1

Cropping Pattern By Channel Reach
Chowky Distributary
Rabi 1990-91

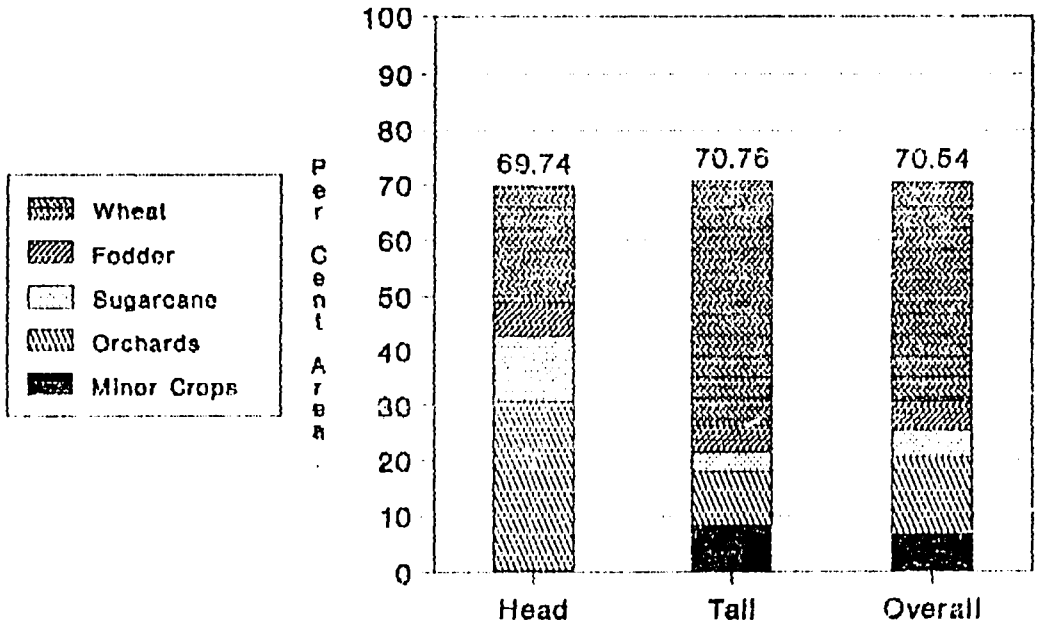


Figure IV-2

Cropping Pattern By Channel Reach
Chowky Minor-1
Kharif 1990

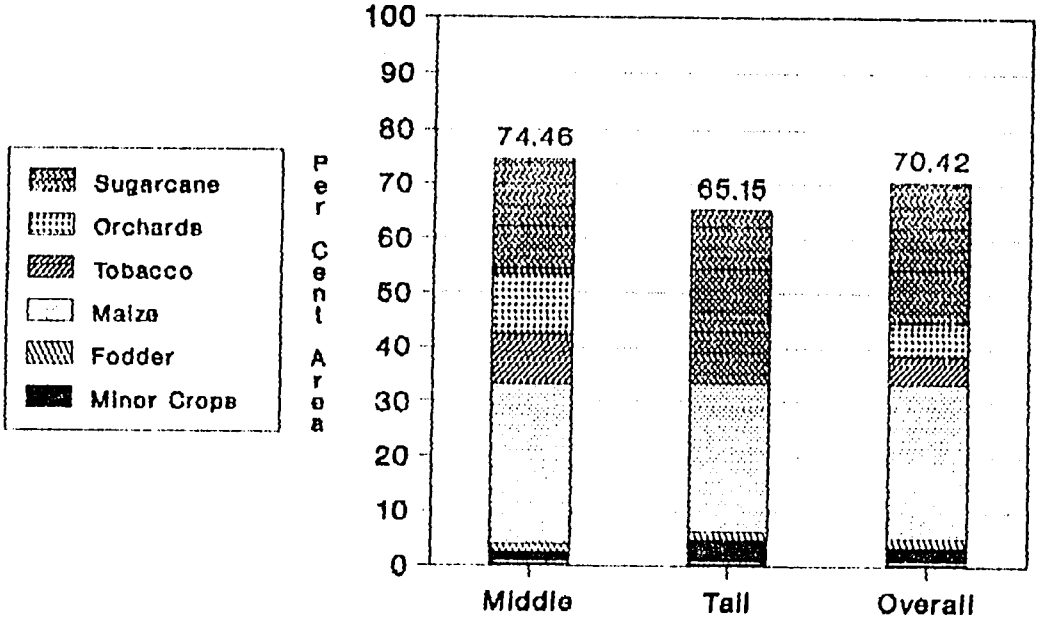


Figure IV-3

Cropping Pattern By Channel Reach
Chowky Minor-1
Rabi 1990-91

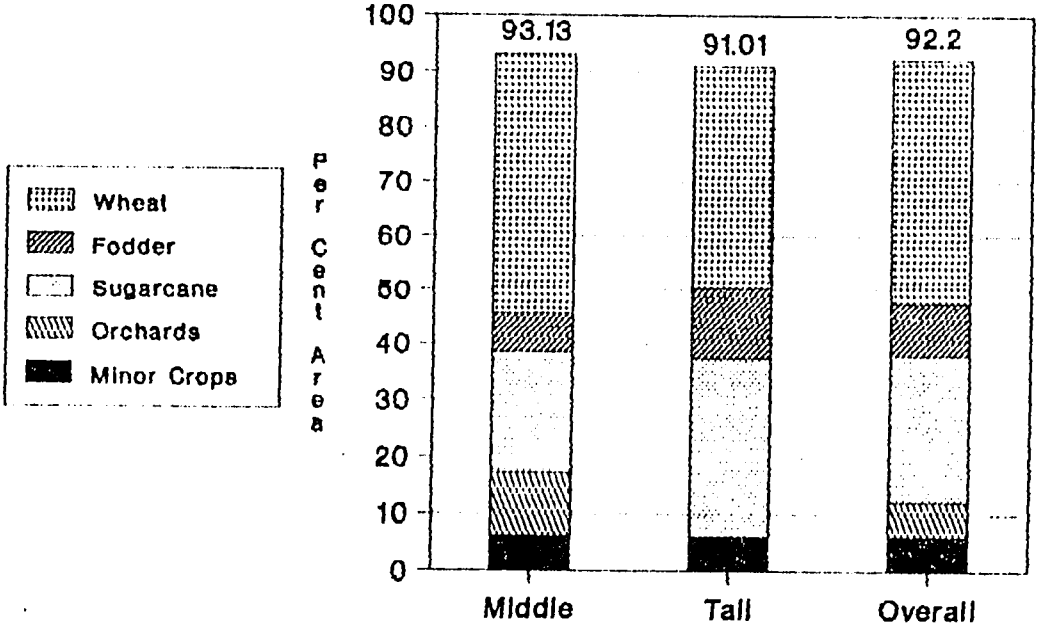
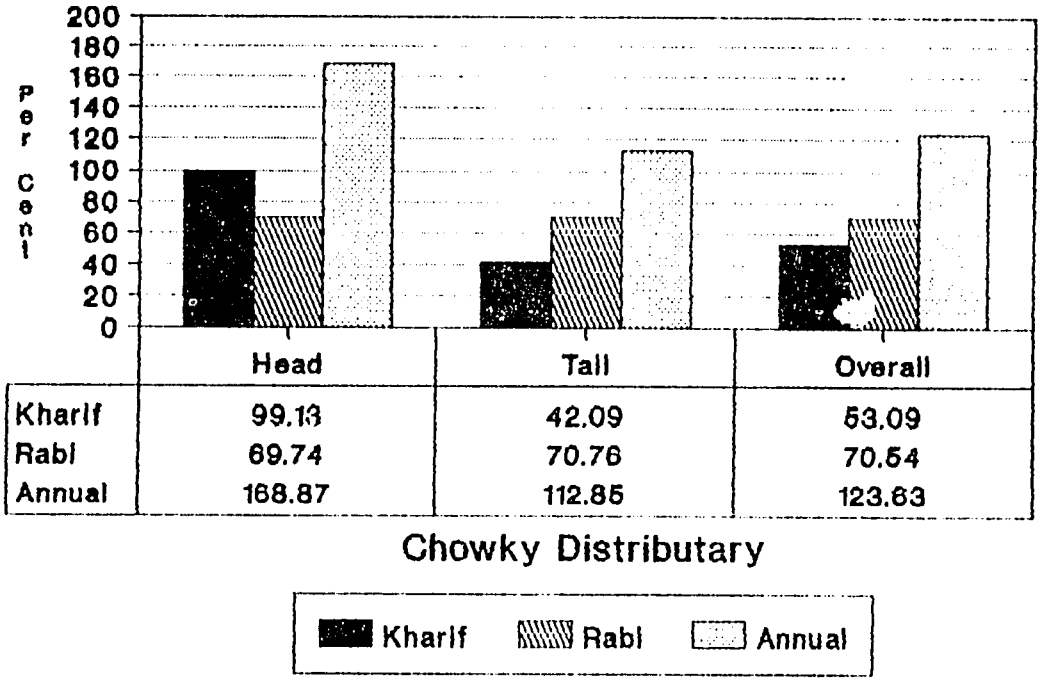


Figure IV-4

Cropping Intensities
By Channel Reaches

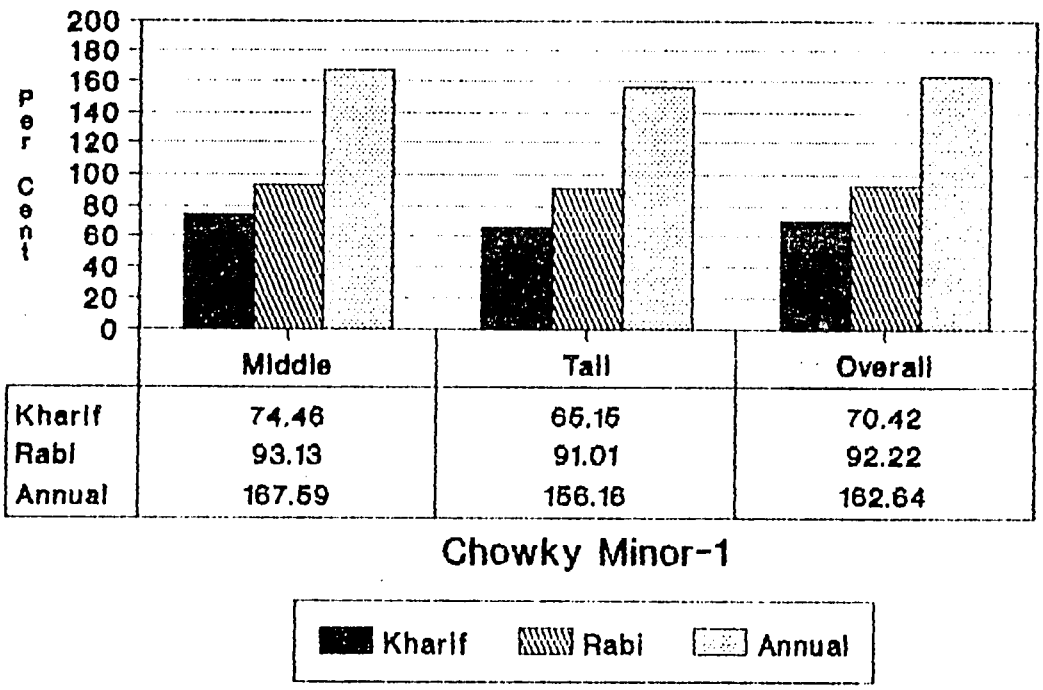


	Head	Tail	Overall
Kharif	99.13	42.09	53.09
Rabi	69.74	70.76	70.54
Annual	168.87	112.85	123.63

Chowky Distributary

Figure III-5

Cropping Intensities
By Channel Reaches



	Middle	Tail	Overall
Kharif	74.46	65.15	70.42
Rabi	93.13	91.01	92.22
Annual	167.59	156.16	162.64

Chowky Minor-1

Figure III-6

are shown in Table IV-3 and Figure IV-7. The Lined sample watercourse located in tail of Chowky Disty, shows about 2.59 percent higher annual cropping intensity than that of unlined watercourse in the same reach. Advantage gained during Kharif is partially nuetrelized during Rabi season.

Table IV-3

COMPARISON OF CROPPING INTENSITY BETWEEN
LINED AND UNLINED WATERCOURSES
CHOWKY DISTY
(1990-91)

Season	Lined Tail	Unlined Tail
Chowky Disty		
Kharif	45.95	40.25
Rabi	68.66	71.76
Annual	114.61	112.02

Percent of CCA.

Results at Farm Level

4.11 On farm level the pertinent data relate to the agro-economic conditions and other associated factors. The data package covers one year (Kharif-1990 and Rabi 1990-91) and have been compiled through interviews with operators of 88 sample farms through a well designed and pretested questionnaire.

4.12 Holding Size by Type of Tenureship: The agrarian structure is a part of social system with social relationship and interactions. The changes can originate in any part of the system due to outside influence. There are a number of reactions to the project and thus these affect the eventual level of benefits. These variables are mostly of social nature and their number is quite large therefore most important have been studied to avoid huge data collection and analysis.

4.13 In this case size of holding means land area cultivated by a farm operator. The size of holding is considered as one of the important factors which affect the yields and farm management practices. The type of tenure means the manner and conditions of land holding or the proprietary right of individual to the land. The size of holding have been grouped into four groups while the tenure types have been broadly grouped as owners, owner cum tenants and tenants. Considering both factors the information of holding size and type of tenure have been cross tabulated.

4.14 Holding size of farms as grouped into various size for the distributary, minor and overall system, is given in Annexure-4, Table 4.2. The results pertaining to relationship of farm size (only on sample watercourses) with type of tenure by channel reaches is presented in Table IV-4. The information reveals that equal number of owners and tenants are operating the farms and majority of them fall in 0-2.50 hectares farm size group on system basis. On both channels maximum operators also belong to farm size group 0-2.50 hectares. Two types of tenureship either owner or tenants exist on chowky minor-1.

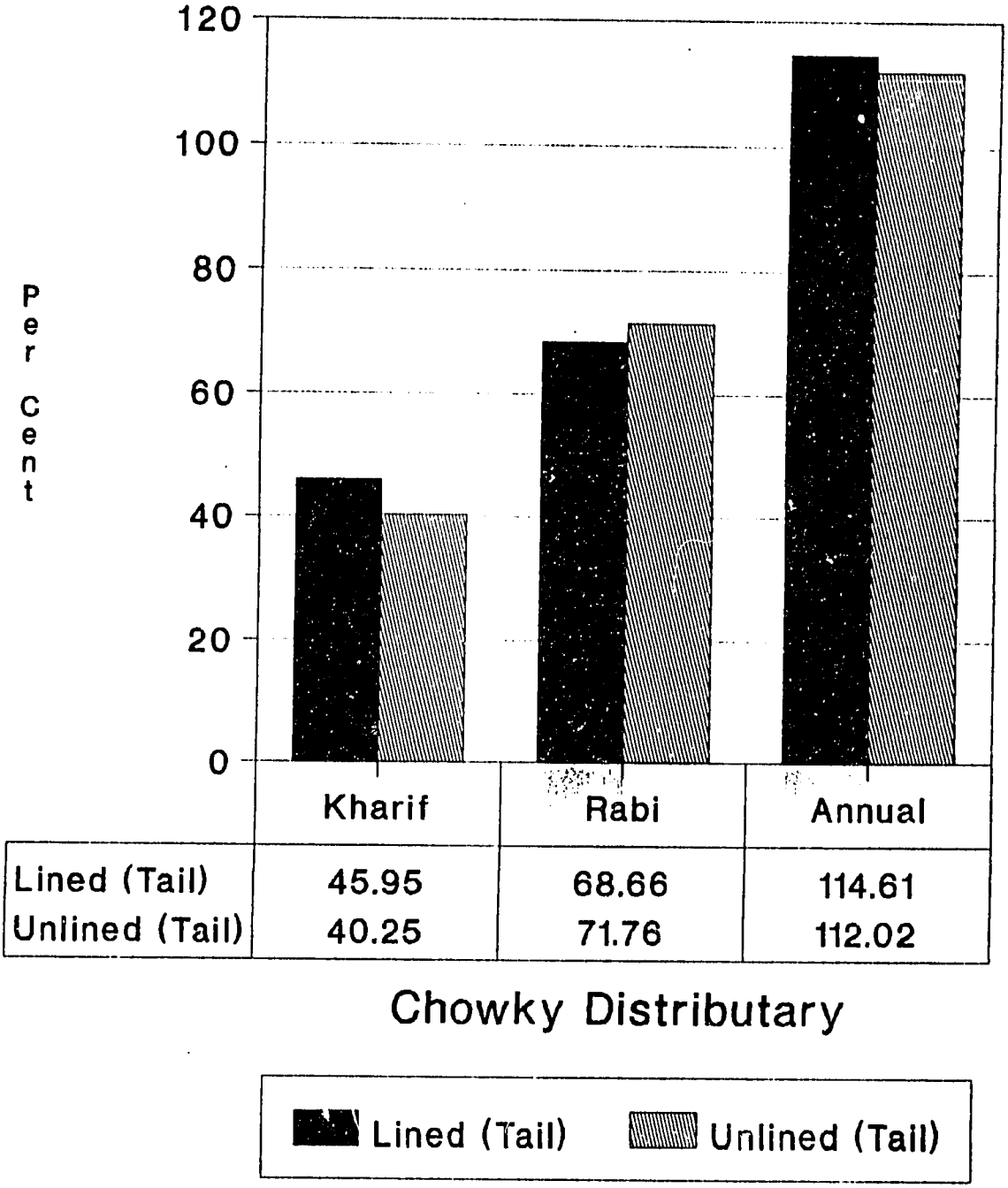
Table IV-4

DISTRIBUTION OF FARMS BY HOLDING SIZE AND TYPE OF TENURE (SAMPLE WATERCOURSES)

Chowky Disty

Count Percent FARM SIZE GROUP	Type of Tenure			Row Total
	OWNER	OWER CUM TENANT	TENANT	
0.00 - 2.50	20 38.5		15 28.8	35 67.3
2.51 - 5.00	3 5.8	1 1.9	6 11.5	10 19.2
5.01 - 7.50	2 3.8	1 1.9		3 5.8
ABOVE 7.50	3 5.8		1 1.9	4 7.7
Column Total	28 53.8	2 3.8	22 42.3	52 100.0

Cropping Intensities
Of Lined and Unlined Watercourses



	Kharif	Rabi	Annual
Lined (Tail)	45.95	68.66	114.61
Unlined (Tail)	40.25	71.76	112.02

Chowky Distributary

Figure IV-7

Cont'd Table IV-4

Chowky Minor

FARM SIZE GROUP (Count / Percent)	Type of Tenure: OWNER	Type of Tenure: TENANT	Row Total
0.00 - 2.50	13 36.1	13 36.1	26 72.2
2.51 - 5.00		7 19.4	7 19.4
5.01 - 7.50	1 2.8	1 2.8	2 5.6
ABOVE 7.50	1 2.8		1 2.8
Column Total	15 41.7	21 58.3	36 100.0

Chowky System

FARM SIZE GROUP (Count / Percent)	Type of Tenure: OWNER	Type of Tenure: OWER CUM TENANT	Type of Tenure: TENANT	Row Total
0.00 - 2.50	33 37.5		28 31.8	61 69.3
2.51 - 5.00	3 3.4	1 1.1	13 14.8	17 19.3
5.01 - 7.50	3 3.4	1 1.1	1 1.1	5 5.7
ABOVE 7.50	4 4.5		1 1.1	5 5.7
Column Total	43 48.9	2 2.3	43 48.9	88 100.0

Cont'd Table IV-4

CHOWKY DISTY-HEAD REACH

FARM SIZE GROUP (Count / Percent)	Type of tenure: OWNER	Type of tenure: TENANT	Row Total
0.00 - 2.50		13 72.2	13 72.2
2.51 - 5.00		4 22.2	4 22.2
5.01 - 7.50			0 0.0
ABOVE 7.50	1 5.6		1 5.6
Column Total	1 5.6	17 94.4	18 100.0

CHOWKY DISTY-TAIL REACH

FARM SIZE GROUP (Count / Percent)	Type of Tenure: OWNER	Type of Tenure: OWNER CUM TENANT	Type of Tenure: TENANT	Row Total
0.00 - 2.50	20 58.8		2 5.9	22 64.7
2.51 - 5.00	3 8.8	1 2.9	2 5.9	6 17.6
5.01 - 7.50	2 5.9	1 2.9		3 8.8
ABOVE 7.50	2 5.9		1 2.9	3 8.8
Column Total	27 79.4	2 5.9	5 14.7	34 100.0

Cont'd Table IV-4

CHOWKY MINOR-MIDDLE REACH

Count Percent FARM SIZE GROU	Type of tenure OWNER	TENANT	Row Total
0.00 - 2.50	4 22.2	9 50.0	13 72.2
2.51 - 5.00		4 22.2	4 22.2
5.01 - 7.50	1 5.6		1 5.6
ABOVE 7.50			0 0.0
Column Total	5 27.8	13 72.2	18 100.0

CHOWKY MINOR - TAIL REACH

Count Percent FARM SIZE GOURP	Type of tenure OWNER	TENANT	Row Total
0.00 - 2.50	9 50.0	4 22.2	13 72.2
2.51 - 5.00		3 16.7	3 16.7
5001 - 7.50		1 5.6	1 5.6
ABOVE 7.50	1 5.6		1 5.6
Column Total	10 55.6	8 44.4	18 100.00

4.15 <u>Farm Fragmentation:</u> The data indicating farm fragmentation have been presented in Table IV-5. According to data 40, 78 and 56 percent of sample farms are in the shape of compact block while about 35, 19 and 28 percent of sample farms have two fragments on chowky disty, Chowky minor and overall

system, respectively. Number of parcels even upto 5 have been reported by remaining 25 percent on chowky disty, while 3 percent farms have 3 parcels on chowky minor. Fragmentation of holdings appears to be a more serious problem on chowky distributary espacially for holdings upto 2.50 ha.

Table IV-5

FRAGMENTATION OF HOLDING BY FARM SIZE GROUP

CHOWKY DISTY

FARM SIZE GROUP (Count / Percent)	Number of Parcels: 1	2	3	4	5	Row Total
0.00 - 2.50	17 32.7	13 25.0	3 5.8	1 1.9	1 1.9	35 67.3
2.51 - 5.00	2 3.8	2 3.8	5 9.6		1 1.9	10 19.2
5.01 - 7.50	1 1.9	1 1.9			1 1.9	3 5.8
ABOVE 7.50	1 1.9	2 3.8	1 1.9			4 7.7
Column Total	21 40.4	18 34.6	9 17.3	1 1.9	3 5.8	52 100.0

CHOWKY MINOR

FARM SIZE GROUP (Count / Percent)	Number of Parcels: 1	2	3	Row Total
0.00 - 2.50	22 61.1	4 11.1		26 72.2
2.51 - 5.00	6 16.7	1 2.8		7 19.4
5.01 - 7.50		1 2.8	1 2.8	2 5.6
ABOVE 7.50		1 2.8		1 2.8
Column Total	28 77.8	7 19.4	1 2.8	36 100.0

Table IV-6

DESCRIPTIVE STATISTICS OF IRRIGATION TURN TIME

Liters/Ha.

Measures	Chowky Disty	Chowky Minor	Chowky System
Mean	2.35	2.32	2.34
Median	1.85	2.30	2.09
Minimum	0.54	1.29	0.54
Maximum	5.65	5.40	5.65
Std.Dev.	1.06	0.79	0.96

4.17 **Main Watercourse Cleanings:** The mean number of main watercourse cleanings during Kharif and Rabi by channel reach and overall system is shown in Table IV-7. There is complete uniformity in this respect as one cleaning per crop season (2 per year) is being done on all sample watercourses irrespective of their location.

Cont'd Table IV-5

CHOWKY SYSTEM

FARM SIZE GROUP (Count / Percent)	Number of Parcels: 1	2	3	4	5	Row Total
0.00 - 2.50	39 44.3	17 19.3	3 3.4	1 1.1	1 1.1	61 69.3
2.51 - 5.00	8 9.1	3 3.4	5 5.7		1 1.1	17 19.3
5.01 - 7.50	1 1.1	2 2.3	1 1.1		1 1.1	5 5.7
ABOVE 7.50	1 1.1	3 3.4	1 1.1			5 5.7
Column Total	49 55.7	25 28.4	10 11.4	1 1.1	3 3.4	88 100.0

4.16 **Irrigation Turn:** The descriptive statistics relating to irrigation turn time by channel is depicted in Table IV-6, while the same by channel reach is given in Annexure-4, Table 4.3. The data indicate that the irrigation turn time (Hrs/Ha.) averages almost same for both channels and overall system. There is a large variation in turn time, almost an hour by channel reach from head to tail on chowky disty which created a large gap in Kharif intensities. However irrigation turn time per hectare on tail watercourse of minor-I is higher by 30 minutes compared with middle reach watercourse. This mainly explains the cropping intensity differences between the distributary and the minor.

Table IV-7

MEAN NUMBER OF WATERCOURSE CLEANINGS BY CHANNEL REACH

CHOWKY SYSTEM

Channel/Reach	Kharif	Rabi	Annual
Chowky Disty			
Head	1	1	2
Tail	1	1	2
Overall	1	1	2
Chowky Minor			
Middle	1	1	2
Tail	1	1	2
Overall	1	1	2
Chowky System	1	1	2

4.18 <u>Equity in Irrigation Water Supply:</u> The respondents were asked that whether they were satisfied with the allocation of irrigation water. The information reveals (Table IV-8) that about 97 percent farmers were not satisfied with allocation of irrigation turn time. The majority of them narrated that the allocation is less compared to their size of holdings. The farmers response appears to be much more close to their tradition than reality. The level of satisfaction for the allocation of water by channels reaches is given in Annexure-4, Table 4.4.

Table IV-8

FREQUENCY DISTRIBUTION OF FARMS BY REASONS OF DISSATISFACTION OF WATER ALLOCATION

CHOWKY DISTY

Count Percent	Satisfied	Not Satisfied	Row Total
Satisfied	2 3.8	–	2 3.8
Less time per Size of Holding		50 96.2	50 96.2
Column Total	2 3.8	50 96.2	52 100.0

CHOWKY MINOR

Count Percent	Satisfied	Not Satisfied	Row Total
Satisfied	1 2.8		1 2.8
Less time per Size of Holding		2 5.6	2 5.6
Less time/holding		33 91.7	33 91.7
Column Total	1 2.8	35 97.2	36 100.0

Cont'd Table IV-8

CHOWKY SYSTEM

Count Percent	Satisfied	Not Satisfied	Row Total
Satisfied	3 3.4		3 3.4
Less time Compared Other Farms		2 2.3	2 2.3
Less time per Holding Size		83 94.3	83 94.3
Column Total	3 3.4	85 96.6	88 100.0

4.19 <u>Farms Not Getting Allocated Share by Reasons:</u> The data generated from the frequency distribution of farms not getting the allocated share of irrigation water by reasons on channel and overall system basis is depicted in Table IV-9, while the same for reaches of both channels of the system is given in Annexure-4, Table 4.5. The data show that the majority (67 percent) of chowky disty and all respondents of chowky minor have reported the fluctuating supplies in the parent channels as the main reason. This indicates the unreliable water flows in the channels. About 6 percent respondents on chowky distributary have pointed out that high topography of fields and poor maintenance of watercourses are the other reason.

Table IV-9

FREQUENCY DISTRIBUTION OF FARMS NOT GETTING ALLOCATED SHARE OF IRRIGATION WATER BY REASONS

CHOWKY DISTY

Count Percent	Getting Share	Topogr-phy	Poor Mainten. of W/C	Siltat-ion	Fluctuat-ing Supply	Any Other	Row Total
Getting	9 17.3						9 17.3
Not Getting		3 5.8	3 5.8	1 1.9	35 67.3	1 1.9	43 82.7
Column Total	9 17.3	3 5.8	3 5.8	1 1.9	35 67.3	1 1.9	52 100.0

CHOWKY MINOR

Count Percent	Fluctuat-ing Supply 7	Row Total
Not Getting	36 100.0	36 100.0
Column Total	36 100.0	36 100.0

CHOWKY SYSTEM

Count Percent	Getting Share	Topog-raphy	Poor man-tinence of W/C	Siltat-ion	Fluctuat-ing Supply	Any Other	Row Total
Getting	9 10.2						9 10.2
Not Getting		3 3.4	3 3.4	1 1.1	71 80.7	1 1.1	79 89.8
Column Total	9 10.2	3 3.4	3 3.4	1 1.1	71 80.7	1 1.1	88 100.0

4.20 **Turns Missed Under Regular Canal Closures:** The mean number of turns missed under regular canal closures (Table IV-10) for Rabi and Kharif have been recorded uniform (1 and 3) on chowky disty and tail watercourse of chowky minor. The middle reach watercourse on minor is comparatively at a disadvantage as the farmers missed 5 turns during Rabi season. It is understandable as the canals are closed during Rabi (winter) for annual maintenance.

Table IV-10

MEAN NUMBER OF TURNS MISSED
UNDER REGULAR CLOSURES
CHOWKY SYSTEM

Channel/Reach	Kharif	Rabi	Annual
Chowky Disty			
Head	1	3	4
Tail	1	3	4
Overall	1	3	4
Chowky Minor			
Middle	1	5	6
Tail	1	3	4
Overall	1	4	5
Chowky System	1	3	4

4.21 **Turns Missed Under Unexpected Canal Closures by Reasons:** Table IV-11 reveals that about 29 percent of sample farms have not missed their irrigation turns under unexpected canal closures on chowky disty, while all respondents 39 and 61 percent have missed 4 and 5 turns on chowky minor, respectively. The majority (54 percent) have reported missing of 4 irrigation turns on

chowky disty and even same number of missing (4) have been reported on head and tail of the channel reach (Annexure-4, Table 4.6). Unexpectedly tail reach farmers on the distributary are more favoured in this respect compared with head reach.

Table IV-11

TURNS MISSED UNDER UNEXPECTED CANAL CLOSURES BY REASONS

CHOWKY DISTY

Count / Percent	Number of Turns							Row Total
	2	3	4	5	6	7	8	
Turn Not Missed	15 28.8							15 28.8
Reasons Not Known		2 3.8	28 53.8	1 1.9	3 5.8	1 1.9	1 1.9	36 69.2
Any Other		1 1.9						1 1.9
Column Total	15 28.8	3 5.8	28 53.8	1 1.9	3 5.8	1 1.9	1 1.9	52 100.0

CHOWKY MINOR

Count / Percent	Number of Turns		Row Total
	4	5	
Reasons Not Known	14 38.9	22 61.1	36 100.0
Column Total	14 38.9	22 61.1	36 100.0

Cont'd Table IV-11

CHOWKY SYSTEM

Count Percent	Number of Turns							Row Total
	2	3	4	5	6	7	8	
Turn Not Missed	15 17.0							15 17.0
Reasons Not Known		2 2.3	42 47.7	23 26.1	3 3.4	1 1.1	1 1.1	72 81.8
Any Other		1 1.1						1 1.1
Column Total	15 17.0	3 3.4	42 47.7	23 26.1	3 3.4	1 1.1	1 1.1	88 100.0

4.22 <u>Turns Having Inadequate Discharge by Reasons:</u> The information pertaining to number of turns availed under low channel flow conditions by reasons for both channels and overall chowky system is depicted in Table IV-12, while the same for channel reach is given in Annexure-4, Table 4.7. According to data all farms on both channels have availed irrigation turns having inadequate discharge during the year due to low flow in parent channels. All the farmers on chowky distributary availed 6-14 such turns while the farmers on the minor suffered more as in this case 25 percent farmers availed 34 such turns. The reliability in water supply is thus a major concern of the farmer on the minor although the supplies are not reliable on the distributary as well.

Table IV-12

TURNS HAVING INADEQUATE DISCHARGE BY REASONS

CHOWKY DISTY

Count Percent	Number of Turns								Row Total
	6	7	9	10	11	12	13	14	
Less Flow In the Channel	7 13.5	11 21.2	1 1.9	11 21.2	1 1.9	5 9.6	2 3.8	14 26.9	52 100.0
Column Total	7 13.5	11 21.2	1 1.9	11 21.2	1 1.9	5 9.6	2 3.8	14 26.9	52 100.0

Cont'd Table IV-12

CHOWKY MINOR

Count Percent	Number of Turns									Row Total
	7	14	22	27	29	31	33	34	35	
Less Flow In the Channel	1 2.8	14 38.9	1 2.8	1 2.8	1 2.8	1 2.8	6 16.7	9 25.0	2 5.6	36 100.0
Column Total	1 2.8	14 38.9	1 2.8	1 2.8	1 2.8	1 2.8	6 16.7	9 25.0	2 5.6	36 100.0

CHOWKY SYSTEM

Count Percent	Number of Turns									
	6	7	9	10	11	12	13	14	22	27
Less Flow in the Channel	7 8.0	12 13.6	1 1.1	11 12.5	1 1.1	5 5.7	2 2.3	28 31.8	1 1.1	1 1.1
Column Total	7 8.0	12 13.6	1 1.1	11 12.5	1 1.1	5 5.7	2 2.3	28 31.8	1 1.1	1 1.1

Count Percent	No. of Turns					Row Total
	29	31	33	34	35	
Less Flow in the Channel	1 1.1	1 1.1	6 6.8	9 10.2	2 2.3	88 100.0
Column Total	1 1.1	1 1.1	6 6.8	9 10.2	2 2.3	88 100.0

4.23 <u>Contribution of Tubewell Water for Crop Production:</u> The data given in Table IV-13 show that 7 farms at the tail watercourses of chowky disty, 2 farms at the middle and 12 farms at tail watercourses of the chowky minor have used tubewell water for crop production. The notable thing is that there have been no tubewell water user on the head reach of the Chowky disty and only two operators have used tubewell water on middle reach of chowky minor. This shows the shortage of irrigation water at the tail of the channels. Due to inequitable and unreliable water supplies the farmers have to supplement their irrigation water through private tubewells on the tail watercourses. Majority of those using tubewell water to supplement canal supplies have reported contribution of 26-50 % in crop production. It is quite clear that some of the tail watercourse respondents have to

supplement irrigation supplies from private tubewells as the surface supplies are not adequate and reliable.

Table IV-13

CONTRIBUTION OF TUBEWELL WATER TOWARDS CROP PRODUCTION BY CHANNEL REACH

CHOWKY DISTY

	Channel / Reach					
	Head		Tail		Overall	
Percent Range	Number	Percent	Number	Percent	Number	Percent
0 - 25	-	-	1	14.3	1	14.3
26 - 50	-	-	4	57.1	4	57.1
51 - 75	-	-	1	14.3	1	14.3
76 - 100	-	-	1	14.3	1	14.3
Total:	-	-	7	100	7	100

CHOWKY MINOR

	Channel / Reach					
	Middle		Tail		Overall	
Percent Range	Number	Percent	Number	Percent	Number	Percent
0 - 25	1	50	-	-	1	7.1
26 - 50	1	50	10	83.3	11	78.6
51 - 75	-	-	2	6.7	2	14.3
76 - 100	-	-	-	-	-	-
Total:	2	100	12	100	14	100

Cont'd Table IV-13

CHOWKY SYSTEM

Percent Range	Chowky System	
	Number	Percent
0 - 25	2	9.5
26 - 50	15	71.4
51 - 75	3	14.3
76 - 100	1	4.8
Total:	21	100

4.24 **Farm Level Land Use Pattern:** Table IV-14 indicates the descriptive statistics of annual cropping intensities at farm level by channel and overall system basis. The same related to farm size group is depicted in Table IV-15, while the relationship by channel reach is given in Annexure-4, Table 4.8. The crosstab information covering the relationship of type of tenure to cropping intensities by channel and channel reach is appended in Annexure-4, Table 4.9.

4.25 The mean value of percent area of farm under crops have been worked out to be 137, 194 and 160 for chowky disty, minor and system for the year, respectively. These values are considerably higher than those worked out on watercourse basis. However superiority of Minor is confirmed. For farms upto 7.5 ha. size the range of cropping intensities is very wide while it is narrow for the farms above 7.50 ha. This indicates achievement of higher cropping intensities for larger farms.

Table IV-14

DESCRIPTIVE STATISTICS OF ANNUAL CROPPING INTENSITIES AT FARM LEVEL BY CHANNELS

CHOWKY DISTY

Measures	Chowky Disty	Chowky Minor	Chowky System
Mean	136.72	193.55	159.97
Median	142.31	200.00	177.06
Minimum	36.67	74.29	36.67
Maximum	256.67	250.00	256.67
Std.Dev.	54.56	42.57	57.13

Table IV-15

ANNUAL CROPPING INTENSITIES AT FARM LEVEL BY FARM SIZE

CHOWKY DISTY

	Cropping Intensities					
Count Percent FARM SIZE GROUP	0-50	51-100	101-150	151-200	201 AND ABOVE	Row Total
0.00 - 2.50	2 3.8	8 15.4	9 17.3	16 30.8		35 67.3
2.51 - 5.00	1 1.9	2 3.8	2 3.8	5 9.6		10 19.2
5.01 - 7.50	2 3.8			1 1.9		3 5.8
ABOVE 7.50			2 3.8	1 1.9	1 1.9	4 7.7
Column Total	5 9.6	10 19.2	13 25.0	23 44.2	1 1.9	52 100.0

Cont'd Table IV-15

CHOWKY MINOR

FARM SIZE GROUP (Count / Percent)	Cropping Intensities: 51-100	101-150	151-200	201 AND ABOVE	Row Total
0.00 - 2.50	2 5.6	1 2.8	12 33.3	11 30.6	26 72.2
2.51 - 5.00	1 2.8		4 11.1	2 5.6	7 19.4
5.01 - 7.50		1 2.8	1 2.8		2 5.6
ABOVE 7.50				1 2.8	1 2.8
Column Total	3 8.3	2 5.6	17 47.2	14 38.9	36 100.0

CHOWKY SYSTEM

FARM SIZE GROUP (Count / Percent)	Cropping Intensities: 0-50	51-100	101-150	151-200	201 AND ABOVE	Row Total
0.00 - 2.50	2 2.3	10 11.4	10 11.4	28 31.8	11 12.5	61 69.3
2.51 - 5.00	1 1.1	3 3.4	2 2.3	9 10.2	2 2.3	17 19.3
5.01 - 7.50	2 2.3		1 1.1	2 2.3		5 5.7
ABOVE 7.50			2 2.3	1 1.1	2 2.3	5 5.7
Column Total	5 5.7	13 14.8	15 17.0	40 45.5	15 17.0	88 100.0

Farm Inputs

4.26 Man has long observed that whatever successive inputs of a production factor are added to a limited fixed input, a point is reached after which the additional output of product per unit of input decreases and eventually becomes a negative quantity, this is law of deminishing return and is widely applicable in agricultural production. It is expected that the canal rehabilitation will exert influence on the use of inputs and ultimately yields. Some of these variables are however, significant even under present conditions, and will become more important as the project is implemented. The level and use of main explanatory variables for yields are being reported so as to have a record of data over time to furnish a Baseline for measuring the future development.

