

9L209

Report No. R-34

**PILOT PROJECT FOR FARMER-MANAGED AGRICULTURE UNDER
THE LEFT BANK OUTFALL DRAIN, STAGE I PROJECT, PAKISTAN**

**FINANCIAL FEASIBILITY ANALYSIS
OF OPERATION AND MAINTENANCE COSTS
FOR WATER USERS FEDERATIONS
ON THREE PILOT DISTRIBUTARIES
IN PROVINCE OF SINDH, PAKISTAN**



SIN R
IIMI
G317.4
G730
SCH
H 9425

Interim Report

By

**Amin Sohani
Financial Analyst**

**SEPTEMBER 1997
HYDERABAD OFFICE
PAKISTAN NATIONAL PROGRAM
INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE**

H 9245

TABLE OF CONTENTS

LIST OF ANNEXURES	iii
ACKNOWLEDGEMENTS	v
FOREWORD	vi
1. INTRODUCTION	1
1.1 BACKGROUND	1
1.2 MAJOR OBJECTIVES	1
1.3 NEED FOR A BUSINESS PLAN	2
1.3.1 Technical Viability	2
1.3.2 Social Viability	2
1.3.3 Financial Viability	2
1.4 PROCESS FOR DEVELOPING A BUSINESS PLAN	3
1.4.1 Step 1 Farm Income Analysis	3
1.4.2 Step 2 Analysis of O&M Costs	3
1.4.3 Step 3 WUOs Ability to Pay for O&M Costs	3
1.4.4 Steps 4, 5 and 6	3
1.5 FINANCIAL FEASIBILITY ANALYSIS	5
2. FARM INCOME ANALYSIS	5
2.1 OBJECTIVES	5
2.2 FINANCIAL CONCEPTS	5
2.3 DATA COLLECTION METHODOLOGY	6
2.3.1 Pre-Testing of the Questionnaire	6
2.3.2 Basic Feature of the Questionnaire	6
2.4 DATA COLLECTION ISSUES AND STRATEGY	7
2.4.1 Collection of Sensitive Information	8
2.4.2 Data Entry, Validation and Analysis	8
2.4.3 Identity of Respondents	8
2.5 GENERAL CHARACTERISTICS OF THE SAMPLE	8
2.6 FARM INCOME ANALYSIS	9
2.7 MAIN FINDINGS	9
3. ANALYSIS OF OPERATION AND MAINTENANCE COSTS	10
3.1 OBJECTIVES	10
3.2 DEFINITION OF O&M	10
3.3 INITIAL FINDINGS	11
3.3.1 O&M Costs for the Distributary/Minor	11
3.3.2 O&M Costs for the Divisions	11
3.4 ANALYSIS OF O&M COSTS	12
3.4.1 Verification of Establishment Costs	12
3.4.2 Reasonable Requirements for Irrigation and Drainage O&M	13

3.5	ANALYSIS OF ABIANA AND RELATED CHARGES (COST RECOVERY)	13
3.5.1	Deh Acres	13
3.5.2	Revenue Assessed and Recovered	14
3.5.3	Revenue Data from Irrigation Department	14
3.5.4	Abiana Assessment on GoS Crop Rates	17
3.5.5	Verification of Revenue Assessed and Recovered	18
3.5.6	Other Water Related Charges	19
3.6	MAIN FINDINGS OF STEP 2	20
4.	ABILITY OF WATER USERS ORGANIZATIONS TO PAY	21
4.1	OBJECTIVE	21
4.2	CURRENT SITUATION	21
4.3	BENCH MARKS FOR IRRIGATION AND DRAINAGE O&M COSTS	21
4.4	COST RECOVERY AND O&M BENCH MARKS	21
4.5	WUOs ABILITY TO PAY THE IRRIGATION O&M DIFFERENCE	22
4.6	WUOs ABILITY TO PAY THE IRRIGATION AND DRAINAGE O&M DIFFERENCE	22
4.7	O&M COSTS OF DRAINAGE IN LBOD AREA	22
4.8	FINDINGS OF IIMI'S CONSULTANTS	23
5.	CONCLUSIONS	24
6.	RECOMMENDATIONS	24
	REFERENCES	25

ANNEXURES

Annexure A PLAN OF ACTION FOR DEVELOPING A BUSINESS PLAN		
	Plan of Action prepared by Financial Analyst	26
Figure 1	Process for Developing a Business Plan	29
Annexure B SUPPORTING INFORMATION FOR FARM INCOME ANALYSIS		
Table 1	Difference between Farm Income Analysis, Funds Flow Analysis, and Farm Investment Analysis	30
Exhibit 1	Sample Questionnaire	31
Exhibit 2	Definitions of Variable used in various Tables and Figures Of Supporting Information	40
Table 2a	Basic Data of the Water User (Bareji Distributary, Mirpurkhas)	42
Table 2b	Basic Data of the water User (Dhoro Naro Minor, Nawabshah)	43
Table 2c	Basic Data of the Water User Heran Distributary and Khadwari Monir, Sanghar	44
Table 2d	Summary of the Basic Data	44
Table 3	Financial Data Analysis Bareji Distributary	45
Table 4	Financial Data Analysis Dhoro Naro Minor	46
Table 5	Financial Data Analysis Heran Distributary	47
Figure 2	Kharif 96 Farm Income Derivation	48
Figure 3	Total Farm Cost Derivation for Rabi 95/96	49
Figure 4	Rabi 95/96 Farm Income Derivation	50
Figure 5	Annual Farm Income derivation for Rabi 95/96 & Kharif 96	51
Table 6	Farm Income Analysis (Mean figures)	52
Table 7	Farm Income Analysis (Actual figures)	53
Annexure C IRRIGATION OPERATION AND MAINTENANCE COSTS		
Exhibit 3	From 64 Schedule of Works Expenditure 52000 Irrigation Non-Development 523000-459 M&R (June 1989).	54
Table 8	Statement Showing the M&R, E&I and Establishment Expenditures Incurred on Bareji Distributary during the year 1985/86 to 1995/96	55
Table 9	Statement Showing the Expenditure Incurred for E&I from the year 1985-86 to 1995/96 of Bareji Distry, Heran Distry & Khudwari minor and Dhoronaro minor	56
Exhibit 4	Statement Showing the Staff of all Categories of Jamrao Division, Mirpurkhas	57
Exhibit 5	Name of Sub-divisions under Jamrao Canal	58
Exhibit 6	Statement Showing the Names and Number of Distributaries in Jamrao Division	59
Table 10	Statement Showing the Year-wise Expenditures under the Head of Establishment of Jamrao Division	61
Table 11	Extract from Annual Administration Report of Jamrao Division	62
Table 12	Irrigation Works (E&I + M&R) Costs in 1996 Rs	63
Table 13	Establishment Costs, 1986-95.	63
Table 14	Salary of regular staff of Jamrao Division (estimated)	64