4.27 **Seed Rate:** The mean seed rates (Table IV-16) on project basis figures out to be 5930, 35, 32, 99 and 16 kgs/ha. for sugarcane, maize, Kharif fodders, wheat and Rabi fodders, respectively. Significant variations by channel reach for the use of seed in respect of sugarcane, maize, kharif fodder, kharif vegetable have been observed on chowky disty. Wheat seed ratio are adequate but are low for sugarcane crop.

Table IV-16

MEAN SEED RATE OF CROPS BY CHANNEL REACH

(Kgs./Ha.)

Crops	Chowky Disty			Chowky Minor			Chowky System
	Head	Tail	Overall	Middle	Tail	Overall	
Sugarcane	6251	4778	5896	5931	5949	5943	5930
Tobacco	0.6	-	0.6	0.6	-	0.6	0.6
Maize	34	46	40	30	30	30	35
K.Fodders	49	26	27	59	42	45	32
K.Vegetables	1119	514	923	596	1186	891	917
Wheat	91	99	97	99	110	104	99
R.Fodders	15	18	17	16	15	15	16
Oilseed	2	5	4	5	-	5	4
R.Vegetables	-	-	-	-	2	2	2

4.28 <u>Irrigation:</u> The mean number of irrigations (Table VI-17) for sugarcane, orchards, tobacco, wheat and Rabi fodders figures out to be 10. 8, 6, 2 and 4, respectively. Sugarcane, wheat and Rabi fodders have been applied uniform irrigations invariably by channel reach. Except sugarcane, number of irrigations applied to other crops are less than 50% mainly because of rainfall contribution.

Table IV-17

MEAN NUMBER OF IRRIGATIONS BY CHANNEL REACH

Crops	Chowky Disty			Chowky Minor			Chowky System
	Head	Tail	Overall	Middle	Tail	Overall	
Kharif 1990							
Sugarcane	10	10	10	9	9	9	10
S.cane(Ratoon)	-	9	9	-	-	-	9
Orchards	10	7	8	8	-	8	8
Tobacco	7	-	7	5	-	5	6
Maize	2	2	2	3	2	3	2
Fodders	2	2	2	2	3	3	2
Vegetables	5	5	5	6	4	5	5
Rabi 90-91							
Wheat	2	2	2	2	2	2	2
Fodder	4	4	4	4	4	4	4
Vegetables	-	-	-	-	4	4	4
Oilseed	1	2	2	1	-	1	1
Misc.	3	5	4	4	3	4	4

4.29 **Fertilizer:** Table IV-18 summarises the information regarding fertilizer use for all crops by channel reach and overall system basis. The data indicate that fertilizer application rates are lower than recommended for major crops espacially for sugarcane (Ratoon) crop. Variation in the use of fertilizers have been recorded on channel reach basis. A declining trend by channel reach especially for maize and wheat crops have been observed on the distributary. On project basis the use of nitrogenous fertilizer for sugarcane, tobacco, maize, kharif fodders, wheat Rabi fodders works out to be 90, 137, 71, 31, 65 and 68 kgs./ha., respectively. Potash is not applied at all in the area.

Table IV-18

MEAN FERTILIZER RATE BY CHANNEL REACH

(Kgs./Ha.)

	Head		Tail		Overall		Middle		Tail		Overall		Chowky System	
Crops	N	P	N	P	N	P	N	P	N	P	N	P	N	P
Kharif-91														
S.Cane	96	60	148	36	108	54	87	49	80	58	83	54	90	54
S.cane(R)	-	-	77	-	77	-	-	-	-	-	-	-	77	-
Tobacco	147	53	-	-	147	53	56	58	-	-	56	58	137	54
Maize	71	43	55	26	63	35	81	49	82	59	82	53	71	43
Fodders	-	-	10	3	10	3	76	20	78	42	77	38	31	14
Vegetables	92	49	66	62	84	53	136	57	79	57	107	57	88	54
Orchards	68	28	68	52	68	40	87	-	-	-	87	-	68	39
Rabi 90-91														
Wheat	74	46	51	25	58	32	79	49	82	57	80	53	65	38
Fodder	81	14	38	13	58	13	72	9	80	46	77	31	68	23
Oil Seed	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vegetables	-	-	-	-	-	-	-	-	64	-	64	-	64	-
Misc.	-	-	82	63	43	33	-	-	-	-	-	-	23	-

4.30 <u>Farm Yard Manure:</u> Data given in Table IV-19 reveal the extent of use of farm yard manure for different crops grown at the sample farms by channel reach and overall system basis. According to data, the trend of highest dosage of manure is eminent in tobacco, maize and kharif vegetables. Use of farm yard manure is very common which is good for the soil health.

Table IV-19

MEAN FARM YARD MANURE RATE BY CHANNEL REACH

(Kgs./Ha.)

Crops	Chowky Disty			Chowky Minor			Chowky System
	Head	Tail	Overall	Middle	Tail	Overall	
Sugarcane	6381	7070	6547	-	4694	3039	4016
Tobacco	21382	-	21382	-	-	-	19050
Maize	7686	7662	7674	19766	20576	20081	13331
K.Fodders	-	-	-	-	10931	8944	2811
K.Vegetables	12832	9391	11719	14757	-	7378	10892
Orchards	3689	3587	3641	19942	-	19942	3720
Wheat	-	228	159	-	-	-	108
R.Fodders	757	5944	3523	943	-	373	1816

Crop Yields

4.31 Cropping pattern and intensities are greatly influenced by the irrigation supplies. It has been assumed that most of the increase in agricultural production and farm income would come from increase in cropped area and shifting of cropping pattern in favour of high value crops requiring high delta of water. Nevertheless, it has been assumed that the project would bring about increases in crop yield at full development due to ensured and increased irrigation supplies and thereby reducing the water stress on critical crop growth stages. The adequate and dependable irrigation supplies would induce the farmers for increased use of farm inputs and improve farm practices. Such favrouable conditions would help to achieve target yields with rehabilitation as compared with no such provision. Keeping in view the importance of this key indicator the data of crop yields is being discussed here.

4.32 Table IV-20 depicts the mean yields of all crops by channel reach and overall chowky system. A declining trend of yields from head to tail watercourse for all crops except oilseeds have been recorded on chowky disty. The yields of sugarcane, maize Kharif Vegetables and wheat crops have been reported more on tail watercourse compared to middle watercourse

of chowky minor. The reason is that some area of the tail watercourse is abandoned and irrigation water allocated to that area is being used by the farms of upper reaches. Data also indicate that tubewell water is being used by the farms of tail watercourse, hence water is not a major constraints on the tail watercourses.

Table IV-20

MEAN YIELD OF CROPS

CHOWKY SYSTEM

(Kgs./Ha.)

Crops	Chowky Disty			Chowky Minor			Chowky System
	Head	Tail	Overall	Middle	Tail	Overall	
Sugarcane	34064	19302	29402	33384	39344	36494	33285
S.cane(Ratoon)	-	16176	16176	-	-	-	16176
Tobacco	1639	-	1639	1845	-	1845	1673
Maize	1402	751	1035	1217	1408	1303	1154
K.Fodder	18446	5917	7707	22135	9223	13527	9453
K.Veg.	12236	4345	9277	6456	9223	7378	8759
Wheat	1950	1138	1414	1051	1428	1228	1341
R.Fodders	27187	26140	26616	22914	20121	21776	24438
R.Veg.	-	-	-	-	36892	36892	36892
Oilseeds	123	553	338	369	-	369	348
R.Misc.	18501	17512	17842	55338	31051	37123	25554

4.33 **Sugarcane Yield by Farm Size:** Table IV-21 shows the yield of sugarcane in relation to different farm size groups. There are three cases on distributary where yields are very low i.e. less than 15000 kg/ha. No such case has been reported on the minor. From size has influenced sugarcane yield to some extent as farm size larger than 5 ha. has given more than 30,000 kg./ha. in all cases when a lower yields have also been recorded for smaller farms.

Table IV-21

SUGARCANE YIELD BY FARM SIZE

CHOWKY DISTY

FARM SIZE GROUP (Count / Percent)	Yield Kgs. per Hectare: 0-15000	15001-30000	30001-60000	Row Total
0.00 - 2.50	1 5.3	3 15.8	7 36.8	11 57.9
2.51 - 5.00	2 10.5		4 21.1	6 31.6
5.01 - 7.50		1 5.3	1 5.3	2 10.5
Column Total	3 15.8	4 21.1	12 63.2	19 100.0

CHOWKY MINOR

FARM SIZE GROUP (Count / Percent)	Yield kgs per hectare: 15001-30000	30001-60000	Row Total
0.00 - 2.50	5 21.7	10 43.5	15 65.2
2.51 - 5.00	1 4.3	4 17.4	5 21.7
5.01 - 7.50		2 8.7	2 8.7
ABOVE 7.75		1 4.3	1 4.3
Column Total	6 26.1	17 73.9	23 100.0

Cont'd Table IV-21

CHOWKY SYSTEM

FARM SIZE GROUP (Count / Percent)	Yield kgs. per Hectare: 0-15000	15001-30000	30001-60000	Row Total
0.00 - 2.50	1 2.4	8 19.0	17 40.5	26 61.9
2.51 - 5.00	2 4.8	1 2.4	8 19.0	11 26.2
5.01 - 7.50		1 2.4	3 7.1	4 9.5
ABOVE 7.75			1 2.4	1 2.4
Column Total	3 7.1	10 23.8	29 69.0	42 100.0

4.34 <u>Sugarcane Yield by Type of Tenure:</u> The majority of the sugarcane growers are tenants on the distributary as well as the minor althoug they are in overwhelming majority of the distributary. Perfomence of tenants is comparatively better on the distributary but the trend is different on minor where the owners have done better.

Table IV-22

SUGARCANE YIELD BY TYPE OF TENURE

CHOWKY DISTY

TENURE TYPE	Count / Percent	Yield kgs. per hectare 0-15000	15001-30000	30001-60000	Row Total
OWNER		1 5.3	1 5.3	1 5.3	3 15.8
OWNER CUM TENANT		1 5.3			1 5.3
TENANT		1 5.3	3 15.8	11 57.9	15 78.9
	Column Total	3 15.8	4 21.1	12 63.2	19 100.0

CHOWKY MINOR

TENURE TYPE	Count / Percent	Yield kgs. per hectare 15001-30000	30001-60000	Row Total
OWNER		1 4.3	8 34.8	9 39.1
TENANT		5 21.7	9 39.1	14 60.9
	Column Total	6 26.1	17 73.9	23 100.0

Cont'd Table IV-22

CHOWKY SYSTEM

TENURE TYPE — Count / Percent	Yield kg. per hectare 0-15000	15001-30000	30001-60000	Row Total
OWNER	1 2.4	2 4.8	9 21.4	12 28.6
OWNER CUM TENANT	1 2.4			1 2.4
TENANT	1 2.4	8 19.0	20 47.6	29 69.0
Column Total	3 7.1	10 23.8	29 69.0	42 100.0

4.35 **Wheat Yield by Farm Size:** Though farm size does not appear to have any relationship with wheat yield but comparatively the smaller a farm size groups have produced better yields than the larger farms. This trend is reverse compared with sugarcane.

Table IV-23

WHEAT YIELD BY FARM SIZE

CHOWKY DISTY

FARM SIZE GROUP (Count / Percent)	Yield kgs. per hectare 0-1000	1001-2000	2001-3000	Row Total
0.00 - 2.50	6 12.0	20 40.0	7 14.0	33 66.0
2.51 - 5.00	2 4.0	6 12.0	2 4.0	10 20.0
5.01 - 7.50	2 4.0	1 2.0		3 6.0
ABOVE 7.75	3 6.0	1 2.0		4 8.0
Column Total	13 26.0	28 56.0	9 18.0	50 100.0

CHOWKY MINOR

FARM SIZE GROUP (Count / Percent)	Yield kgs. per hectare 0-1000	1001-2000	2001-3000	Row Total
0.00 - 2.50	7 21.9	14 43.8	1 3.1	22 68.8
2.51 - 5.00	1 3.1	6 18.8		7 21.9
5.01 - 7.50		2 6.3		2 6.3
ABOVE 7.75	1 3.1			1 3.1
Column Total	9 28.1	22 68.8	1 3.1	32 100.0

Cont'd Table IV-23

CHOWKY SYSTEM

FARM SIZE GROUP (Count / Percent)	Yield kgs. per hectare 0-1000	1001-2000	2001-3000	Row Total
0.00 - 2.50	13 15.9	34 41.5	8 9.8	55 67.1
2.51 - 5.00	3 3.7	12 14.6	2 2.4	17 20.7
5.01 - 7.50	2 2.4	3 3.7		5 6.1
ABOVE 7.75	4 4.9	1 1.2		5 6.1
Column Total	22 26.8	50 61.0	10 12.2	82 100.0

4.36 **Wheat Yield by Type of Tenure:** According to Table IV-24, the owners are in majority at distributary while the tenants dominents at minor. On overall basis the tenants have done better than owners as a number of tenants have achieved yields higher than 2000 kg/ha. but non of the owner could achieve that.

Table IV-24

WHEAT YIELD BY TYPE OF TENURE

CHOWKY DISTY

TENURE TYPE	Count / Percent	Yield kgs. per hectare 0-1000	1001-2000	2001-3000	Row Total
OWNER		10 20.0	17 34.0		27 54.0
OWNER CUM TENANT		1 2.0	1 2.0		2 4.0
TENANT		2 4.0	10 20.0	9 18.0	21 42.0
	Column Total	13 26.0	28 56.0	9 18.0	50 100.0

CHOWKY MINOR

TENURE TYPE	Count / Percent	Yield kgs. per hectare 0-1000	1001-2000	2001-3000	Row Total
OWNER		4 12.5	8 25.0		12 37.5
TENANT		5 15.6	14 43.8	1 3.1	20 62.5
	Column Total	9 28.1	22 68.8	1 3.1	32 100.0

Cont'd Table IV-24

CHOWKY SYSTEM

TENURE TYPE	Count Percent	Yield kgs. per Hectare 0-1000	1001-2000	2001-3000	Row Total
OWNER		14 17.1	25 30.5		39 47.6
OWNER CUM TENANT		1 1.2	1 1.2		2 2.4
TENANT		7 8.5	24 29.3	10 12.2	41 50.0
	Column Total	22 26.8	50 61.0	10 12.2	82 100.0

Value of Output

4.37 The ultimate success of the rehabilitation project will be measured in terms of the value of additional output generated from the more equitable and reliable irrigation water supplies especially to tail enders. The existing values are presented here as a record of the pre project situation. Crop output values were calculated by multiplying total production with weighted average farm gate price of respective crop for the year 1990-91. The computed crop output values of all crops have been used for calculating the other related income variables. The mean output value of major crop by channel reach and overall system basis is presented in Table IV-25. The mean output values for sugarcane (fresh), maize and wheat are higher on head reach compared with tail of distributary whereas the trend is reverse for minor-I.

Table IV-25

OUTPUT VALUE OF MAJOR CROPS

CHOWKY SYSTEM

(Rs./Ha.)

Crops	Chowky Disty			Chowky Minor			Chowky System
	Head	Tail	Overall	Middle	Tail	Overall	
Sugarcane	16428	9309	14179	16100	18974	17600	16052
Sugarcane(R)	-	7801	7801	-	-	-	7801
Maize	4396	2355	3245	3814	4415	4085	3617
Wheat	7052	4117	5115	3803	5165	4441	4852

Farm Income

4.38 Farm income is an important parameter which explains the farmers economic position in comparison with others. Generally the measurable benefits of the project are represented by the increase in agricultural production to be brought about through implementation of irrigation and drainage works. The computation of net farm income is complex as it is influenced by so many variables. Some of the most important variables have already been considered in preceeding sections. These relate particularly to use of water and non-water inputs and the yields obtained. These are direct or primary indicators of project impact which are expected to show major movements as the project takes effect, to avoid complications and having direct indicators, the benefits have been measured separately in terms of crop income, livestock income and non-farm income.

4.39 Crop Income: The income from crops has been computed by adding the output values of crops at farm level minus the cost of inputs used such as seed, chemical fertilizer, farm yard manure, pesticides, irrigation water, charges of ploughing and planking, cost of casual labour and motive power hired, permanent labour and 50 percent cost of family labour. The reason of charging half family labour is that family members are generally engaged in livestock maintenance and non-farm activities. The crop income have been stratified into income per cropped hectare and income per hectare dividing the crop income by total cropped area and farm area (on sample W/C only), respectively.

4.40 According to Table IV-26 the crop income per cropped hectare and per hectare have been recorded negative by channel reaches and overall system except head reach of chowky disty. The gross crop income per farm have shown steep declining trend and farming at tail reach of the distributary is not profitable. Middle-tail differences on the minor are comparatively much less. The crop income per farm works out to be Rs. 6290/- on project basis for the year under report which is soly by due to head reach watercourse of the distributary.

4.41 Livestock Income: The detailed investigation for this source is beyond the scope of M&E activities of this project. The income covers the value of cash sales of livestock and livestock product during the year. The information generated as income from livestock per farm and livestock income per hectare is presented in Table IV-26. This income have been recorded more by the farms of tail watercourses compared to the farms of upper reaches of the channels.

Table IV-26

AVERAGE INCOME BY CHANNEL REACH

(Rupees)

Income	Chowky Disty			Chowky Minor			Chowky System
	Head	Tail	Overall	Middle	Tail	Overall	
Crop Income	16353	-1777	4498	9277	8480	8878	6290
Crop Income per Cropped Hectare	3413	-3733	-1259	-903	-969	-936	-1127
Crop Income per Hectare	5717	-3699	-440	-1937	-1776	-1856	-1019
Livestock Income	1822	2292	2130	1539	2869	2204	2160
Livestock Income per Hectare	855	1523	1292	1745	2015	1881	1533
Non-Farm Income	6833	20538	15794	12000	7667	9833	13356
Non-Farm income per Hectare	3931	14777	11023	15275	5813	10544	10827

4.42 **Non-Farm Income:** Mobilization of farm resources, with the hope of additional income have been observed in respect of certain farmers. Such mobilization involves farmers willingness and ability to undertake it. However, data were collected on farmers non-farm income including labour hiring out, services, trading of livestock and other miscellaneous sources. The non-farm income per farm and non-farm income per hectare works out to be Rs. 13356 and 10827, on project basis, respectively. The descriptive statistics of non-farm income is shown in Table IV-27. The maximum non-farm income have been recorded Rs. 120000 on the tail watercourses of the chowky disty. This explains why the farmers at the tail of distributary are in business.

Table IV-27

DESCRIPTIVE STATISTICS OF NON-FARM INCOME

CHOWKY SYSTEM

(Rupees)

Measures	Chowky Disty			Chowky Minor			Chowky System
	Head	Tail	Overall	Middle	Tail	Overall	
Mean	6833	20538	15794	12000	7667	9833	13356
Median	0	13850	10000	0	0	0	6200
Minimum	0	0	0	0	0	0	0
Maximum	30000	120000	120000	60000	48000	60000	120000
Std.Dev.	10382	24120	21347	18150	14813	16474	19622

Livestock Inventory

4.43 Livestock constitute an integral part of the crop sector as it supplies draft power for farming operations. It converts crop residues into more nutritious and valuable food products viz; milk and meat. Moreover it happens to be main source of organic manures in the area. The livestock population per farm by channel reaches is depicted in Table IV-28. According to data the number of draught oxen per farm are higher on tail on both the channels whereas the mixed trend can be observed fo other types of livestock.

Table IV-28

AVERAGE LIVESTOCK NUMBER PER FARM BY CHANNEL REACH

CHOWKY SYSTEM

Livestock	Chowky Disty			Chowky Minor			Chowky System
	Head	Tail	Overall	Middle	Tail	Overall	
Draft Oxen	0.3	1.1	0.8	0.8	1.3	1.0	0.9
Buffaloes	1.4	0.9	1.1	1.5	1.6	1.6	1.3
Draft Buffaloes	0.6	0.3	0.4	0.8	0.6	0.7	0.5
Buffaloes (Immature)	1.4	0.9	1.1	1.4	1.6	1.5	1.3
Cows	0.6	0.8	0.7	0.7	0.8	0.8	0.7
Cows (Immature)	0.4	0.8	0.7	0.8	0.9	0.9	0.8
Donkey (Immature)	-	0.1	0.1	-	-	-	0.1
Horses	-	0.1	-	-	0.1	-	-
Sheep & Goats All Ages	4.1	2.8	3.3	2.7	2.6	2.6	3.0

Equipment Inventory

4.44 The information pertaining to mechanized farming have been collected and presented in Table IV-29. The farms located at the tail watercourse of the chowky disty seem to be more equipped with tubewells and tractors. No farmer has reported the tubewell, tractor and tractor implements at the head watercourse of the chowky disty. Similarly no tubewell is installed on middle watercourse of minor-I. This means that only on tail watercourses, supplemented irrigation from tubewells is must. It is further clear that the tail farmers are more pregressives in terms of farm equipment.

Table IV-29

EQUIPMENT INVENTORY BY CHANNEL REACH

(Number)

Equipment	Chowky Disty			Chowky Minor			Chowky System
	Head	Tail	Overall	Middle	Tail	Overall	
Electric Tubewell	-	4	4	-	1	1	5
Diesel Tubewell	-	-	-	-	1	1	1
Tractor	-	7	7	1	1	2	9
Tractor Plough	-	6	6	1	1	2	8
Disc Harrow	-	1	1	-	1	1	2
Seed Drill	-	1	1	-	-	-	1
Trailer	-	6	6	1	1	2	8
Thresher	-	4	4	-	-	-	4

Chapter-V

AGRO-ECONOMIC CONDITIONS

PURAN SYSTEM

Results at Watercourse Command Level

5.01 The pertinent agronomic results comprise of cropped area, cropping pattern and cropping intensities collected and recorded at watercourse command level for sample watercourses located at head and tail of distributary and the minor. The cropped area information for Kharif-90 were collected from irrigation department due to delayed commencement of Baseline Survey. The Rabi cropping pattern data were collected through crop mapping technique. Data for an additional Kharif season i.e. Kharif-91 have been collected through crop survey as the rehabilitation works were not started by Kharif 1991.

5.02 Cropping Pattern: Cropping pattern reflects the particular agro-climatic zone and water supply situation to some extent. The detailed cropping pattern and cropping intensity data by watercourse for Kharif 1990 and Rabi 90-91 are given in Annexure-5, Table 5.1 while the data for Kharif 1991 are presented in Annexure-5, Table 5.2. Table V-1 depicts the cropping pattern by channel reach during Kharif 1990 and Rabi 1990-91. The Kharif cropping pattern by channel and its reach basis is presented in Figure V-1 and V-2, while the same for Rabi 1990-91 is given in Figure V-3 and V-4.

5.03 The data indicate that cotton and wheat have occupied 23 and 12 percent of CCA at head watercourse while the area for these crops is about 4 and 41 percent at tail reach of Puran distributary. The cotton area for tail watercourse is about 16 percent of the head watercourse but wheat acreage show only one percent decline. Wide variations for Kharif season for head and tail watercourses for the distributary and the minor clearly reflect serious shortage of water in tail reach during this season. It is a clear example of inequity for head and tail reaches. For Rabi season, variations in cropping intensity for the distributary and minor are less serious for head and tail watercourses. However, 9 percent less cropping intensity for tail watercourse of Puran Minor do reflect inequity of water supply. The orchard is a major crop at head reach of the Puran minor having about 24 percent of CCA. The area under cotton and wheat crops is almost same i.e. 12 and 19 percent of CCA at head and tail watercourses of the Puran minor. The area under orchard is about 14 percent less at tail compared to head watercourse.

5.04 Table V-2 (Figures V-5 and V-6) show the percent area Under crops during Kharif 1991. The pertinent data again indicate the channel reach differential. The area under major crops have shown declining trend on each channel. The steep declining of

Table V-1

CROPPING PATTERN BY CHANNEL REACH-PURAN SYSTEM

Season/Crops	Puran Disty			Puran Minor		
	Head	Tail	Overall	Head	Tail	Overall
Kharif 1990						
Sugarcane	0.49	0.30	0.42	0.97	5.44	3.40
Cotton	22.89	3.64	16.09	11.58	12.08	11.86
Orchards	2.60	1.06	2.06	24.40	9.55	16.30
Minor Crops	14.44	5.45	11.26	33.07	5.84	18.22
Sub Total:	40.42	10.46	29.83	70.02	32.91	49.78
Rabi 1990-91						
Wheat	42.03	40.65	41.54	18.69	18.75	18.73
Fodder	3.69	1.97	3.08	2.94	4.54	3.81
Sugarcane	0.49	0.30	0.42	0.97	5.44	3.40
Orchards	2.60	1.06	2.06	24.40	9.55	16.30
Minor Crops	0.16	1.97	1.55	1.65	1.49	1.56
Sub Total:	48.98	45.95	48.65	48.65	39.76	43.80
Annual:	89.40	56.41	78.48	118.66	72.67	93.58

Percent of Culturable Commanded Area

Cropping Pattern Puran Disty.
Kharif - 1990

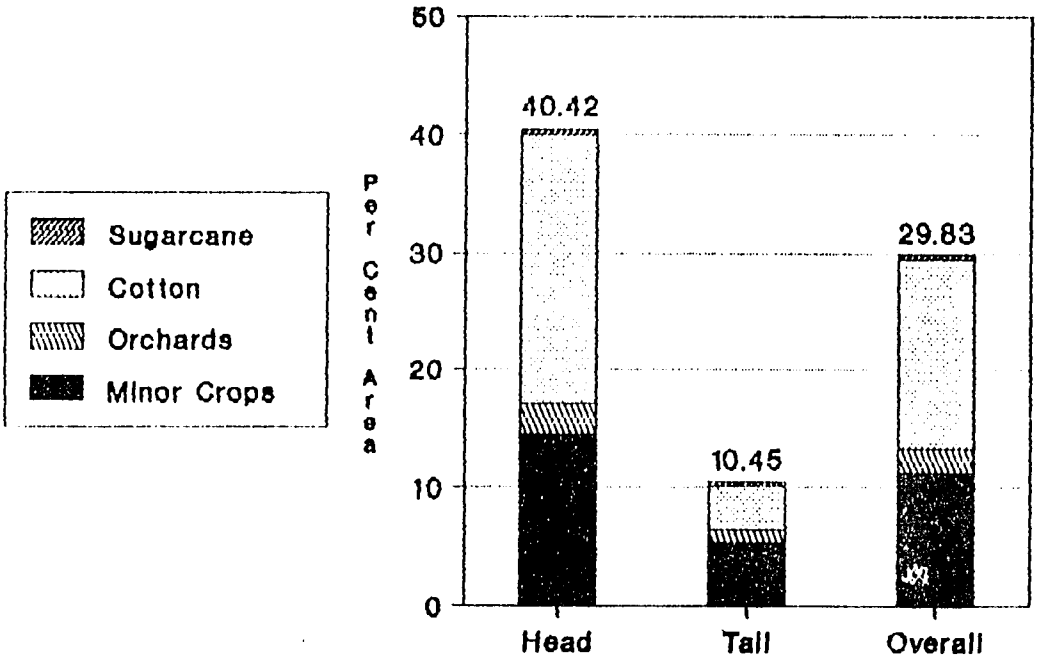


Figure V-1

Cropping Pattern Puran Minor
Kharif - 1990

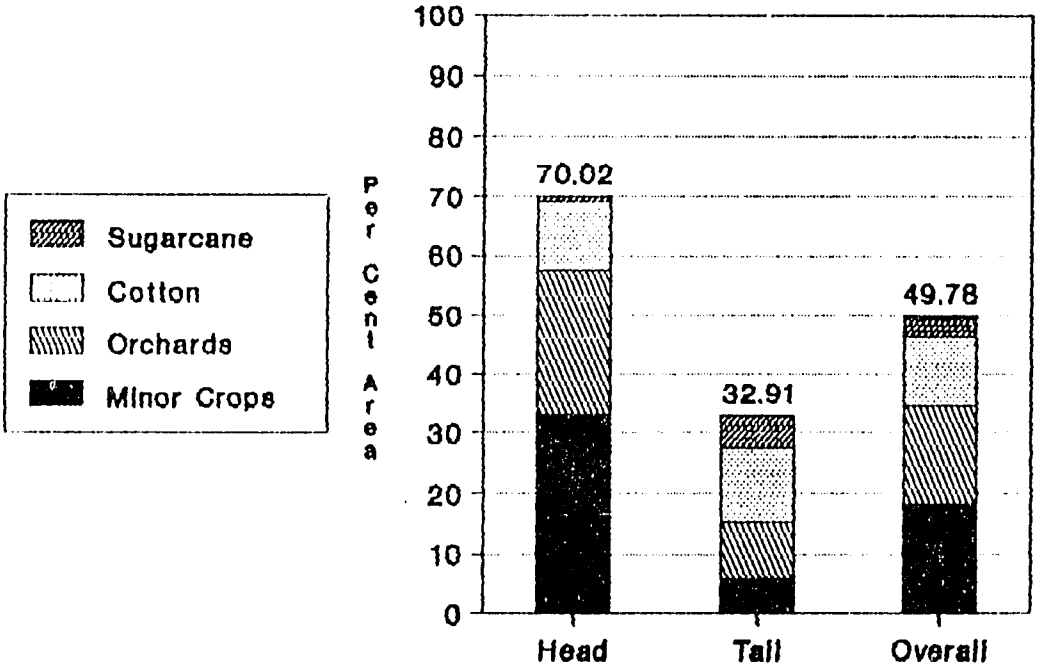


Figure V-2

Cropping Pattern Puran Disty.
Rabi 1990-91

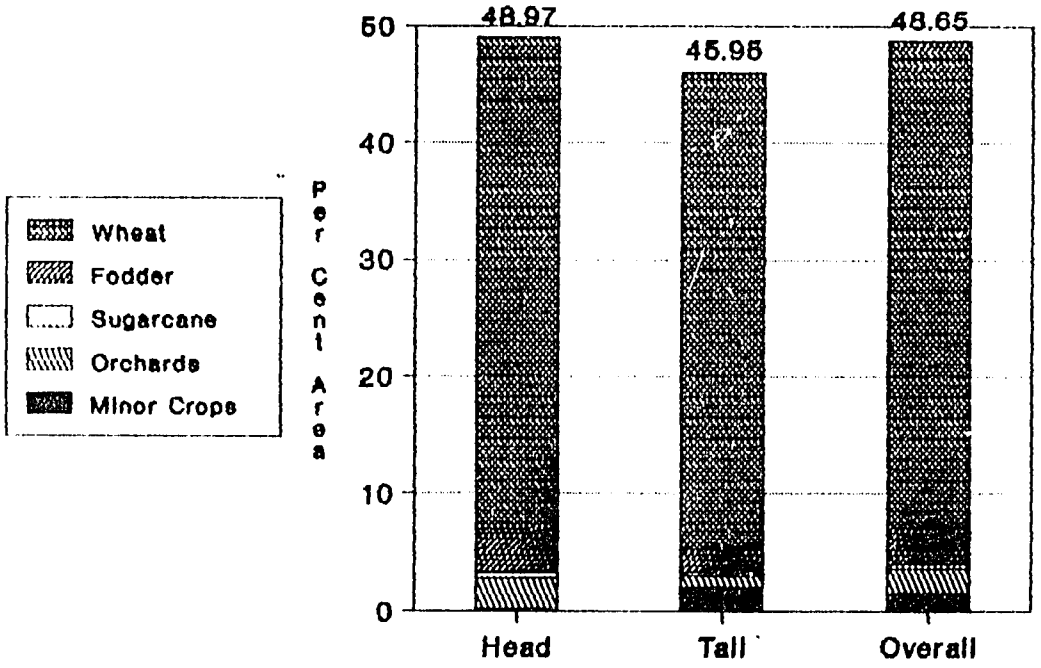


Figure V-3

Cropping Pattern Puran Minor
Rabi 1990-91

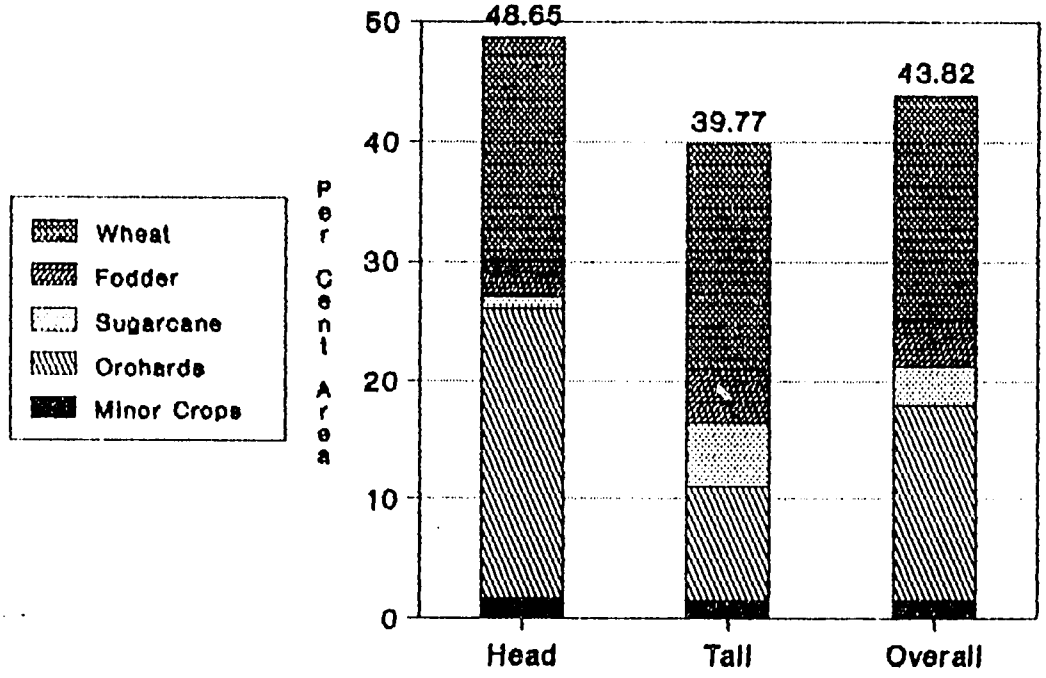


Figure V-4

Cropping Pattern Puran Disty.
Kharif - 1991

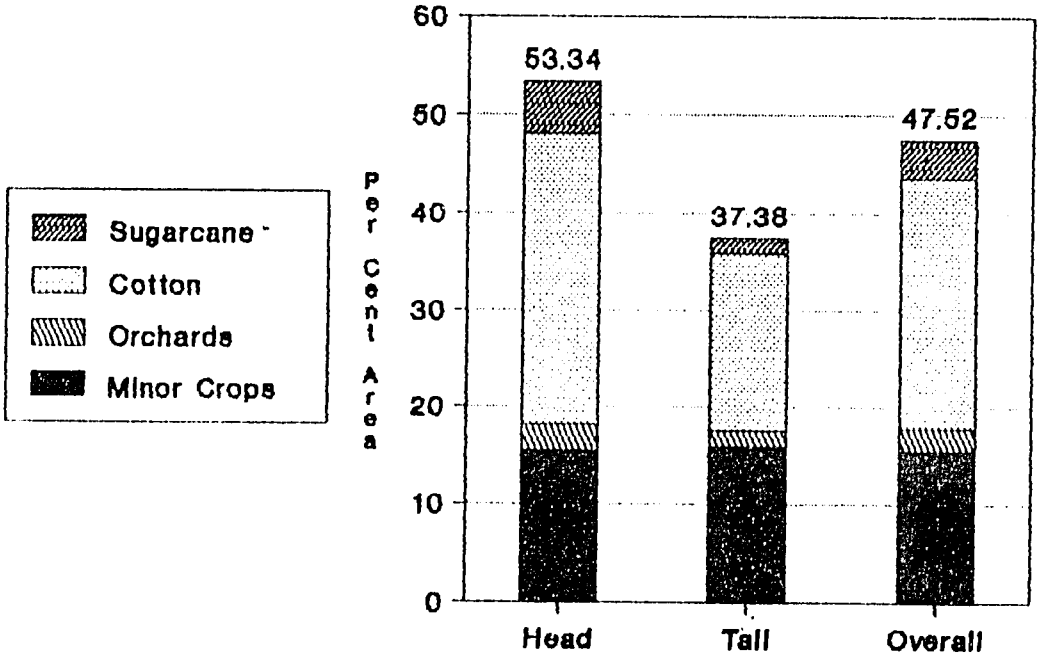


Figure V-5

Cropping Pattern Puran Minor
Kharif - 1991

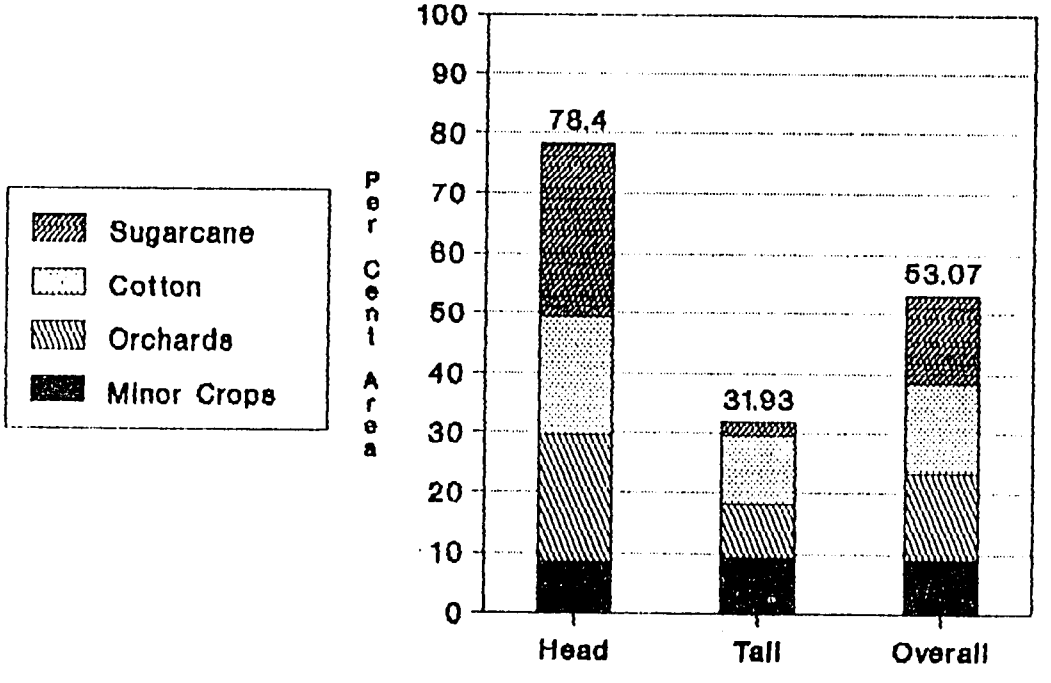


Figure V-6

high delta crops such as Sugarcane, orchards and vegetables is significant showing thereby inequitable supplies at tail reaches of channels. The cotton and sugarcane are major crops of Puran Disty while sugarcane, orchards and cotton are the dominant crops of puran minor during Kharif-1991. Comparing Kharif 90 and 91, the difference for tail watercourse of Puran distributary are highly significant.

Table V-2

CROPPING PATTERN AND INTENSITIES BY CHANNEL REACH-PURAN SYSTEM KHARIF 1991

Crops	Puran Disty		Puran Minor	
	Head	Tail	Head	Tail
Sugarcane	5.22	1.49	29.06	2.26
Cotton	30.05	18.51	19.73	11.71
Orchards	2.60	1.46	21.19	8.69
Other Crops	15.47	15.92	8.42	9.27
Total:	53.34	37.38	78.40	31.93

Percent of Culturable Commanded Area.

5.05 <u>Cropping Intensity</u> Table V-3 shows the cropping intensity for Kharif and Rabi by channel reaches and overall Puran system, while Figure V-7 and V-8 indicate the same for both channels. The cropping intensity is high at head of the Distributary and Minor. The overall cropping intensity of Puran minor is about 15 percent higher compared to Puran distributary. The annual cropping at head is 33 percent more compared to tail watercourse of Puran distributary. The same reach differential of about 46 percent have been recorded for Puran minor. On overall system basis the figure is recorded about 86 percent of CCA. The most intresting feature is that head - tail difference for Kharif cropping intensity is much wider compared with Rabi season which is minor.

Table V-3

CROPPING INTENSITY BY CHANNEL REACH
PURAN SYSTEM
(1990-91)

Channel/ Season	Head	Tail	Overall
Puran Disty			
Kharif	40.42	10.46	29.83
Rabi	48.98	45.95	48.65
Annual	89.40	56.41	78.48
Puran Minor			
Kharif	70.02	32.91	49.78
Rabi	48.65	39.76	43.80
Annual	118.67	72.67	93.58
Puran System			
Kharif	52.48	23.95	39.69
Rabi	48.85	42.23	46.26
Annual	101.33	66.18	85.95

5.06 Cropping intensity for Kharif 1991 (Table V-2) based on physical measurements is higher than Kharif 90 data obtained from irrigation department for Puran distributary. The observed data for distributary tail reach watercourse is almost 4 times higher than secondary source data.

Results at Farm Level

5.07 As earlier mentioned under chapter IV, this section covers the agro-economic conditions and other related factors at farm level for Kharif 1990 and Rabi 1990-91. The pertinent information has been compiled through interviews with operators of 71 sample farms (18 at each sample watercourse). These results are briefly discussed as under:

Cropping Intensities
By Channel Reaches

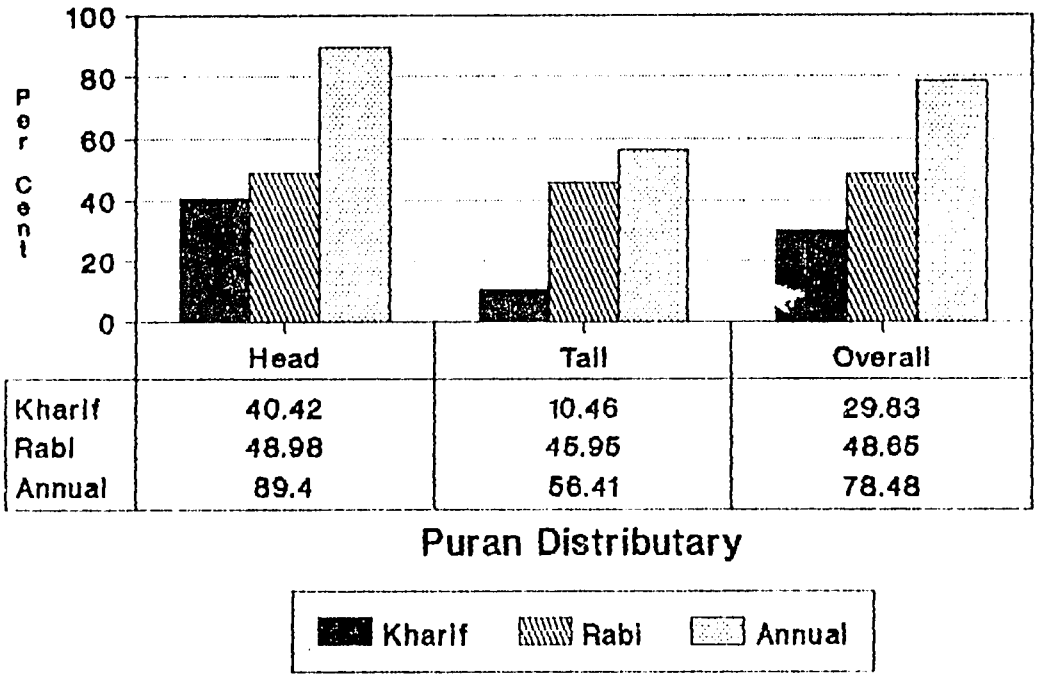


Figure V-7

Cropping Intensities
By Channel Reaches

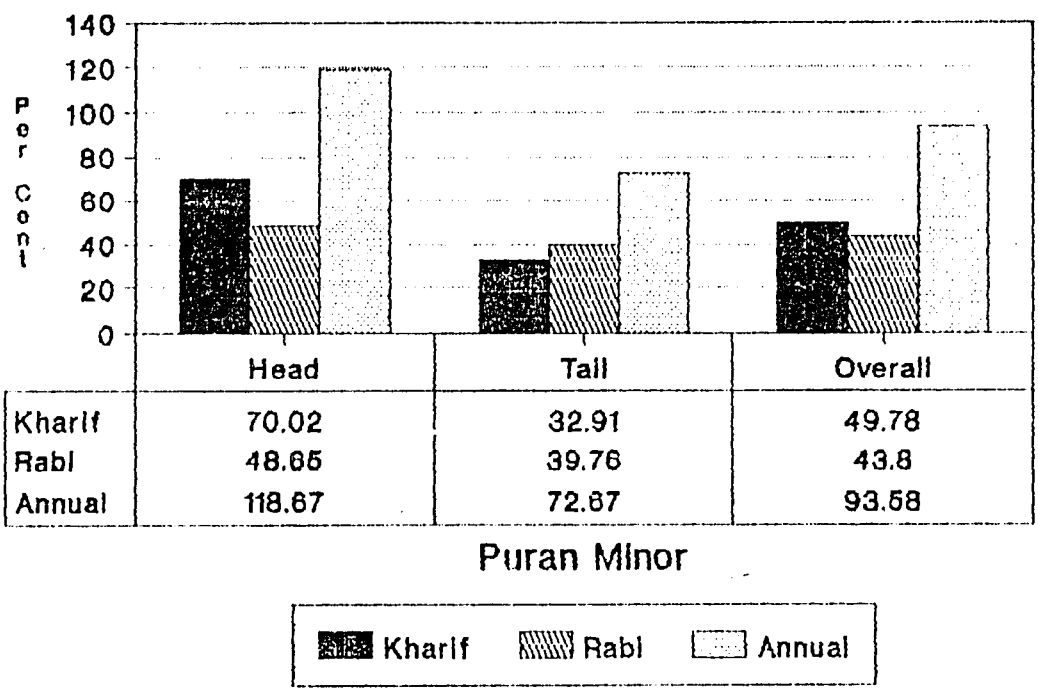


Figure V-8

5.08 <u>Size of Holding by Type of Tenure:</u> The information showing the distribution of farms by holding and type of tenure (all watercourses) at channel and system is given in Annexure-5, Table 5.3. Table V-4 indicates this information only for sample watercourses of the channels. The pertinent information for channel reach of the sample watercourses is appended in Annexure-5, Table 5.4. Table V-4 shows that about 80 percent of farmers are tenants and 20 percent are owners and owner cum tenants at puran system. About 88 percent of tenants operate upto 7.50 Hectares of holdings on project basis. The majority (83%) tenants are cultivating the land on puran disty. There is no case of combination of tenancy (owner cum tenant) on Puran Minor. Maximum farms (39 percent) range upto 2.50 hectares of holding size group at Puran Minor.

Table V-4

DISTRIBUTION OF FARM BY HOLDING SIZE AND TYPE OF TENURE
(SAMPLE WATERCOURSES)

PURAN DISTY

Count Percent FARM SIZE GROUP	OWNER	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50		1 2.9	8 22.9	9 25.7
2.51 - 5.00			6 17.1	6 17.1
5.01 - 7.50	3 8.6		12 34.3	15 42.9
ABOVE 7.50		2 5.7	3 8.6	5 14.3
Column Total	3 8.6	3 8.6	29 82.9	35 100.0

Cont'd Table V-4

PURAN MINOR

Count Percent FARM SIZE GROUP	OWNER	TENANT	Row Total
0.00 - 2.50	2 5.6	12 33.3	14 38.9
2.51 - 5.00		9 25.0	9 25.0
5.01 - 7.50		5 13.9	5 13.9
ABOVE 7.50	6 16.7	2 5.6	8 22.2
Column Total	8 22.2	28 77.8	36 100.0

PURAN SYSTEM

Count Percent FARM SIZE GROUP	OWNER	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50	2 2.8	1 1.4	20 28.2	23 32.4
2.51 - 5.00			15 21.1	15 21.1
5.01 - 7.50	3 4.2		17 23.9	20 28.2
ABOVE 7.50	6 8.5	2 2.8	5 7.0	13 18.3
Column Total	11 15.5	3 4.2	57 80.3	71 100.0

5.09 <u>Farm Fragmentations:</u> The data showing farm fragmentation have been given in Table V-5. It may be observed that 87,47 and 68 percent of the sample farms are in the shape of compact block on Puran disty, Puran minor and overall system, respectively. Farms which are comprised of two parcels work out to be 24 percent while 8 percent are divided into 3 parcels and only 1.4 percent have 4 parcels on system basis. Much more fragmentation has been observed at Minor compared with Distributary.

Table V-5

FRAGMENTATION OF HOLDING BY FARM SIZE GROUP

PURAN DISTY

FARM SIZE GROUP (Count / Percent)	No. of Parcels 1	No. of Parcels 2	Row Total
0.00 - 2.50	8 22.9	1 2.9	9 25.7
2.51 - 5.00	6 17.1		6 17.1
5.01 - 7.50	15 42.9		15 42.9
ABOVE 7.50	2 5.7	3 8.6	5 14.3
Column Total	31 88.6	4 11.4	35 100.0

PURAN MINOR

FARM SIZE GROUP (Count / Percent)	No. of Parcels 1	No. of Parcels 2	No. of Parcels 3	No. of Parcels 4	Row Total
0.00 - 2.50	12 33.3	1 2.8	1 2.8		14 38.9
2.51 - 5.00	2 5.6	5 13.9	2 5.6		9 25.0
5.01 - 7.50	1 2.8	2 5.6	2 5.6		5 13.9
ABOVE 7.50	2 5.6	5 13.9		1 2.8	8 22.2
Column Total	17 47.2	13 36.1	5 13.9	1 2.8	36 100.0

Cont'd Table V-5

PURAN SYSTEM

FARM SIZE GROUP (Count / Percent)	No. of Parcels 1	2	3	4	Row Total
0.00 - 2.50	20 28.2	2 2.8	1 1.4		23 32.4
2.51 - 5.00	8 11.3	5 7.0	2 2.8		15 21.1
5.01 - 7.50	16 22.5	2 2.8	2 2.8		20 28.2
ABOVE 7.50	4 5.6	8 11.3		1 1.4	13 18.3
Column Total	48 67.6	17 23.9	5 7.0	1 1.4	71 100.0

5.10 **Irrigation Turn:** The descriptive statistics relating to irrigation turn time by channel is given in Table V-6 and by Channel reach is presented in Annexure-5, Table 5.5. Mean turn time is recorded as 0.94, 0.90 and 0.94 hours per hectare for distributary, minor and system, respectively. The minimum and maximum values at Puran distributary have been reported as 0.66 and 1.24, whereas same for Puran minor are 0.81 and 1.00 hours/ha. On both channels the farms at tail watercourses are getting 0.57 and 0.17 Hrs./ha. additional benefits of their irrigation turn time.

Table V-6

DESCRIPTIVE STATISTICS OF IRRIGATION TURN TIME

(Hrs/Ha.)

Measures	Puran Disty	Puran Minor	Puran System
Mean	0.94	0.90	0.94
Median	0.69	0.90	0.69
Minimum	0.66	0.81	0.66
Maximum	1.24	1.00	1.24
Std.Dev.	0.29	0.09	0.29

5.11 **Main Watercourse Cleaning:** Mean number of main watercourse Cleanings as reported by the sample farmers for Kharif and Rabi seasons and by channel reach are given in Table V-7. The same information by watercourse reach is appended in Annexure-5, Table 5.6. On overall basis five and four Cleanings have been carried out during Kharif and Rabi on Puran disty. Three and two Cleanings have been reported for each season at puran minor. Annually nine and five Cleanings have been carried out on puran disty and puran minor.

Table V-7

MEAN NUMBER OF WATERCOURSE CLEANINGS BY CHANNEL REACH

PURAN SYSTEM

Channel/Reach	Kharif	Rabi	Annual
Puran Disty			
Head	4	5	9
Tail	5	4	9
Overall	5	4	9
Puran Minor			
Head	2	2	4
Tail	4	2	6
Overall	3	2	5

5.12 **Equity in Irrigation Water Supply:** All the respondents of Puran system reported to be satisfied with the allocation of irrigation turn time. The sample farmers also narrated that they were getting the allocated share of their irrigation turn.

5.13 **Turns Missed Under Regular Closures:** Mean number of irrigation turns missed under regular canal closures by channel reach as well as overall channel basis are presented in Table V-8. Not a single respondent has reported missing the irrigation turn during Kharif. On the average, four number of turns have been missed during Rabi. The corresponding figures are same for both the channels.

Table V-8

MEAN NUMBER OF TURNS MISSED UNDER REGULAR CLOSURES

PURAN SYSTEM

Channel/Reach	Kharif	Rabi	Annual
Puran Disty			
Head	0	4	4
Tail	0	4	4
Overall	0	4	4
Puran Minor			
Head	0	4	4
Tail	0	4	4
Overall	0	4	4

5.14 **Turns Missed Under Unexpected Closures by Reasons:** Table V-9 describes the mean number of irrigation turns missed due to unexpected canal closures by reasons for each channel and on overall system basis. Detail by channel reach is given in Annexure-5, Table 5.7. About 51 percent farmers of Puran disty reported that they have not missed any irrigation turn due to unexpected canal closures. Rest of the respondents (49 percent) missed 2 to 3 turns due to emergency maintenance of the channel by the irrigation department. All farms at Puran minor missed average of 3 irrigation turns due to emergency maintenance. On system basis, 25 percent respondents did not miss any irrigation but about 70 percent respondents missed 3 irrigations per year due to emergency maintenance. Thus emergency maintenance is the main cause for unexpected missing of irrigation turns.

Table V-9

TURNS MISSED UNDER UNEXPECTED CANAL CLOSURES BY REASONS

PURAN DISTY

Count Percent	No. of Turns 0	2	3	Row Total
Turn Not Missed	18 51.4			18 51.4
Emergency Maint		3 8.6	14 40.0	17 48.6
Column Total	18 51.4	3 8.6	14 40.0	35 100.0

PURAN MINOR

Count Percent	No. of Turns 3	Row Total
Emergency Maint	36 100.0	36 100.0
Column Total	36 100.0	36 100.0

PURAN SYSTEM

Count Percent	No. of Turns 0	2	3	Row Total
Turn Not Missed	18 25.4			18 25.4
Emergency Maint		3 4.2	50 70.4	53 74.6
Column Total	18 25.4	3 4.2	50 70.4	71 100.0

5.15 <u>Turns Having Inadequate Discharge by Reasons:</u> The farmers were asked to report the number of turns when less than normal discharge was delivered during Kharif and Rabi seasons. According to Table V-10, the reason reported by the respondent

was less discharge in the respective parent channels. About 76 and 24 percent farms have availed their irrigation turns when flows were below normal during Kharif and Rabi, respectively. The frequency of turns having inadequate discharge have been more on Puran minor compared to Puran disty. Not a single farmer has reported inadequate supply on Puran Minor during Rabi.

Table V-10

TURNS HAVING INADEQUATE DISCHARGE BY CHANNEL

(Percent Farms)

Number of Turns	Puran Disty		Puran Minor		Puran System	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
1	-	6	-	-	-	3
2	-	20	14	-	7	10
3	-	20	14	-	7	10
4	11	-	22	-	17	-
5	9	-	11	-	10	-
6	9	-	3	-	6	-
7	31	-	22	-	27	-
8	6	3	-	-	3	1
Total:	66	49	86	-	76	24

5.16 **Contribution of Tubewell Water for Crop Production:** Not a single farmer has used tubewell water for crop production on this system.

5.17 **Farm Level Land use Pattern:** Table V-11 shows the descriptive statistics of annual cropping intensities by channels, while Table V-12 indicates the information by farm size groups on channel and overall system. The detail information by channel reach is given in Annexure-5, Table 5.8. The annual cropping intensities crosstab with type of tenure is presented in Table V-13 and detailed in Annexure-5, Table 5.9.

5.18 On an average about 95, 86 and 90 percent annual cropping intensities have been recorded for Puran distributary, Puran minor and Puran system, respectively. The majority of the farmer

(55 percent) fall under the category of 51 to 100 percent cropping intensity on system basis. Amongst these 21 percent farmers have upto 2.50 hectare of holdings. On relative basis, small farms gave higher cropping intensity. Tenurewise grouping of cropping intensities for Puran distributary, Puran minor and Puran system are reported in table V-13. As 83, 79 and 80 percent operators have been tenants on the distributary, minor and the system respectively, they achieved maximum cropping intensities upto 200 percent in some cases, whereas the other tenurial systems could not achieve above 150 percent cropping intensity even in a single case.

Table V-11

DESCRIPTIVE STATISTICS OF ANNUAL CROPPING INTENSITIES AT FARM LEVEL BY CHANNELS

Measures	Puran Disty	Puran Minor	Puran System
Mean	94.57	85.63	90.00
Median	100.00	86.37	92.67
Minimum	0.0	0.0	0.0
Maximum	200.0	200.00	200.00
Std. Dev.	54.71	46.75	50.65

Percent of Farm Area

Table V-12

ANNUAL CROPPING INTENSITIES BY FARM SIZE

PURAN DISTY

FARM SIZE GROUP (Count / Percent)	Cropping Intensity Group 0-50	51-100	101-150	151-200	Row Total
0.00 - 2.50	2 5.7	4 11.4	1 2.9	2 5.7	9 25.7
2.51 - 5.00		3 8.6		3 8.6	6 17.1
5.01 - 7.50	3 8.6	11 31.4	1 2.9		15 42.9
ABOVE 7.50	2 5.7	2 5.7	1 2.9		5 14.3
Column Total	7 20.0	20 57.1	3 8.6	5 14.3	35 100.0

PURAN MINOR

FARM SIZE GROUP (Count / Percent)	Cropping Intensity Group 0-50	51-100	101-150	151-200	Row Total
0.00 - 2.50	2 5.6	11 30.6		1 2.8	14 38.9
2.51 - 5.00		3 8.3	4 11.1	2 5.6	9 25.0
5.01 - 7.50	2 5.6	2 5.6		1 2.8	5 13.9
ABOVE 7.50	5 13.9	3 8.3			8 22.2
Column Total	9 25.0	19 52.8	4 11.1	4 11.1	36 100.0

Cont'd Table IV-12

PURAN SYSTEM

FARM SIZE GROUP (Count / Percent)	Cropping Intensity Group 0-50	51-100	101-150	151-200	Row Total
0.00 - 2.50	4 5.6	15 21.1	1 1.4	3 4.2	23 32.4
2.51 - 5.00		6 8.5	4 5.6	5 7.0	15 21.1
5.01 - 7.50	5 7.0	13 18.3	1 1.4	1 1.4	20 28.2
ABOVE 7.50	7 9.9	5 7.0	1 1.4		13 18.3
Column Total	16 22.5	39 54.9	7 9.9	9 12.7	71 100.0

Table V-13

ANNUAL CROPPING INTENSITIES BY TYPE OF TENURE

PURAN DISTY

Tenure Type (Count / Percent)	Cropping Intensity Group 0-50	51-100	101-150	151-200	Row Total
OWNER	1 2.9	1 2.9	1 2.9		3 8.6
OWNER CUM TENANT	1 2.9	1 2.9	1 2.9		3 8.6
TENANT	5 14.3	18 51.4	1 2.9	5 14.3	29 82.9
Column Total	7 20.0	20 57.1	3 8.6	5 14.3	35 100.0

Cont'd Table V-13

PURAN MINOR

Tenure Type	Count / Percent	Cropping Intensity Group 0-50	51-100	101-150	151-200	Row Total
OWNER		5 13.9	3 8.3			8 22.2
TENANT		4 11.1	16 44.4	4 11.1	4 11.1	28 77.8
	Column Total	9 25.0	19 52.8	4 11.1	4 11.1	36 100.0

PURAN SYSTEM

Tenure Type	Count / Percent	Cropping Intensity Group 0-50	51-100	101-150	151-200	Row Total
OWNER		6 8.5	4 5.6	1 1.4		11 15.5
OWNER CUM TENANT		1 1.4	1 1.4	1 1.4		3 4.2
TENANT		9 12.7	34 47.9	5 7.0	9 12.7	57 80.3
	Column Total	16 22.5	39 54.9	7 9.9	9 12.7	71 100.0

Farm Inputs

5.19 The level and use of main explanatory variables for yields are being reported so as to have a record of data over time to furnish a Baseline for measuring the future development.

5.20 **Seed Rate:** Table V-14 shows the aggregate mean seed rates for the principal Kharif and Rabi crops by channel reach. The seed rate for all crops cultivated by channel reach and overall system is given in Annexure-5, Table 5.10. Data indicate that cotton seed rate is averaging from 21-37 kgs./ha., while sugarcane seed rate average 5530-9182 kgs./ha. On tail

watercourse of the distributary comparatively less seed rates have been used. Among the Rabi crops, wheat seed rate ranges between 113-148 kgs./ha. and fodder 24-30 kgs./ha. Seed rate used for all the major reported crops for the minor is higher compared with distributary. However, the seed rate in case of all these crops is adequate.

Table V-14

MEAN SEED RATE OF MAJOR CROPS BY CHANNEL REACH

(Kgs./Ha.)

Crops	Puran Disty		Puran Minor		Puran System
	Head	Tail	Head	Tail	
Cotton	24	21	25	37	28
Sugarcane	8308	5530	9182	-	8642
Wheat	124	113	148	144	131
Rabi Fodder	25	24	25	30	26

5.21 **Irrigation:** Table V-15 summarises the current levels of water use for the major Kharif and Rabi crops while for all crops information is given in Annexure-5, Table 5.11. Number of irrigations applied to all the crops are adequate except sugarcane which appear to be on the lower side. Head tail differences are minor or nil.

Table V-15

MEAN NUMBER OF IRRIGATIONS FOR MAJOR CROPS BY CHANNEL REACH

Crops	Puran Disty		Puran Minor		Puran System
	Head	Tail	Head	Tail	
Cotton	5	5	4	5	5
Sugarcane	10	12	11	-	11
Wheat	5	5	5	5	5
Rabi Fodder	10	9	6	7	8

5.22 Fertilizer: Of the inputs which are readily amenable to farmer's control fertilizer is probably the most important in determining yields. The use of nitrogenous, phosphatic and potashic fertilizer for all corps by channel and overall system has been summarized in Table V-16, while detail by channel reach is given in Annexure-5, Table 5.12. The data indicate that relatively higher amount of nitrogenous fertilizer has been applied to cotton, Kharif vegetables, sugarcane and wheat i.e. at average rate of 120, 147, 111 and 125 kgs. per hectare on overall system level. As regard phosphatic fertilizer, a maximum dosage per hectare (77 kg/ha.) has been applied to Rabi vegetables followed by 70 kg. per hectare to orchards. For the remaining crops, the rate of application has varied from 30 to 56 kg. per hectare. The potashic fertilizer has been used only for orchards and Rabi fodder in the project area. Higher dose of fertilizer have been applied to cotton and Kharif vegetables compared to recommended rates.

TABLE IV-16

MEAN FERTILIZER RATES BY CROPS

(Kgs./Ha.)

	Puran Disty			Puran Minor			Puran System		
Crops	N	P	K	N	P	K	N	P	K
Rice	-	-	-	57	30	-	57	30	-
Cotton	114	47	-	125	49	-	120	48	-
Jantar	57	-	-	57	-	-	57	-	-
K.Fodders	54	-	-	-	-	-	54	-	-
K.Vegetables	148	38	-	144	80	-	147	-	-
Sugarcane	144	76	-	97	28	-	111	43	-
Orchards	28	-	-	46	70	102	44	70	102
Wheat	129	57	-	121	55	-	125	56	-
R.Fodders	56	57	-	60	37	-	59	44	-
R.Vegetables	72	68	-	142	86	82	103	77	82

Crop Yields

5.23 Table V-17 present the mean yields of all crops by channel reach and overall Puran system. The same information pertaining to major crops have been corsstabbed with farm size groups and type of tenure by channel and overall system basis. The yield of cotton with farm size and type of tenure is given under Table V-18, V-19, respectively. Yield of sugarcane and wheat by farm size and type of tenure is presented in Table V-20 to V-23.

5.24 Rice crop have only been sown on the tail watercourse of Puran minor and its yield recorded 1058 kgs./ha. is low. A declining trend of yields from head to tail of the Puran Disty for cotton, jantar, Kharif vegetables, sugarcane, Rabi fodder and Rabi vegetables have been observed. The same trend on Puran minor for jantar, wheat, Rabi fodder and Rabi vegetables have also been recorded.

5.25 **Cotton Yield in relation to Farm Size:** The data given in Table V-18 for puran distributary indicate increasing trend in yield with increase in farm size. In case of the smallest farm size group (upto 2.5 ha.) maximum yield recorded fall in the range of 601 to 900 kgs/ha. whereas it increased above 900 kgs. per ha. for some farms larger than 2.5 ha. Considering all the farm sizes, about 47% farms yielded between 601 to 900 kgs/ha. The farm size group 5.01 - 7.50 ha. represented the largest group (47%) showing yield ranges from the lowest to the highest. The puran Minor does not show any significant effect of farm size on the yield of cotton. In this case 63.2% farms fall in the yield range of 301 to 600 kgs/ha. For Puran Irrigation System, higher yields have been achieved for farm sizes above 2.5 ha. This indicates yield -increase to some extent with increase in farm size.

5.26 **Cotton Yield by Type of Tenure:** The data given in Table V-19 indicate dominance of tenants as they constitute about 77 percent of total farms. The tenants achieved from the lowest to the highest yields and the tenancy system does not show any definite influence on cotton yield. For the Puran Minor, yields trend is similar although one tenant has been able to achieve cotton yield above 1200 kgs/ha. but in case of other categories of tenure the yield was restricted to 1200 kgs/ha. For the Puran System the tenants are dominant (72.2%) and the yield trend goes slightly in favour of tenants.

5.27 **Sugarcane Yield by Farm Size:** There are only two growers of sugarcane on puran distributary and both fall in the farm size group above 7.5 ha. However, for the same farm size, two different levels of yield have been achieved. For Puran Minor, out of the 3 farm size groups, the largest group of more than 7.5 ha. Produced higher yield. In this case increase in farm size had a positive effect in terms of increase in yield. For the Puran System, the farm size group 5 to 7.5 ha. produced higher yield compared with lower and higher size farm groups.

5.28 **Sugarcane Yield by Type of Tenure:** Out of the two sugarcane growers on Puran distributary the tenant received higher yield. At Puran Minor only the tenants grow sugarcane, therefore, no comparison between tenures is possible. For the Puran System on the whole, the tenants produced higher yield compared with owner-cum-tenant.

5.29 **Wheat Yield by Farm Size:** The farm size 5 to 7.5 ha. constitute about 42 percent of the total farms. Although farm size does not appear to have any relationship with wheat yield but on comparative basis the smallest farm size (upto 2.5 ha.), more number of farms fall in the yield range of 2001 to 3000

kgs/ha. In case of Puran Minor about 85 percent farms fall in the range of 1001 to 2000 kgs/ha. irrespective of the farm size. The notable thing in this case is that only one farm from the whole lot with the farm size of 2.5 to 5 ha. produced more than 2000 kgs. of wheat grain per ha. Considering the overall system the farm size does not appear to have any influence on wheat yield although farms upto 5 ha. in size have some edge over the larger farms.

5.30 Wheat Yield by Type of Tenure: Wheat yield by the owners on Puran distributary is the lowest whereas it is comparable for owner-cum-tenant and tenants. Similarly on Puran Minor, tenants have performed better than the owners to some extent. Similar trend has been observed for Puran System as the owner-cum-tenants and tenants have been able to achieve higher yield compared with owners.

TABLE V-17

MEAN YIELDS OF CROPS

PURAN SYSTEM

(Kgs./ha.)

	Channels						
	Puran Disty			Puran Minor			
Crops	Head	Tail	Over-all	Head	Tail	Over-all	Puran System
Rice	-	-	-	-	1059	1059	1059
Cotton	856	694	761	487	643	585	668
Jantar	17985	13066	14296	17060	14444	14967	14669
K.Fodders	17155	-	17155	-	-	-	17155
K.Vegetables	1555	1098	1168	-	1519	1519	1266
Sugarcane	81379	55338	68359	83616	-	83616	80225
Wheat	1911	1987	1946	1455	1366	1404	1685
R.Fodders	14296	6235	8538	24874	8328	14947	12308
R.Vegetables	9223	7148	7494	9695	1091	7974	7712

Table V-18

COTTON YIELD BY FARM SIZE

PURAN DISTY

FARM SIZE GROUP (Count / Percent)	Yield Kg. per Hectare: 0-300	301-600	601-900	901-1200	1201 AND ABOVE	Row Tot.
0.00 - 2.50		1 5.9	1 5.9			2 11.8
2.51 - 5.00		1 5.9	1 5.9	2 11.8		4 23.5
5.01 - 7.50	2 11.8		4 23.5	1 5.9	1 5.9	8 47.1
ABOVE 7.50			2 11.8	1 5.9		3 17.6
Column Total	2 11.8	2 11.8	8 47.1	4 23.5	1 5.9	17 100.0

PURAN MINOR

FARM SIZE GROUP (Count / Percent)	Yield Kg. per Hectare: 301-600	601-900	901-1200	Row Total
0.00 - 2.50	3 15.8	2 10.5		5 26.3
2.51 - 5.00	4 21.1		1 5.3	5 26.3
5.01 - 7.50	1 5.3			1 5.3
ABOVE 7.50	4 21.1	4 21.1		8 42.1
Column Total	12 63.2	6 31.6	1 5.3	19 100.0

Cont'd Table V-18

PURAN SYSTEM

FARM SIZE GROUP (Count / Percent)	Yield Kg. per Hectare: 0-300	301-600	601-900	901-1200	1201 AND ABOVE	Row Tot.
0.00 - 2.50		4 11.1	3 8.3			7 19.4
2.51 - 5.00		5 13.9	1 2.8	3 8.3		9 25.0
5.01 - 7.50	2 5.6	1 2.8	4 11.1	1 2.8	1 2.8	9 25.0
ABOVE 7.50		4 11.1	6 16.7	1 2.8		11 30.6
Column Total	2 5.6	14 38.9	14 38.9	5 13.9	1 2.8	36 100.0

Table V-19

COTTON YIELD BY TYPE OF TENURE

PURAN DISTY

TENURE TYPE (Count / Percent)	Yield Kg. per Hectare: 0-300	301-600	601-900	901-1200	1201 AND ABOVE	Row Total
OWNER			2 11.8			2 11.8
OWNER CUM TENANT			1 5.9	1 5.9		2 11.8
TENANT	2 11.8	2 11.8	5 29.4	3 17.6	1 5.9	13 76.5
Column Total	2 11.8	2 11.8	8 47.1	4 23.5	1 5.9	17 100.0

Cont'd Table V-19

PURAN MINOR

TENURE TYPE	Count / Percent	Yield Kg. per Hectare 301-600	601-900	901-1200	Row Total
OWNER		3 15.8	3 15.8		6 31.6
TENANT		9 47.4	3 15.8	1 5.3	13 68.4
	Column Total	12 63.2	6 31.6	1 5.3	19 100.0

PURAN SYSTEM

TENURE TYPE	Count / Percent	Yield Kg. per Hectare 0-300	301-600	601-900	901-1200	1201 AND ABOVE	Row Total
OWNER			3 8.3	5 13.9			8 22.2
OWNER CUM TENANT				1 2.8	1 2.8		2 5.6
TENANT		2 5.6	11 30.6	8 22.2	4 11.1	1 2.8	26 72.2
	Column Total	2 5.6	14 38.9	14 38.9	5 13.9	1 2.8	36 100.0

Table V-20

SUGARCANE YIELD BY FARM SIZE

PURAN DISTY

FARM SIZE GROUP (Count / Percent)	Yield kg. per Hectare: 30001-60000	Yield kg. per Hectare: 60000-90000	Row Total
ABOVE 7.50	1 50.0	1 50.0	2 100.0
Column Total	1 50.0	1 50.0	2 100.0

PURAN MINOR

FARM SIZE GROUP (Count / Percent)	Yield Kg. per Hectare: 60000-90000	Yield Kg. per Hectare: 90000 AND ABOVE	Row Total
0.00 - 2.50	1 14.3		1 14.3
2.51 - 5.00	3 42.9		3 42.9
5.01 - 7.50	1 14.3	2 28.6	3 42.9
Column Total	5 71.4	2 28.6	7 100.0

Cont.'d Table V-20

PURAN SYSTEM

FARM SIZE GROUP (Count / Percent)	Yield Kg. per Hectare: 30001-60000	60000-90000	90000 AND ABOVE	Row Total
0.00 - 2.50		1 11.1		1 11.1
2.51 - 5.00		3 33.3		3 33.3
5.01 - 7.50		1 11.1	2 22.2	3 33.3
ABOVE 7.50	1 11.1	1 11.1		2 22.2
Column Total	1 11.1	6 66.7	2 22.2	9 100.0

Table V-21

SUGARCANE YIELD BY TYPE OF TENURE

PURAN DISTY

TENURE TYPE (Count / Percent)	Yield Kg. per Hectare: 30001-60000	60001-90000	Row Total
OWNER CUM TENANT	1 50.0		1 50.0
TENANT		1 50.0	1 50.0
Column Total	1 50.0	1 50.0	2 100.0

Cont'd Table V-21

PURAN MINOR

TENURE TYPE	Count / Percent	Yield Kg. per Hectare 60001-90000	90001 AND ABOVE	Row Total
TENANT		5 71.4	2 28.6	7 100.0
	Column Total	5 71.4	2 28.6	7 100.0

PURAN SYSTEM

TENURE TYPE	Count / Percent	Yield Kg. per Hectare 30001-60000	60001-90000	90001 AND ABOVE	Row Total
OWNER CUM TENANT		1 11.1			1 11.1
TENANT			6 66.7	2 22.2	8 88.9
	Column Total	1 11.1	6 66.7	2 22.2	9 100.0

Table V-22

WHEAT YIELD BY FARM SIZE

PURAN DISTY

FARM SIZE GROUP (Count / Percent)	Yield Kg. per Hectare: 1001-20000	2001-3000	Row Total
0.00 - 2.50	2 7.1	3 10.7	5 17.9
2.51 - 5.00	3 10.7	3 10.7	6 21.4
5.01 - 7.50	9 32.1	3 10.7	12 42.9
ABOVE 7.50	3 10.7	2 7.1	5 17.9
Column Total	17 60.7	11 39.3	28 100.0

PURAN MINOR

FARM SIZE GROUP (Count / Percent)	Yield Kg. per Hectare: 0-1000	1001-2000	2001-3000	Row Total
0.00 - 2.50	1 3.8	5 19.2		6 23.1
2.51 - 5.00	1 3.8	6 23.1	1 3.8	8 30.8
5.01 - 7.50		5 19.2		5 19.2
ABOVE 7.50	1 3.8	6 23.1		7 26.9
Column Total	3 11.5	22 84.6	1 3.8	26 100.0

Cont'd Table V-22

PURAN SYSTEM

FARM SIZE GROUP (Count / Percent)	Yield Kg. per Hectare 0-1000	1001-2000	2001-3000	Row Total
0.00 - 2.50	1 1.9	7 13.0	3 5.6	11 20.4
2.51 - 5.00	1 1.9	9 16.7	4 7.4	14 25.9
5.01 - 7.50		14 25.9	3 5.6	17 31.5
ABOVE 7.50	1 1.9	9 16.7	2 3.7	12 22.2
Column Total	3 5.6	39 72.2	12 22.2	54 100.0

Table V-23

WHEAT YIELD BY TYPE OF TENURE
PURAN DISTY

TENURE TYPE (Count / Percent)	Yield Kg. per Hectare 1001-2000	2001-3000	Row Total
OWNER	3 10.7		3 10.7
OWNER CUM TENANT	1 3.6	1 3.6	2 7.1
TENANT	13 46.4	10 35.7	23 82.1
Column Total	17 60.7	11 39.3	28 100.0

Cont'd Table V-23

PURAN MINOR

TENURE TYPE	Count / Percent	Yield Kg. per Hectare 0-1000	1001-2000	2001-3000	Row Total
OWNER		1 3.8	4 15.4		5 19.2
TENANT		2 7.7	18 69.2	1 3.8	21 80.8
	Column Total	3 11.5	22 84.6	1 3.8	26 100.0

PURAN SYSTEM

TENURE TYPE	Count / Percent	Yield Kg. per Hectare 0-1000	1001-2000 0	2001-3000 0	Row Total
OWNER		1 1.9	7 13.0		8 14.8
OWNER CUM TENANT			1 1.9	1 1.9	2 3.7
TENANT		2 3.7	31 57.4	11 20.4	44 81.5
	Column Total	3 5.6	39 72.2	12 22.2	54 100.0

Value of Output

5.31 Mean crop output per hectare for major crops by channel reach and overall system is shown in Table V-24. The output value per hectare on overall basis for cotton, sugarcane, orchards, wheat and Rabi fodder works out to Rs.5425, 34391, 4142, 5327 and 3957, respectively. The declining trend of output value from head to tail correspond to crop yield data (Table V-17).