Table 15	Operation & Maintenance Costs (Based on Yard Sticks and Actual Establishment)	65
Annexure D	REVENUE ASSESSED AND RECOVERED	
Table 16	Deh-wise acres at Bareji Distributary, Mirpurkhas	66
Table 17	Analysis of Revenue Assessed and Recovered for Bareji Distributary	67
Table 18	Statement Showing Cropwise Cultivation figures Khari & Rabi for year with Assessed Abiana Recovered through Revenue Dept. (three Years)	68
Table 19	Abiana Assessed for Bareji Distributary Based on per acre Rates Provided by GoS (three years)	69
Table 20	Summary of Abiana Assessed that was recovered for Bareji Distributary Bases on per acre rates provided by GoS	70
Table 21	Revenue Assessed and Recovered of Heran Distributary (Deh-wise are Data 1987-1996)	71
Table 22	Taxes and Cesses for Kharif and Rabi 95/96 (consolidated)	73
Annexure E	IRRIGATION AND DRAINAGE O&M REQUIREMENTS	
Table 23	Consolidated Statement of Reasonable Requirements for Operation & Maintenance of Irrigation Infra-Structure	74
Table 24	LBOD-Stage I Project Estimated Annual Recurrent (O&M) Cost for Subareas and Overall Stage Project (MID-1984 Consultant Prices)	75
Exhibit 7	Status Report on Financial Feasibility Analysis.	76
Exhibit 8	Business Plan for Water User Organisations: Framework Document	84

ACKNOWLEDGMENTS

The author conveys his profound thanks to the following members of IIMI's field teams at Mirpurkhas, Sanghar, and Nawabshah who collected the data presented in this report.

Mirpurkhas: Mr. Waryam Baloch, Mr. Ghulam Mustafa Talpur, Mr. Nadeem Khanzada, Mr. Asghar Ali Memon and Mr. Badar-ul-Hassan Memon.

Nawabshah: Mr. Nizamuddin Bharchoond, Mr. Abdul Rehman Soomro, Mr. Muneer Ahmed Mangrio, Mr. Ishrat Amir and Mr. Pervaiz Pirzada.

Sanghar: Mr. Naveed Khayal, Mr. Niaz Hussain Sial, Mr. Abdul Majeed, Mr. Ghulam Shabir Soomro, Mr. Ghous Bux Laghari and Mr. Jalil Ursani.

The report benefited considerably from the valuable suggestions by Mr. D. J. Bandaragoda, Project Leader, Mr. Laurence Smith, Wye College University of London, Mr. Christopher J. Perry, Deputy Director General of IIMI in Srilanka, Dr. Yameen Memon, Team Leader and Mr. Mehmood ul Hassan. Thanks are also conveyed to Mr. Ashan Ali Kazi, Mr. Ayaz Anwar Solangi and Mr. Faisal Memon, Xcroxer, who extended their administrative support during the preparation of this report.

The author of this report expresses his deepest gratitude to Mr. Nadeem Khanzada of IIMI's Mirpurkhas Field Station, who extended his full cooperation and untimely support during the course of data collection.

FORWORD

The Water Users Federations are basically economic organizations. They are set up to take important management decisions regarding the operation and maintenance activities in large secondary canal systems. The office bearers of WUFs, as well as those who promote the establishment of WUFs, should be equally convinced that this serious business can be effectively accomplished by the WUFs. For this purpose, they should gain an understanding of the costs and benefits associated with the task of O&M at the secondary canal level.

This report is meant to serve that purpose partially. With the available information, Amin Sohani presents a financial feasibility analysis for the three pilot sites and raises a number of issues related to the assessment and collection of abiyana. Based on his preliminary findings further field work will be undertaken to finalize a Business Plan for each of the three pilot distributaries. I hope this report will be a good guide for us to proceed on our future work plans.

D.Jayatissa Bandaragoda,
Project Leader, Senior Management Specialist,
Pakistan National Program,
International Irrigation Management Institute

1. INTRODUCTION

1.1 BACKGROUND

Pakistan has a long history of irrigation. The country also has considerable experience in planning and implementing large irrigation development projects. The successful completion of these projects has made irrigated agriculture the country's engine of economic growth. However, both donor agencies, as well as government policy authorities in Pakistan, have recently started to feel some concern about the inadequate return on these investments. Both of these groups are actively considering some major institutional changes in the irrigated agriculture sector as an initial step towards achieving improvements in the sector's performance. Serious attention is being given to improving the productivity of irrigated agriculture by encouraging water users' involvement in jointly managing the irrigation systems.

With this policy and research background, the Government of Sindh (GoS) authorities decided to undertake some interventions in social organization at the distributary/minor^{*} level in a pilot project mode. For this purpose, the Left Bank Outfall Drain (LBOD) Project Management in consultation with the World Bank and Swiss Development Cooperation (SDC) entered into a consultancy agreement with the International Irrigation Management Institute (IIMI) to implement three pilot projects in which Water User Organizations (WUOs) would be established to operate and maintain (O&M) irrigation and drainage facilities in distributary/minor^{*} canal command areas.

The Department of Agriculture and Wildlife, therefore, prepared a Supplementary PC-I that was approved by the GoS in September 1994, which includes the implementation strategy for the pilot projects. Based on this PC-I document, IIMI prepared a project proposal, giving the technical details and the methodology for project activities, and a financial proposal for a consultancy arrangement (IIMI, 1995). IIMI's consultancy agreement with the Agriculture Engineering and Water Management Directorate of the Government of Sindh was signed on July 1995, and became retroactive to 1 July 1995 (Inception Report, 1995).

1.2 MAJOR OBJECTIVES

The major objectives of the pilot project are:

- a) To test the viability of farmers' managing parts of the irrigation systems, more specifically, at the level of distributary/minor canals, so that more efficient and equitable allocation of water can be achieved; and
- b) To make recommendations related to future extensions on the basis of results of the pilot projects.

More specifically, the pilot project has aimed, through its activities so far accomplished, to assist in establishing water users organizations in three selected distributary/minor canal command areas, one in each of the three LBOD districts: Mirpurkhas, Nawabshah and Sanghar. In each

^{*} In the Province of Sindh, a small distributary is often called a minor, whereas by common definition a channel off-taking from a distributary that conveys water to two or more watercourses is called a minor, which is also the case in Sindh.

pilot area, Water Users Associations (WUAs) were to be established at the watercourse level, which would then be integrated appropriately to form Water Users Federations (WUFs) at the distributary or minor canal level (In this report the WUAs and WUFs are referred to in the more general term of water users organizations or WUOs.)

Another specific objective was to promote the maximum involvement of the water users and their organizations in the operation and maintenance of distributary/minor canals, without much intervention from the government agencies, but with their institutional support, particularly in the early stages of the pilot projects. Later, the legislative requirements and institutional processes would be identified for effectively organizing and strengthening water users organizations on a wider scale (Phase II Report, 1997).

1.3 NEED FOR A BUSINESS PLAN

The viability of farmers' managing parts of the irrigation system can be viewed from three prospectives, that is technical, social and financial. These three prospectives are linked with one another and are mandatory to test the viability, and then later, the sustainability of WUOs.

1.3.1 Technical Viability

The objective of the Technical Viability is to test the farmers' ability to get involved in O&M of the secondary channel (distributary/minor). If the adequate, equitable and reliable distribution of water among the outlet (moghas) and O&M of the channels (according to set standards) is achieved by the WUOs, then it can be said that Technically the WUOs are viable and can be sustained.

1.3.2 Social Viability

The objective of Social Viability is to test the farmers' ability to organize and resolve all of the disputes regarding water distribution and related matters. It can also be said that social change is brought into the area by the forming of an organization, as well as by conducting development work in the area. The organization is socially viable if the community participation is encouraged in all decisions. Specific objectives of the Social Viability is to test the ability of WUOs to handle the O&M of the distributary/minor and to resolve water distribution disputes without external intervention.

1.3.3 Financial Viability

The objective of the Financial Viability is to test the WUOs ability to bear the O&M costs of the irrigation and drainage facilities. Financial viability can also be understood in the form of a formal framework or a Business Plan. The Business Plan will not only test the financial viability of the WUOs to pay for the O&M of irrigation and drainage facilities but it will also provide a formal business structure to the WUOs so that they can conduct their tasks in a professional manner. To test the financial viability and to develop a Business Plan, a Plan of Action (PoA) was developed by the author. Essential details of this PoA are enclosed in Annexure A.

1.4 PROCESS FOR DEVELOPING A BUSINESS PLAN

A complete overview of this PoA is depicted in Figure 1 (which is also contained in Annexure A). The PoA can be viewed in following six steps:

1.4.1 Step 1, Farm Income Analysis

To test the financial viability, it is important to find out the value of production that WUOs are gaining. The value of production will determine the WUOs capacity to pay for O&M costs of irrigation and drainage facilities.

1.4.2 Step 2, Analysis of O&M Costs

O&M cost data from agencies (Irrigation and Revenue departments) will help to identify the actual O&M cost incurred at the Divisional and distributory/minor levels. Also Irrigation Yard Sticks are used to identify the reasonable levels of O&M costs to attain the required efficiency in the irrigation system. Both of these costs are also incorporated into this step. Cost recovery (abiana and related charges) data are collected from the above agencies to identify the potential of recovered amounts to pay for O&M costs.

1.4.3 Step 3, WUOs Ability to Pay for O&M Costs

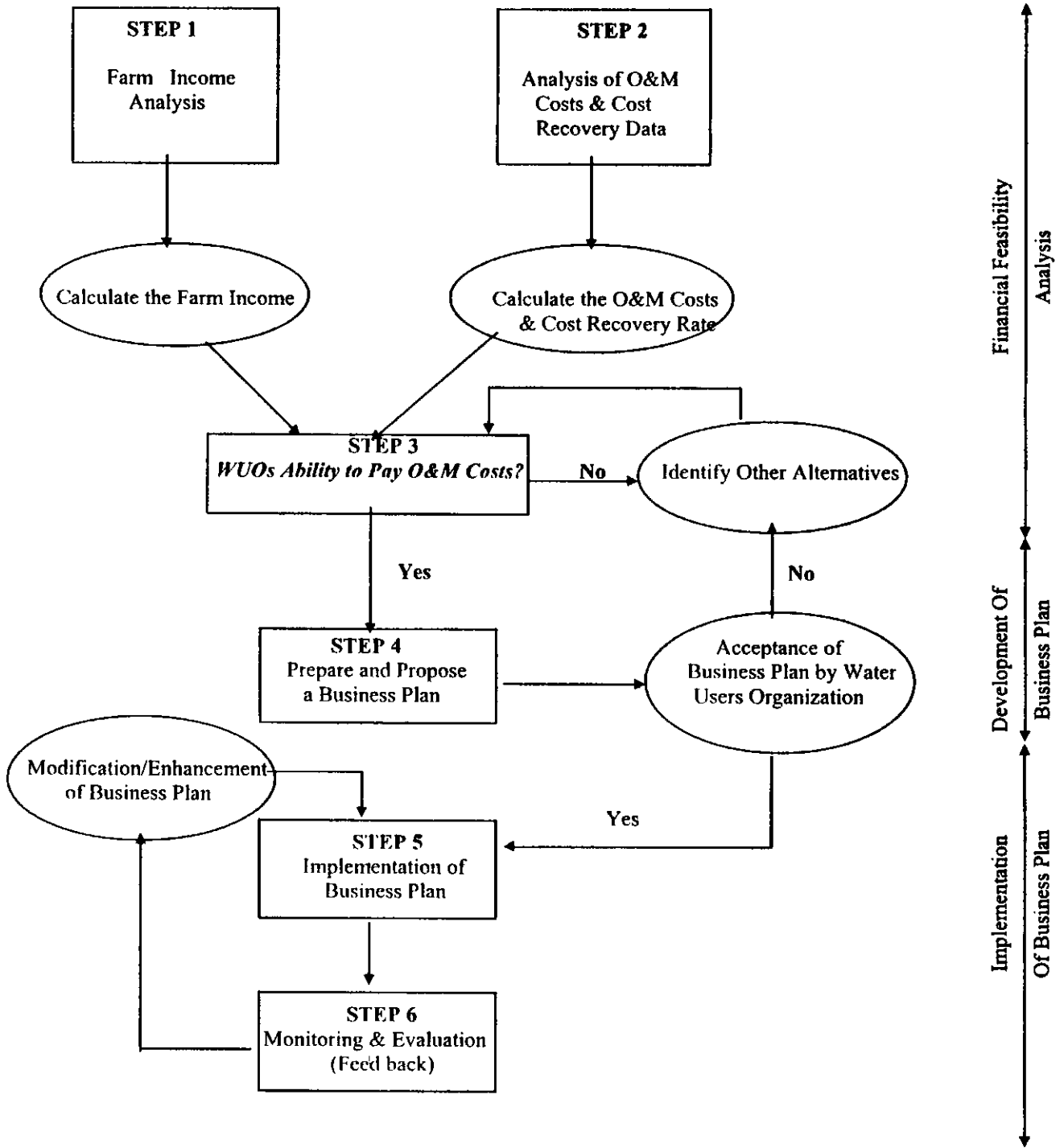
This step will consolidate steps 1 and 2. Based on historical data of O&M, cost recovery data, and farm income analysis, the WUOs' ability to pay for O&M costs will be tested. Estimates of O&M costs of LBOD drainage and reports by IIMI's short-term consultants will be incorporated into Step 3.