Table V-24

MEAN OUTPUT VALUE OF MAJOR CROPS
PURAN SYSTEM

(Rs./Ha.)

	Puran Disty			Puran Minor			
Crops	Head	Tail	Overall	Head	Tail	Overall	Puran System
Cotton	6950	5636	6177	3952	5218	4752	5425
Sugarcane	34885	23722	29303	35844	-	35844	34391
Orchards	-	1236	1236	3820	4539	4242	4142
Wheat	6043	6282	6154	4599	4319	4437	5327
R.Fodder	4596	2005	2745	7997	2678	4805	3957

Farm Income

5.32 The information related to farm income have been generated to present the main sources of income such as crop, livestock and non-farm. These information have been systematically discussed here as under:

5.33 Crop Income: The descriptive statistics of crop income is presented in Table V-25 which includes mean, median, minimum, maximum values of crop income alongwith its standard deviation. On overall system the mean crop income works out to Rs. 10218/- for the year under report. The average figure of crop income shows declining trend from head to tail watercourse on both channels. Minimum income from crops have been negatively recorded while the maximum ranges up to Rs. 168263 on head of Puran distributary and overall puran system. The average income and income per cropped hectare and income per hectare is given in Table V-26. The income per cropped hectare and per hectare have been recorded Rs. 889/- and Rs. 674/-, respectively for the year, while same values are negative on Puran minor.

5.34 The crop income and income per cropped hectare by farm Size groups and type of Tenure on channel and overall system basis is given in Annexure-5, Tables 5.13 to 5.16. Data indicate that majority (37 percent) of the farmer have reported less than

zero income and out of these 18 percent are from 0.00 to 2.50 hectares of holdings (smaller size). The farms reporting income per cropped hectare ranged their income from Rs. 3001 and above are 11 percent in the category of 5.01 to 7.50 hectare of holding size.

Table V-25

DESCRIPTIVE STATISTICS OF CROP INCOME

PURAN MINOR

(Rupees)

	Puran Disty			Puran Minor			
Measures	Head	Tail	Overall	Head	Tail	Overall	Puran System
Mean	17405	16904	17161	4779	2155	3467	10218
Median	6013	12169	8558	1523	-784	-97	4002
Minimum	-9367	-10731	-10731	-7449	-8953	-8953	-10731
Maximum	168263	59305	168263	22035	49295	49295	168263
Std. Dev.	40888	18718	31636	10338	13488	11918	24590

Table V-26

AVERAGE INCOME BY CHANNEL REACH

PURAN SYSTEM

(Rupees)

Income	Puran Disty			Puran Minor			Puran System
	Head	Tail	Overall	Head	Tail	Overall	
Crop Income	17405	16904	17161	4779	2155	3467	10218
Crop Income Per-Cropped Hectare	1489	3972	2730	-1210	-355	-795	889
Crop Income Per Hectare	1878	2940	2394	-1479	-515	-997	674
Livestock Income	2394	1006	1720	1411	1971	1691	1705
Livestock Income per Hectare	605	118	368	2347	187	1267	824
Non-Farm Income	400	1412	891	800	583	692	790
Non-Farm Income per Hectare	156	122	140	1121	76	598	372

5.35 <u>Livestock Income:</u> Detailed investigation of livestock sector of the farming system is beyond the scope and resources of the monitoring & Evaluation programme, but the respondents were asked to provide livestock inventories and an estimate of the value of cash sales of livestock and livestock product during the year under report. The information pertaining to average income from livestock and income per hectare is given in Table V-26, while the same is crosstab with size of holding groups and type of tenure and appended in Annexure-5, Table 5.17 to 5.18. The average livestock income and livestock income per hectare on system basis is Rs. 1705 and Rs. 825, respectively.

5.36 <u>Non-Farm Income:</u> The data presented in Table V-26 as average non-farm income per farm and non farm income per hectare. Which are Rs. 790/- and Rs.372/- on project basis, respectively. The descriptive statistics is given in Table V-27. The non-farm

income have been crosstab with holding groups and tenure type and is added in Annexure-5, Table 5.19 to 5.20. The farmers reporting no non-farm income are about 89 percent on system level. About 9 percent farms ranged non-farm income from Rs. 5001-1000 amongst these 6 percent fall inbetween 2.51 to 7.50 hectare size of holding.

Table V-27

DESCRIPTIVE STATISTICS OF NON-FARM INCOME
PURAN SYSTEM

(Rupees)

	Puran Disty			Puran Minor			
Measures	Head	Tail	Overall	Head	Tail	Overall	Puran System
Mean	400	1412	891	800	583	692	790
Median	0	0	0	0	0	0	0
Minimum	0	0	0	0	0	0	0
Maximum	7200	9600	9600	7200	6000	7200	9600
Std. Dev.	1697	3293	2609	2328	1717	2019	2314

Livestock Inventory

5.37 The livestock population per farm by channel reach for the year under report is given in Table V-27. It manifests that number of mature buffaloes is 0.7, 1.6 and 1.2 per farm on Puran minor, Puran disty and the system, respectively. Corresponding number for immature buffaloes are 0.3, 0.5 and 0.4, respectively. Data indicates that cows are of less importance as their mean population works out to be 0.4, 1.0 and 0.7 per farm. The draft oxen population is 1.1, 1.7 per farm. The oxen population is 1.1, 1.7 and 1.4 per farm on these channels and system. The figure of Horses is uniform (0.1). The sheep and goats, of all ages have been recorded as 5.6, 7.5 and 6.6 per farm for Puran minor, Puran disty and Puran system, respectively. A slight variation have been worked out for the population of livestock by channel reach.

Table V-28

AVERAGE LIVESTOCK NUMBER PER FARM BY CHANNEL REACH

PURAN SYSTEM

	CHANNEL / Reach						
	Puran Disty			Puran Minor			
Livestock	Head	Tail	Overall	Head	Tail	Overall	Puran System
Buffaloes	0.5	0.9	0.7	1.3	1.9	1.6	1.2
Draught Buffaloes	-	-	-	-	0.2	0.1	0.1
Buffaloes (Immature)	0.3	0.3	0.3	0.5	0.4	0.5	0.4
Cows	0.4	0.4	0.4	0.4	1.6	1.0	0.7
Draught Oxen	1.1	1.2	1.1	1.8	1.6	1.7	1.4
Cow (Immature)	0.5	-	0.3	-	0.6	0.3	0.3
Horses	-	0.1	0.1	0.1	0.1	0.1	0.1
Camels	-	0.1	-	-	-	-	-
Sheep & Goats All ages	2.8	8.6	5.6	9.8	5.2	7.5	6.6

Equipment Inventory

5.38 The data (Table V-29) indicates that the Puran disty is ill equipped as far as mechanized farming is concerned. The cultural operations have been mainly performed by bullocks and bullocks driven implements. The information reveals that there are 5 tractors 2 Rotavator and 1 thresher in the entire command of the sample watercourses and these are owned by the farmers of Puran Minor.

Table V-29

EQUIPMENT INVENTORY BY CHANNEL REACH

PURAN SYSTEM

(Number)

	Puran Disty			Puran Minor			
Livestock	Head	Tail	Overall	Head	Tail	Overall	Puran System
ractor	-	-	-	1	4	5	5
Rotavator	-	-	-	-	2	2	2
Thresher	-	-	-	1	1	1	1

Chapter VI

AGRO-ECONOMIC CONDITIONS

NAGNA SYSTEM

Results at Watercourse Command Level

6.01 The agro-economic results on watercourse command level comprise of cropped area, cropping pattern and cropping intensities. As narrated in the previous chapters, the field data collection were started during Feb. 1991, therefore, the cropped area data for Kharif 1990 was collected from Irrigation Department while the same information for Rabi 1990-91 was recorded through crop surveys. Like Puran system additional crop mapping for Kharif-1991 was carried out to supplement the results as the rehabilitation works were not started by Kharif-1991.

6.02 Cropping Pattern: The cropping pattern refers to the weight of different crops on farm holdings in total cropped area. Cropping pattern details for each sample watercourse are given in Annexure-6, Table 6.1, whereas the cropping pattern for these watercourses in respect of Kharif-1991 is appended in Annexure-6, Table 6.2. The Nagna System is being represented by sample of five watercourses, two at head, two at middle and one at tail reach of the channel. The information depicted in Table VI-1, Figure VI-1 and VI-2 show the cropping pattern by channel and its reach for Kharif 1990 and Rabi 1990-91, while Table VI-2 and Figure VI-3 indicate the same for Kharif, 1991.

6.03 According to data (Table VI-1) the middle reach watercourses have more cropped area under sugarcane and orchards compared to head and tail reach watercourses. The reasons are that majority of the farms at middle watercourses are owner operators having more than 7.50 hectare holdings (Table VI-5). Further they are socially influential and are utilizing the sources at their optimum level. The acreage of sugarcane in tail reach do reflect inequity in water supply.

Table VI-1

CROPPING PATTERN BY CHANNEL REACH
NAGNA SYSTEM

Season/Crops	Channel Reach			
	Head	Middle	Tail	Overall
Kharif 1990				
Sugarcane	15.28	17.12	8.63	14.96
Cotton	5.88	3.67	2.16	4.13
Orchards	21.69	38.69	15.10	28.70
Fodder	14.23	8.64	4.31	9.72
Minor Crops	8.23	2.45	1.08	4.13
Sub Total:	65.31	70.57	31.28	61.64
Rabi 1990-91				
Wheat	15.61	19.19	20.30	18.54
Fodder	0.51	0.72	1.21	0.74
Sugarcane	15.28	17.12	8.63	14.96
Orchards	21.69	38.69	15.10	28.70
Minor Crops	4.73	-	-	1.58
Sub Total:	57.82	76.44	45.24	64.52
Annual:	123.13	147.01	76.52	126.16

Percent of Culturable Command Area

6.04 The cropping pattern data for Kharif 1991 (Table VI-2) especially for sugarcane in the middle reach watercourses is significantly lower than Kharif 1990. Which is probably because of law and order situation in the area created by the decoits. The area under cotton have increased by 6.8 percent at middle reach of the channel. On head watercourses sugarcane area has however considerably increased while cotton area has decreased which is contrary to the other two reaches. On overall basis there is 3.67 percent decrease in cropped area compared to Kharif-1990. The cropping pattern has on the whole undergone considerable changes during the last year i.e. 1991.

Cropping Pattern Nagna System
Kharif - 1990

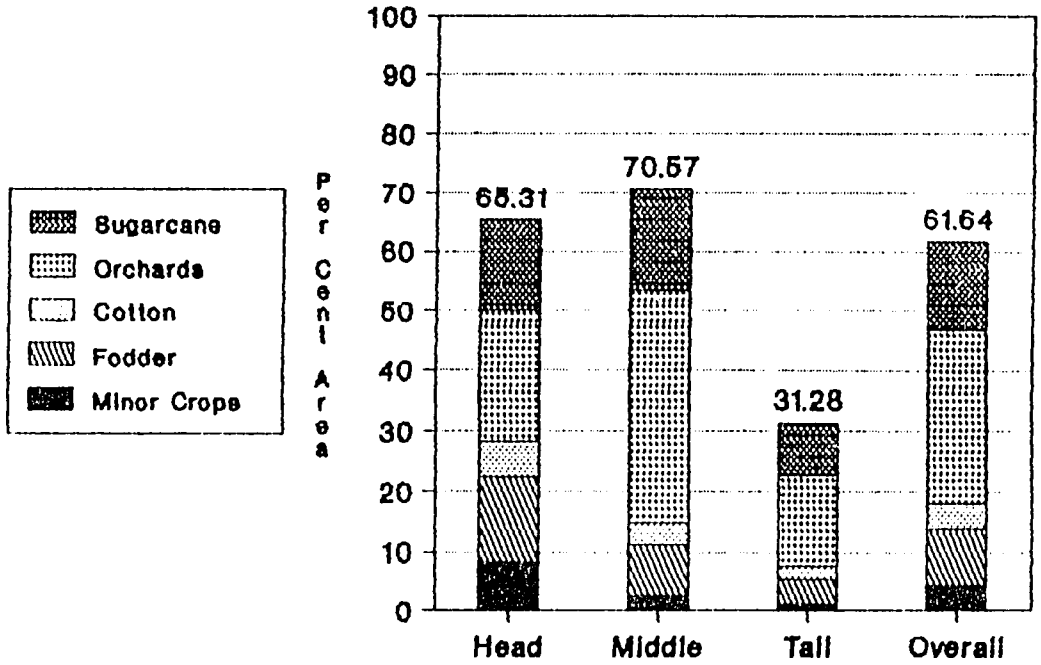


Figure VI-1

Cropping Pattern Nagna System
Rabi 1990-91

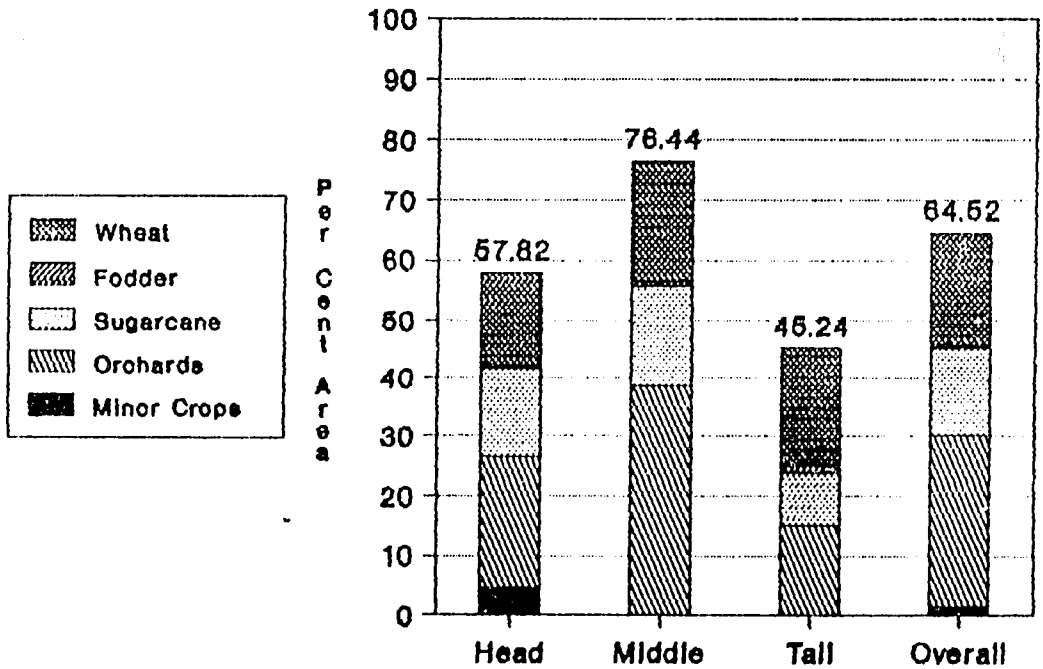


Figure VI-2

Table VI-2

CROPPING PATTERN BY CHANNEL REACH
NAGNA SYSTEM
KHARIF 1991

Crops	Channel Reach			Overall
	Head	Middle	Tail	
Sugarcane	27.19	1.74	9.65	11.70
Cotton	3.42	10.42	18.41	9.54
Orchards	22.67	42.64	15.10	30.93
Fodder	1.78	0.13	5.34	1.63
Minor Crops	3.84	4.32	4.39	4.17
Sub Total:	58.90	59.25	52.89	57.97

Percent of Culturable Commanded Area

6.05 Cropping Intensity: The cropping intensity being key indicator have also been stratified to represent the data on reach basis of the system and lined/unlined watercourses by reach (Table VI-3 and Figure VI-4). The cropping intensity at middle reach is 24 and 71 percent higher compared to head and tail reaches, respectively. The middle reach watercourses are most favoured and tail reach watercourses at a great disadvantage on terms of cropping intensity.

Table VI-3

CROPPING INTENSITIES BY CHANNEL REACH (1990-91)

Crops	Channel Reach			
	Head	Middle	Tail	Overall
Kharif	65.31	70.57	31.28	61.64
Rabi	57.82	76.44	45.24	64.52
Annual	123.13	147.01	76.52	126.16

Percent of Culturable Commanded Area.

6.06 Cropping Intensities of Lined and Unlined Watercourses:

The cropping intensities by lined and unlined watercourses are given in Table VI-4 and Figure VI-5 and VI-6. Two sample watercourses, one at head and the other at middle are lined. The cropping intensities are significantly high for lined watercourses i.e. about 25 and 39 percent higher for head and middle watercourses respectively, which show clear advantage of watercourse lining.

Table VI-4

CROPPING INTENSITIES OF LINED AND UNLINED WATERCOURSES NAGNA SYSTEM (1990-91)

Season	Lined		Unlined	
	Head	Middle	Head	Middle
Kharif	69.60	84.88	56.31	56.06
Rabi	61.55	81.21	50.03	71.63
Annual	131.15	166.09	106.34	127.69

Cropping Pattern Nagna System
Kharif - 1991

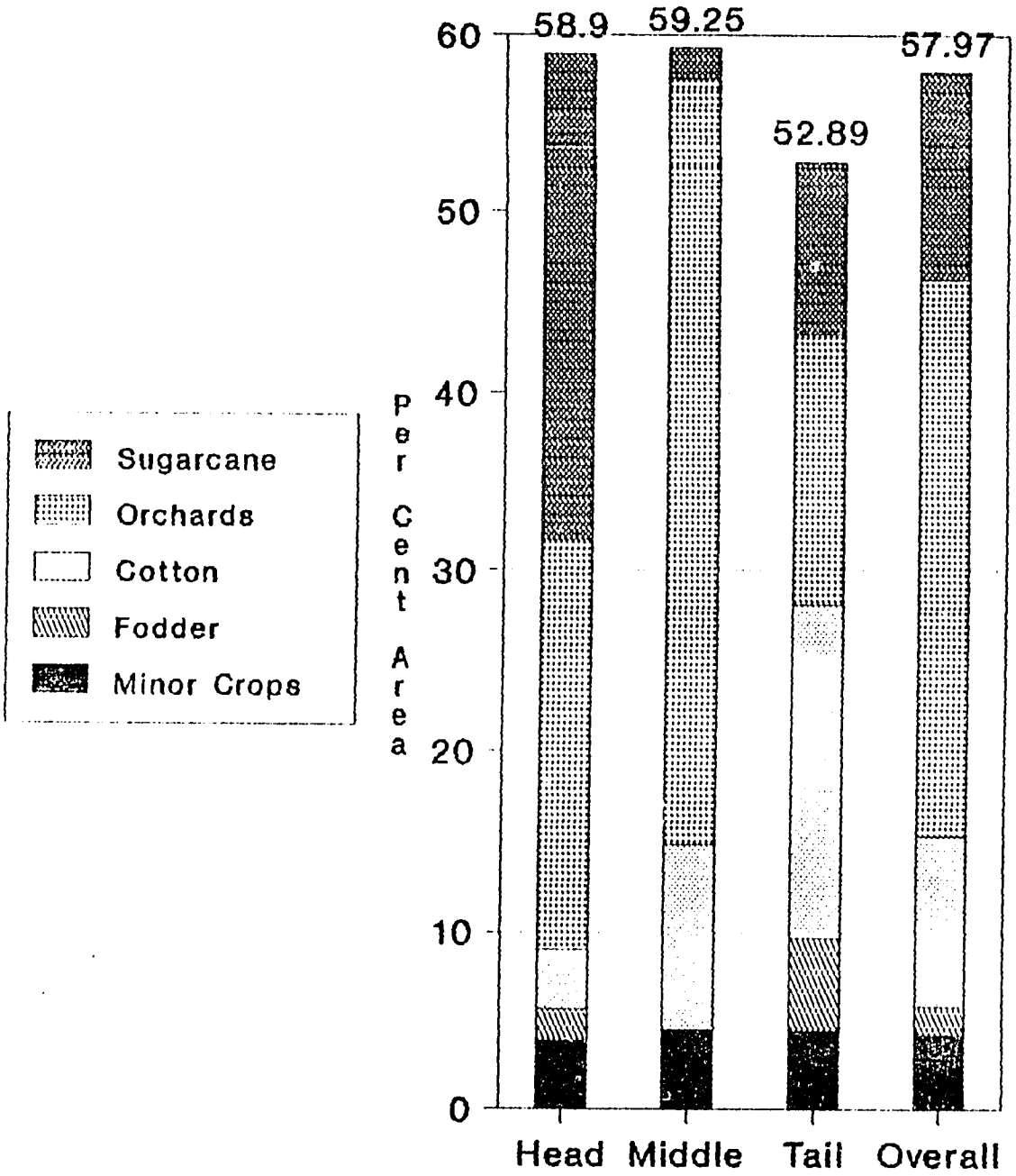
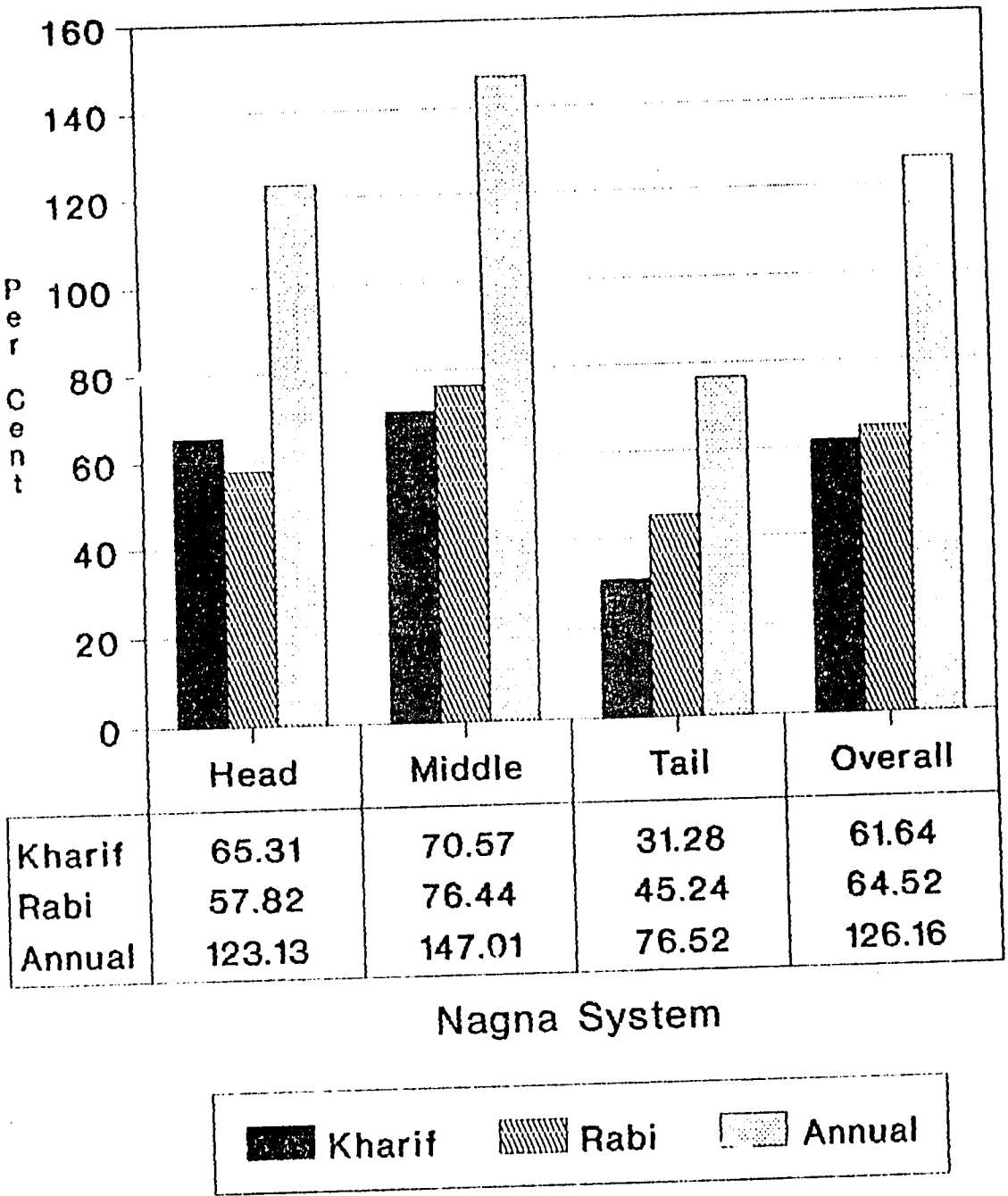


Figure VI-3

Cropping Intensities
By Channel Reaches



	Head	Middle	Tail	Overall
Kharif	65.31	70.57	31.28	61.64
Rabi	57.82	76.44	45.24	64.52
Annual	123.13	147.01	76.52	126.16

Nagna System

Figure VI-4

Cropping Intensities of
Lined and Unlined Head Watercourses

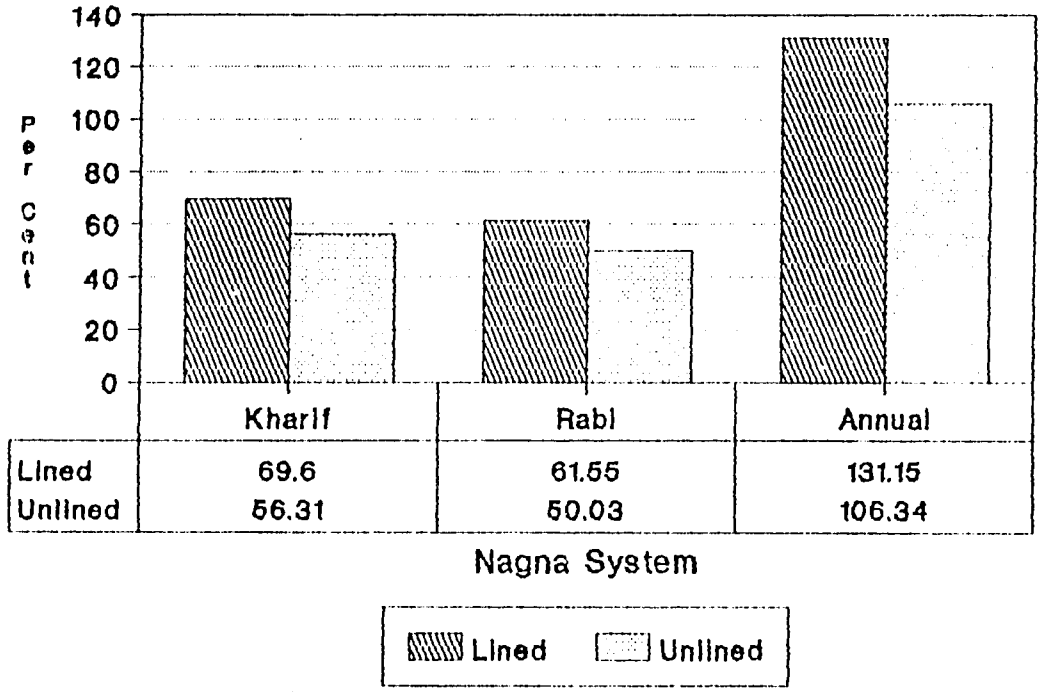


Figure VI-5

Cropping Intensities of
Lined and Unlined Middle Watercourses

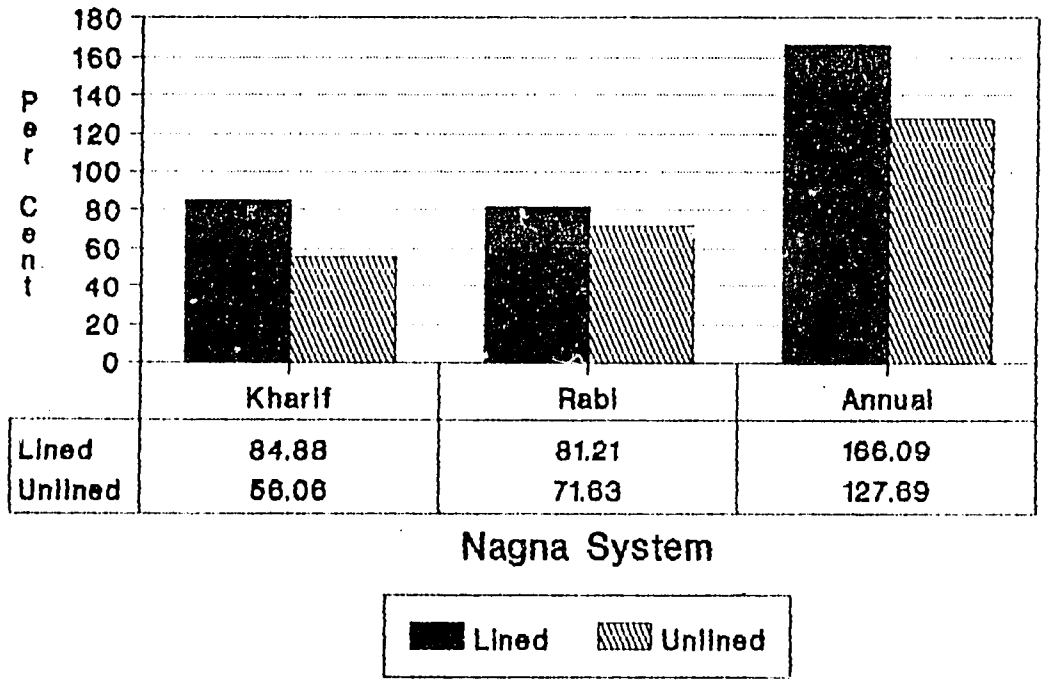


Figure VI-6

Results at Farm Level

6.07 This section covers the agro-economic indicators at farm level for Kharif 1990 and Rabi 1990-91. The pertinent information has been compiled through interviews with operators of 88 sample farms of 5 watercourses.

6.08 **Size of Holding by Type of Tenure:** The information in respect of size of holding by type of tenure processed for the entire farm area in addition to sample watercourses is given in Annexure-6, Table 6.3, while the same information for the area on sample watercourses by channel reach and overall system is given in Table VI-5. The descriptive statistics of farm size by type of tenure is shown in Table VI-6, the detail by reach is given in Annexure-6, Table 6.4. The data (Table VI-5) reveals that about 57 percent farms have been operated by the tenants while 36 percent farms are controlled by owner operators. Majority of the owners and owner cum tenants have a larger holding size i.e. more than 7.5 ha. whereas majority of the tenants have less than 7.5 ha. holding. On middle watercourses majority (63 percent) are the owner operators while majority on head watercourses (75%) and tail watercourses (82%) are tenants. The owner operators with comparatively large holding size on middle reach watercourses have advantages over the head and tail reach watercourses. On system basis, majority of the operators (57%) are tenants and second category is owners (36%).

Table VI-5

DISTRIBUTION OF FARMS BY HOLDING SIZE AND TYPE OF TENURE (SAMPLE WATERCOURSES)

NAGNA SYSTEM

FARM SIZE GROUP (Count / Percent)	OWNER	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50	7 8.0	1 1.1	17 19.3	25 28.4
2.51 - 5.00	5 5.7	1 1.1	11 12.5	17 19.3
5.01 - 7.50	3 3.4		15 17.0	18 20.5
ABOVE 7.50	17 19.3	4 4.5	7 8.0	28 31.8
Column Total	32 36.4	6 6.8	50 56.8	88 100.0

Cont'd Table VI-5

HEAD REACH

FARMSIZE (Count / Percent)	OWNER	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50	1 2.8	1 2.8	7 19.4	9 25.0
2.51 - 5.00	1 2.8		4 11.1	5 13.9
5.01 - 7.50			13 36.1	13 36.1
ABOVE 7.50	5 13.9	1 2.8	3 8.3	9 25.0
Column Total	7 19.4	2 5.6	27 75.0	36 100.0

MIDDLE REACH

FARM SIZE GROUP (Count / Percent)	OWNER	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50	6 17.1		7 20.0	13 37.1
2.51 - 5.00	4 11.4	1 2.9		5 14.3
5.01 - 7.50	2 5.7		1 2.9	3 8.6
ABOVE 7.50	10 28.6	3 8.6	1 2.9	14 40.0
Column Total	22 62.9	4 11.4	9 25.7	35 100.0

Cont'd Table VI-5

TAIL REACH

Count / Percent / FARM SIZE GROUP	OWNER	TENANT	Row Total
0.00 - 2.50		3 17.6	3 17.6
2.51 - 5.00		7 41.2	7 41.2
5.01 - 7.50	1 5.9	1 5.9	2 11.8
ABOVE 7.50	2 11.8	3 17.6	5 29.4
Column Total	3 17.6	14 82.4	17 100.0

6.09 According to Table VI-6 the mean farm size on project basis works out to be 8.3 hectares, while the corresponding figure for owners, owner-cum tenants and Tenants are 12.10, 3.17 and 2.24, respectively. The maximum and minimum farm size have been recorded for owners i.e. 66.12 and 0.80 ha. respectively.

Table VI-6

DESCRIPTIVE STATISTICS OF FARM SIZE
BY TYPE OF TENURE

Measure	Owner	Owner-cum Tenant	Tenant	All Farms
Mean	12.10	3.17	2.24	8.28
Median	8.91	4.00	2.00	5.20
Minimum	0.80	1.00	1.00	0.04
Maximum	66.12	4.00	4.00	66.12
Std. Dev.	14.27	1.33	1.08	10.30

6.10 Farm Fragmentations: The data in Table VI-7 depict that about 49 percent of sample farms comprise of a single parcel. The farms comprising of two and three pieces of land are 26 and 16 percent, respectively. The remaining 9 percent farms consist

of 1 to 6 fragments. It is notable that the number of fragments increase with increase in holding size.

Table VI-7

FRAGMENTATION OF HOLDING BY FARM SIZE GROUPS
NAGNA SYSTEM

Count Percent FARM SIZE GROUP	Number of parcels 1	2	3	4	5	6	Row Total
0.00 - 2.50	19 21.6	5 5.7	1 1.1				25 28.4
2.51 - 5.00	10 11.4	5 5.7	2 2.3				17 19.4
5.01 - 7.50	5 5.7	6 6.8	6 6.8		1 1.1		18 20.4
ABOVE 7.50	9 10.2	7 8.0	5 5.7	5 5.7		2 2.2	28 31.8
Column Total	43 48.9	23 26.2	14 15.9	5 5.7	1 1.1	2 2.2	88 100.0

6.11 Irrigation Turn: The information relating to average Irrigation Turn Time per hectare for channel reach and overall channel basis is presented in Table VI-8. The average irrigation turn time on head, middle and tail reach and for overall channel basis have been recorded as 0.85, 0.56, 0.99 and 0.75 Hrs./ha., respectively. On tail watercourse more irrigation turn time has been allocated compared to head and middle watercourses.

Table VI-8

DESCRIPTIVE STATISTICS OF IRRIGATION TURN TIME

(Hrs./Ha.)

Measures	Channel Reach			Overall
	Head	Middle	Tail	
Mean	0.85	0.56	0.99	0.75
Median	0.71	0.62	0.99	0.71
Minimum	0.00	0.05	0.89	0.00
Maximum	1.65	0.89	0.90	1.65
Std. Dev.	0.34	0.20	0.00	0.29

6.12 Main Watercourse Cleanings: Table VI-9 depicts the mean number of main watercourse cleanings by channel reach for Kharif and Rabi seasons. On an average 4, 6, and 5 cleanings have been done by the farmers on head, middle and tail watercourses of the distributary during the year. Equal number of cleanings (2) have been performed on reach and overall system basis during the Rabi season.

Table VI-9

MEAN NUMBER OF WATERCOURSE CLEANINGS
BY CHANNEL REACH

Season	Channel Reach			Overall
	Head	Middle	Tail	
Kharif	2	4	3	3
Rabi	2	2	2	2
Annual	4	6	5	5

6.13 Equity in Irrigation Water Supply: All the farmers of this system were satisfied in terms of allocation of turn time and availing of the irrigation turn. This information is based on the interviews of the sample farmers.

6.14 **Turn Missed Under Regular Closures:** Average number of irrigation turns missed under regular canal closures by channel reach is given in Table VI-10. No canal closures have been observed by the farmers during Kharif season while equal canal closures by channel reach and on overall basis (4 times) have been reported by the respondents of the system on Rabi and annual basis.

Table VI-10

MEAN NUMBER OF TURNS MISSED UNDER REGULAR CLOSURES

Season	Channel Reach			Overall
	Head	Middle	Tail	
Kharif	0	0	0	0
Rabi	4	4	4	4
Annual	4	4	4	4

6.15 **Turns Missed Under Unexpected Closures by Reasons:** According to Table VI-11, about 98 percent farms have reported that they missed their Irrigation turns due to unexpected canal closures. On the basis of further stratifications 10 and 88 percent missed 3 and 4 turns during the year due to emergency maintenance of the channel. On head and tail watercourses 94 and 100 percent farms have not availed 4 irrigations due to the emergency maintenance by the departments. The situation have been better at middle reach watercourses as for as loosing of irrigation turns is concerned.

Table VI-11

TURNS MISSED UNDER UNEXPECTED CANAL CLOSURES BY REACHES

NAGNA SYSTEM

Count / Percent	Turns Missed 0	3	4	Row Total
Turn Not Missed	2 2.3			2 2.3
Emergency Maint.		9 10.2	77 87.5	86 97.7
Column Total	2 2.3	9 10.2	77 87.5	88 100.0

Head Reach

Count / Percent	Turns Missed 0	4	Row Total
Turn Not Missed	2 5.6		2 5.6
Emergency Maint.		34 94.4	34 94.4
Column Total	2 5.6	34 94.4	36 100.0

Middle Reach

Count / Percent	Turns Missed 3	4	Row Total
Emergency Maint.	9 25.7	26 74.3	35 100.0
Column Total	9 25.7	26 74.3	35 100.0

Cont'd Table VI-11

Tail Reach

	Count Percent	Turns Missed 4	Row Total
Emergency Maint.		17 100.0	17 100.0
	Column Total	17 100.0	17 100.0

6.16 Turns Having Inadequate Discharge by Reasons: The response to the number of turns having inadequate flow in the channel by reason is presented in Table VI-12, while the same information on the reach basis is given in Annexure-6, Table 6.5. In 44 percent cases, the supplies to farms were full, while in the majority of the cases (56%) the supplies delivered were inadequate. The reason reported has been less flow in the distributary. The number of turns when supplies were reported as inadequate varied between 2 to 15.

Table VI-12

TURNS HAVING INADEQUATE DISCHARGE BY REASONS

NAGNA SYSTEM

Count Percent	Number of turns 0	2	3	5	6	7	8	9	10	11	12	15	Row Total
Full Supply.	39 44.3												39 44.3
Less Flow In Channel		8 9.1	5 5.7	3 3.4	8 9.1	3 3.4	9 10.2	7 8.0	3 3.4	1 1.1	1 1.1	1 1.1	49 55.7
Column Total	39 44.3	8 9.1	5 5.7	3 3.4	8 9.1	3 3.4	9 10.2	7 8.0	3 3.4	1 1.1	1 1.1	1 1.1	88 100

6.17 Contribution of Tubewell Water for Crop Production: According to the data generated, 8 respondents (22 percent of farms) of head watercourses have been using tubewell water for crop production. There was no contribution on middle and tail reaches. In 11 percent cases, the contribution of tubewell water on crop production has been recorded as 0-25% while in 4 remaining cases contribution is higher.