1.4.4 Steps 4, 5 and 6

Once Step 3 has been tested positively, that is WUOs are able to bear the O&M costs, a Business Plan will be prepared and then implemented (Step 5). During implementation, monitoring and evaluation will be conducted (Step 6). Step 6 will be repeated to accommodate any adjustments or enhancements that are observed during the implementation phase.

As indicated in Figure 1, Steps 1,2 and 3 constitute Phase I, which is the Financial Feasibility Analysis that is the subject of this Interim Report. Phase II consists of Step 4, which is the Development of Business Plan Phase. Finally, Steps 5 and 6 represent Phase III on Implementation of Business Plan.

Figure 1. Process for developing a Business Plan.



1.5 FINANCIAL FEASIBILITY ANALYSIS

At the time of writing this report, Phases I and II of the PoA (Annexure A) were accomplished. The end product for both of these phases is a report on Financial Feasibility Analysis. Therefore, the main objectives of this report are; (1) to document the results of Phase I and Phase II of PoA (or Steps 1-3 of Figure 1); and (2) to conduct the Financial Feasibility Analysis to test the financial viability of WUOs as discussed above.

2. FARM INCOME ANALYSIS

As shown in Figure 1, the first step in the Process of Developing a Business Plan is the Farm Income Analysis. This is also Step 1 (Figure 1) of three steps in the Financial Feasibility Analysis Phase.

2.1 OBJECTIVES

The objectives of this step is to document the findings of the financial data survey and through various diagrams summarize the procedure that was used to calculate the Farm Income for the WUOs at the three pilot sites. Data collection methodology, general characteristic of the sample, and the farm income findings, which included Kharif 96 and Rabi 95/96 farm costs, income and net annual farm income, are discussed under Step 1.

2.2 FINANCIAL CONCEPTS

The performance of an agriculture project can be measured with the help of three techniques (Gittinger 1992):

- a) Farm income analysis;
- b) Fund flow analysis; and
- c) Farm investment analysis.

Farm income analysis is generally used to evaluate the performance of a farm during a particular year. The objective is to help improve the management of the farm. Fund flow analysis, also called sources-and-uses-of funds analysis, is used to determine liquidity in an analysis of the farmer's credit situation. Farm investment analysis, in contrast, is undertaken to determine the attractiveness of a proposed investment for a farmer and to other participants, including the society as a whole (Gittinger 1992).

Table 1 in Annexure B summarizes the difference between the three techniques. Techniques of farm income analysis are applied here to generate the net farm income and to identify the cash position of a particular farmer.

2.2 DATA COLLECTION METHODOLOGY

According to Figure 1, Step 1 involves the collection of financial data from the water users (WUs) and this data is analyzed to calculate the farm income for the three pilot sites. In order to collect the financial data from the WUs, a questionnaire was developed. Exhibit 1 of Annexure B depicts the sample questionnaire that was used by the field teams to collect the financial data from the WUs.

2.3.1 Pre-Testing of the Questionnaire

For the pre-testing, sample interviews were conducted from selected WUs at the three pilot areas. At each pilot area, two sample interviews were conducted based on the initial format of the questionnaire. Each interview lasted for about 1.5-2 hours. During the sample interviews, it was noticed that of the WUs preferred to provide farm input costs on a per acre basis and per acre crop production on the basis of total production. Based on the outcome of the pre-testing, the questionnaire was modified to facilitate the financial data collection procedure. Before the final version of this Questionnaire was developed, the questionnaire was thoroughly reviewed by IIMI's field team, IIMI's team leader at Hyderabad and various experts at the Sindh Development Studies Center (SDSC).

2.3.2 Basic Features of the Questionnaire

The questionnaire was designed to collect a variety of informations.

- a) Basic data about the WUs, their land ownership (LOS) status and their land location with respect to the hydrological boundaries within the ditributary/minor, as well as at the watercourse level.
- b) Information collected in this questionnaire was based on the farmer re-call; therefore, efforts were made to collect the most recent data about the farm-input costs and crop production. Thus, it was decided to collect data for the Rabi 95/96 and Kharif 1996 seasons. Kharif 96 and Rabi 95/96 data included area sown, area destroyed, irrigation details, costs of various inputs, labor costs, and details regarding crop production.
- c) As mentioned earlier, the technique of Fund Flow Analysis determines the surplus (deficit) cash available to each farmer. Although the Farm Income Analysis is the main focus of Step1, data regarding Fund Flow Analysis is collected to conduct a comparative analysis if needed. Fund flow technique requires that the cash inflow from other sources (off-farm income) should be included with the farm revenue to check the liquidity of each farmer. In this regard, a section in the questionnaire was developed to capture income from other sources. This section included revenue (cash inflow) from sale of livestock, sale of livestock products, income from labor, remittances/govt. payments, and revenue from other sources (employment of other family members). Many respondents in the Mirpurkhas pilot area received govt. payments for the drainage systems, which are passing through their lands.
- d) Fund Flow Analysis also requires that non-farm cash outflow (non-farm expense) should be utilize to calculate the net cash available to each farmer. Thus, a section in

the questionnaire collected this information. Cash outflow included other farm equipment and power usage costs, livestock expenses (veterinary expense, hired labor), feed purchased for livestock, livestock purchased, equipment rent, utilities expenses for the year, farm related repairs, interest payments on the loans, capital purchased, family living and other expenses. (Both the cash inflow (off-farm income) and cash outflow (non-farm expense) were recorded on an annual basis).