Table VI-13

CONTRIBUTION OF TUBEWELL WATER FOR CROP PRODUCTION

(Farms Reporting)

Percentage Range	Channel Reach: Head		Overall System	
	Number	Percent	Number	Percent
0 - 25	4	11.1	4	4.5
26 - 50	2	5.6	2	2.3
51 - 75	-	-	-	-
76 - 100	2	5.6	2	2.3
Total:	8	22.3	8	9.1

6.18 **Farm Level Land use Pattern:** Table VI-14 presents the descriptive statistics of average annual cropping intensities at farm level. This data is related to farm size groups and type of tenure in Table VI-15 and VI-16, while the same by channel reach is given in Annexure-6, Table 6.6 and 6.7, respectively. The averages (mean and median) show the channel reach differential. The farm level cropping intensities have shown declining trend especially from middle to tail reaches. Although cropping intensities recorded have a wide range (0-more than 201) but the largest group (34% of operators fall in 51-100 percent category. The data also indicate somewhat increase in cropping intensity with increase in farms size. Tenants enjoying majority (57%) have some edge over the other types of tenants.

Table VI-14

DESCRIPTIVE STATISTICS OF ANNUAL CROPPING INTENSITIES AT FARM LEVEL BY CHANNEL REACH

Measures	Channel Reach			
	Head	Middle	Tail	Overall
Mean	107.4	105.8	64.3	98.4
Median	103.6	98.8	73.2	99.1
imum	0.0	0.0	0.0	0.0
ximum	219.6	259.2	125.0	259.0
Std. Dev.	56.8	76.6	44.6	65.1

Percent of Farm Area

Table VI-15

ANNUAL CROPPING INTENSITIES BY FARM SIZE
NAGNA SYSTEM

FARM SIZE GROUP (Count / Percent)	Annual Cropping Intensities 0-50	51-100	101-150	151-200	201 AND ABOVE	Row Total
0.00 - 2.50	9 10.2	8 9.1	4 4.5	4 4.5		25 28.4
2.51 - 5.00	4 4.5	5 5.7	4 4.5	4 4.5		17 19.3
5.01 - 7.50	1 1.1	8 9.1	5 5.7	3 3.4	1 1.1	18 20.5
ABOVE 7.50	8 9.1	9 10.2	4 4.5	4 4.5	3 3.4	28 31.8
Column Total	22 25.0	30 34.1	17 19.3	15 17.0	4 4.5	88 100.0

Table VI-16

ANNUAL CROPPING INTENSITIES BY TYPE OF TENURE
NAGNA SYSTEM

TENURE TYPE	Count / Percent	Annual Cropping Intensities 0-50	51-100	101-150	151-200	201 AND ABOVE	Row Total
OWNER		14	4	1	2	11	32
		15.9	4.5	1.1	2.3	12.5	36.4
OWNER CUM TENANT		1	1	3		1	6
		1.1	1.1	3.4		1.1	6.8
TENANT		7	15	12	6	10	50
		8.0	17.0	13.6	6.8	11.4	56.8
	Column Total	22	20	16	8	22	88
		25.0	22.7	18.2	9.1	25.0	100.0

Farm Inputs

6.19 The level and use of main explanatory variables for crop yields are briefly by discussed as under:

6.20 Seed Rate: Mean seed rates used as reported by the sample farmers by channel reach are presented in Table VI-17. Reachwise seed rates differ to some extent but no reach has superiority so far as all major crops are concerned. Seed rate for wheat for all the distributary reaches is on the higher side whereas in other cases it is reasonable.

Table VI-17

MEAN SEED RATE OF CROPS BY CHANNEL REACH

(Kgs/Ha)

Crops	Channel Reach			Overall
	Head	Middle	Tail	
Kharif				
Sugarcane	7449	9238	-	7693
Cotton	22	28	21	24
Jantar	25	25	25	25
Maize (Fd.)	120	118	-	120
Bajra	12	-	-	12
Vegetables	5	12	5	10
Rabi				
Wheat	144	139	149	144
Fodder	27	31	26	29
Vegetables	4	-	-	4

6.21 Irrigation: Data in Table VI-18 depicts the number of irrigations applied to crops on reach basis. On middle reach watercourses, irrigations applied to Khairf vegetables and Rabi fodder are on the higher side compared with other reaches. For rest of the crops reachwise differences are minor.

Table VI-18

MEAN NUMBER OF IRRIGATIONS FOR CROPS BY CHANNEL REACH

Crops	Channel Reach			
	Head	Middle	Tail	Overall
Kharif				
S.Cane. (Fresh)	10	9	-	10
S.Cane.(Ratoon)	10	-	-	10
Orchards	7	7	-	7
Cotton	5	5	5	5
Jantar	8	8	5	7
Fodder	4	4	-	4
Bajra	4	-	-	4
Vegetables	9	11	7	10
Rabi				
Wheat	5	5	4	5
Fodder	6	8	6	7
Vegetables	8	-	-	8

6.22 Fertilizer: The use of nitrogenous, phosphatic and potashic fertilizers by channel reach has been summarized in Table VI-19. The potashic fertilizer has only been applied to orchards at the middle watercourses. The phosphatic fertilizers have been applied to all crops except Jantar and Bajra There is variation in the rate of use of fertilizer by channel reach in the project area. The rates of fertilizers are just close to the recommended doses of the fertilizer.

Table VI-19

MEAN FERTILIZER RATES OF CROPS BY CHANNEL REACH

(Kgs/ha.)

Crops	Channel Reach									
	Head		Middle			Tail		Overall		
	N	P	N	P	K	N	P	N	P	K
Kharif										
S.cane (Fresh)	121	72	46	115	-	-	-	111	78	-
S.cane (Ratoon)	99	60	-	-	-	-	-	90	60	-
Orchards	86	49	84	56	42	-	-	84	55	42
Cotton	111	57	120	57	-	72	44	99	51	-
Jantar	28	-	-	-	-	-	-	28	-	-
Fodder	69	47	59	-	-	-	-	65	47	-
Bajra	57	-	-	-	-	-	-	57	-	-
Vegetables	117	59	124	47	-	158	114	125	53	-
Rabi										
Wheat	105	56	113	44	-	63	42	98	50	-
Fodder	51	27	66	30	-	16	41	51	35	-

6.23 **Farm Yard Manure:** Data given in Table VI-20 reveal the use of farm yard manure by channel reach and on overall project basis. Application rate to wheat on head reach is quite high. It is applied to two major crops only in head and middle reaches whereas tail reach operators do not use it at all.

Table VI-20

MEAN FARM YARD MANURE RATE BY CHANNEL REACH

(Kgs/Ha)

Crops	Channel Reach			Overall
	Head	Middle	Tail	
Orchards	3058	3461	-	3388
Wheat	17402	-	-	17402
Fodder	-	3689	-	3689

Crop Yields

6.24 Average yield of crops as observed on the sample farms by channel reach has been summarized in Table VI-21. The descriptive statistics worked out for major crops is depicted in Table VI-22, while the same by channel reach is given in Annexure-6, Table 6.8. The relationship in between yields of sugarcane, cotton and wheat with groups of holding size and type of tenure is appended in Annexure-6, Table 6.9 to 6.11.

6.25 According to data (Table VI-21) the yield of sugarcane (fresh), Cotton and Kharif Vegetables are significantly high at middle compared to other reaches. Except wheat, the yield of all other crops are lower at the tail reach. Mean yields of all the reported major crops on table VI-22 are good by national standards.

Table VI-21

MEAN YIELD OF CROPS BY CHANNEL REACH

(Kgs/Ha.)

Crops	Channel Reach			
	Head	Middle	Tail	Overall
Kharif				
Sugarcane (Fresh)	48485	83188	-	51640
Sugarcane (Ratoon)	55338	-	-	55338
Cotton	586	1171	608	842
Jantar	18446	17831	15052	17398
Fodder	17985	15325	-	16987
Bajra	727	-	-	727
Vegetables	879	4032	876	3191
Rabi				
Wheat	1581	1732	1807	1676
Fodders	36892	12011	5764	15738
Vegetables	3582	-	-	3582

Table VI-22

DESCRIPTIVE STATISTICS OF MAJOR CROPS YIELD
NAGNA SYSTEM

(Kgs/Ha.)

Measure	S.Cane (Fresh)	S.Cane (Ratoon)	Cotton	Wheat
Mean	51640	55338	842	1676
Median	50477	55338	646	1566
Minimum	5859	55338	467	609
Maximum	97418	55338	1383	3560
Std. Dev.	23640	0.00	342	622

Value of Output

6.26 Mean crop output value per hectare for major crops by channel reach and overall system is given in Table VI-23. The mean output value per hectare for sugarcane, orchards, cotton and wheat on project basis works out to be Rs. 22137, 47636, 6097 and 5073, respectively. Middle reach watercourses have given better output value for sugarcane, orchards and cotton while tail reach is in advantage in wheat production.

Table VI-23

MEAN OUTPUT VALUE OF MAJOR CROPS
BY CHANNEL REACH

(Rupees)

Crops	Channel Reach			
	Head	Middle	Tail	Overall
Sugarcane	20785	35661	-	22137
Orchards	13234	58030	-	47636
Cotton	4237	8472	4400	6097
Wheat	4785	5242	5472	5073

Farm Income

6.27 The farm income being an important key indicator has been studied as income from crops, livestock and Non-farm income separately. The average values of these sources of income have been depicted in Table VI-24 on project basis.

6.28 Crop Income: Crop income per cropped hectare and crop income per hectare (Table VI-24) is much higher on middle watercourses compared to head reach. The income per cropped hectare and per hectare have been negative on the farms of tail watercourse.

6.29 Livestock Income: The livestock income by selling the milk, milk by-products and livestock at farm level (Table VI-24) indicate declining trend from head to tail reach of the channel.

Table VI-24

AVERAGE INCOME BY CHANNEL REACH

(Rupees)

Crops	Channel Reach			
	Head	Middle	Tail	Overall
Crop Income	27558	189483	1325	86893
Crop Income per cropped hectare	1405	8844	-603	3880
Crop Income per hectare	3367	10097	-104	5373
Livestock Income	4091	1686	1053	2548
Livestock Income per Hectare	1054	629	157	712
Non-Farm Income	4437	4276	2647	3836
Non-Farm Income per Hectare	1987	1048	665	1065

6.30 Non-Farm Income: The non-farm income (Table VI-24) has been recorded more at head watercourses compared to other reaches. On overall basis the non-farm income and non-farm income per hectare work out to be Rs. 3836 and 1056, respectively. The information relating to minimum, maximum, mean values and standard deviation of non-farm income is given in Table VI-25. Data indicate lowest non-farm income for tail reach watercourses.

Table VI-25

DESCRIPTIVE STATISTICS OF NON-FARM INCOME BY CHANNEL REACH

(Rupees)

Measures	Channel Reach			
	Head	Middle	Tail	Overall
Mean	4437	4276	2647	3836
Median	5100	0	0	0
Minimum	0	0	0	0
Maximum	9600	40452	19200	40452
Std. Dev.	4057	10750	5487	8791

Livestock Inventory

6.31 The information relating to average number of livestock per farm by channel reach is presented in Table VI-26. The mean number of milch buffaloes, milch cows and draught oxen per farm have been recorded 1.5, 0.8 and 1.0, respectively. A slight variation by channel reach have been recorded. Number of milch buffaloes, milch cows and immature cows per farm have been uniform on middle and tail watercourses.

Table VI-26

AVERAGE LIVESTOCK NUMBER PER FARM

Livestock	Head	Middle	Tail	Overall
Milch Buffaloes	1.7	1.4	1.4	1.5
Immature Buffaloes	0.7	0.9	0.8	0.8
Milch Cow	0.4	0.3	0.3	0.3
Draught Oxen	1.1	0.8	1.2	1.0
Immature Cows/Oxen	0.3	0.2	0.2	0.3
Hourse/Mules Mature	0.1	-	-	-
Camels Mature	-	-	0.1	0.1
Sheep & Goats	5.0	7.6	9.6	6.9

Equipment Inventory

6.32 The data given in Table VI-27 show that there are 5 tractors, 1 disc harrow, 2 tractor trolleys and 3 Threshers in the project area. No such type of equipments have been recorded by the farms of tail watercourse. Trolleys and threshers have been kept by the operators of middle watercourses.

Table VI-27

EQUIPMENT INVENTORY
NAGNA SYSTEM

(Number)

Equipment Type	Head	Middle	Tail	Overall
Tractors	2	3	-	5
Disc Harrow	1	-	-	1
Trolleys	-	2	-	2
Threshers	-	3	-	3

Chapter-VII

AGRO-ECONOMIC CONDITIONS

NARI SYSTEM

Results at Watercourse Command Level

7.01 Two channels of the Nari System viz; Sibi and Kurak have been studied. Two sample watercourses on each channel have been selected for establishing the bench mark for impact evaluation. Both sample watercourses of Sibi branch offtake from the tail reach of the channel, while one watercourse of the Kurak branch fall in the middle and the other in the tail reach as these were the only possibilities under the existing layout. As already mentioned in the previous chapter, the field data collection assignments started in Feb. 1991, therefore, the physical measurements for Rabi 1990-91 could be done. The crop data pertaining to Kharif-1990 have been collected on recall basis from all the operators on the sample watercourses. However additional data for one corp season i.e. in Kharif-1991 have also been collected through observation. It is added that it had been difficult to identify and measure the Culturable Command Area (CCA) for sample watercourses nor the watercourses command maps of this system were available with irrigation department. Thus the pertinent data have been processed to represent the results as percent of total cropped area.

7.02 Cropping Pattern: The cropping pattern by channel reach and overall Nari system for 1990-91 is depicted in Table VII-1 while same for individual sample watercourses is given in Annexure-7, Table 7.1. The pertinent information generated at watercourse level for Kharif-1991 is appended in Annexure-7, Table 7.2. The data for Sibi branch show that during Kharif Jowar (296.15 hectares) is the only crop planted. Similarly on the middle reach of Kurak branch single crop of sorghum (Jowar) have been grown. On tail reach of Kurak branch sorghum is the main crop although vegetables occupy about 7 percent area. The data for Rabi 1990-91 show that on Sibi distributary and middle of Kurak branch wheat and barley are the two major crops while vegetables occupy third place on tail reach of Kurak. Sorghum-wheat is the existing cropping pattern on Sibi and Kurak channel, of Nari Canal.

7.03 The cropping pattern for Kharif 1991 (Table VII-2) is not different from Kharif 1990 which was collected on recall basis. The same pattern i.e. sorghum-wheat have been recorded though observations for all the systems studied. However major difference in the cropped area for Sibi branch has been observed when comparing the data for Kharif 1990 and 1991. The measured area is much smaller than that collected on recall basis. The gap is not wider for middle and tail reaches of Kurak branch.

Results at Farm Level

7.04 The information package in respect of the agro-economic variables at farm level is based on the data gathered from all farms (60 farms) located on 4 sample watercourse i.e. 50 on the watercourses of Sibi branch and 10 on both watercourses of Kurak branch. The results derived thereof, have been briefly discussed here under:

Table VII-1

CROPPING PATTERN BY CHANNEL REACH
NARI SYSTEM

Crop	Channel/Reach									
	Sibi		Kurak							
	Tail		Middle		Tail		Overall Kurak		Overall System	
	Cropped Area (Ha)	Percent of CA	Cropped Area (Ha)	Percent of CA	Cropped Area (Ha)	Percent of CA	Cropped Area (Ha)	Percent of CA	Cropped Area (Ha)	Percent of CA
Kharif-90										
Jowar	296.15	100.0	73.25	100.0	40.49	92.59	113.74	97.23	409.89	99.22
Vegetables	-	-	-	-	3.24	7.41	3.24	2.77	3.24	0.78
Sub. Total:	296.15	100.0	73.25	100.0	43.73	100.0	116.98	100.0	413.13	100.0
Rabi 90-91										
Wheat	239.67	84.38	63.38	88.82	42.87	62.47	106.25	75.90	445.92	82.19
Barley	62.05	15.42	6.41	8.98	9.00	13.11	15.41	11.01	77.46	14.28
Vegetables	0.81	0.20	0.08	0.11	13.61	19.83	13.69	9.78	14.50	2.67
Fodders	-	-	1.49	2.09	3.15	4.59	4.64	3.31	4.64	0.86
Sub. Total:	402.53	100.0	71.36	100.0	68.63	100.0	139.99	100.0	542.52	100.0
Total:	698.68	100.0	144.61	100.0	112.36	100.0	256.97	100.0	955.65	100.0

CA Means Cropped Area

Table VII-2
CROPPING PATTERN BY CHANNEL REACH
NARI SYSTEM

	Channel/Reach									
	Sibi		Kurak							
	Tail		Middle		Tail		Overall Kurak		Overall System	
Crop	Cropped Area (Ha)	Percent of CA	Cropped Area (Ha)	Percent of CA	Cropped Area (Ha)	Percent of CA	Cropped Area (Ha)	Percent of CA	Cropped Area (Ha)	Percent of CA
Kharif-1991										
Jowar	198.38	100.0	68.71	100.0	51.23	87.13	119.94	94.06	309.32	97.61
Vegetables	-	-	-	-	6.27	10.66	6.27	4.92	6.27	1.98
Oilseed	-	-	-	-	1.30	2.11	1.30	1.02	1.30	0.41
Total:	189.38	100.0	68.71	100.0	58.80	100.0	127.51	100.0	316.89	100.0

CA Means Cropped Area

7.05 **Size of Holding by Type of Tenure:** The distribution of farm size even on other non-sampled watercourses by type of tenure on channel and overall basis is given in Annexure-7, Table 7.3, while the same for sample watercourse by channel reach and overall system is depicted in the same Table. It is clear from the data that farms have been operated by almost equal number of owners and tenants while owner cum tenants consists about 8 percent on overall basis. Owner cum tenants do not exist on Kurak branch that they are in minority (10 percent) on Sibi branch. Tenants are in majority (60 percent) on Kurak branch and exactly same pattern can be seen for middle and tail reach watercourses. All farms on middle reach watercourses are larger than 7.50 ha. while on tail reach 80 percent farms on Kurak branch are of the same size. On Sibi branch small farms also exist. On overall, basis 83 percent farms are larger than 7.50 ha.

Table VII-3

DISTRIBUTION OF FARMS BY HOLDING SIZE AND TYPE OF TENURE (SAMPLE WATERCOURSES)

SIBI BRANCH

FARM SIZE GROUP (Count / Percent)	OWNER	OWNER CUM TENANT	TENANT	Row Total
2.51 - 5.00	3 6.0		1 2.0	4 8.0
5.01 - 7.50	3 6.0		2 4.0	5 10.0
ABOVE 7.50	18 36.0	5 10.0	18 36.0	41 82.0
Column Total	24 48.0	5 10.0	21 42.0	50 100.0

KURAK BRANCH

FARM SIZE GROUP (Count / Percent)	OWNER	TENANT	Row Total
5.01 - 7.50		1 10.0	1 10.0
ABOVE 7.50	4 40.0	5 50.0	9 90.0
Column Total	4 40.0	6 60.0	10 100.0

Cont'd Table VII-3

NARI SYSTEM

Count Percent FARM SIZE GROUP	OWNER	OWNER CUM TENANT	TENANT	Row Total
2.51 - 5.00	3 5.0		1 1.7	4 6.7
5.01 - 7.50	3 5.0		3 5.0	6 10.0
ABOVE 7.50	22 36.7	5 8.3	23 38.3	50 83.3
Column Total	28 46.7	5 8.3	27 45.0	60 100.0

KURAK BRANCH-MIDDLE REACH

Count Percent FARM SIZE GROUP	OWNER	TENANT	Row Total
ABOVE 7.50	2 40.0	3 60.0	5 100.0
Column Total	2 40.0	3 60.0	5 100.0

KURAK BRANCH-TAIL REACH

Count Percent FARM SIZE GROUP	OWNER	TENANT	Row Total
5.01 - 7.50		1 20.0	1 20.0
ABOVE 7.50	2 40.0	2 40.0	4 80.0
Column Total	2 40.0	3 60.0	5 100.0

7.06 **Farm Fragmentation:** The data in Table VII-4 show the level of farm fragmentation in the project area. Farms comprising of two parcels are in majority and constitute 72, 60 and 70 percent of farms on Sibi, Kurak and Nari System, respectively. The holdings in single parcel have been recorded for 14, 40 and 18 percent of farms on Sibi and Kurak channels and Overall System respectively. The difference in Sibi and Kurak branches is apparent in terms of number of parcels which are maximum of 2 on Kurak but upto 8 on Sibi branch.

Table VII-4

FRAGMENTATION OF HOLDING BY FARM SIZE GROUP

SIBI BRANCH

FARM SIZE GROUP (Count / Percent)	Number of Parcels: 1	2	3	4	8	Row Total
2.51 - 5.00		4 8.0				4 8.0
5.01 - 7.50		5 10.0				5 10.0
ABOVE 7.50	7 14.0	27 54.0	1 2.0	5 10.0	1 2.0	41 82.0
Column Total	7 14.0	36 72.0	1 2.0	5 10.0	1 2.0	50 100.0

KURAK BRANCH

FARM SIZE GROUP (Count / Percent)	Number of Parcels: 1	2	Row Total
5.01 - 7.50		1 10.0	1 10.0
ABOVE 7.50	4 40.0	5 50.0	9 90.0
Column Total	4 40.0	6 60.0	10 100.0

Cont'd Table VII-4

NARI SYSTEM

FARM SIZE GROUP (Count / Percent)	Number of Parcels: 1	2	3	4	8	Row Total
2.51 - 5.00		4 6.7				4 6.7
5.01 - 7.50		6 10.0				6 10.0
ABOVE 7.50	11 18.3	32 53.3	1 1.7	5 8.3	1 1.7	50 83.3
Column Total	11 18.3	42 70.0	1 1.7	5 8.3	1 1.7	60 100.0

7.07 Irrigation Turn: Table VII-5 describes the averages (Mean and Median) and ranges of irrigation turn time (Hrs./Ha.) as reported by the farmers of Nari system. Mean values are 0.82, 1.73 and 0.97 Hrs/Ha. for Sibi, Kurak and Nari System, respectively. Mean irrigation turn time per hectare for tail reach watercourse of Kurak branch is more than 300 percent higher than other watercourses.

Table VII-5

DESCRIPTIVE STATISTICS OF IRRIGATION TURN TIME
NARI SYSTEM

(Hrs/Ha.)

	Sibi	Kurak			
Measures	Tail	Middle	Tail	Overall	Nari System
Mean	0.82	0.80	2.66	1.73	0.97
Median	0.61	0.90	2.76	1.37	0.65
Minimum	0.38	0.56	1.80	0.56	0.38
Maximum	1.85	0.95	3.76	3.76	3.76
Std.Dev.	0.39	0.18	0.86	1.14	0.67

7.08 **Main Watercourse Cleaning:** Mean number of main watercourse Cleaning by season and channel reach are shown in Table VII-6. The data show that one cleaning of the main watercourse has been carried out each season except on tail watercourses of Sibi branch, where 2 Cleaning have been done during the Kharif season. On the whole cleaning frequencies are low compared with other canal area.

Table VII-6

MEAN NUMBER OF WATERCOURSE CLEANING BY CHANNEL REACH NARI SYSTEM

Channel/Reach	Kharif	Rabi	Annual
Sibi			
Tail	2	1	3
Kurak			
Middle	1	1	2
Tail	1	1	2
Overall	1	1	2
Nari System	1	1	2

7.09 **Equity in Irrigation Water Supply:** All the operators of this system are reported to be satisfied as far as the allocation of irrigation turn time is concerned.

7.10 **Turns Missed Under Regular Canal Closures:** The irrigation turns missed due to regular Canal Closures as reported by the respondents by season and channel reach are given in Table VII-7. According to the data, two irrigations have been missed during Rabi season on both channels and overall system basis. No irrigation turn have been missed during Kharif season on these channels.

Table VII-7

IRRIGATION TURNS MISSED UNDER REGULAR CANAL CLOSURE NARI SYSTEM

Season	Channel / Reach: Sibi Tail	Kurak Middle	Kurak Tail	Kurak Overall	Nari System
Kharif	-	-	-	-	-
Rabi	2	2	2	2	2
Annual	2	2	2	2	2

7.11 Turns Missed Under Unexpected Closures by Reasons: The number of irrigation turns missed under unexpected canal closures during the year with reasons as observed by the respondents is shown in Table VII-8. On an average 78, 80 and 78 percent of farms have reported missing of 4 irrigation turns annually in Sibi, Kurak and Nari System, respectively. Reasons for these closures for Kurak branch are the rains which account for 90 percent of the cases. There is no variation for middle and tail watercourses on the Kurak branch. In case of Sibi branch in 46 percent cases the respondents do not know the reason while the next on order is heavy rains and distributary breaches. No breach problem is faced by Kurak branch whereas in 26 percent cases canal and distributary branches are the causes for missing irrigation turns.

Table VII-8

TURNS MISSED UNDER UNEXPECTED CANAL CLOSURES BY REASONS

SIBI BRANCH

Count / Percent	Number of Turns Missed: 2	3	4	6	Row Total
Canal Breach		1 2.0	1 2.0		2 4.0
Breach Of Disty.	1 2.0		7 14.0	3 6.0	11 22.0
Reasons Not Known			22 44.0	1 2.0	23 46.0
Heavy Rains	4 8.0	1 2.0	9 18.0		14 28.0
Column Total	5 10.0	2 4.0	39 78.0	4 8.0	50 100.0

Cont'd Table VII-8

KURAK BRANCH

Count Percent	Number of turns missed		Row Total
	2	4	
Reasons Not Known		1 10.0	1 10.0
Heavy Rains	2 20.0	7 70.0	9 90.0
Column Total	2 20.0	8 80.0	10 100.0

NARI SYSTEM

Count Percent	Number of Turns Missed				Row Total
	2	3	4	6	
Canal Breach		1 1.7	1 1.7		2 3.3
Breach Of Disty.	1 1.7		7 11.7	3 5.0	11 18.3
Reasons Not Known			23 38.3	1 1.7	24 40.0
Heavy Rains	6 10.0	1 1.7	16 26.7		23 38.3
Column Total	7 11.7	2 3.3	47 78.3	4 6.7	60 100.0

7.12 Turns Having Inadequate Discharge by Reasons: All the respondents have reported that they availed 4-6 turns when discharge was abnormal. The Kurak branch operators are comparatively suffering less as they availed 4 such turns, while Sibi farmers availed 4-6 such turns. This situation when combined with missing of unexpected turns do point out unreliability in water supply.

Table VII-9

TURNS HAVING INADEQUATE DISCHARGE BY REASONS

SIBI BRANCH

	Count / Percent	Number of Turns 4	5	6	Row Total
Less Flow In Channel		42 84.0	1 2.0	7 14.0	50 100.0
	Column Total	42 84.0	1 2.0	7 14.0	50 100.0

KURAK BRANCH

	Count / Percent	Number of turns 4	Row Total
Less Flow In Channel		10 100.0	10 100.0
	Column Total	10 100.0	10 100.0

NARI SYSTEM

	Count / Percent	Number of Turns 4	5	6	Row Total
Less Flow In Channel		52 86.7	1 1.7	7 11.7	60 100.0
	Column Total	52 86.7	1 1.7	7 11.7	60 100.0

7.13 Contribution of Tubewell Water for Crop Production: As there is no tubewell in the command area of sample watercourses, not a single farmer has reported use of tubewell water for crop production.

Farm Inputs

7.14 The use and level of water and non-water inputs by the operators in the system have been studied. The results derived, thereof, are discussed briefly here under:

7.15 Seed Rate: According to data given in Table VII-10 almost uniform seed have been used for Jowar irrespective of channel reach. There are variations in the application of seed for Kharif fodders, wheat and Rabi fodder by channel reach. The tail reach operators of Kurak branch are using low seed rate.

Table VII-10

MEAN SEED RATE OF MAJOR CROPS BY CHANNEL REACH

(Kgs./Ha.)

	Channel / Reach				
	Sibi	Kurak			
Crops	Tail	Middle	Tail	Overall	Nari System
Jowar	19	20	19	20	19
K.Fodder	18	20	6	13	17
Wheat	90	90	60	75	87
R.Fodders (Barley)	78	22	28	25	69

7.16 Irrigation: Table VII-11 indicates the average number of irrigations applied to the Kharif and Rabi crops. Data show practically difference of 1-2 irrigations by channel reach at Kurak branch. Due to hot and dry conditions, average number of irrigations applied to all the crops are 2-3 times higher than other irrigated areas. One major reason is oasis effect as cropped area are located in patches surrounded by barren lands. Wheat is applied 4-5 irrigations in other canal irrigated areas for optimum production, whereas the crop received 12-16 irrigations in the sample area. Comparatively more irrigation have been applied in Kurak branch watercourses.

Table VII-11

MEAN NUMBER OF IRRIGATION BY CHANNEL REACH

	Channel / Reach				
	Sibi	Kurak			
Crops	Tail	Middle	Tail	Overall	Nari System
Jowar	12	16	15	16	13
K.Fodder	16	18	14	18	16
Wheat	12	16	14	15	12
R.Fodder	12	18	17	18	13
R.Vegetables	16	20	21	21	20
R.Misc	-	-	16	16	16

7.17 **Fertilizer:** The use of nitrogenous and phosphatic fertilizers, by channel reach have been summarized in Table VII-12. The nitrogenous and phosphatic use rate for all the crops is far less than the recommendations. Another finding is that fertilizer use is more common on tail reach of Kurak branch which is something unusual. One reason for low usage rate of fertilizers is shifting of cropped area which is on abundance and they depend more on natural recovery. Potash is not used for any crop planted on the sample watercourses.

Table VII-12

MEAN FERTILIZER RATES BY CHANNEL REACH

(Kgs./Ha.)

Crops	Tail		Middle		Tail		Overall		Nari System	
	N	P	N	P	N	P	N	P	N	P
Jowar	21	-	2	5	5	14	4	10	7	10
K.Fodder	9	-	-	-	-	-	-	-	9	-
K.Veg.	-	-	-	-	15	38	15	38	15	38
Wheat	14	14	8	7	5	7	7	7	11	12
R.Fodder	-	-	-	-	2	6	2	6	2	6
R.Veg.	29	-	-	-	33	87	33	87	32	87
R.Misc.	-	-	-	-	9	24	9	24	9	24

Crop Yields

7.18 Table VII-13 presents the mean yields of all crops by channel reach and overall Nari System, while the descriptive statistics in respect of yields of major crops is given Annexure-7, Table 7.6. The yields of Jowar and wheat in relation to farm size groups and type of tenure is given in Annexure-7, Table 7.7 to 7.9. Except vegetables the yields of other crops are quite low by national standards. Reach wise trend is mixed as yield of some crops is higher on tail reach of Kurak branch. Data given on annexure-7 and 7.8 indicate some increase in yield of sorghum and wheat with increase in farm size. While tenureship does not give any clear indication.

Table VII-13

MEAN YIELD OF CROPS BY CHANNEL REACH
NARI SYSTEM

(Kgs./Ha.)

	Channel / Reach				
	Sibi	Kurak			
Crops	Tail	Middle	Tail	Overall	Nari System
Jowar Grain	529	672	560	616	544
K.Fodder	6089	5885	11529	6826	6171
K.Veg.	-	-	6661	6661	6661
Wheat	971	1253	1532	1358	1024
R.Fodder	7047	9469	8303	8886	7264
R.Veg.	4611	2306	3705	3355	3606
R.Misc.	1260	1034	1378	1133	1171

Value of Output

7.19 Mean crop output value per hectare for the major crops by channel reach and overall Nari System is depicted in Table VII-14. The data indicate that output value of Jowar and Wheat crops are high at Kurak branch compared to Sibi branch. On average the output value in respect of Jowar, Kharif fodder, wheat and Rabi fodder figures to be Rs. 2041, 3307, 3073 and 3893 per hectare, respectively.

Table VII-14

OUTPUT VALUE OF CROPS

(Rs./Ha.)

	Channel / Reach				
	Sibi	Kurak			
Crops	Tail	Middle	Tail	Overall	Nari System
Jowar	1984	2521	2101	2311	2041
K.Fodder	3263	3154	6178	3658	3307
Wheat	2914	3760	4598	4075	3073
R.Fodder	3777	5074	4450	4762	3893

Farm Income

7.20 Three sources of income have been computed viz; crops, livestock and Non-Farm income. These outcome variables are given in Table VII-15 by channel reach and overall system. The income per cropped hectare in relation farm size groups and type of tenure is given in Annexure-7, Table 7.11 and 7.12.

7.21 Crop Income: The gross crop income, crop income per cropped hectare for Nari system workout to be Rs. 28233 and 1690, respectively. The gross income and income per cropped hectare is the highest on tail of Kurak branch and lowest for Sibi branch (Table VII-15). This indicates that the tail watercourses are not at a disadvantage as in usual in many of the surface irrigation systems in Pakistan.

Table VII-15

MEAN INCOME BY CHANNEL REACH
NARI SYSTEM

(Rupees)

	Channel / Reach				
	Sibi	Kurak			
Income	Tail	Middle	Tail	Overall	Nari System
Crop Income	24232	40008	56473	48241	28233
Crop Income Per Cropped Hectare	1632	1801	2161	1981	1690
Livestock income	4120	15400	10400	12900	5583
Livestock Income per Cropped Hectare	296	739	412	576	342
Non-Farm Income	6100	0	0	0	5083
Non-Farm Income per cropped Hectare	286	0	0	0	238

7.22 Livestock Income: The gross income by selling the milk and milk byproducts or the animals is summarized in Table VII-15. The average income from livestock and livestock income per hectare workout to be Rs. 5583 and 342, respectively for the Nari system. The gross income from livestock have been recorded to be 2 to 4 times higher on Kurak branch compared with Sibi branch.

7.23 Non-Farm Income: Not a single farmer has reported non-farm income on Kurak branch, while it has been reported as Rs. 6100 per farm on Sibi branch. Non-farm income per hectare has been recorded as Rs. 286 and 283 on Sibi branch and overall project basis, respectively (Table VII-15). The descriptive statistics of the Non-farm income is shown in Table VII-16. The data again show the mean and range values at Sibi Branch.

Table VII-16

DESCRIPTIVE STATISTICS OF NON-FARM INCOME

NARI SYSTEM

(Rupees/Farm)

	Channel / Reach				
	Sibi	Kurak			
Income	Tail	Middle	Tail	Overall	Nari System
Mean	6100	0	0	0	5083
Median	0	0	0	0	0
Minimum	0	0	0	0	0
Maximum	100,000	0	0	0	1,00,000
Std.Dev.	20881	0	0	0	19167

Livestock Inventory

7.24 The data presented in Table VII-17 indicates that draught oxen, cows mature and immature, horses, mature and immature, donkeys immature and sheeps, goats have been kept on the farms and their strength at farm have been recorded 1.2, 2.2, 2.0, 0.2, 0.1, 0.3 and 5.5, on project basis respectively. More animals per farm have been recorded on Kurak compared to Sibi branch. This is reflected in terms of higher gross livestock income on Kurak branch (Table VII-15). A slight variation in the strength of animals by channel reach on Kurak branch have been recorded.

Table VII-17

AVERAGE LIVESTOCK NUMBER PER FARM BY CHANNEL REACH

Livestock	Channel				
	Sibi	Kurak			
	Tail	Middle	Tail	Overall	Nari System
Draught Oxen	1.0	2.0	2.8	2.4	1.2
Cows	1.7	5.0	4.0	4.5	2.2
Cows (Immature)	1.7	4.0	3.2	3.6	2.0
Horses	0.2	0.4	0.2	0.3	0.2
Horses (Immature)	0.1	0.2	0.2	0.2	0.1
Donkeys (Immature)	0.4	-	-	-	0.3
Sheep & Goats all ages	5.8	2.4	5.6	4.0	5.5

Equipment Inventory

7.25 According to data given in Table VII-18, the Sibi branch is well equipped as compared to Kuark branch but middle watercourse of Kurak branch is without any tractor and tractor equipment etc. Although ownership size on both the channels is not much different but for less number of operators on Kurak (5 on each watercourse) may be cause in this wide difference. The data given the indication that farmers on Sibi are more progressive in mechanising the farm operations.

Table VII-18

EQUIPMENT INVENTORY BY CHANNEL REACH
NARI SYSTEM

(Number)

Equipment	Sibi	Kuark			Overall System
	Tail	Middle	Tail	Overall	
Tractor	2	-	1	1	3
Tractor Plough	2	-	1	1	3
Disc Harrow	1	-	-	-	1
Trolley	2	-	1	1	3
Thresher	2	-	1	1	3

ANNEXURE – 3

SUPPLEMENTARY TABULATIONS

IRRIGATION WATER SUPPLIES

Annexure-3
Table 3.1

IRRIGATION EVALUATION DATA

CHOWKY SYSTEM

Water-course Code	Re-ach	Date	Discharge (Cusecs) Source	Discharge (Cusecs) Farm	Delivery Efficiency (percent)	a/ Distance-source to Farm Nucca (Meters)	Area (Acre)	Total Irr. Time (Hrs)	Irri. Time Per Unit Area (Hrs)	Water Table Depth (M)
Kharif 1991										
1	1	01/06/1991	0.34	0.29	85.29	820	0.25	2.00	8.00	8.23
1	2	01/25/1991	1.73	0.87	50.29	1111	1.25	6.00	4.80	8.23
1	2	09/26/1991	0.92	0.72	78.26	1068	1.00	1.00	1.00	9.15
1	3	10/18/1991	0.97	0.74	76.29	1218	1.32	4.17	3.16	2.89
1	3	04/07/1991	0.45	0.29	64.44	1502	0.98	6.83	6.97	8.23
2	1	05/07/1991	0.90	0.87	96.67	(174)174	0.72	3.75	5.21	15.50
2	1	09/12/1991	0.32	0.29	90.62	(167)116	0.15	3.13	6.96	15.54
2	2	04/21/1991	1.41	1.21	85.82	(375)553	0.63	6.00	3.68	15.50
2	2	09/22/1991	0.10	0.32	80.00	197	0.63	5.62	8.92	11.93
2	3	04/26/1991	1.36	0.35	25.74	(375)1177	0.88	6.33	7.20	15.50
2	3	09/19/1991	0.27	0.20	74.07	(362)768	0.50	4.42	8.83	12.19
3	1	09/20/1991	0.22	0.18	81.82	637	0.20	1.17	7.33	10.67
3	1	07/21/1991	0.22	0.19	86.36	698	0.62	1.08	6.59	11.58
3	2	08/21/1991	0.54	0.44	81.48	1458	0.75	1.42	1.89	
3	2	07/22/1991	0.23	0.18	78.26	1524	0.25	2.97	11.87	4.93
3	2	07/22/1991	0.23	0.18	78.26	1524	0.35	4.15	12.71	4.93
3	3	09/18/1991	0.68	0.50	73.53	1232	0.40	2.17	6.17	2.54
3	3	07/21/1991	0.66	0.49	74.24	1908	0.90	5.60	6.22	3.30
4	1	01/27/1991	0.65	0.54	83.08	462	0.97	6.17	6.36	8.23
4	2	09/22/1991	0.72	0.57	79.17	146	0.60	1.83	3.06	3.05
4	2	05/05/1991	0.54	0.45	83.33	989	0.28	1.92	6.85	8.23
4	2	05/05/1991	0.54	0.43	79.63	989	0.23	1.83	7.97	8.23
4	3	08/19/1991	0.39	0.31	79.49	1073	0.05	0.30	6.00	
4	3	08/19/1991	0.36	0.29	80.56	1073	0.20	1.25	6.25	
4	3	05/04/1991	0.45	0.14	31.11	1318	0.53	7.67	14.47	8.23
5	1	08/19/1991	1.02	0.94	92.16	146	1.40	2.83	2.02	
5	1	01/08/1991	1.39	1.07	76.98	168	1.05	3.50	3.33	2.43
5	1	04/08/1991	1.37	1.11	81.02	168	0.70	3.75	5.36	2.13
5	2	09/17/1991	1.01	0.84	83.17	212	0.13	2.00	1.65	2.13
5	2	09/17/1991	1.01	0.84	83.17	212	0.13	0.62	1.74	2.13
5	2	05/09/1991	0.51	0.44	86.27	657	0.82	6.50	7.93	2.43
5	3	06/09/1991	0.49	0.32	65.31		0.48	4.00	8.33	2.43
5	3	09/20/1991	0.92	0.68	73.91	670	0.50	5.67	11.33	1.27

a/ Figures in parenthesis represent lined length of main watercourse.

Annexure-3
Table 3.2

IRRIGATION EVALUATION DATA

PURAN SYSTEM

Water-course Code	Re-ach	Date	Discharge (Cusecs) Source	Discharge (Cusecs) Farm	Delivery Efficiency (percent)	Distance-source to Farm Nucca (Meters)	Area (Acre)	Total Irr. Time (Hrs)	Irri. Time Per Unit Area (Hrs)	Water Table Depth (M)
Kharif 1991										
6	1	07/12/1991	3.06	2.20	71.90	823	0.93	2.08	2.24	4.55
6	1	09/09/1991	2.14	1.57	73.36	823	0.93	2.67	2.87	4.55
6	2	07/17/1991	2.61	1.43	54.79	1657	0.77	1.92	2.49	4.55
6	2	09/10/1991	2.06	1.15	55.83	1657	0.77	2.42	3.14	4.55
6	3	07/17/1991	3.06	1.69	55.23	2265	0.85	2.58	3.04	4.55
6	3	09/11/1991	2.10	1.26	60.00	2265	0.85	3.42	1.02	4.55
7	1	09/14/1991	0.87	0.29	33.33	556	0.25	1.50	6.00	9.10
7	1	07/13/1991	0.90	0.30	33.33	556	0.25	1.50	6.00	9.10
7	2	09/12/1991	1.27	1.13	88.98	1387	0.84	2.42	2.88	9.10
7	2	07/18/1991	0.99	0.60	60.61	1387	0.42	1.25	2.98	9.10
7	3	09/13/1991	0.87	0.70	80.46	1991	0.93	3.08	3.32	9.10
7	3	07/19/1991	1.10	0.60	54.55	1991	0.93	2.42	2.60	9.10
8	1	09/07/1991	1.20	0.91	75.83	441	0.48	1.83	3.82	1.82
8	1	07/14/1991	2.30	1.80	78.26	441	0.48	1.00	2.08	1.51
8	2	09/08/1991	1.20	0.90	75.00	858	0.52	1.67	3.21	1.82
8	2	07/12/1991	2.20	1.70	77.27	858	0.52	1.67	3.21	1.51
8	3	07/16/1991	2.40	1.20	50.00	1254	0.42	1.60	3.81	1.82
8	3	09/06/1991	1.50	0.82	54.67	1354	0.42	1.83	4.37	1.82
9	1	07/15/1991	1.69	1.09	64.50	1174	0.64	4.08	6.38	1.21
9	1	10/30/1991	2.27	1.45	63.88	1886	0.46	1.83	3.99	1.21
9	1	09/09/1991	1.40	0.96	68.57	1174	0.64	3.75	5.86	1.51
9	2	09/10/1991	2.40	1.50	62.50	1174	1.10	3.33	3.03	1.51
9	2	07/16/1991	2.50	1.59	63.60	1174	1.10	4.00	3.64	1.21
9	3	09/12/1991	1.70	1.19	70.00	1174	0.43	1.42	3.29	1.51
9	3	07/18/1991	2.23	1.52	68.16	1174	0.43	1.33	3.10	1.21
Rabi 1991-92										
6	1	02/18/1992	2.70	1.94	71.85	568	0.98	2.00	2.04	5.31
6	1	10/27/1991	2.84	2.79	98.24	44	0.40	1.33	3.33	4.55
6	1	12/30/1991	3.00	2.50	83.33	568	0.98	2.17	2.21	7.60
6	1	02/15/1992	2.70	2.70	100.00	44	0.40	1.33	3.33	5.31
6	2	02/14/1992	2.70	1.70	62.96	909	0.92	3.25	3.53	5.31
6	2	10/30/1991	3.00	2.17	72.33	909	0.92	3.00	3.26	4.55
6	2	02/17/1992	2.55	1.51	59.22	1657	0.77	2.75	3.57	5.31

Annexure-3
Table 3.3

IRRIGATION EVALUATION DATA

NAGNA SYSTEM

Water-course Code	Re-ach	Date	Discharge (Cusecs) Source	Discharge (Cusecs) Farm	Delivery Efficiency (percent)	a/ Distance-source to Farm Nucca (Meters)	Area (Acre)	Total Irr. Time (Hrs)	Irri. Time Per Unit Area (Hrs)	Water Table Depth (M)
Kharif 1991										
10	1	10/16/1991	2.50	2.40	96.00	(217) 234	0.49	1.33	2.72	1.82
10	1	10/17/1991	2.70	2.06	76.30	(217) 710	1.70	4.75	2.79	1.82
10	1	10/16/1991	2.50	2.40	96.00	(217) 234	1.00	2.58	2.58	1.82
10	1	08/01/1991	2.40	1.90	79.17	(217) 752	0.50	0.75	1.50	1.97
10	1	06/19/1991	2.80	2.10	75.00	(217) 752	0.50	0.58	1.17	1.82
10	2	06/19/1991	2.70	2.20	81.48	(217)1509	0.32	0.58	1.82	1.82
10	2	08/19/1991	2.60	1.84	70.77	(217)1509	0.69	1.42	2.05	1.97
10	3	08/20/1991	2.16	1.69	78.24	(217)2221	0.41	2.00	4.88	1.97
10	3	06/19/1991	2.80	2.09	74.64	(217)2221	0.41	1.75	4.27	1.82
11	1	06/20/1991	1.50	1.16	77.33	579	1.10	1.17	1.06	1.82
11	2	06/20/1991	1.50	1.00	66.67	1219	1.25	1.83	1.47	1.82
11	3	06/20/1991	1.49	0.84	56.38	1853	1.03	3.17	3.07	1.82
12	1	06/19/1991	3.00	2.80	93.33	(430)1046	1.10	1.50	1.36	1.82
12	1	08/02/1991	2.88	2.37	82.29	(430)1046	1.10	1.67	1.52	1.97
12	2	09/01/1991	2.80	1.93	68.93	(430)2036	0.60	1.50	2.50	1.97
12	2	06/20/1991	2.90	2.30	79.31	(430)2036	0.60	1.25	2.08	1.82
12	3	06/20/1991	2.90	2.00	68.97	(430)3090	0.34	0.75	2.21	1.82
12	3	08/27/1991	3.00	2.00	66.67	(430)3090	0.34	0.92	2.70	1.97
13	1	07/26/1991	4.00	3.23	80.75	974	0.65	0.75	1.15	3.00
13	1	08/09/1991	3.77	3.22	85.41	974	0.65	0.75	1.15	3.00
13	2	07/24/1991	3.80	2.35	61.84	1637	0.81	1.25	1.54	3.00
13	2	08/13/1991	3.50	2.02	57.71	1637	0.81	1.25	1.54	3.00
13	3	07/24/1991	3.68	2.80	76.09	2816	1.00	0.83	0.83	3.00
13	3	08/13/1991	3.50	2.65	75.71	2816	1.00	0.83	0.83	3.00
13	3	10/19/1991	3.90	2.84	72.82	2840	0.74	1.50	2.03	3.00
14	1	07/21/1991	2.00	0.90	45.00	471	0.46	2.00	4.35	4.50
14	1	08/11/1991	1.80	0.80	44.44	471	0.46	2.00	4.35	4.50
14	1	07/21/1991	2.60	2.23	85.77	490	0.41	1.25	3.05	4.50
14	1	08/18/1991	1.93	1.70	88.08	490	0.41	1.67	1.07	1.50
14	3	07/25/1991	2.60	2.20	84.62	1304	0.49	1.50	3.06	4.50
14	3	08/28/1991	1.70	1.46	85.88	1304	0.39	1.50	3.85	4.50
Rabi 1991-92										
10	1	01/05/1992	2.50	2.30	92.00	(217) 234	0.30	1.50	5.00	1.44
10	1	03/19/1992	2.40	2.30	95.83	(217) 234	1.00	2.75	2.75	2.12

Water-course Code	Re-ach	Date	Discharge (Cusecs) Source	Farm	Deliv-ery Effici-ency (per-cent)	Distance-source to Farm Nucca (Meters)	Area (Acre)	Total Irr. Time (Hrs)	Irri. Time Per Unit Area (Hrs)	Water Table Depth (M)
6	3	02/11/1992	2.90	1.86	64.14	1427	0.53	1.92	3.62	5.31
6	3	02/11/1992	2.90	1.78	61.38	2265	0.85	1.00	4.71	5.31
6	3	10/26/1991	3.00	2.03	67.67	1127	0.53	1.67	3.14	1.55
7	1	02/16/1992	1.00	0.30	30.00	556	0.25	1.75	7.00	9.10
7	2	02/12/1992	1.80	1.18	65.56	1065	0.16	2.00	4.35	9.10
7	2	11/17/1991	2.00	1.25	62.50	1065	0.16	1.83	3.99	9.10
7	2	11/19/1991	1.70	1.10	64.71	1387	1.15	3.50	3.01	9.10
7	2	02/10/1992	1.30	1.10	84.62	1387	0.84	2.50	2.98	9.10
7	2	02/13/1992	1.48	0.96	64.86	1387	1.15	3.17	2.75	9.10
7	3	11/16/1991	1.70	1.10	64.71	1991	0.91	3.08	3.28	9.10
7	3	01/01/1992	1.00	0.60	60.00	1991	1.21	3.42	2.82	9.10
7	3	02/20/1992	1.20	0.82	68.33	1991	1.21	3.33	2.75	9.10
7	3	02/19/1992	1.61	0.96	59.63	1991	0.94	2.83	3.01	9.10
8	1	02/23/1992	2.00	1.47	73.50	441	0.48	1.75	3.65	2.12
8	1	10/28/1991	2.00	1.80	90.00	275	0.20	0.67	3.33	1.51
8	2	10/27/1991	2.10	1.60	76.19	905	0.53	1.58	2.99	1.51
8	2	03/06/1992	1.95	1.32	67.69	858	0.52	1.83	3.53	2.12
8	2	03/04/1992	2.20	1.70	77.27	905	0.53	1.67	3.14	2.12
8	3	02/23/1992	2.00	1.27	63.50	1242	0.46	1.75	3.80	2.12
8	3	11/18/1991	2.20	1.38	62.73	1242	0.46	1.50	3.26	1.51
8	3	02/14/1992	1.88	1.02	54.26	1354	0.42	2.00	4.76	2.12
9	1	02/21/1992	2.38	1.57	65.97	712	0.46	2.00	4.35	1.82
9	1	03/02/1992	2.00	1.37	68.50	1174	0.64	3.25	5.08	1.82
9	2	10/31/1991	2.40	1.40	58.33	1944	0.69	2.17	3.14	1.21
9	2	03/05/1992	2.00	1.18	59.00	1174	1.10	3.50	3.18	1.82
9	2	02/21/1992	2.30	1.72	74.78	1513	0.66	0.75	1.14	1.82
9	2	11/22/1991	2.50	1.77	70.80	1513	0.66	0.58	0.88	1.21
9	2	02/21/1992	2.30	1.36	59.13	1914	0.69	2.25	3.26	1.82
9	3	03/07/1992	2.00	1.30	65.00	1174	0.43	1.42	3.29	1.82

Annexure-3
Table 3.1

IRRIGATION EVALUATION DATA

NARI SYSTEM

Water-course Code	Re-ach	Date	Discharge (Cusecs) Source	Discharge (Cusecs) Farm	Delivery Efficiency (percent)	Distance-source to Farm Nucca (Meters)	Area (Acre)	Total Irr. Time (Hrs)	Irri. Time Per Unit Area (Hrs)	Water Table Depth (M)
Kharif 1991										
15	1	07/20/1991	1.50	1.20	80.00	660	1.50	3.73	2.19	9.00
15	1	07/21/1991	1.50	0.95	63.33	950	0.60	2.18	3.61	9.00
15	1	07/22/1991	1.60	0.95	59.37	1210	0.70	3.85	5.50	9.00
15	1	07/23/1991	1.50	1.25	83.33	620	1.65	4.50	2.73	9.00
15	1	07/24/1991	1.50	1.00	66.67	880	2.00	7.37	3.68	9.00
15	1	07/25/1991	1.50	0.85	56.67	1070	0.66	3.72	5.63	9.00
15	3	09/20/1991	2.30	1.60	69.57	8020	3.00	4.00	1.33	
15	3	09/23/1991	1.80	1.50	83.33	8020	2.00	3.55	1.77	
16	3	07/22/1991	1.60	1.20	75.00	9220	1.50	3.70	2.17	9.00
16	3	07/25/1991	1.46	1.10	75.34	9100	1.81	3.95	2.18	9.00
16	3	07/26/1991	1.54	0.90	58.11	9460	0.92	3.92	4.26	9.00
16	3	07/27/1991	1.50	1.05	70.00	9354	1.50	3.92	2.61	9.00
16	3	07/27/1991	1.50	1.12	74.67	9012	1.60	3.28	2.05	9.00
16	3	07/28/1991	1.46	0.85	58.22	9540	0.75	2.92	3.89	9.00
16	3	09/21/1991	1.50	1.15	76.67	8482	2.65	3.08	1.16	
16	3	09/22/1991	1.28	1.00	78.12	8482	2.05	3.00	1.46	
17	2	06/12/1991	1.30	0.89	68.46	3670	2.10	7.23	3.11	
17	2	06/16/1991	1.40	0.80	57.14	3752	1.54	4.97	3.23	
17	2	08/22/1991	1.34	0.90	67.16	3660	1.50	3.75	2.50	
17	2	08/21/1991	2.35	1.60	68.09	3660	1.65	2.75	1.67	
17	2	10/14/1991	0.99	0.80	80.81	3660	2.44	4.75	1.95	
17	2	10/15/1991	1.02	0.87	85.29	3660	2.55	4.00	1.57	
18	1	10/16/1991	0.70	0.62	88.57	820	2.00	4.08	2.01	
18	1	10/20/1991	0.85	0.75	88.24	820	2.10	4.50	2.14	
18	2	06/14/1991	0.90	0.74	82.22	1402	0.65	2.50	3.85	
18	2	08/21/1991	1.30	1.05	80.77	1190	1.50	4.30	2.87	
18	3	06/13/1991	0.80	0.60	75.00	2312	0.42	1.95	4.64	
18	3	06/15/1991	0.90	0.55	61.11	2978	1.38	6.15	4.46	
Rabi 1991-92										
15	3	01/23/1992	1.70	1.35	79.11	11440	1.65	2.00	1.21	
15	3	01/22/1992	1.60	1.30	81.25	11440	1.62	2.08	1.29	
15	3	01/20/1992	1.80	1.35	75.00	11440	1.50	2.17	1.44	
15	3	01/19/1992	1.70	1.30	76.47	11440	1.90	2.75	1.45	

Watercourse Code	Reach	Date	Discharge (Cusecs) Source	Discharge (Cusecs) Farm	Delivery Efficiency (percent)	a/ Distance-source to Farm Nucca (Meters)	Area (Acre)	Total Irr. Time (Hrs)	Irri. Time Per Unit Area (Hrs)	Water Table Depth (M)
10	1	03/24/1992	2.40	2.20	91.67	(217) 234	0.30	1.75	5.83	2.12
10	1	03/13/1992	2.50	1.86	74.40	(217) 710	0.88	2.50	2.84	2.12
10	1	03/19/1992	2.40	2.30	95.83	(217) 234	0.19	1.58	3.23	2.12
10	2	03/28/1992	2.40	1.61	67.08	(217)1509	0.69	1.75	2.54	2.12
10	3	03/28/1992	2.40	1.86	77.50	(217)2221	0.41	2.33	5.69	2.12
11	1	02/25/1992	1.50	1.40	93.33	618	0.18	0.58	1.22	1.82
11	1	12/16/1991	1.60	1.44	90.00	458	0.75	2.33	3.11	1.44
11	1	02/25/1992	1.50	1.33	88.67	458	0.75	2.67	3.56	1.82
11	1	12/16/1991	1.60	1.30	81.25	618	0.48	0.58	1.22	1.44
11	2	12/22/1991	1.60	1.10	68.75	1235	0.43	1.00	2.33	1.44
11	2	12/22/1991	1.60	1.10	68.75	1215	0.60	2.58	4.31	1.11
11	2	02/25/1992	1.50	0.96	64.00	1235	0.43	1.17	2.71	1.82
11	2	03/15/1992	1.50	1.00	66.67	1245	0.60	2.92	4.86	1.82
11	3	12/23/1991	1.50	0.84	56.00	1853	0.96	3.25	3.39	1.44
11	3	12/23/1991	1.50	0.66	44.00	1520	0.75	2.67	3.56	1.44
11	3	02/08/1992	1.40	0.91	65.00	1520	0.75	3.08	4.11	1.82
11	3	02/08/1992	1.40	0.52	37.14	1853	0.50	1.75	3.50	1.82
12	1	11/13/1991	3.00	2.90	96.67	(182) 182	1.12	3.00	2.68	1.97
12	1	03/18/1992	2.90	2.34	80.69	(430)1046	1.10	1.75	1.59	2.12
12	1	11/12/1991	2.90	2.80	96.55	(182) 182	0.78	1.92	2.46	1.97
12	1	03/12/1992	2.80	2.70	96.43	(182) 182	1.12	3.25	2.90	2.12
12	1	03/12/1992	2.80	2.70	96.43	(182) 182	0.78	2.08	2.67	2.12
12	2	03/26/1992	2.80	1.82	65.00	(430)2036	0.60	2.00	3.33	2.12
12	3	03/18/1992	2.90	1.97	67.93	(430)3090	0.34	1.25	3.68	2.12
12	3	03/26/1992	2.80	1.77	63.21	(430)2760	0.58	2.00	3.15	2.12
12	3	11/10/1991	2.70	1.80	66.67	(430)2760	0.58	1.83	3.16	1.97
13	1	02/21/1992	3.30	2.02	61.21	814	0.50	1.00	2.00	3.00
13	1	03/14/1992	3.30	2.61	79.09	974	0.65	0.83	1.28	3.00
13	1	03/17/1992	3.50	1.86	53.14	1045	0.44	1.17	2.65	3.00
13	1	11/11/1991	3.70	2.06	55.68	1045	0.44	1.08	2.46	3.00
13	1	10/18/1991	3.80	2.30	60.53	814	0.50	1.00	2.00	3.00
13	2	02/28/1992	3.40	1.94	57.06	1637	0.81	1.33	1.65	3.00
13	3	03/25/1992	3.50	2.50	71.43	2840	0.74	2.25	3.04	3.00
14	1	02/22/1992	2.20	1.10	50.00	490	0.44	2.50	5.68	4.50
14	1	02/27/1992	2.20	1.80	81.82	490	1.00	3.00	3.00	4.50
14	1	03/27/1992	2.10	0.94	44.76	471	0.46	2.17	4.71	4.50
14	1	12/24/1991	2.50	1.30	52.00	490	0.44	2.25	5.11	4.10
14	1	12/25/1991	2.50	2.10	84.00	490	1.00	3.25	3.25	4.10
14	1	03/27/1992	2.20	1.84	83.64	490	0.41	1.67	4.07	4.50
14	2	12/26/1991	2.40	2.00	83.33	1304	0.90	3.25	3.61	4.10
14	2	02/26/1992	2.20	1.83	83.18	1304	0.90	3.00	3.33	4.50
14	3	03/16/1992	2.13	1.80	84.51	1304	0.39	2.00	5.13	1.50

a/ Figures in parenthesis represent lined length of main watercourse.

Water-course Code	Re-ach	Date	Discharge (Cusecs) Source	Farm	Deliv-ery Effici-ency (per-cent)	Distance-source to Farm Nucca (Meters)	Area (Acre)	Total Irr. Time (Hrs)	Irri. Time Per Unit Area (Hrs)	Water Table Depth (M)
15	3	11/20/1991	1.55	1.35	87.10	11470	1.15	3.00	2.61	
15	3	11/20/1991	1.65	1.31	79.39	11440	2.10	3.00	1.43	
15	3	01/25/1992	1.60	1.30	81.25	11440	1.65	2.25	1.36	
15	3	01/21/1992	1.60	1.30	81.25	11440	1.40	2.25	1.61	
16	2	01/13/1992	1.70	1.35	79.41	6140	2.30	4.00	1.74	
16	2	01/11/1992	1.50	1.20	80.00	6140	1.90	3.30	1.74	
16	2	11/19/1991	1.35	1.10	81.48	6160	2.25	3.00	1.33	
16	2	01/11/1992	1.60	1.30	81.25	6140	2.10	3.83	1.83	
16	2	11/17/1991	2.00	1.65	82.50	6140	3.20	3.00	0.94	
16	2	01/12/1992	1.50	1.20	80.00	6140	2.20	4.17	1.89	
16	2	01/15/1992	1.50	1.20	80.00	6140	1.90	3.00	1.58	
16	2	01/16/1992	1.60	1.30	81.25	6140	1.60	2.75	1.72	
17	3	04/14/1992	1.50	1.20	80.00	5875	1.35	4.50	3.33	
17	3	04/15/1992	1.40	1.10	78.57	5875	1.00	4.50	4.50	
17	3	04/16/1992	1.40	1.10	78.57	5875	1.30	4.00	3.08	
17	3	12/13/1991	1.50	1.20	80.00	5875	1.05	3.50	3.33	
17	3	04/18/1992	1.60	1.30	81.25	5875	1.20	4.00	3.33	
17	3	04/19/1992	1.50	1.25	83.33	5875	1.00	1.00	1.00	
17	3	12/10/1991	1.50	1.20	80.00	5875	1.10	4.50	4.09	
17	3	12/12/1991	1.30	1.05	80.77	5875	0.90	3.25	3.61	
17	3	12/14/1991	1.40	1.20	85.71	5875	1.00	3.58	3.58	
17	3	12/09/1991	1.40	1.10	78.57	5875	1.30	4.50	3.46	
18	3	04/21/1992	0.90	0.70	77.78	2117	1.25	4.00	3.20	
18	3	12/16/1991	0.90	0.70	77.78	2117	1.00	4.00	4.00	
18	3	04/23/1992	0.80	0.63	78.75	2117	0.90	4.00	4.44	
18	3	12/15/1991	0.90	0.70	77.78	2117	1.18	5.00	4.24	
18	3	12/17/1991	0.90	0.70	77.78	2117	1.05	5.00	4.76	
18	3	04/25/1992	0.90	0.70	77.78	2117	0.90	4.00	4.44	

ANNEXURE–4

SUPPLEMENTARY TABULATIONS

CHOWKY SYSTEM

Annexure-4,
Table 4.1

CROPPING PATTERN BY WATERCOURSE

CHOWKY SYSTEM
(1990-91)

Season/Crops	W/C # 6750-R CCA 54.23 Ha.		W/C # 17912-R CCA 73.25 Ha.		W/C # 25000-TL CCA 153.38 Ha.		W/C # 3500-L CCA 91.86 Ha.		W/C # 8000-TF CCA 70.01 Ha.	
	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA
Kharif-90										
Sugarcane	6.59	12.15	0.46	0.63	7.15	4.66	19.41	21.13	22.10	31.57
Orchard	16.48	30.39	12.15	16.59	9.86	6.43	10.12	11.02	-	-
Tobacco	12.93	23.84	0.61	0.83	0.51	0.33	8.32	9.06	-	-
Maize	14.68	27.07	9.91	13.53	38.12	24.85	27.00	29.39	19.06	27.23
Fodder	0.38	0.70	2.11	2.88	1.54	1.01	1.24	1.35	1.19	1.70
Melons	0.15	0.28	1.13	1.54	0.22	0.14	-	-	2.88	4.11
Vegetables	1.89	3.48	1.24	1.69	1.44	0.94	1.35	1.47	0.38	0.54
Oil Seeds	0.15	0.28	5.23	7.14	0.92	0.60	0.51	0.55	-	-
Pulses	-	-	-	-	1.86	1.21	-	-	-	-
Misc.	0.51	0.94	0.82	1.12	0.12	0.08	0.45	0.49	-	-
Sub-Total:	**53.76**	**99.13**	**33.66**	**45.95**	**61.74**	**40.25**	**68.40**	**74.46**	**45.61**	**65.15**
Rabi 1990-91										
Wheat	11.14	20.54	27.96	38.17	72.77	47.44	43.68	47.55	28.52	40.74
Fodder	3.49	6.44	4.13	5.64	7.01	4.57	6.63	7.22	8.96	12.80
Sugarcane	6.59	12.15	0.46	0.63	7.15	4.66	19.41	21.13	22.10	31.56
Orchards	16.48	30.39	12.15	16.59	9.86	6.43	10.12	11.02	-	-
Sugarbeat	-	-	0.66	0.90	4.90	3.19	1.84	2.00	2.15	3.07
Barley	-	-	0.93	1.27	4.25	2.77	0.14	0.15	1.89	2.70
Oil Seeds	-	-	2.80	3.82	2.28	1.49	-	-	-	-
Vegetables	0.12	0.22	0.51	0.70	1.07	0.70	3.73	4.06	0.10	0.14
Rabi Pulses	-	-	0.60	0.80	0 73	0.48	-	-	-	-
Misc.	-	-	0.09	0.12	0.05	0.03	-	-	-	-
Sub-Total:	**37.82**	**69.74**	**50.29**	**68.66**	**110.07**	**71.76**	**85.55**	**93.13**	**63.72**	**91.01**
Grand Toall:	**91.58**	**168.87**	**83.95**	**114.61**	**171.81**	**112.02**	**153.95**	**167.59**	**109.33**	**156.16**

Annexure 4
Table 4.2

DISTRIBUTION OF FARMS BY HOLDING SIZE AND TYPE OF TENURE (ALL WATERCOURSES)

CHOWKY DISTY

Count Percent FARM SIZE GROUP	Type of Tenure OWNER	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50	15 28.8		13 25.0	28 53.8
2.51 - 5.00	6 11.5	1 1.9	7 13.5	14 26.9
5.01 - 7.50		1 1.9	1 1.9	2 3.8
ABOVE 7.50	7 13.5		1 1.9	8 15.4
Column Total	28 53.8	2 3.8	22 42.3	52 100.0

CHOWKY MINOR

Count Percent FARM SIZE GROUP	Type of Tenure OWNER	TENANT	Row Total
0.00 - 2.50	7 19.4	11 30.6	18 50.0
2.51 - 5.00	1 2.8	7 19.4	8 22.2
5.01 - 7.50		3 8.3	3 8.3
ABOVE 7.50	7 19.4		7 19.4
Column Total	15 41.7	21 58.3	36 100.0

Cont'd Table 4.2

CHOWKY SYSTEM

Count Percent FARM SIZE GROUP	Type of tenure OWNER	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50	22 25.0		24 27.3	46 52.3
2.51 - 5.00	7 8.0	1 1.1	14 15.9	22 25.0
5.01 - 7.50		1 1.1	4 4.5	5 5.7
ABOVE 7.50	14 15.9		1 1.1	15 17.0
Column Total	43 48.9	2 2.3	43 48.9	88 100.0

Annexure-4
Table 4.3

DESCRIPTIVE STATISTICS OF IRRIGATION TURN TIME BY CHANNEL REACH

(Hrs./Ha.)

Disty/Reach	Mean	Median	Minimum	Maximum	Std.Dev.
Chowky Disty					
Head	3.01	2.95	0.99	4.94	0.94
Tail	1.99	1.85	0.54	5.65	0.96
Overall	2.35	1.85	0.54	5.65	1.06
Chowky Minor					
Middle	2.17	1.78	1.29	5.40	0.97
Tail	2.47	2.38	1.98	4.31	0.53
Overall	2.32	2.30	1.29	5.40	0.79
Chowky System	2.34	2.09	0.54	5.65	0.96

Annexure-4
Table 4.4

FREQUENCY DISTRIBUTION OF FARMS BY REASONS OF DISSATISFACTION OF WATER ALLOCATION

CHOWKY DISTY-HEAD REACH

Count / Percent	Not Satisfied	Row Total
Less time per Holding size	18 100.0	18 100.0
Column Total	18 100.0	18 100.0

CHOWKY DISTY-TAIL REACH

Count / Percent	Satisfied	Not Satisfied	Row Total
Satisfied	2 5.9		2 5.9
Less time per Holding Size		32 94.1	32 94.1
Column Total	2 5.9	32 94.1	34 100.0

CHOWKY MINOR-MIDDLE REACH

Count / Percent	Not Satisfied	Row Total
Less time Compared other Share Holders	1 5.6	1 5.6
Less time per Holding Size	17 94.4	17 94.4
Column Total	18 100.0	18 100.0

Cont'd Table 4.4

CHOWKY MINOR TAIL REACH

Count Percent	Satisfied	Not Satisfied	Row Total
Satisfied	1 5.6		1 5.6
Less Lime compared other Share Holders		1 5.6	1 5.6
Less Lime per Holding Size		16 88.9	16 88.9
Column Total	1 5.6	17 94.4	18 100.0

Annexure-4
Table 4.5

FREQUENCY DISTRIBUTION OF FARMS NOT GETTING ALLOCATED SHARE OF IRRIGATION WATER BY REASONS

CHOWKY DISTY HEAD REACH

Count Percent	Fluctuating Supply	Row Total
Not Getting	18 100.0	18 100.0
Column Total	18 100.0	18 100.0

CHOWKY DISTY-TAIL REACH

Count Percent	Getting Share	Topo graphy	Poor mai nt. of Wcs.	Silta-tion	Fluctuat-ing Supply	Any Other	Row Total
Getting	9 26.5						9 26.5
Not Getting		3 8.8	3 8.8	1 2.9	17 50.0	1 2.9	25 73.5
Column Total	9 26.5	3 8.8	3 8.8	1 2.9	17 50.0	1 2.9	34 100.0

CHOWKY MINOR-MIDDLE REACH

Count Percent	Fluctuat-ing Supply	Row Total
Not Getting	18 100.0	18 100.0
Column Total	18 100.0	18 100.0

CHOWKY MIINOR-TAIL REACH

Count Percent	Fluctuat-ing Supply	Row Total
Not Getting	18 100.0	18 100.0
Column Total	18 100.0	18 100.0

Annexure-4
Table 4.6

TURNS MISSED UNDER UNEXPECTED CANAL CLOSURES

CHOWKY DISTY-HEAD REACH

Count / Percent	Number of Turns 4	7	8	Row Total
Reasons Not Known	16 88.9	1 5.6	1 5.6	18 100.0
Column Total	16 88.9	1 5.6	1 5.6	18 100.0

CHOWKY DISTY-TAIL REACH

Count / Percent	Number of Turns 2	3	4	5	6	Row Total
Turn Not Missed	15 44.1					15 44.1
Reasons Not Known		2 5.9	12 35.3	1 2.9	3 8.8	18 52.9
Any Other		1 2.9				1 2.9
Column Total	15 44.1	3 8.8	12 35.3	1 2.9	3 8.8	34 100.0

CHOWKY MINOR-MIDDLE REACH

Count / Percent	Number of Turns 5	Row Total
Reasons Not Known	18 100.0	18 100.0
Column Total	18 100.0	18 100.0

CHOWKY MINOR-TAIL REACH

Count / Percent	Number of Turns 4	5	Row Total
Reasons Not Known	14 77.8	4 22.2	18 100.0
Column Total	14 77.8	4 22.2	18 100.0

Annexure-4
Table 4.7

TURNS HAVING INADEQUATE DISCHARGE BY REASONS
CHOWKY DISTY

HEAD-REACH

Count	Number of Truns				Row
Percent	9	10	11	12	Total
Less Flow In Channel	1 5.6	11 61.1	1 5.6	5 27.8	18 100.0
Column Total	1 5.6	11 61.1	1 5.6	5 27.8	18 100.0

TAIL REACH

Count	Number of Turns				Row
Percent	6	7	13	14	Total
Less Flow In Channel	7 20.6	11 32.4	2 5.9	14 41.2	34 100.0
Column Total	7 20.6	11 32.4	2 5.9	14 41.2	34 100.0

CHOWKY MINOR-MIDDLE REACH

Count	Number of Turns					Row
Percent	14	22	33	34	35	Total
Less Flow In Channel	1 5.6	1 5.6	6 33.3	8 44.4	2 11.1	18 100.0
Column Total	1 5.6	1 5.6	6 33.3	8 44.4	2 11.1	18 100.0

CHOWKY MINOR-TAIL REACH

Count	Number of Turns						Row
Percent	7	14	27	29	31	34	Total
Less Flow In Channel	1 5.6	13 72.2	1 5.6	1 5.6	1 5.6	1 5.6	18 100.0
Column Total	1 5.6	13 72.2	1 5.6	1 5.6	1 5.6	1 5.6	18 100.0

Annexure-4
Table 4.8

ANNUAL CROPPING INTENSITES AT FARM LEVEL BY FARM SIZE

CHOWKY DISTY-HEAD REACH

Count Percent FARM SIZE GROUP	Cropping Intensity Group 101-150	151-200	201 AND ABOVE	Row Total
0.00 - 2.50	1 5.6	12 66.7		13 72.2
2.51 - 5.00		4 22.2		4 22.2
5.01 - 7.50				0 00.00
ABOVE 7.50			1 5.6	1 5.6
Column Total	1 5.6	16 88.9	1 5.6	18 100.0

CHOWKY DISTY-TAIL REACH

Count Percent FARM SIZE GROUP	Cropping Intensity Group 0-50	51-100	101-150	151-200	Row Total
0.00 - 2.50	2 5.9	8 23.5	8 23.5	4 11.8	22 64.7
2.51 - 5.00	1 2.9	2 5.9	2 5.9	1 2.9	6 17.6
5.01 - 7.50	2 5.9			1 2.9	3 8.8
ABOVE 7.50			2 5.9	1 2.9	3 8.8
Column Total	5 14.7	10 29.4	12 35.3	7 20.6	34 100.0

Cont'd Table 4.8

CHOWKY MINOR-MIDDLE REACH

Count / Percent	Cropping Intensity Group: 51-200	201 AND ABOVE	Row Total
FARM SIZE GROUP			
0.00 - 2.50	9 50.0	4 22.2	13 72.2
2.51 - 5.00	4 22.2		4 22.2
5.01 - 7.50	1 5.6		1 5.6
Above 7.50			0 00.0
Column Total	14 77.8	4 22.2	18 100.0

CHOWKY MINOR-TAIL REACH

Count / Percent	Cropping Intensity Group: 51-200	101 - 150	151 - 200	201 AND ABOVE	Row Total
FARM SIZE GROUP					
0.00 - 2.50	2 11.1	1 5.6	3 16.7	7 38.9	13 72.2
2.51 - 5.00	1 5.6			2 11.1	3 16.7
5.01 - 7.50		1 5.6			1 5.6
Above 7.50				1 5.6	1 5.6
Column Total	3 16.7	2 11.1	3 16.7	10 55.6	18 100.0

Annexure-4
Table 4.9

ANNUAL CROPPING INTENSITIES BY TYPE OF TENURE

CHOWKY DISTY

Count / Percent	Cropping Intensity Group: 0-50	51-100	101-150	151-200	201 AND ABOVE	Row Total
TENURE TYPE						
OWNER	4 7.7	8 15.4	10 19.2	5 9.6	1 1.9	28 53.8
OWNER CUM TENANT	1 1.9		1 1.9			2 3.8
TENANT		2 3.8	2 3.8	18 34.6		22 42.3
Column Total	5 9.6	10 19.2	13 25.0	23 44.2	1 1.9	52 100.0

CHOWKY MINOR

Count / Percent	Cropping Intensity Group: 51-100	101-150	151-200	201 AND ABOVE	Row Total
TENURE TYPE					
OWNER	2 5.6		7 19.4	6 16.7	15 41.7
TENANT	1 2.8	2 5.6	10 27.8	8 22.2	21 58.3
Column Total	3 8.3	2 5.6	17 47.2	14 38.9	36 100.0

CHOWKY SYSTEM

Count / Percent	Cropping Intensity Group: 0-50	51-100	101-150	151-200	201 AND ABOVE	Row Total
TENURE TYPE						
OWNER	4 4.5	10 11.4	10 11.4	12 13.6	7 8.0	43 48.9
OWNER CUM TENANT	1 1.1		1 1.1			2 2.3
TENANT		3 3.4	4 4.5	28 31.8	8 9.1	43 48.9
Column Total	5 5.7	13 14.8	15 17.0	40 45.5	15 17.0	88 100.0

Cont'd Table 4.9

CHOWKY DISTY-HEAD REACH

TENURE TYPE (Count / Percent)	Cropping Intensity Group: 101-150	151-200	201 AND ABOVE	Row Total
OWNER			1 5.6	1 5.6
TENANT	1 5.6	16 88.9		17 94.4
Column Total	1 5.6	16 88.9	1 5.6	18 100.0

CHOWKY DISTY-TAIL REACH

TENURE TYPE (Count / Percent)	Cropping Intensity Group: 0-50	51-100	101-150	151-200	Row Total
OWNER	4 11.8	8 23.5	10 29.4	5 14.7	27 79.4
OWNER CUM TENANT	1 2.9		1 2.9		2 5.9
TENANT		2 5.9	1 2.9	2 5.9	5 14.7
Column Total	5 14.7	10 29.4	12 35.3	7 20.6	34 100.0