- c) Estimation of O&M costs is an essential ingredient in Development of the Business Plan. A separate section in the questionnaire was designed to record O&M costs and activities conducted by the WUs who were interviewed. This section included information about the type of O&M activity conducted at the distributary and watercourse level, duration of the activity (hours and days), number of laborers utilized, total expenses, and O&M cost-sharing between the Hari (share tenant) and Zamindar.
- f) Collection of unofficial charges by the Irrigation Department and other agencies is common in the entire command area. Thus, the questionnaire was designed to collect this information regarding the amount paid by the WUs to the departments and the conditions on which this amount was paid. This data was recorded in the Tax Section (Misc. and other charges) of the questionnaire.

2.4 DATA COLLECTION ISSUES AND STRATEGY

For this questionnaire, respondents from all of the three pilot distributary sites were interviewed. Before the actual data collection took place the Financial Analyst had a meeting with selected members of IIMI's three field teams, as well as at IIMI's Hyderabad Office. The purpose of this meeting was to collectively identify the problems and issues that might be encountered during data collection, to design a strategy for efficient and accurate data collection, and discuss the changes that were made in the questionnaire after the testing.

The field teams observed that lately, on several occasions, WUs at the three pilot sites were asked by the field teams to provide various types of information related to them and their command areas. One such example was the data collection for the Baseline Survey, which was quite comprehensive. Thus, to fill out the financial data questionnaire, it was decided that the interviews would be conducted with those WUs who were not interviewed during the Baseline survey, or any other major survey.

One of the lessons learned from the Baseline Survey was that in all of the three pilot distributary areas, the main decision-makers regarding the cultivation of land and matters pertaining to water delivery were taken by the small owner-operator (self-cultivators) or by Zamindar (who share the crop out put with a Hari-share tenant, or by an individual who is leasing the land for cultivation on a cash basis, not by the tenants who are working on a temporary basis. Therefore, for this questionnaire, interviews were conducted with owner-operators, zamindars and individuals that were leasing the land. Also, as most of the data collected was quantitative and was provided on a recall basis, therefore, it was important to collect this information from the source where the actual decision was made.

One of the essential condition for the Development of a Business Plan for the WUOs is that the farm income of the WUs should adequately represent all of the reaches (head, middle and tail) of the distributary/minor. Therefore, to satisfy this condition, equal numbers of respondents were selected from the head, middle and tail reaches of the three pilot areas. Pre-testing of the questionnaire indicated that each interview (to fill out the questionnaire) takes about two hours; therefore, it was mutually decided by the IIMI field teams that two members from each field station should conduct the interviews with WUs. One member asked the questions from the WUs, while the other member recorded the information on the questionnaire.

2.4.1 Collection of Sensitive Information

The Questionnaire is in presented Exhibit 1 of Annexure B, which requested sensitive information from the WUs (such as amount for special charges, crop production and price at which it was sold, income from other sources). Therefore, the accuracy of such information is questionable. However, IIMI's field team expressed their confidence regarding this issue. IIMI's field teams believed that, since the beginning of the pilot projects, they have developed strong rapport with the WUs; therefore, they were confident that the WUs would extend their full cooperation during the financial data collection process.

2.4.2 Data Entry, Validation and Analysis

Once the data was recorded on the Questionnaire, it was entered into the computer by using MS Excel (MS Office). The data entry was quite a complicated task. Various units of cost (liters of pesticide, kg of seed per acre) and crops produced (kgs and maunds) were either not recorded or mixed with each other. Therefore, after data entry, data validation was conducted by the Financial Analyst. Each questionnaire had about 600 entries (cells); therefore, the entire procedure for data entry, validation and analysis required a lot of time.

2.4.3 Identity of Respondents

To protect the identity of the respondents, each respondent was assigned a serial number. Respondents at the Mirpurkhas command area are represented by serial numbers 101 to 124, respondents from Nawabshah are represented by serial numbers 201 to 226, respondents from Heran distributary near Sanghar were assigned serial numbers 301 to 327, while respondents from Khadwari Minor were assigned serial numbers 401 to 405.

2.5 GENERAL CHARACTERISTICS OF THE SAMPLE

Tables 2a, 2b and 2c in Annexure B depict the basic data that was collected using the questionnaire for the three pilot sites, while Table 2d shows the summary of the basic data. Exhibit 2 in Annexure B depicts the definition for all of the variables used in the various figures and tables in Annexure B. Important findings of the basic data (Table 2d) are discussed below.

2.6 FARM INCOME ANALYSIS

Tables 3 to 5 in Annexure B shows the per *acre* annual farm income for Bareji Distributary near Mirpurkhas, Dhoro Naro Minor near Nawabshah and Heran Distributary (and Khadwari Minor) near Sanghar, respectively, while Figures 2 to 5 in Annexure B demonstrates the procedures involved in these calculations. Definitions for all of the variables used in these tables and figures are given in Exhibit 2 in Annexure B before Tables 2a. Table 6 and 7 in Annexure B presents the consolidated Farm Income Analysis (from Tables 3-5) on a per *hectare* basis. Table 7 presents the consolidated Farm Income Analysis on actual data (total for the sample), while Table 6 presents the same on mean data. Important findings from Table 6 are given below:

- Mean annual per hectares (CCA) farm revenue for Bareji Distributary is Rs 18,536, Dhoro Naro Minor is Rs 5,757, and Heran Distributary is Rs 9,018, while the mean revenue for the three pilot distributaries is Rs 11,104;
- Mean annual per hectare (CCA) farm cost for Bareji Distributary is Rs 13,106, Dhoro Naro Minor is Rs 4,807, and Heran Distributary is Rs 6,405, while the mean costs for the three pilot sites is Rs 8,106; and
- Mean annual per hectare (CCA) net farm income for Bareji Distributary is Rs 5,430 Dhoro Naro Minor is Rs 950, and Heran Distributary is Rs 2,613, while the mean income for the three pilot distributaries is Rs 2,998.

2.7 MAIN FINDING

While the mean per CCA hectare of Net Farm Income in 1995/96 (one year) for the three pilot distributary sites is about Rs 3,000, or Rs. 3,000/ha/ year, this varies from Rs. 950/ha/year for Dhoro Naro Minor, to Rs. 2,600 for Heran Distributary (including Khadwari Minor) and is at a maximum of Rs. 5,400 for Bareji Distributary

3. ANALYSIS OF OPERATION AND MAINTENANCE COSTS

As portrayed in Figure 1, the second step in the Process of Developing a Business Plan is a companion of the first step. Step 2 is the Analysis of Operation and Maintenance (O&M) costs, which is required before proceeding to the final step (Step 3 in Figure 1) for completing the Financial Feasibility Analysis.

3.1 OBJECTIVES

The objective of this step is to analyze the O&M costs and cost recovery (abiana and related charges) collected from the water users by the agencies. The main outcome of this step will be the assessment of the actual O&M costs borne by the agencies, recovery of abiana (and related charges) and the estimation of required O&M costs for irrigation and drainage. The O&M data for drainage collected from the Irrigation Department was not sufficient to conduct a detailed analysis. However, efforts have been made to collect this data from other sources in order to conduct a basic analysis of O&M costs for drainage facilities.

3.2 DEFINITION OF OPERATION AND MAINTENANCE

One of the problems encountered while collecting O&M data from the agencies was with respect to having a clear definition of O&M. According to the data collected, most of the activities for O&M are inter-related. However, after thorough evaluation of the data collected from the agencies, it was observed that there are three main accounting entries that may represent the total O&M costs. These entries are listed under the categories of Maintenance and Repairs (M&R), Extension and Improvements (E&I), and Establishments.

Further study of these accounting categories indicated that activities for M&R and E&I are inter-related, therefore, for the purpose of this analysis, both M&R and E&I are discussed under a single head that is termed "Works" (or Maintenance). A study of operational costs indicated that almost all of the expenses related to the operations consisted of Establishments. Thus in this analysis, establishment costs are referred to as operational costs. Simply, these categories can be expressed as:

$$\mathbf{M\&R + E\&I + Estt = O\&M}$$

where **O&M represents only irrigation costs, not drainage and
Estt = Operation Costs**

So that M&R + E&I = Maintenance Costs

Exhibit 3 in Annexure C depicts the Form-64 Schedule of Works Expenditure that shows the typical activities of M&R. While the major activities that are conducted under E&I are:

- a) Reconditioning of Banks;
- b) Earth Work Maintenance of Banks;
- c) Re-handling of Spoils; and
- d) Re-sectioning of Soil.

A comparison of the above activities with M&R activities in Exhibit 3 of Annexure C reveals that almost all of the activities for E&I are also found under M&R.

3.3 INITIAL FINDINGS

The O&M data collection process focused on the O&M data for the pilot distributaries and their respective Division. As the O&M costs are allocated at the Division to its sub-systems (sub-divisions), it was necessary to collect data for both the Distributary and the parent Division.

3.3.1 O&M Cost for the Distributary/Minor

Bareji and Heran distributaries fall under the Jamrao and Thar Divisions of the Nara Canal system, while the Dhoro Naro minor falls under the Nustrat Division of the Rohri Canal system. The Executive Engineer offices for Jamrao and Thar divisions are located in the Mirpurkhas District while the Office of Executive Engineer of Nustrat Division is located in the Nawabshah District. During the data collection, it was observed that very little data was available for either the distributaries or the minors. Assistant Engineers (Sub-division officers, SDOs were contacted) at the respective pilot sites. Several meetings with the engineers revealed that very little O&M expenses were borne on the pilot distributaries. Even if some expenses were incurred on the O&M of the distributary, very little record was available. Table 8 in Annexure C depicts the statement showing the expenditures incurred on Bareji Distributary from 1985/86 to 1995/96. Table 8 shows separately the available M&R, E&I and Establishment expenses for Bareji Distributary, while Table 9 depicts the E&I expenses for all of the three pilot sites from 1985/86 to 1995/96. Important findings from Table 9 are:

- For a period of 11 years, the total amount incurred by the Irrigation Department on E&I is Rs 278,043 at Bareji Distributary, Rs 420,200 at Heran Distributary (and Khadwari Minor), and Rs 352,012 at Dhoro Naro Minor.

3.3.2 O&M Costs for the Divisions

Efforts were made to collect O&M data from all of the three divisions. However, sufficient data was available only on Jamrao Division. Considering the same organizational structure of the Irrigation Department, it can be assumed that an analysis of O&M data of Jamrao Division could be representative of the other two divisions. Exhibit 4 in Annexure C depicts the statement showing the staff category for Jamrao Division, including their Basic Pay Scale, while Exhibit 5 (Annexure C) shows the name of the sub-divisions under Jamrao Division, and Exhibit 6 (Annexure C) depicts the name for all of the distributaries that fall under Jamrao Division.

Table 10 in Annexure C depicts a statement showing the year-wise (85/86 to 95/96) expenditure under the Head of Establishment for Jamrao Division. The main findings from Table 10 are:

- Mean per year Establishment Cost is Rs 10,12,0648 and mean per CCA hectare Establishment Cost is Rs 28 per hectare.

Table 11 in Annexure C depicts extracts from the Annual Administrative Report of the Jamrao Division. This includes information about Capital, E&I and M&R expenses of Jamrao Division from 1983/84 to 1993/94. Important findings from Table 11 are:

- Mean per year E&I expense for Jamrao Division are Rs 1,818,128 and mean per CCA hectare E&I expenses are Rs 5.00 per hectare.
- Mean per year M&R expenses for Jamrao Division are Rs 9,282,303 and mean per CCA hectare M&R expenses are Rs 25 per hectare.

Initial findings from the O&M data analysis indicated the following outcomes at the divisional level:

- Mean Establishment charges are Rs 28/CCA ha;
- Mean E&I charges are Rs 5/CCA ha;
- Mean M&R charges are Rs 25/CCA ha; and
- Therefore, Mean Actual O&M (Estt + E&I + M&R) charges are Rs 58/ CCA ha

3.4 ANALYSIS OF O&M COSTS

The main objective of this analysis is to derive per CCA hectare O&M costs in 1996 prices at the divisional level. The above mean actual O&M costs are not adjusted to current prices. Therefore, all of the costs, that is Irrigation Works (E&I + M&R) and Establishment Costs, both for the Distributary and Division, are adjusted to 1996 prices. The Consumer Price Index (from 1996/97 economic survey of Pakistan) was used to adjust these prices. As the O&M data for Jamrao was available, to have more relevance, Bareji Distributary of Jamrao Division was selected for detailed analysis.