Cont'd Table 4.9

CHOWKY MINOR-MIDDLE REACH

TENURE TYPE	Count / Percent	Cropping Intensity Group: 51-200	201 AND ABOVE	Row Total
OWNER		5 27.8		5 27.8
TENANT		9 50.0	4 22.2	13 72.2
	Column Total	14 77.8	4 22.2	18 100.0

CHOWKY MINOR-TAIL REACH

TENURE TYPE	Count / Percent	Cropping Intensity Group: 51-100	101-150	151-200	201 AND ABOVE	Row Total
OWNER		2 11.1		2 11.1	6 33.3	10 55.6
TENANT		1 5.6	2 11.1	1 5.6	4 22.2	8 44.4
	Column Total	3 16.7	2 11.1	3 16.7	10 55.6	18 100.0

Annexure–5
SUPPLEMENTARY TABULATIONS

PURAN SYSTEM

Annexure-5
Table 5.1

CROPPING PATTERN BY WATERCOURSE

PURAN SYSTEM
(1990-91)

Season/Crops	Puran Disty				Puran Minor			
	W/C # 254/2R CCA 243.97 Ha.		W/C # 261/1R CCA 133.39 Ha.		W/C # 277/2AL CCA 167.64 Ha.		W/C # 282/2T CCA 200.93 Ha.	
	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA
Kharif-90								
Sugarcane	1.21	0.49	0.40	0.30	1.62	0.97	10.93	5.44
Cotton	55.85	22.89	4.86	3.64	19.42	11.58	24.28	12.08
Orchard	6.35	2.60	1.41	1.06	40.91	24.40	19.18	9.55
Vegetables	12.14	4.98	5.66	4.24	-	-	-	-
Misc.	23.07	9.46	1.62	1.21	55.44	33.07	11.73	5.84
Sub-Total:	**98.62**	**40.42**	**13.95**	**10.46**	**117.39**	**70.02**	**66.12**	**32.91**
Rabi 1990-91								
Wheat	102.53	42.03	54.23	40.65	31.34	18.69	37.68	18.75
Fodder	9.01	3.69	2.63	1.97	4.93	2.94	9.12	4.54
Sugarcane	1.21	0.49	0.40	0.30	1.62	0.97	10.93	5.44
Orchards	3.92	1.61	1.01	0.76	-	-	12.91	6.42
Vegetables	0.40	0.16	2.63	1.97	2.76	1.65	2.99	1.49
Orchard+Wheat	2.43	1.00	-	-	19.94	11.89	3.24	1.61
Orchard+Fodder	-	-	0.40	0.30	20.97	12.51	3.03	1.51
Sub-Total:	**119.50**	**48.98**	**61.30**	**45.95**	**81.56**	**48.65**	**79.90**	**39.76**
Grand Total:	**218.12**	**89.40**	**75.25**	**56.41**	**198.95**	**118.66**	**146.02**	**72.67**

Annexure_5
Table 5.2

CROPPING PATTERN BY WATERCOURSE

PURAN SYSTEM
(Kharif-91)

Crops	W/C # 254/2R CCA 243.97 Ha.		W/C # 261/1R CCA 133.39 Ha.		W/C # 277/2AL CCA 167.64 Ha.		W/C # 282/2T CCA 200.93 Ha.	
	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA
Sugarcane	12.73	5.22	1.98	1.49	48.71	29.06	4.55	2.26
Cotton	73.31	30.05	24.69	18.51	33.07	19.73	23.54	11.71
Orchard	3.82	1.57	0.40	0.30	35.53	21.19	5.35	2.67
Fodder	1.98	0.80	0.81	0.61	0.10	0.05	0.49	0.24
Vegetables	26.96	11.05	17.38	13.03	-	-	1.60	0.80
Jantar	8.13	3.58	3.04	2.28	14.03	8.37	12.06	6.00
Rice	-	-	-	-	-	-	4.36	2.17
Orch. + Cotton	0.81	0.33	0.60	0.44	-	-	8.54	4.25
Orch. + Veg.	1.61	0.66	0.96	0.72	-	-	0.06	0.03
Orch. + Fodders	0.10	0.04	-	-	-	-	3.50	1.74
Orch. + S.Cane	-	-	-	-	-	-	-	-
Misc.	0.01	0.04	-	-	-	-	0.12	0.06
Total:	**130.06**	**53.2**	**49.86**	**37.33**	**131.44**	**78.37**	**64.17**	**31.88**

Annexure_5
Table 5.2

CROPPING PATTERN BY WATERCOURSE

PURAN SYSTEM
(Kharif-91)

Crops	W/C # 254/2R CCA 243.97 Ha.		W/C # 261/1R CCA 133.39 Ha.		W/C # 277/2AL CCA 167.64 Ha.		W/C # 282/2T CCA 200.93 Ha.	
	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA
Sugarcane	12.73	5.22	1.98	1.49	48.71	29.06	4.55	2.26
Cotton	73.31	30.05	24.69	18.51	33.07	19.73	23.54	11.71
Orchard	3.82	1.57	0.40	0.30	35.53	21.19	5.35	2.67
Fodder	1.98	0.80	0.81	0.61	0.10	0.05	0.49	0.24
Vegetables	26.96	11.05	17.38	13.03	-	-	1.60	0.80
Jantar	8.13	3.58	3.04	2.28	14.03	8.37	12.06	6.00
Rice	-	-	-	-	-	-	4.36	2.17
Orch. + Cotton	0.81	0.33	0.60	0.44	-	-	8.54	4.25
Orch. + Veg.	1.61	0.66	0.96	0.72	-	-	0.06	0.03
Orch. + Fodders	0.10	0.04	-	-	-	-	3.50	1.74
Orch. + S.Cane	-	-	-	-	-	-	-	-
Misc.	0.01	0.04	-	-	-	-	0.12	0.06
Total:	**130.06**	**53.2**	**49.86**	**37.33**	**131.44**	**78.37**	**64.17**	**31.88**

Annexure-5
Table 5.3

DISTRIBUTION OF FARMS BY HOLDING SIZE AND TYPE OF TENURE (ALL WATERCOURSES)

PURAN DISTY

FARM SIZE (Count / Percent)	OWNER	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50		1 2.9	8 22.9	9 25.7
2.51 - 5.00			6 17.1	6 17.1
5.01 - 7.50	3 8.6		12 34.3	15 42.9
ABOVE 7.50		2 5.7	3 8.6	5 14.3
Column Total	3 8.6	3 8.6	29 82.9	35 100.0

PURAN MINOR

FARM SIZE (Count / Percent)	OWNER	TENANT	Row Total
0.00 - 2.50	2 5.6	11 30.6	13 36.1
2.51 - 5.00		9 25.0	9 25.0
5.01 - 7.50		6 16.7	6 16.7
ABOVE 7.50	6 16.7	2 5.6	8 22.2
Column Total	8 22.2	28 77.8	36 100.0

Cont'd Table 5.3

PURAN SYSTEM

FARM SIZE (Count / Percent)	OWNER	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50	2 2.8	1 1.4	19 26.8	22 31.0
2.51 - 5.00			15 21.1	15 21.1
5.01 - 7.50	3 4.2		18 25.4	21 29.6
ABOVE 7.50	6 8.5	2 2.8	5 7.0	13 18.3
Column Total	11 15.5	3 4.2	57 80.3	71 100.0

PURAN DISTY HEAD REACH

FARM SIZE (Count / Percent)	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50		6 33.3	6 33.3
2.51 - 5.00		5 27.8	5 27.8
5.01 - 7.50		4 22.2	4 22.2
ABOVE 7.50	1 5.6	2 11.1	3 16.7
Column Total	1 5.6	17 94.4	18 100.0

Cont'd Table 5.3

PURAN DISTY TAIL REACH

FARM SIZE (Count / Percent)	OWNER	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50		1 5.9	2 11.8	3 17.6
2.51 - 5.00			1 5.9	1 5.9
5.01 - 7.50	3 17.6		8 47.1	11 64.7
ABOVE 7.50		1 5.9	1 5.9	2 11.8
Column Total	3 17.6	2 11.8	12 70.6	17 100.0

PURAN MINOR HEAD REACH

FARM SIZE (Count / Percent)	OWNER	TENANT	Row Total
0.00 - 2.50		6 33.3	6 33.3
2.51 - 5.00		6 33.3	6 33.3
5.01 - 7.50		5 27.8	5 27.8
ABOVE 7.50	1 5.6		1 5.6
Column Total	1 5.6	17 94.4	18 100.0

Cont'd Table 5.3

PURAN MINOR TAIL REACH

Count Percent	OWNER	TENANT	Row Total
FARM SIZE			
0.00 - 2.50	2 11.1	5 27.8	7 38.9
2.51 - 5.00		3 16.7	3 16.7
5.01 - 7.50		1 5.6	1 5.6
ABOVE 7.50	5 27.8	2 11.1	7 38.9
Column Total	7 38.9	11 61.1	18 100.0

Annexure-5
Table 5.4

DISTRIBUTION OF FARMS BY HOLDING SIZE AND TYPE OF TENURE (SAMPLE WATERCOURSES)

PURAN DISTY-HEAD REACH

Count Percent FARM SIZE GROUP	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50		6 33.3	6 33.3
2.51 - 5.00		5 27.8	5 27.8
5.01 - 7.50		4 22.2	4 22.2
ABOVE 7.50	1 5.6	2 11.1	3 16.7
Column Total	1 5.6	17 94.4	18 100.0

PURAN DISTY-TAIL REACH

Count Percent FARM SIZE GROUP	OWNER	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50		1 5.9	2 11.8	3 17.6
2.51 - 5.00			1 5.9	1 5.9
5.01 - 7.50	3 17.6		8 47.1	11 64.7
ABOVE 7.50		1 5.9	1 5.9	2 11.8
Column Total	3 17.6	2 11.8	12 70.6	17 100.0

Cont'd Table 5.4

PURAN MINOR-HEAD REACH

Count / Percent	OWNER	TENANT	Row Total
FARM SIZE GROUP			
0.00 - 2.50		6 33.3	6 33.3
2.51 - 5.00		7 38.9	7 38.9
5.01 - 7.50		4 22.2	4 22.2
ABOVE 7.50	1 5.6		1 5.6
Column Total	1 5.6	17 94.4	18 100.0

PURAN MINOR-TAIL REACH

Count / Percent	OWNER	TENANT	Row Total
FARM SIZE GROUP			
0.00 - 2.50	2 11.1	6 33.3	8 44.4
2.51 - 5.00		2 11.1	2 11.1
5.01 - 7.50		1 5.6	1 5.6
ABOVE 7.50	5 27.8	2 11.1	7 38.9
Column Total	7 38.9	11 61.1	18 100.0

Annexure-5
Table 5.5

DESCRIPTIVE STATISTICS OF IRRIGATION TURN TIME

(Hrs./Ha.)

Measures	Puran Disty		Puran Minor	
	Head	Tail	Head	Tail
Mean	0.67	1.24	0.99	0.82
Median	0.67	1.24	0.99	0.82
Minimum	0.66	1.23	0.98	0.81
Maximum	0.69	1.24	1.00	0.83
Std. Dev.	0.01	0.02	0.02	0.04

Annexure-5
Table 5.6

MEAN NUMBERS OF WATERCOURSE CLEANINGS BY WATERCOURSE REACH PURAN SYSTEM

Watercourse/Reach	Kharif	Rabi	Annual
Puran Disty			
254/2R			
Head	4	5	9
Middle	4	5	9
Tail	4	5	9
261/1R			
Head	5	4	9
Middle	5	4	9
Tail	5	4	9
Puran Minor			
277/2AL			
Head	2	2	4
Middle	2	2	4
Tail	2	2	4
282/2T			
Head	-	-	-
Middle	4	2	6
Tail	4	2	6

Annexure-5
Table 5.7

TURNS MISSED UNDER UNEXPECTED CANAL CLOSURES BY REASONS
PURAN DISTY-HEAD REACH

	No. of Turns	Row Total
Count / Percent	0	
Turn Not Missed	18 100.0	18 100.0
Column Total	18 100.0	18 100.0

PURAN DISTY-TAIL REACH

	No. of Turns		Row Total
Count / Percent	2	3	
Emergency Maint	3 17.6	14 82.4	17 100.0
Column Total	3 17.6	14 82.4	17 100.0

Cont'd Table 5.7

PURAN MINOR-HEAD REACH

	No. of Turns	
Count Percent	3	Row Total
Emergency Maint	18 100.0	18 100.0
Column Total	18 100.0	18 100.0

PURAN MINOR-TAIL REACH

	No. of Turns	
Count Percent	3	Row Total
Emergency Maint	18 100.0	18 100.0
Column Total	18 100.0	18 100.0

Annexure-5
Table 5.8

ANNUAL CROPPING INTENSITIES BY FARM SIZE

PURAN DISTY-HEAD REACH

FARM SIZE GROUP (Count / Percent)	Cropping Intensity 0-50	51-100	101-150	151-200	Row Total
0.00 - 2.50	1 5.6	4 22.2		1 5.6	6 33.3
2.51 - 5.00		2 11.1		3 16.7	5 27.8
5.01 - 7.50	1 5.6	3 16.7			4 22.2
ABOVE 7.50		2 11.1	1 5.6		3 16.7
Column Total	2 11.1	11 61.1	1 5.6	4 22.2	18 100.0

PURAN DISTY-TAIL REACH

FARM SIZE GROUP (Count / Percent)	Cropping Intensity 0-50	51-100	101-150	151-200	Row Total
0.00 - 2.50	1 5.9		1 5.9	1 5.9	3 17.6
2.51 - 5.00		1 5.9			1 5.9
5.01 - 7.50	2 11.8	8 47.1	1 5.9		11 64.7
ABOVE 7.50	2 11.8				2 11.8
Column Total	5 29.4	9 52.9	2 11.8	1 5.9	17 100.0

Cont'd Table 5.8

PURAN MINOR-HEAD REACH

FARM SIZE GROUP (Count / Percent)	Cropping Intensity 0-50	51-100	101-150	151-200	Row Total
0.00 - 2.50		6 33.3			6 33.3
2.51 - 5.00		1 5.6	4 22.2	2 11.1	7 38.9
5.01 - 7.50	1 5.6	2 11.1		1 5.6	4 22.2
ABOVE 7.50		1 5.6			1 5.6
Column Total	1 5.6	10 55.6	4 22.2	3 16.7	18 100.0

PURAN MINOR TAIL REACH

FARM SIZE GROUP (Count / Percent)	Cropping Intensity 0-50	51-100	151-200	Row Total
0.00 - 2.50	2 11.1	5 27.8	1 5.6	8 44.4
2.51 - 5.00		2 11.1		2 11.1
5.01 - 7.50	1 5.6			1 5.6
ABOVE 7.50	5 27.8	2 11.1		7 38.9
Column Total	8 44.4	9 50.0	1 5.6	18 100.0

Annexure-5
Table 5.9

ANNUAL CROPPING INTENSITIES BY TYPE OF TENURE

PURAN DISTY-HEAD REACH

Tenure Type	Count / Percent	Cropping Intensity 0-50	51-100	101-150	151-200	Row Total
OWNER CUM TENANT			1 5.6			1 5.6
TENANT		2 11.1	10 55.6	1 5.6	4 22.2	17 94.4
	Column Total	2 11.1	11 61.1	1 5.6	4 22.2	18 100.0

PURAN DISTY-TAIL REACH

Tenure Type	Count / Percent	Cropping Intensity Group 0-50	51-100	101-150	151-200	Row Total
OWNER		1 5.9	1 5.9	1 5.9		3 17.6
OWNER CUM TENANT		1 5.9		1 5.9		2 11.8
TENANT		3 17.6	8 47.1		1 5.9	12 70.6
	Column Total	5 29.4	9 52.9	2 11.8	1 5.9	17 100.0

Cont'd Table 5.9

PURAN MINOR-HEAD REACH

Tenure Type	Count / Percent	Cropping Intensity 0-50	51-100	101-150	151-200	Row Total
OWNER			1 5.6			1 5.6
TENANT		1 5.6	9 50.0	4 22.2	3 16.7	17 94.4
	Column Total	1 5.6	10 55.6	4 22.2	3 16.7	18 100.0

PURAN MINOR-TAIL REACH

Tenure Type	Count / Percent	Cropping Intensity 0-50	51-100	151-200	Row Total
OWNER		5 27.8	2 11.1		7 38.9
TENANT		3 16.7	7 38.9	1 5.6	11 61.1
	Column Total	8 44.4	9 50.0	1 5.6	18 100.0

Annexure-5
Table 5.10

MEAN SEED RATE BY CHANNEL REACH
PURAN SYSTEM

(Kgs./Ha.)

Crops	Channels						
	Puran Disty			Puran Minor			Puran System
	Head	Tail	Overall	Head	Tail	Overall	
Rice	-	-	-	-	23	23	23
Cotton	24	21	23	25	37	32	28
Jantar	25	23	23	25	25	25	24
K.Fodder	25	-	25	-	-	-	25
K.Vegetables	5	5	5	-	5	5	5
Sugarcane	8308	5530	7382	9182	-	9182	8642
Wheat	124	113	119	148	140	144	131
R.Fodder	25	24	24	25	30	28	26
R.Vegetables	5	5	5	5	0.3	4	5

Annexure-5
Table 5.11

MEAN NUMBER OF IRRIGATIONS FOR CROPS BY CHANNEL REACH-PURAN SYSTEM

Crops	Puran Disty		Puran Minor		Puran System Overall
	Head	Tail	Head	Tail	
Rice	-	-	-	8	8
Cotton	5	5	4	5	5
Jantar	8	9	8	8	5
K.Fodder	9	-	-	-	9
K.Vegetables	6	8	-	10	8
Sugarcane	10	12	11	-	11
Orchards	-	-	4	4	4
Wheat	5	5	5	5	5
R.Fodder	10	9	6	7	8
R.Vegetables	10	7	11	10	9

Annexure-5
Table 5.12

MEAN FERTILIZER RATE BY CHANNEL REACH

(Kgs/Ha.)

	Puran Disty						Puran Minor					
	Head			Tail			Head			Tail		
Crops	N	P	K	N	P	K	N	P	K	N	P	K
Rice	-	-	-	-	-	-	-	-	-	57	30	-
Cotton	136	57	-	99	34	-	162	36	-	102	57	-
Jantar	-	-	-	57	-	-	57	-	-	-	-	-
K.Fodder	54	-	-	-	-	-	-	-	-	-	-	-
K.Vegetables	124	52	-	152	33	-	-	-	-	144	80	-
Sugarcane	137	57	-	158	113	-	97	28	-	-	-	-
Orchard	-	-	-	28	-	-	47	83	119	37	27	45
Wheat	135	57	-	122	57	-	152	56	-	98	54	-
R.Fodder	54	-	-	57	57	-	45	-	-	70	37	-
R.Vegetables	84	57	-	69	71	-	156	93	82	84	57	-

Annexure-5
Table 5.13

CROP INCOME BY FARM SIZE GROUP

PURAN DISTY

FARM SIZE GROUP (Count / Percent)	Crop Income (Rupees): LESS THAN 0	0-5000	5001-10000	10001-15000	15000 AND ABOVE	Row Total
0.00 - 2.50	3 8.6	4 11.4	1 2.9	1 2.9		9 25.7
2.51 - 5.00		2 5.7	2 5.7	2 5.7		6 17.1
5.01 - 7.50	4 11.4	1 2.9	3 8.6	1 2.9	6 17.1	15 42.9
ABOVE 7.50			1 2.9		4 11.4	5 14.3
Column Total	7 20.0	7 20.0	7 20.0	4 11.4	10 28.6	35 100.0

PURAN MINOR

FARM SIZE GROUP (Count / Percent)	Crop Income (Rupees): LESS THAN 0	0-5000	5001-10000	15000 AND ABOVE	Row Total
0.00 - 2.50	10 27.8	2 5.6	2 5.6		14 38.9
2.51 - 5.00	4 11.1	2 5.6		3 8.3	9 25.0
5.01 - 7.50	1 2.8	1 2.8	1 2.8	2 5.6	5 13.9
ABOVE 7.50	4 11.1	1 2.8	1 2.8	2 5.6	8 22.2
Column Total	19 52.8	6 16.7	4 11.1	7 19.4	36 100.0

Cont'd Table 5.13

PURAN SYSTEM

	Crop Income (Rupees)					
Count Percent	LESS THAN 0	0-5000	5001-10000	10001-15000	15000 AND ABOVE	Row Total
FARM SIZE GROUP 0.00 - 2.50	13 18.3	6 8.5	3 4.2	1 1.4		23 32.4
2.51 - 5.00	4 5.6	4 5.6	2 2.8	2 2.8	3 4.2	15 21.1
5.01 - 7.50	5 7.0	2 2.8	4 5.6	1 1.4	8 11.3	20 28.2
ABOVE 7.50	4 5.6	1 1.4	2 2.8		6 8.5	13 18.3
Column Total	26 36.6	13 18.3	11 15.5	4 5.6	17 23.9	71 100.0

Annexure-5
Table 5.14

CROP INCOME BY TYPE OF TENURE

PURAN DISTY

Count Percent	Crop Income (Rupees)					Row Total
	LESS THAN 0	0-5000	5001-10000	10001-15000	15000 AND ABOVE	
TENURE TYPE						
OWNER					3 8.6	3 8.6
OWNER CUM TENANT			1 2.9		2 5.7	3 8.6
TENANT	7 20.0	7 20.0	6 17.1	4 11.4	5 14.3	29 82.9
Column Total	7 20.0	7 20.0	7 20.0	4 11.4	10 28.6	35 100.0

PURAN MINOR

Count Percent	Crop Income (Rupees)				Row Total
	LESS THAN 0	0-5000	5001-10000	15000 AND ABOVE	
TENURE TYPE					
OWNER	4 11.1	1 2.8	1 2.8	2 5.6	8 22.2
TENANT	15 41.7	5 13.9	3 8.3	5 13.9	28 77.8
Column Total	19 52.8	6 16.7	4 11.1	7 19.4	36 100.0

Cont'd Table 5.14

PURAN SYSTEM

Count Percent	Crop Income (Rupees) LESS THAN 0	0-5000	5001-10000	10001-15000	15000 AND ABOVE	Row Total
TENURE TYPE						
OWNER	4 5.6	1 1.4	1 1.4		5 7.0	11 15.5
OWNER CUM TENANT			1 1.4		2 2.8	3 4.2
TENANT	22 31.0	12 16.9	9 12.7	4 5.6	10 14.1	57 80.3
Column Total	26 36.6	13 18.3	11 15.5	4 5.6	17 23.9	71 100.0

Annexure-5
Table 5.15

INCOME PER CROPPED HECTARE BY FARM SIZE GROUP

PURAN DISTY

FARM SIZE GROUP (Count / Percent)	Crop Income per Cropped Hectare (Rupees): LESS THAN 0	0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
0.00 - 2.50	2 6.3		3 9.4		3 9.4	8 25.0
2.51 - 5.00		1 3.1	2 6.3	2 6.3	1 3.1	6 18.8
5.01 - 7.50	2 6.3	1 3.1	4 12.5	1 3.1	5 15.6	13 40.6
ABOVE 7.50			1 3.1		4 12.5	5 15.6
Column Total	4 12.5	2 6.3	10 31.3	3 9.4	13 40.6	32 100.0

PURAN MINOR

FARM SIZE GROUP (Count / Percent)	Crop Income per Cropped Hectare (Rupees): LESS THAN 0	0-1000	1001-2000 0	2001-3000 0	3001 AND ABOVE	Row Total
0.00 - 2.50	9 25.7			1 2.9	3 8.6	13 37.1
2.51 - 5.00	4 11.4	2 5.7			3 8.6	9 25.7
5.01 - 7.50	1 2.9	1 2.9	1 2.9		2 5.7	5 14.3
ABOVE 7.50	4 11.4	2 5.7	1 2.9	1 2.9		8 22.9
Column Total	18 51.4	5 14.3	2 5.7	2 5.7	8 22.9	35 100.0

Cont'd Table 5.15

PURAN SYSTEM

FARM SIZE GROUP	Count / Percent	Crop Income per Cropped Hectare (Rupees): LESS THAN 0	0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
0.00 - 2.50		11 16.4		3 4.5	1 1.5	6 9.0	21 31.3
2.51 - 5.00		4 6.0	3 4.5	2 3.0	2 3.0	4 6.0	15 22.4
5.01 - 7.50		3 4.5	2 3.0	5 7.5	1 1.5	7 10.4	18 26.9
ABOVE 7.50		4 6.0	2 3.0	2 3.0	1 1.5	4 6.0	13 19.4
	Column Total	22 32.8	7 10.4	12 17.9	5 7.5	21 31.3	67 100.0

Annexure-5
Table 5.16

INCOME PER CROPPED HECTARE BY TYPE OF TENURE

PURAN DISTY

TENURE TYPE (Count / Percent)	Income per Cropped Hectare (Rupees): LESS THAN 0	0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
OWNER					3 9.4	3 9.4
OWNER CUM TENANT					3 9.4	3 9.4
TENANT	4 12.5	2 6.3	10 31.3	3 9.4	7 21.9	26 81.3
Column Total	4 12.5	2 6.3	10 31.3	3 9.4	13 40.6	32 100.0

PURAN MINOR

TENURE TYPE (Count / Percent)	Income per Cropped Hectare (Rupees): LESS THAN 0	0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
OWNER	3 8.6	1 2.9	1 2.9	1 2.9	1 2.9	7 20.0
TENANT	15 42.9	4 11.4	1 2.9	1 2.9	7 20.0	28 80.0
Column Total	18 51.4	5 14.3	2 5.7	2 5.7	8 22.9	35 100.0

Cont'd Table 5.16

PURAN SYSTEM

TENURE TYPE — Count / Percent	Income per Cropped Hectare (Rupees): LESS THAN 0	0-1000	1001-200	2001-300	3001 AND ABOVE	Row Total
OWNER	3 4.5	1 1.5	1 1.5	1 1.5	4 6.0	10 14.9
OWNER CUM TENANT					3 4.5	3 4.5
TENANT	19 28.4	6 9.0	11 16.4	4 6.0	14 20.9	54 80.6
Column Total	22 32.8	7 10.4	12 17.9	5 7.5	21 31.3	67 100.0

Annexure-5
Table 5.17

LIVESTOCK INCOME BY FARM SIZE GROUP

PURAN DISTY

Count Percent	Livestock Income (Rupees)					Row Total
FARM SIZE GROUP	LESS THAN 0	0-1000	1001-2000	2001-3000	3001 AND ABOVE	
0.00 - 2.50	7 20.0	1 2.9		1 2.9		9 25.7
2.51 - 5.00	3 8.6	1 2.9			2 5.7	6 17.1
5.01 - 7.50	9 25.7	2 5.7	2 5.7	1 2.9	1 2.9	15 42.9
ABOVE 7.50	3 8.6				2 5.7	5 14.3
Column Total	22 62.9	4 11.4	2 5.7	2 5.7	5 14.3	35 100.0

PURAN MINOR

Count Percent	Livestock Income (Rupees)					Row Total
FARM SIZE GROUP	LESS THAN 0	0-1000	1001-2000	2001-3000	3001 AND ABOVE	
0.00 - 2.50	9 25.0	1 2.8	1 2.8	1 2.8	2 5.6	14 38.9
2.51 - 5.00	7 19.4			1 2.8	1 2.8	9 25.0
5.01 - 7.50	4 11.1				1 2.8	5 13.9
ABOVE 7.50	4 11.1			1 2.8	3 8.3	8 22.2
Column Total	24 66.7	1 2.8	1 2.8	3 8.3	7 19.4	36 100.0

Cont'd Table 5.17

PURAN SYSTEM

Count Percent FARM SIZE GROUP	Livestock Income (Rupees) LESS THAN 0	0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
0.00 - 2.50	16 22.5	2 2.8	1 1.4	2 2.8	2 2.8	23 32.4
2.51 - 5.00	10 14.1	1 1.4		1 1.4	3 4.2	15 21.1
5.01 - 7.50	13 18.3	2 2.8	2 2.8	1 1.4	2 2.8	20 28.2
ABOVE 7.50	7 9.9			1 1.4	5 7.0	13 18.3
Column Total	46 64.8	5 7.0	3 4.2	5 7.0	12 16.9	71 100.0

Annexure-5
Table 5.18

LIVESTOCK INCOME BY TYPE OF TENURE

PURAN DISTY

Count Percent TENURE TYPE	Livestock Income (Rupees) LESS THAN 0	0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
OWNER		1 2.9	2 5.7			3 8.6
OWNER CUM TENANT	1 2.9				2 5.7	3 8.6
TENANT	21 60.0	3 8.6		2 5.7	3 8.6	29 82.9
Column Total	22 62.9	4 11.4	2 5.7	2 5.7	5 14.3	35 100.0

PURAN MINOR

Count Percent TENURE TYPE	Livestock Income (Rupees) LESS THAN 0	0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
OWNER	6 16.7			1 2.8	1 2.8	8 22.2
TENANT	18 50.0	1 2.8	1 2.8	2 5.6	6 16.7	28 77.8
Column Total	24 66.7	1 2.8	1 2.8	3 8.3	7 19.4	36 100.0

Cont'd Table 5.18

PURAN SYSTEM

Count Percent TENURE TYPE	Livestock Income (Rupees) LESS THAN 0	0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
OWNER	6 8.5	1 1.4	2 2.8	1 1.4	1 1.4	11 15.5
OWNER CUM TENANT	1 1.4				2 2.8	3 4.2
TENANT	39 54.9	4 5.6	1 1.4	4 5.6	9 12.7	57 80.3
Column Total	46 64.8	5 7.0	3 4.2	5 7.0	12 16.9	71 100.0

Annexure-5
Table 5.19

NON-FARM INCOME BY FARM SIZE GROUP
PURAN DISTY

FARM SIZE GROUP (Count / Percent)	Non-Farm Income (Rupees): LESS THAN 0	0-5000	5001-10000	Row Total
0.00 - 2.50	9 25.7			9 25.7
2.51 - 5.00	5 14.3		1 2.9	6 17.1
5.01 - 7.50	14 40.0		1 2.9	15 42.9
ABOVE 7.50	3 8.6	1 2.9	1 2.9	5 14.3
Column Total	31 88.6	1 2.9	3 8.6	35 100.0

PURAN MINOR

FARM SIZE GROUP (Count / Percent)	Non-Farm Income (Rupees): LESS THAN 0	0-5000	5001-10000	Row Total
0.00 - 2.50	13 36.1		1 2.8	14 38.9
2.51 - 5.00	8 22.2		1 2.8	9 25.0
5.01 - 7.50	4 11.1		1 2.8	5 13.9
ABOVE 7.50	7 19.4	1 2.8		8 22.2
Column Total	32 88.9	1 2.8	3 8.3	36 100.0

Cont'd Table 5.19

PURAN SYSTEM

FARM SIZE GROUP (Count / Percent)	Non-Farm Income (Rupees): LESS THAN 0	0-5000	5001-1000	Row Total
0.00 - 2.50	22 31.0		1 1.4	23 32.4
2.51 - 5.00	13 18.3		2 2.8	15 21.1
5.01 - 7.50	18 25.4		2 2.8	20 28.2
ABOVE 7.50	10 14.1	2 2.8	1 1.4	13 18.3
Column Total	63 88.7	2 2.8	6 8.5	71 100.0

Annexure-5
Table 5.20

NON-FARM INCOME BY TYPE OF TENURE

PURAN DISTY

TENURE TYPE (Count / Percent)	Non-Farm Income (Rupees): LESS THAN 0	0-5000	5001-10000	Row Total
OWNER	3 8.6			3 8.6
OWNER CUM TENANT	2 5.7	1 2.9		3 8.6
TENANT	26 74.3		3 8.6	29 82.9
Column Total	31 88.6	1 2.9	3 8.6	35 100.0

PURAN MINOR

TENURE TYPE (Count / Percent)	Non-Farm Income (Rupees): LESS THAN 0	0-5000	5001-10000	Row Total
OWNER	8 22.2			8 22.2
TENANT	24 66.7	1 2.8	3 8.3	28 77.8
Column Total	32 88.9	1 2.8	3 8.3	36 100.0

Cont'd Table 5.20

PURAN SYSTEM

TENURE TYPE (Count / Percent)	Non-Farm Income (Rupees): LESS THAN 0	0-5000	5001-10000	Row Total
OWNER	11 15.5			11 15.5
OWNER CUM TENANT	2 2.8	1 1.4		3 4.2
TENANT	50 70.4	1 1.4	6 8.5	57 80.3
Column Total	63 88.7	2 2.8	6 8.5	71 100.0

ANNEXURE – 6

SUPPLEMENTARY TABULATIONS

NAGNA SYSTEM

Annexure-6
Table 6.1

CROPPING PATTERN BY WATERCOURSE

NAGNA DISTY
(1990-91)

Season/Crops	W/C # 3R CCA 233.06 Ha.		W/C # 1AL CCA 111.14		W/C # 7R CCA 249.90		W/C # 9L CCA 246.39		W/C # 14AL CCA 187.53	
	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA
Kharif-90										
Sugarcane	40.47	17.36	12.14	10.92	32.37	12.95	52.61	21.35	16.19	8.63
Cotton	12.14	5.21	8.09	7.28	10.12	4.05	8.09	3.28	4.05	2.16
Orchard	54.98	23.59	19.69	17.72	136.05	54.44	55.99	22.73	28.31	15.10
Fodder	34.40	14.76	14.57	13.11	25.49	10.20	17.40	7.06	8.09	4.31
Vegetables	20.23	8.68	8.09	7.28	8.09	3.24	4.05	1.64	2.02	1.08
Misc.	-	-	-	-	-	-	-	-	-	-
Sub-Total:	**162.22**	**69.60**	**62.58**	**56.31**	**212.12**	**84.88**	**183.14**	**56.06**	**58.66**	**31.28**
Rabi 1990-91										
Wheat	31.15	13.37	22.57	20.31	33.55	13.42	65.27	26.49	38.07	20.30
Fodder	0.55	0.24	1.21	1.09	0.98	0.39	2.61	1.06	2.27	1.21
Sugarcane	40.47	17.36	12.14	10.92	32.37	12.95	52.61	21.35	16.19	8.63
Orchards	47.58	20.42	13.96	12.56	127.72	51.11	54.37	22.07	28.31	15.10
Vegetables	16.29	6.99	-	-	-	-	-	-	-	-
Orchard+Wheat	7.40	3.17	5.73	5.15	1.82	0.73	0.81	0.33	-	-
Orchard+Vegetable	-	-	-	-	-	-	0.81	0.33	-	-
Orchard+Fodder	-	-	-	-	6.51	2.60	-	-	-	-
Misc.	-	-	-	-	-	-	-	-	-	-
Sub-Total:	**143.44**	**61.55**	**55.61**	**50.03**	**202.95**	**81.21**	**176.48**	**71.63**	**84.84**	**45.24**
Grand Total:	**305.66**	**131.15**	**118.19**	**106.34**	**415.07**	**166.09**	**314.62**	**127.69**	**143.50**	**76.52**

Annexure-6
Table 6.2

CROPPING PATTERN BY WATERCOURSE

NAGNA DISTY
(Kharif-91)

Crops	W/C # 3R CCA 233.06 Ha.		W/C # 1AL CCA 111.14		W/C # 7R CCA 249.90		W/C # 9L CCA 246.39		W/C # 14AL CCA 187.53	
	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA	Hectare	Percent of CCA
Sugarcane	50.25	21.56	43.33	38.99	8.62	3.45	-	-	18.10	9.65
Cotton	11.78	5.05	-	-	4.78	1.91	46.94	19.05	34.53	18.42
Orchard	33.75	14.48	21.41	19.26	104.30	41.74	48.92	19.85	27.76	14.80
Fodder	6.12	2.62	-	-	0.56	0.22	0.10	0.04	10.02	5.34
Vegetables	10.18	4.37	-	-	1.20	0.48	8.43	3.42	4.65	2.48
Jantar	3.03	1.30	-	-	5.93	2.38	1.85	0.75	3.58	1.91
Rice	-	-	-	-	4.05	1.62	-	-	-	-
Orch. + Cotton	5.40	2.32	-	-	1.90	0.76	0.20	0.08	-	-
Orch. + Veg.	7.44	3.19	-	-	-	-	2.40	0.98	-	-
Orch. + Fodders	8.99	3.86	-	-	28.46	11.38	0.10	0.04	0.55	0.29
Orch. + S.cane	-	-	1.06	0.95	25.35	10.15	-	-	-	-
Misc.	-	-	-	-	-	-	-	-	-	-
Total:	**136.94**	**58.75**	**65.80**	**59.20**	**185.33**	**74.16**	**108.94**	**44.21**	**99.19**	**52.89**

Annexure-5
Table 6.3

DISRTIBUTION OF FARMS BY HOLDING SIZE AND TYPE OF TENURE (ALL WATERCOURSES) NAGNA SYSTEM

TENURE-> Count / Percent — FARM SIZE GROUP	OWNER	OWNER CUM TENANT	TENANT	Row Total
0.00 - 2.50	4 4.5		16 18.2	20 22.7
2.51 - 5.00	5 5.7		11 12.5	16 18.2
5.01 - 7.50	4 4.5		16 18.2	20 22.7
ABOVE 7.50	19 21.6	6 6.8	7 8.0	32 36.4
Column Total	32 36.4	6 6.8	50 56.8	88 100.0

Annexure-6
Table 6.4

REACHWISE DESCRIPTIVE STATISTICS OF FARM SIZE BY TYPE OF TENURE

Reach/Type of Tenure	Measure				
	Mean	Median	Minimum	Maximum	Std. Dev.
Head					
Owner	9.41	10.12	0.80	16.45	5.21
Owner-cum Tenant	20.80	20.80	2.47	39.13	25.92
Tenant	5.21	5.35	0.81	11.74	2.93
Middle					
Owner	13.35	5.39	1.55	66.12	16.92
Owner-cum Tenant	11.48	12.19	4.95	16.59	5.83
Tenant	4.26	2.02	0.81	20.08	6.40
Tail					
Owner	9.25	9.26	5.71	12.78	3.53
Owner-cum Tenant	-	-	-	-	-
Tenant	5.33	3.90	0.41	15.12	4.44
Overall					
Owner	12.10	8.91	0.80	66.12	14.27
Owner-cum Tenant	3.17	4.00	1.00	4.00	1.33
Tenant	2.24	2.00	1.00	4.00	1.08