Table 12 in Annexure C depicts the Irrigation Works (E&I and M&R); actual as well as adjusted, expenses for both the Distributary and Division. The main findings from Table 12 are:

- Mean Irrigation Works expenses in 1996 prices are Rs 16 per CCA hectare at the Distributary level and Rs 32 / CCA hectare at the Division level.

Table 13 in Annexure C depicts the Irrigation Establishment Costs in 1996 prices for the Distributary, as well as for the Division. The main findings from Table 13 are:

- Mean Irrigation Establishment expenses in 1996 prices are Rs 30 per / CCA hectare at the Distributary level and Rs 48 / CCA hectare at the Division level.

3.4.1 Verification of Establishment Costs

In order to verify the Establishment Costs data collected from Jamrao Division, a cross-checking was done. All of the staff categories for Jamrao Division, their total numbers and their Basic Pay Scale (BPS) were obtained from Exhibit 4 in Annexure C to determine their annual salary. There was difficulty in determining the status (grade step) of particular staff at their BPS, therefore; the BPS for all of the staff categories was adjusted to their mid-BPS level to obtain their estimated salary. Table 14 in Annexure C depicts the estimation of Establishment Costs for the entire Jamrao Division in current prices. The results from Table 14 indicate that per CCA hectare Establishment costs for Jamrao Division are about Rs 51/CCA hectare. This estimation is quite close to the actual Establishment expenses of Rs 48 per CCA hectare calculated from the actual data.

Analysis of O&M data resulted in following outcome at the Divisional level:

- Mean Establishment charges in 1996 prices are Rs 48/CCA ha;
- Mean Irrigation Works (E&I and M&R) charges in 1996 prices are 32/CCA ha; and
- Therefore, mean actual O&M charges in current prices are Rs 80/ CCA ha.

3.4.2 Reasonable Requirements for Irrigation & Drainage O&M

The above O&M costs only reflect the actual cost which was borne by the Irrigation Department. However, this actual cost does not reflect the expenses that should be incurred to attain the minimum efficiency level in the irrigation system.

In 1986/87, a detailed Yard Stick for O&M costs was prepared by the Irrigation Department and submitted to the Government of Sindh. According to this Yard Stick in 1986/87, Rs 25.16 per CCA *acre* was required for Irrigation O&M Costs to attain a reasonable efficiency level in the system and Rs 38.03 were required for both Irrigation and Drainage O&M to attain the same level.

Although this Yard Stick is a good measurement for required O&M costs, it does not take into account the Establishment Cost which are a major fixed portion of the O&M costs. In order to calculate true O&M costs, the 86/87 Yard Stick and per acre actual establishment costs were added and adjusted for the current prices to attain the per CCA hectare required O&M costs. Table 15 in Annexure C shows the O&M costs based on the 86/87 Yard Stick and actual Establishment costs. The main findings from Table 15 are:

- 1995/96 Irrigation O&M Costs are Rs 198/CCA ha.
- 1995/96 Irrigation and Drainage O&M Costs are Rs 276/CCA ha.

3.5 ANALYSIS OF ABIANA AND RELATED CHARGES (COST RECOVERY)

So far, the actual and required O&M costs have been analyzed. This section will focus on the recovery and analysis of abiana and related charges. The objective of this section is to compare, contrast and analyze the revenue assessed and recovered as collected from the agencies and to estimate the per acre (and per hectare) total water charges (abiana and related charges) paid by the water users in the Bareji Distributary command area in Mirpurkhas District. Sufficient revenue data was available for Bareji Distributary; therefore, it was selected for revenue analysis. It is assumed that this revenue analysis will be representative for the other two pilot distributaries.

3.5.1 Deh Acres

According to the data collected from the Mukhtiarkar's Office of Mirpurkhas, the command area of Bareji Distributary is divided into 12 Dehs. The acres in some Dehs overlaps with the acres of neighboring command areas. A Deh is an administrative unit. A Deh is comprised of the entire geographical area including the buildings, roads, land etc. Table 16 in Annexure D depicts that

the entire geographical area (or GCA) is 18,217 acres. However, the GCA of Bareji Distributary, according to the Irrigation Department is 14,842 acres.

3.5.2 Revenue Assessed and Recovered

Table 17 in Annexure D shows of revenue data collected during eleven years for the Bareji distributary from the Mukhtiarkar's Office of Mirpurkhas. Total revenue in Table 17 is analyzed on the basis of abiana assessed and recovered and other revenue assessed and recovered. The "other" revenue portion of the total revenue is comprised of land revenue, local cess, water management charges, Usher, etc. Important findings from Table 17 are listed below:

- The mean acres cultivated in a year (out of 18,217) is 9094 (or 50%).
- Mean abiana assessed in a year is Rs 282,756, while the recovered abiana is Rs. 218,327, with a mean recovery rate of 75%. Similarly, mean per acre abiana assessed based for a year on area cultivated is Rs. 31 and recovered per acre is Rs 24.
- Mean other revenue assessed for a year is Rs 120,693 and recovered is 99,145, with recovery rate of 84%.
- Mean total (abiana + other) revenue assessed for a years is Rs 403,449, while recovered is 317,472, with a recovery rate of 77%. Similarly, mean per acre total revenue assessed in a year is Rs 44.66 and recovered is 34.43.

Based on Table 17, it may be inferred that, on average, abiana recovered is approximately 68 % of the total revenue recovered. Mean per acre abiana assessed and recovered is low for Bareji Distributary. There may be various reasons for low assessment and recovery of Abiana. One obvious reason could be the under-reporting of assessed abiana by the Revenue Department so that the revenue collectors can collect their unofficial abiana-related charges from the WUs (water users). On various occasions, (last JRM visit to Bareji) when interviewing WUs, it was explored that often the Revenue Collector does not issue a revenue receipt to the WUs, or the receipt issued by them does not reflect the actual amount paid by the WUs.