Annexure-6
Table 6.5

NUMBER OF TURNS HAVING INADEQUATE DISCHARGE BY REASONS

HEAD REACH

Count Percent	Number of Turns 0	2	3	5	6	8	9	10	12	15	Row Total
Full Supply	19 52.8										19 52.8
Less Flow in Channel		3 8.3	2 5.6	1 2.8	4 11.1	2 5.6	1 2.8	2 5.6	1 2.8	1 2.8	17 47.2
Column Total	19 52.8	3 8.3	2 5.6	1 2.8	4 11.1	2 5.6	1 2.8	2 5.6	1 2.8	1 2.8	36 100.0

MIDDLE REACH

Count Percent	Number of Turns 0	2	5	6	7	8	9	11	Row Total
Full Supply	19 54.3								19 54.3
Less Flow in Channel		1 2.9	1 2.9	3 8.6	1 2.9	5 14.3	4 11.4	1 2.9	16 45.7
Column Total	19 54.3	1 2.9	1 2.9	3 8.6	1 2.9	5 14.3	4 11.4	1 2.9	35 100.0

TAIL REACH

Count Percent	Number of Turns 0	2	3	5	6	7	8	9	10	Row Total
Full Supply	1 5.9									1 5.9
Less Flow in Channel		4 23.5	3 17.6	1 5.9	1 5.9	2 11.8	2 11.8	2 11.8	1 5.9	16 94.1
Column Total	1 5.9	4 23.5	3 17.6	1 5.9	1 5.9	2 11.8	2 11.8	2 11.8	1 5.9	17 100.0

Annexure-6
Table 6.6

ANNUAL CROPPING INTENSITIES BY FARM SIZE
NAGNA SYSTEM

HEAD REACH

FARM SIZE GROUP (Count / Percent)	Cropping Intensities 0-50	51-100	101-150	151-200	201 AND ABOVE	Row Total
- 2.50	2 5.6	3 8.3	2 5.6	2 5.6		9 25.0
- 5.00	1 2.8		1 2.8	3 8.3		5 13.9
5.01 - 7.50	1 2.8	5 13.9	4 11.1	3 8.3		13 36.1
ABOVE 7.50	2 5.6	4 11.1	2 5.6		1 2.8	9 25.0
Column Total	6 16.7	12 33.3	9 25.0	8 22.2	1 2.8	36 100.0

MIDDLE REACH

FARM SIZE GROUP (Count / Percent)	Cropping Intensities 0-50	51-100	101-150	151-200	201 AND ABOVE	Row Total
0.00 - 2.50	6 17.1	3 8.6	2 5.7	2 5.7		13 37.1
2.51 - 5.00	2 5.7	2 5.7		1 2.9		5 14.3
5.01 - 7.50		1 2.9	1 2.9		1 2.9	3 8.6
ABOVE 7.50	2 5.7	4 11.4	2 5.7	4 11.4	2 5.7	14 40.0
Column Total	10 28.6	10 28.6	5 14.3	7 20.0	3 8.6	35 100.0

Annexure-6
Table 6.7

ANNUAL CROPPING INTENSITIES BY TYPE OF TEUNRE
NAGNA SYSTEM - HEAD REACH

TENURE TYPE	Count / Percent	Cropping Intensities 0-50	51-100	101-150	151-200	201 AND ABOVE	Row Total
OWNER		4 11.1	1 2.8		1 2.8	1 2.8	7 19.4
OWNER CUM TENANT			1 2.8	1 2.8			2 5.6
TENANT		2 5.6	4 11.1	7 19.4	5 13.9	9 25.0	27 75.0
	Column Total	6 16.7	6 16.7	8 22.2	6 16.7	10 27.8	36 100.0

MIDDLE REACH

TENURE TYPE	Count / Percent	Cropping Intensities 0-50	51-100	101-150	151-200	201 AND ABOVE	Row Total
OWNER		8 22.9	2 5.7	1 2.9	1 2.9	10 28.6	22 62.9
OWNER CUM TENANT		1 2.9		2 5.7		1 2.9	4 11.4
TENANT		1 2.9	4 11.4	2 5.7	1 2.9	1 2.9	9 25.7
	Column Total	10 28.6	6 17.1	5 14.3	2 5.7	12 34.3	35 100.0

Cont'd Table 6.7

TAIL REACH

TENURE TYPE	Count / Percent	Cropping Intensities 0-50	51-100	101-150	Row Total
OWNER		2 11.8	1 5.9		3 17.6
TENANT		4 23.5	7 41.2	3 17.6	14 82.4
	Column Total	6 35.3	8 47.1	3 17.6	17 100.0

Annexure-6
Table 6.8

DESCRIPTIVE STATISTICS OF MAJOR CROPS YIELD

Reach/Crop	Mean	Median	Minimum	Maximum	Std. Dev.
Head					
S.Cane (Fresh)	48485	47895	5859	97418	22408
S.Cane (Ratoon)	55338	55338	55338	55338	0
Cotton	586	576	526	646	85
Wheat	1581	1557	609	2436	417
Middle					
S.Cane (Fresh)	83188	83188	81525	84851	2352
S.Cane(Ratoon)	-	-	-	-	-
Cotton	1171	1291	623	1383	283
Wheat	1732	1586	747	3560	830
Tail					
S.Cane (Fresh)	-	-	-	-	-
S.Cane (Ratoon)	-	-	-	-	-
Cotton	608	615	467	715	80
Wheat	1807	1745	928	3105	695
Overall					
S.Cane (Fresh)	51640	50477	5859	97418	2364
S.Cane (Ratoon)	55338	55338	55338	55338	0
Cotton	842	640	467	1383	342
Wheat	1676	1566	609	3560	622

Annexure-6
Table 6.9

YIELD OF SUGARCANE BY SIZE OF HOLDING

NAGNA SYSTEM

FARM SIZE GROUP — Count / Percent	Yield Kgs/Ha. 0-15000	15001-30000	30001-60000	60001-90000	90001 AND ABOVE	Row Total
0.00 - 2.50				1 4.5		1 4.5
2.51 - 5.00			3 13.6	1 4.5		4 18.2
5.01 - 7.50	1 4.5	1 4.5	7 31.8	1 4.5		10 45.5
ABOVE 7.50		1 4.5	2 9.1	3 13.6	1 4.5	7 31.8
Column Total	1 4.5	2 9.1	12 54.5	6 27.3	1 4.5	22 100.0

YIELD OF SUGARCANE BY TYPE OF TENURE

TENURE TYPE — Count / Percent	Yield kgs/ha. 0-15000	15001-30000	30001-60000	60001-90000	90001 AND ABOVE	Row Total
OWNER				3 13.6	1 4.5	4 18.2
OWNER CUM TENANT			1 4.5			1 4.5
TENANT	1 4.5	2 9.1	11 50.0	3 13.6		17 77.3
Column Total	1 4.5	2 9.1	12 54.5	6 27.3	1 4.5	22 100.0

Annexure-6
Table 6.10

YIELD OF COTTON BY HOLDING SIZE

NAGNA SYSTEM

FARM SIZE GROUP (Count / Percent)	Yield kgs/ha. 301-600	601-900	901-1200	1201 AND ABOVE	Row Total
0.00 - 2.50		1 5.0		1 5.0	2 10.0
2.51 - 5.00	3 15.0	2 10.0		3 15.0	8 40.0
5.01 - 7.50	1 5.0	1 5.0			2 10.0
ABOVE 7.50	1 5.0	4 20.0	1 5.0	2 10.0	8 40.0
Column Total	5 25.0	8 40.0	1 5.0	6 30.0	20 100.0

YIELD OF COTTON BY TYPE OF TENURE

TENURE TYPE (Count / Percent)	Yield kgs/hs. 301-600	601-900	901-1200	1201 AND ABOVE	Row Total
OWNER		5 25.0		4 20.0	9 45.0
OWNER CUM TENANT			1 5.0	1 5.0	2 10.0
TENANT	5 25.0	3 15.0		1 5.0	9 45.0
Column Total	5 25.0	8 40.0	1 5.0	6 30.0	20 100.0

Annexure-6
Table 6.11

YIELD OF WHEAT BY HOLDING SIZE

NAGNA SYSTEM

FARM SIZE GROUP (Count / Percent)	Yield kgs/ha. 0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
0.00 - 2.50	3 5.7	9 17.0	1 1.9	1 1.9	14 26.4
2.51 - 5.00		8 15.1	3 5.7		11 20.8
5.01 - 7.50	2 3.8	7 13.2	3 5.7		12 22.6
ABOVE 7.50	2 3.8	12 22.6		2 3.8	16 30.2
Column Total	7 13.2	36 67.9	7 13.2	3 5.7	53 100.0

YIELD OF WHEAT BY TYPE OF TENURE

TENURE TYPE (Count / Percent)	Yield kgs/ha. 0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
OWNER	1 1.9	7 13.2	1 1.9		9 17.0
OWNER CUM TENANT	1 1.9	3 5.7		1 1.9	5 9.4
TENANT	5 9.4	26 49.1	6 11.3	2 3.8	39 73.6
Column Total	7 13.2	36 67.9	7 13.2	3 5.7	53 100.0

Annexure-6,
Table 6.12

CROP INCOME BY HOLDING SIZE
NAGNA SYSTEM

FARM SIZE GROUP (Count / Percent)	Rupees: LESS THAN 0	0-5000	5001-10000	10001-15000	15000 AND ABOVE	Row Total
0.00 - 2.50	16 18.2	1 1.1	2 2.3		6 6.8	25 28.4
2.51 - 5.00	3 3.4	4 4.5	3 3.4		7 8.0	17 19.3
5.01 - 7.50	3 3.4	5 5.7	1 1.1	2 2.3	7 8.0	18 20.5
ABOVE 7.50	5 5.7	5 5.7		1 1.1	17 19.3	28 31.8
Column Total	27 30.7	15 17.0	6 6.8	3 3.4	37 42.0	88 100.0

ANNEXURE–7
SUPPLEMENTARY TABULATIONS
NARI SYSTEM

Annexure-7,
Table 7.1

CROPPING PATTERN BY WATERCOURSE
NARI SYSTEM

Crops	Sibi Branch				Kurak Branch			
	OT-6TF		OT-7TL		OT-3		OT-7	
	Cropped Area (Ha.)	Percent of cropped area	Cropped Area (Ha.)	Percent of cropped area	Cropped Area (Ha.)	Percent of cropped area	Cropped Area (Ha.)	Percent of cropped area
Kharif-90								
Jowar	180.36	100	115.79	100	73.25	100	40.49	92.59
Vegetables	-	-	-	-	-	-	3.24	7.41
Sub-Total:	**180.36**	**100**	**115.79**	**100**	**73.25**	**100**	**43.73**	**100**
Rabi 1990-91								
Wheat	205.26	84.61	134.41	84.05	63.38	88.82	42.87	62.47
Barley	36.54	15.06	25.51	15.95	6.41	8.98	9.00	13.11
Vegetables	0.81	0.33	-	-	0.08	0.11	13.61	19.83
Fodder	-	-	-	-	1.49	2.09	3.15	4.59
Sub-Total:	**242.61**	**100**	**159.92**	**100**	**71.36**	**100**	**68.63**	**100**
Total	**422.97**	**100**	**275.71**	**100**	**144.61**	**100**	**112.36**	**100**

Annexure-7,
Table 7.2

CROPPING PATTERN BY WATERCOURSE
NARI SYSTEM
Kharif-91

Crops	Sibi Branch				Kurak Branch			
	OT-6TF		OT-7TL		OT-3		OT-7	
	Cropped Area (Ha.)	Percent of cropped area	Cropped Area (Ha.)	Percent of cropped area	Cropped Area (Ha.)	Percent of cropped area	Cropped Area (Ha.)	Percent of cropped area
Jowar	109.64	100	79.74	100	68.71	100	51.23	87.13
Vegetables	-	-	-	-	-	-	6.27	10.66
Oilseeds	-	-	-	-	-	-	1.30	2.21
Total	109.64	100	79.74	100	68.71	100	58.80	100

Annexure-7,
Table 7.3

DISTRIBUTION OF FARMS BY HOLDING SIZE AND TYPE OF TENURE (ALL WATERCOURSES)

SIBI BRANCH

Count / Percent	OWNER	OWNER CUM TENANT	TENANT	Row Total
FARM SIZE GROUP				
2.51 - 5.00	3 6.0		1 2.0	4 8.0
5.01 - 7.50	3 6.0		1 2.0	4 8.0
ABOVE 7.50	18 36.0	5 10.0	19 38.0	42 84.0
Column Total	24 48.0	5 10.0	21 42.0	50 100.0

KURAK BRANCH

Count / Percent	OWNER	TENANT	Row Total
FARM SIZE GROUP			
5.01 - 7.50		1 10.0	1 10.0
ABOVE 7.50	4 40.0	5 50.0	9 90.0
Column Total	4 40.0	6 60.0	10 100.0

NARI SYSTEM

Count / Percent	OWNER	OWER CUM TENANT	TENANT	Row Total
FARM SIZE GROUP				
2.51 - 5.00	3 5.0		1 1.7	4 6.7
5.01 - 7.50	3 5.0		2 3.3	5 8.3
ABOVE 7.50	22 36.7	5 8.3	24 40.0	51 85.0
Column Total	28 46.7	5 8.3	27 45.0	60 100.0

Annexure-7,
Table 7.4

ANNUAL CROPPING INTENSITIES BY FARM SIZE GROUP

SIBI BRANCH

FARM SIZE GROUP (Count / Percent)	Cropping Intensities: 51-100	101-150	151 AND ABOVE	Row Total
2.51 - 5.00	4 8.0			4 8.0
5.01 - 7.50	3 6.0		2 4.0	5 10.0
ABOVE 7.50	32 64.0	1 2.0	8 16.0	41 82.0
Column Total	39 78.0	1 2.0	10 20.0	50 100.0

KURAK BRANCH

FARM SIZE GROUP (Count / Percent)	Cropping Intensities: 51-100	101-150	151 AND ABOVE	Row Total
5.01 - 7.50	1 10.0			1 10.0
ABOVE 7.50	6 60.0	1 10.0	2 20.0	9 90.0
Column Total	7 70.0	1 10.0	2 20.0	10 100.0

NARI SYSTEM

FARM SIZE GROUP (Count / Percent)	Cropping Intensites: 51-100	101-150	151 AND ABOVE	Row Total
2.51 - 5.00	4 6.7			4 6.7
5.01 - 7.50	4 6.7		2 3.3	6 10.0
ABOVE 7.50	38 63.3	2 3.3	10 16.7	50 83.3
Column Total	46 76.7	2 3.3	12 20.0	60 100.0

Annexure-7.
Table 7.5

ANNUAL CROPPING INTENSITIES BY TYPE OF TENURE

SIBI BRANCH

TENURE TYPE — Count / Percent	Cropping Intensities 51-100	101-150	151 AND ABOVE	Row Total
OWNER	18 36.0		6 12.0	24 48.0
OWNER CUM TENANT	4 8.0		1 2.0	5 10.0
TENANT	17 34.0	1 2.0	3 6.0	21 42.0
Column Total	39 78.0	1 2.0	10 20.0	50 100.0

KURAK BRANCH

TENURE TYPE — Count / Percent	Cropping Intensities 51-100	101-150	151 AND ABOVE	Row Total
OWNER	2 20.0	1 10.0	1 10.0	4 40.0
TENANT	5 50.0		1 10.0	6 60.0
Column Total	7 70.0	1 10.0	2 20.0	10 100.0

NARI SYSTEM

TENURE TYPE — Count / Percent	Cropping Intensities 51-100	101-150	151 AND ABOVE	Row Total
OWNER	20 33.3	1 1.7	7 11.7	28 46.7
OWNER CUM TENANT	4 6.7		1 1.7	5 8.3
TENANT	22 36.7	1 1.7	4 6.7	27 45.0
Column Total	46 76.7	2 3.3	12 20.0	60 100.0

Annexure-7,
Table 7.6

DESCRIPTIVE STATISTICS OF CROPS YIELD
NARI SYSTEM

(Kgs/Ha.)

Channels/ Measure	Jowar	K.Fodder	Wheat	R.Fodder
Sibi Branch				
Mean	529	6089	971	7047
Median	553	5957	922	6917
Minimum	307	4611	545	4611
Maximum	830	11529	1998	15372
Std.Dev.	117	1197	243	1938
Kurak Branch				
Mean	616	6826	1358	8886
Median	494	6149	1393	8841
Minimum	461	4611	742	6118
Maximum	1476	11529	1768	11529
Std.Dev.	315	2400	287	2253
Nari System				
Mean	544	6171	1024	7264
Median	553	6149	980	6917
Minimum	307	4611	545	4611
Maximum	1476	11529	1998	15372
Std.Dev.	166	1367	281	2043

Annexure-7,
Table 7.7

JOWAR YIELDS BY FARM SIZE GROUPS

SIBI BRANCH

FARM SIZE GROUP (Count / Percent)	Kgs. per Hectare: 301-600	Kgs. per Hectare: 601-900	Row Total
2.51 - 5.00	3 6.0	1 2.0	4 8.0
5.01 - 7.50	4 8.0	1 2.0	5 10.0
ABOVE 7.50	29 58.0	12 24.0	41 82.0
Column Total	36 72.0	14 28.0	50 100.0

KURAK BRANCH

FARM SIZE GROUP (Count / Percent)	Kgs. per Hectare: 301-600	Kgs. per Hectare: 601-900	Kgs. per Hectare: 1201 AND ABOVE	Row Total
5.01 - 7.50	1 10.0			1 10.0
ABOVE 7.50	6 60.0	2 20.0	1 10.0	9 90.0
Column Total	7 70.0	2 20.0	1 10.0	10 100.0

NARI SYSTEM

FARM SIZE GROUP (Count / Percent)	Kgs. per Hectare: 301-600	Kgs. per Hectare: 601-900	Kgs. per Hectare: 1201 AND ABOVE	Row Total
2.51 - 5.00	3 5.0	1 1.7		4 6.7
5.01 - 7.50	5 8.3	1 1.7		6 10.0
ABOVE 7.50	35 58.3	14 23.3	1 1.7	50 83.3
Column Total	43 71.7	16 26.7	1 1.7	60 100.0

Annexure-7,
Table 7.8

JOWAR YIELDS BY TYPE OF TENURE

SIBI BRANCH

TENURE TYPE (Count / Percent)	Kgs. per Hectare: 301-600	601-900	Row Total
OWNER	17 34.0	7 14.0	24 48.0
OWNER CUM TENANT	3 6.0	2 4.0	5 10.0
TENANT	16 32.0	5 10.0	21 42.0
Column Total	36 72.0	14 28.0	50 100.0

KURAK BRANCH

TENURE TYPE (Count / Percent)	Kgs. per Hectare: 301-600	601-900	1201 AND ABOVE	Row Total
OWNER	3 30.0	1 10.0		4 40.0
TENANT	4 40.0	1 10.0	1 10.0	6 60.0
Column Total	7 70.0	2 20.0	1 10.0	10 100.0

NARI SYSTEM

TENURE TYPE (Count / Percent)	Kgs. per Hectare: 301-600	601-900	1201- AND ABOVE	Row Total
OWNER	20 33.3	8 13.3		28 46.7
OWNER CUM TENANT	3 5.0	2 3.3		5 8.3
TENANT	20 33.3	6 10.0	1 1.7	27 45.0
Column Total	43 71.7	16 26.7	1 1.7	60 100.0

Annexure-7,
Table 7.9

WHEAT YIELDS BY FARM SIZE GROUPS

SIBI BRANCH

FARM SIZE GROUP (Count / Percent)	Kgs. per Hectare: 0-1000	Kgs. per Hectare: 1001-2000	Row Total
2.51 - 5.00	2 4.0	2 4.0	4 8.0
5.01 - 7.50	3 6.0	2 4.0	5 10.0
ABOVE 7.50	25 50.0	16 32.0	41 82.0
Column Total	30 60.0	20 40.0	50 100.0

KURAK BRANCH

FARM SIZE GROU (Count / Percent)	Kgs. per Hectare: 0-1000	Kgs. per Hectare: 1001-2000	Row Total
5.01 - 7.50		1 12.5	1 12.5
ABOVE 7.50	1 12.5	6 75.0	7 87.5
Column Total	1 12.5	7 87.5	8 100.0

NARI SYSTEM

FARM SIZE GROUP (Count / Percent)	Kgs. per Hectare: 0-1000	Kgs. per Hectare: 1001-2000	Row Total
2.51 - 5.00	2 3.4	2 3.4	4 6.9
5.01 - 7.50	3 5.2	3 5.2	6 10.3
ABOVE 7.50	26 44.8	22 37.9	48 82.8
Column Total	31 53.4	27 46.6	58 100.0

Annexure-7,
Table 7.10

WHEAT YIELDS BY TYPE OF TENURE

SIBI BRANCH

TENURE TYPE — Count / Percent	Kgs. per Hectare 0-1000	Kgs. per Hectare 1001-2000	Row Total
OWNER	12 24.0	12 24.0	24 48.0
OWNER CUM TENANT	1 2.0	4 8.0	5 10.0
TENANT	17 34.0	4 8.0	21 42.0
Column Total	30 60.0	20 40.0	50 100.0

KURAK BRANCH

TENURE TYPE — Count / Percent	Kgs. per Hectare 0-1000	Kgs. per Hectare 1001-2000	Row Total
OWNER	1 12.5	2 25.0	3 37.5
TENANT		5 62.5	5 62.5
Column Total	1 12.5	7 87.5	8 100.0

NARI SYSTEM

TENURE TYPE — Count / Percent	Kgs. per Hectare 0-1000	Kgs. per Hectare 1001-2000	Row Total
OWNER	13 22.4	14 24.1	27 46.6
OWNER CUM TENANT	1 1.7	4 6.9	5 8.6
TENANT	17 29.3	9 15.5	26 44.8
Column Total	31 53.4	27 46.6	58 100.0

Annexure-7,
Table 7.11

INCOME PER CROPPED HECTARE BY FARM SIZE

SIBI BRANCH

FARM SIZE GROUP (Count / Percent)	Kgs. per Hectare: 0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
2.51 - 5.00	2 4.0	1 2.0	1 2.0		4 8.0
5.01 - 7.50	1 2.0	3 6.0	1 2.0		5 10.0
ABOVE 7.50	1 2.0	30 60.0	9 18.0	1 2.0	41 82.0
Column Total	4 8.0	34 68.0	11 22.0	1 2.0	50 100.0

KURAK BRANCH

FARM SIZE GROUP (Count / Percent)	Kgs. per Hectare: 1001-2000	2001-3000	3001 AND ABOVE	Row Total
5.01 - 7.50	1 10.0			1 10.0
ABOVE 7.50	4 40.0	4 40.0	1 10.0	9 90.0
Column Total	5 50.0	4 40.0	1 10.0	10 100.0

NARI SYSTEM

FARM SIZE GROUP (Count / Percent)	Kgs. per Hectare: 0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
2.51 - 5.00	2 3.3	1 1.7	1 1.7		4 6.7
5.01 - 7.50	1 1.7	4 6.7	1 1.7		6 10.0
ABOVE 7.50	1 1.7	34 56.7	13 21.7	2 3.3	50 83.3
Column Total	4 6.7	39 65.0	15 25.0	2 3.3	60 100.0

Annexure-7,
Table 7.12

INCOME PER CROPPED HECTARE BY TYPE OF TENURE

SIBI BRANCH

TENURE TYPE (Count / Percent)	0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
OWNER	2 4.0	17 34.0	4 8.0	1 2.0	24 48.0
OWNER CUM TENANT		2 4.0	3 6.0		5 10.0
TENANT	2 4.0	15 30.0	4 8.0		21 42.0
Column Total	4 8.0	34 68.0	11 22.0	1 2.0	50 100.0

KURAK BRANCH

TENURE TYPE (Count / Percent)	1001-2000	2001-3000	3001 AND ABOVE	Row Total
OWNER	3 30.0		1 10.0	4 40.0
TENANT	2 20.0	4 40.0		6 60.0
Column Total	5 50.0	4 10.0	1 10.0	10 100.0

NARI SYSTEM

TENURE TYPE (Count / Percent)	0-1000	1001-2000	2001-3000	3001 AND ABOVE	Row Total
OWNER	2 3.3	20 33.3	4 6.7	2 3.3	28 46.7
OWNER CUM TENANT		2 3.3	3 5.0		5 8.3
TENANT	2 3.3	17 28.3	8 13.3		27 45.0
Column Total	4 6.7	39 65.0	15 25.0	2 3.3	60 100.0

APPENDICES

WATERCOURSE MONITORING AND EVALUATION DIRECTORATE
PLANNING AND INVESTIGATION ORGANIZATION
PLANNING DIVISION
W A P D A

IRRIGATION SYSTEMS REHABILITATION PROJECT - II

(ISRP - II)

AGRO-ECONOMIC VARIABLES/PARAMETERS

1990-91

1.0 IDENTIFICATION

1.1 Watercourse R.D _____ 1.4 Operator's Name _____

1.2 Distributary\Minor _____ 1.5 Father's Name _____

1.3 Distt./Province _____ 1.6 Village _____

1.7

Watercourse Code		Wc. Reach Code	Farm Code	

WC. Reach Code	
Head	-1
Middle	-2
Tail	-3

	D	D	M	M	Y	Y
Collected by:----------						
Checked by :----------						
Edited by :----------						

2.0 OPERATOR'S AND FARM CHARACTERISTICS

Education level Codes

2.1 Operator's education

None	= 1	Primary	= 2
Middle	= 3	Matric	= 4
Inter.	= 5	B.A/M.A	= 6

2.2 Total Farm size . (Acres)

(Even on any other watercourse)

2.3 Farm size (acres) operated

(on this watercourse)

2.4 Number of parcels on this watercourse

2.5 Tenure status

Owner	1
Owner cum Tenant	2
Tenant	3

3.0 CANAL IRRIGATION WATER

3.1 Type of Warabandi

Sanctioned by irrigation department 1

Mutually decided by the shareholders 2

If mutually decided

Weekly	1
Fortnigltly	2
Other type_____	3

3.2 In case of mutually decided warabandi what is done to compensate who miss the turn

Nothing	1
Fully Compensated	2

3.3 Is warabandi changed

Yes	1
No	2

If yes, at what interval

Six Months	1
One year	2
_____	3

3.4 Irrigation turn time

Start time_____

End Time _____

Total Time_____

4.0 Equity in Irrigation Water Supply

4.1 Are you satisfied with the allocation of irrigation water

Yes	1	
No	2	☐

If no

Turn time is less as compared to other shareholders	1	
Turn time is less as per holding size	2	☐
Sanctioned warabandi is not being followed	3	
Any other_____	4	

4.2 Are you getting allocated share of your irrigation turn

Yes	1	
No	2	☐

If no reasons being

Breaches on upper sections	1	
Stealing at upper reaches	2	
Topography of the farm	3	
Gradient of the watercourse	4	
Poor maintenance of the wc.	5	☐
Siltation	6	
Fluctuated supply in disty.	7	
Any other_____	8	

5.0 Reliability in Irrigation Water Supply

5.1 Number of turns missed due to canal closure

a) Regular closure

Kharif_____ Rabi_____

b) Unexpected closure

Kharif_____ Rabi_____

Range	Code
0	1
1 -3	2
4 -6	3
7 -9	4
10-12	5
13-15	6
> 15	7

If missed unexpected what were the reasons

Canal Breach	1
Breach of Disty	2
Emergency Maintenance	3
Reasons not known	4
Any other_____	5

5.2 Did you receive less than normal discharge

Yes	1
No	2

If yes,

no. of turns when less discharge was received

Kharif_____ Rabi_____

Range	Code
0	1
1 -3	2
4 -6	3
7 -9	4
10-12	5
13-15	6
> 15	7

Reasons:

- Less discharge in the distributary	1
- High watercourse conveyance losses	2
- Any other	3

6.0 Watercourse Cleaning Information

6.1 Have you organized a regular programme of watercourse cleaning and maintenance

Yes	1	☐
No	2	

6.2 If yes,
How many Times main wc. was cleaned collectively

Kharif_____ Rabi_____

6.3 Who decides when to clean

A designated individual	1	☐
Informal committee	2	
Water Users Association	3	
Any other_____	4	

6.4 How is the cleaning work divided among farmers

According to turn time	1	☐
All work togather	2	
Any other_____	3	

6.5 System of fines or sanctions for those who do not participate in cleaning

None	1	☐
Fine in cash	2	
Fine in kind	3	
Any other_____	4	

7.0 Do you use Tubewell water for crop production ?

Yes_____ No _____

If yes:

7.1 What percentage Tubewell water contributed towards your overall crop production during:

Kharif_____ Rabi_____

(Enter respective Code by looking the range given under)

% age Range	Code	% Range	Code
1 - 5	1	51 - 55	11
6 - 10	2	56 - 60	12
11 - 15	3	61 - 65	13
16 - 20	4	66 - 70	14
21 - 25	5	71 - 75	15
26 - 30	6	76 - 80	16
31 - 35	7	80 - 85	17
36 - 40	8	86 - 90	18
41 - 45	9	91 - 95	19
46 - 50	10	96 - 100	20

8.0 CROP ACREAGE AND PRODUCTION

Crop	Crop Code	Area Planted (ac.)	Area Harvested (ac.)	Major Product		By Product		Remarks
				Production (Mds.)	Farm Gate Price Rs./Md.	Production (Mds.)	Farm Gate Price Rs./Md.	

CROP NAME	CODE	CROP NAME	CODE	CROP NAME	CODE
Rice Fine	01	Jantar	08	Rabi Pulses	15
Rice Coarse	02	Kharif Fodder	09	Rabi Fodder	16
Maize (grain)	03	Kharif Veget.	10	Sugarcane	17
Bajra (grain)	04	Kharif Misc	11	Orchards	18
Jowar (grain)	05	Wheat Imp.	12	Rabi Veget.	19
Cotton	06	Tobbacco	13	Ratoon S.Cane	20
Kharif O/Seed	07	Rabi Oilseeds	14	Rabi Misc.	21
				Gram	22

9.0 CROP INPUTS AND COSTS

Crop Name	Crop Code	Seed		Fertilizer* (Kg.)				F.Y.M		Pesti-cide	Irrig. Water Purch.
		Qty Kg.	Cost Rs.	Qty N	Qty P	Qty K	Cost Rs.	Qty Mds.	Cost Rs.	Cost Rs.	Cost Rs.

* : NPK to be reported in active nutrients

10.0 CULTURAL OPERATION : MANUAL, BULLOCK AND TRACTOR - NUMBER AND HOURS PER ACRE

CROPS	IDEAL DATE	PLOUGHING (HOURS) 1/						PLANKING (HOURS)						TRANSPORTATION & APPLICATION OF FYM (HOURS)			APPLICATION OF CHEMICAL FERTILIZER (HOURS)			CHEMICAL SPRAY (HOURS)		
		TRACTOR			BULLOCK			TRACTOR			BULLOCK											
		N	M	T	N	M	B	N	M	T	N	M	B	N	B	T	N	M	T	N	M	T

1/ N = Number of Operations B = Bullock Hours
M = Manual Hours T = Tractor Hours

Continue.....

MBT = Left two columns to be used for hours and right columns for minutes.

BEST AVAILABLE DOCUMENT

10.0 CULTURAL OPERATIONS: MANUAL, BULLOCK AND TRACTOR - NUMBER AND HOURS PER ACRE

CROPS	CROP CODE	SOWING (HOURS) 2/						HOEING/WEEDING (HOURS)			IRRIGATION 3/				HARVESTING / PICKING (HOURS)				THRESHING , CLEANING (HOURS)		
		MANUAL		BULLOCK		TRACTOR					TUBEWELL		CANAL								
		N	HRS	N	HRS	N	HRS	N	H	T	N	HRS	N	HRS	N	H	S	T	H	S	T

2/ H/HRS = HOURS
3/ T/W = TUBEWELL

3/ CAN = CANAL

BEST AVAILABLE DOCUMENT

11.0 FAMILY LABOUR SUPPLY

No	Relationship to Operator	Sex M/F	Age Yrs	Available for Farm Work: Full Time	3/4	1/2	1/4	Labour Units	Standard Man Equivalents
1	Self								
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
								Total	

Notes:

1. Availability:

Include only household members who are available for work on crop production. Crop production includes cutting fodder but not other livestock activities.

2. Labour Units:

Tick the box (Full Time, 1/2 etc.) indicating the approximate proportion of time available. For coding Labour units, convert the fractions to decimal and sum.

3. Standard Man Equivalents:

Convert Labour Units at the following rates:

Male	16 ≤ 60	1 LU =	1.00	SME
Male	12 ≤ 15	1 LU =	0.50	SME
Male	> 60	1 LU =	0.50	SME
Female	16 ≤ 60	1 LU =	0.50	SME
Female	> 60	1 LU =	0.25	SME
Female	12 ≤ 15	1 LU =	0.25	SME

12.0 PERMANENT HIRED LABOUR FORCE

12.1 Number of permanent agricultural workers employed during the Kharif season. [ ][ ]

12.2 Average monthly wages per permanent worker: Rs. [ ][ ][ ][ ]

12.3 Did the permanent workers receive food as well as cash payment? (tick one reply)

Yes	1
No	2

13.0 CASUAL LABOUR COSTS

13.1 What was the cash cost of casual manual/ motive labour on crops ?

Crop	Code	Cost for Operation				Total Cost (Rs.)
		Land Preparation (Rs.)	Planting & T/planting (Rs.)	Post Planting (Rs.)	Harvest & Post harvest (Rs.)	
Casual Labour hired for irrigation						
					Total Rs	

13.2 Did casual labourers receive food as well as cash ? (tick one reply)

Yes	1
No	2

14.0 LIVESTOCK INVENTORY

14.1 Strength of Livestock

Livestock Category	No.
1 Milch Buffaloes	
2 Draught Buffaloes	
3 Immature Buffaloes	
4 Milch Cows	
5 Draught Oxen	
6 Immature Cows/Oxen	
7 Horses/Mules mature	
8 Horses /Mules immature	
9 Donkeys mature	
10 Donkeys immature	
11 Camels mature	
12 Camels immature	
13 Sheep & goats, all ages	

14.2 What was the approximate total income from livestock ?

Rs. _____

14.3 Cost of Maintenance Of Livestock

Kharif Rs. _____

Rabi Rs. _____

Total Rs. _____

15.0 EQUIPMENT INVENTORY

15.1 Inventory at date of Interview

Implements	Number
Tubewell	
1 Electric	
2 Diesel	
3 Tractor Driven	
Tractor Driven Implements	
4 Tractor	
5 Plough	
6 Disc harrow	
7 Rotavator	
8 Seed/fertilizer drill	
9 Trailer	
10 Thresher	

16.0 INCOME OTHER THAN FARM

Source of Income	Amount (Rs.)
1. Livestock	
2. Dairy Products	
3. Poultry	
4. Handicrafts	
5. Forest/Wood	
6. Off Farm Wages	
7. Other Specify_____	
Total	

Sheet-----of----

WATERCOURSE MONITORING & EVALUATION PROJECT
PLANNING AND INVESTIGATION ORGANIZATION
PLANNING DIVISION WAPDA
ISRP-II (ISM-II)
IRRIGATION EVALUATION

Irrigation Date: Day-------Month--------Year-------
Collected by :----------
Checked By :----------
Turn Started at: Hrs-----Min--------
Lag Time
a: Source to Farm Nakka : Hrs-----Min--------
b: Farm to Field Nakka : Hrs-----Min--------
Intermediate Flume Installed: Yes-----No---------

System Code :----------
Disty/Minor Code :----------
Disty/Minor Reach :----------
Watercourse Code & R.D.:-----/----------
Improvement Status :Lined-----Unlined----
Farm Location & Code : H ---- M ---- T ----
Farmer's Name :----------
Pre/Post-Improvement :----------
Source of Irrigation :----------
Type of Irrigation :Basin-----Furrow-----

			Outlet (Fixed Point)						Farm Nakka (Fixed Point)						Distance - Outlet to Farm Nakka (Meters)		Field Nakka						Distance - Outlet/Farm to Field Nakka (Meter)		Begin-ning and Ending Times	Length of Dry/ Drained Ditch (Meters)
Field Code	Crop Code	Field Size (Acre)	Flume Size	Time	H_a	H_b	Q_s (Cfs)	Time for Same Q_s (M)	Flume Size	Time	H_a	H_b	Q_{fm} (Cfs)	Time for Same Q_{fm}(M)	Lined	Un-lined	Flume Size	Time	H_a	H_b	Q_{fd} (Cfs)	Time for Same Q_{fd}(M)	Lined	Un-lined		
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Reasons if a flume is not used:- _____

BEST AVAILABLE DOCUMENT

TIME OF IRRIGATION PER UNIT AREA

Crop Code	Area Irrigated (Acres)	Irrigation Time (Hours) Start	End	Net	Time of Irrigation Per Unit Area (Minutes/acre)

GENERAL OBSERVATIONS
(To be filled once during each Visit)

1. Has the Outlet (mogna) been rehabilitated under the ISM-II Programme ?

   Yes_____No.____

   If "No." why ?_____

2. Physical condition of the watercourse:
   (Maintenance, gradient/slope, siltation, dead storage, vegitation etc.)

   a) Main : _____

   b) Branch : _____

   c) Field ditch : _____

3. Watercourse improvements made after the last visit

   i. W.C. lenght lined (meters) Main_____Branch_____

   ii. W.C. length earthen improved (meters) Main_____Branch_____

   iii. No. of nakkas installed Main_____Branch_____

4. Main reasons of watercourse losses (Overtopping, Vegetation, Seepage, Leakage etc.)

   a) Main _____

   b) Branch _____

   c) Field Ditches _____

5. Watertable depth (To be observed from the nearby open-well _____Meters

6. Supply level in feeding Distributary/Minors

   Full_____76 to 99 % _____50 to 75 % _____ Less than 50 % _____

BEST AVAILABLE DOCUMENT

IDENTIFICATION CODES

FOR IRRIGATION EVALUATION DATA

System	Disty./ Minor	Dy/Mr. a/ Reach	Watercourse RD.	Water-course Code	Lined/ Unlined
Chowky	Chowky Dy.	1	6750-R	1	Unlined
		3	17912-R	2	Lined
		3	25000-TL	3	Unlined
	Chowky Minor-I	2	3500-L	4	Unlined
		3	8000-TF	5	Unlined
Puran	Puran Dy.	1	2-R	6	Unlined
		3	1-R	7	Unlined
	Puran Mr.	1	2-AL	8	Unlined
		3	2-T	9	Unlined
Nagna	Nagna Dy.	1	3-R	10	Lined
		1	1-AL	11	Unlined
		2	7-R	12	Lined
		2	9-L	13	Unlined
		3	14-AL	14	Unlined
Nari	Sibi Br.	3	OT-6TF	15	Unlined
		3	OT-7TF	16	Unlined
	Kurak Br.	2	OT-3	17	Unlined
		3	OT-7	18	Unlined

a/ Reach codes for distributary, minor and watercourse are as under:

1 = Head
2 = Middle
3 = Tail