Another reason for under-reporting of abiana assessed would be to facilitate the abiana recovery process. During revenue data collection, one Mukhtiarkar said that they would like to recover 100% abiana. Low abiana recovery could go against their reputation and, hence, may not allow them to be transferred to their desired district (where higher unofficial abiana-related charges can be collected). In most cases, revenue is first recovered and than assessed. For instance, when the revenue data was collected for Heran Distributary of Sanghar District, there were no assessment figures available. According to the Revenue Department, the revenue assessed is equal to the revenue recovered. Data from Sanghar District will be discussed later in this section.

3.5.3 Revenue Data from Irrigation Department

In order to cross check the abiana data collected for Bareji Distributary from the Revenue Department, data from the Assistant Executive Engineer, Assessment Sub-Division, and Mirpurkhas was collected. Abiana assessed and cultivation figures for three years (1993-1995) for Bareji Distributary were obtained from the above office. Table 18 in Annexure D displays the crop-wise cultivation (acres) for the Bareji Distributary command area and abiana assessed

for both of the seasons during three years. Total abiana recovered (Revenue Dept. Records) from 1993-1995 in Table 17 of Annex D does not match with the total Abiana assessed from 1993-1995 in Table 18 (Irrigation dept. Records). This miss-match in total could be because of the inclusion of revenue from overlapped area that is reported by the revenue department while the Irrigation assessment may not have accounted for this overlapped area for the Bareji Distributary. However, per acre abiana assessed in Table 17 (Revenue) and Table 18 (Irrigation) should be the same.

The goal in analyzing Tables 17 and 18 is to identify the per acre abiana assessed and recovered so that some kind of conclusion can be drawn regarding the accuracy for the per acre abiana assessed and recovered. The main conclusion drawn from Table 18 (Irrigation Dept.) as compared with Table 17 (Revenue Dept.) is:

- Per acre abiana assessed for the years 1993, 1994 and 1995 in Table 17 (Revenue) is Rs 30, 37 and 39, respectively, with an average of Rs 35 while the abiana assessed in Table 18 (Irrigation) is Rs 38, 46 and 56, respectively, with an average of Rs 47.

An important observation is that the per acre abiana assessed in Table 18 (Irrigation Dept.) is 34 % higher than abiana recovered in Table 17 (Revenue Dept.). The abiana assessed in Table 18 seems more reliable than those in Table 17. To confirm this fact, the following analysis was conducted.

Exhibit A. Area cultivated and abiana recovered taken from Tables 17 and 18.

Agency	GCA	Area cult. 93-94	Percent cult. 93-94	Abiana Assessed/acre 93-94	Area cult. 94-95	% cult 94-95	Abiana assessed/acre 94-95	Area cult 95-96	% Cult 95-96	Abiana assessed/acre 95-96	%Avg. acre cult 3yr	Avg. Abiana Rec./acre 3yr
Revenue	18,216	8462	46%	36	8781	48%	37	10766	59%	39	51%	35
Irrigation	14,842	7642	51%	37.92	6295	42%	45.25	8140	55%	55.27	50%	46

According to the Revenue Department, the GCA of Bareji Distributary is 18,216, which includes the overlapped area, while the GCA according to the Irrigation Department is 14,842 acres, which does not include the overlapped area. It can be inferred from Exhibit A. that, if the abiana rates are the same and if the mean cultivation percentage (for 3 years) is the same for the Revenue and Irrigation Departments, then the mean per acre abiana assessed should also be the same. This can be understood from the following example:

Assume that the year is 1997.

Year is 1997

R= Revenue Dept., GCA of R= 1000 acres

I= Irrigation Dept., GCA of I=700 acres

The Abiana rate set by GoS is Rs 25/acre (average for all crops) for the year.

The cropping pattern is also the same since both R & I departments are evaluating abiana for Bareji Distributary.

If R cultivates 50% of the acres for the three years, then the acres cultivated should be $1000 \times .5 = 500$.

Abiana for the Year = $500 \times 25 = \text{Rs } 12,500$.

Per acre abiana assessed would be $\text{Total Abiana/Acre cultivated} = 12500/500 = \text{Rs } 25/\text{acre}$

If I cultivates 50% of the acres for the three years, then the acres cultivated should be $700 \times .5 = 350$.

Abiana for the year = $350 \times 25 = \text{Rs } 8750$.

Per acre abiana assessed would be $\text{Total Abiana/Acres cultivated} = 8750/350 = \text{Rs } 25/\text{acre}$.

From the above calculations, it is clear that the abiana assessed should be the same for both the Revenue and Irrigation Departments, while Exhibit A does not confirm this fact. Average (3 yrs) abiana assessed by the Revenue Dept. is 34 % lower than that of the Irrigation Department. An obvious reason for this difference could be the under-reporting of abiana by the Revenue Department. However, to further verify the per acre abiana assessed in Table 18, the following analysis was conducted.

3.5.4 Abiana Assessment Using GoS Crop Rates

Acres cultivated for various crops for three years in the Bareji Distributary command area were taken from Table 18 and were multiplied by the abiana rates for each crop provided by the GoS Revenue Department. Table 19 in Annexure D depicts the assessed abiana for the three years. Interestingly, per acre abiana assessed in Table 19 is almost equal to abiana assessed in Table 18. Table 20 in Annexure D presents the summary of Table 18 and Table 19. Important results from this Table 20 are given below.

- Per acre abiana assessed (Table 18) for three years (1993-1996) is Rs 37.92, 45.25 and 55.27, respectively, with the average for three years being 46, while abiana assessed (Table 19) for three years is Rs 37.92, 45.11, 55.08, respectively, with an average for three years also being 46.

- The mean per acre rate of abiana for all of the crops for three years (93-96) is Rs 49.91, 57.40 and 71.77, respectively, and the average rate for three years is Rs 60.

An important observation is that the mean per acre rate of Abiana for all of the crops for three years is Rs 60. According to Table 17, abiana recovery rate for the last 11 years is 75%. Thus, 75% of the mean abiana rate (Rs 60/acr) is Rs 45. This means that according to the Revenue Department records, the mean (93-96) per acre abiana recovered in a year should be Rs 45, while the mean actual recovered abiana in Table 17 is Rs 33 per acre.

So far, the detailed analysis of Tables 17, 18, 19 and 20 strongly suggests that the per acre abiana assessed for three year is between Rs 45 and Rs 46. To further support the results of Tables 17,18,19 and 20, the analysis reported in the next section was conducted.

3.5.5 Verification of Revenue Assessed and Recovered

Table 21 (two pages) in Annexure D presents the revenue recovered by the Mukhtiarkar Office at Sangher. As discussed above, at this office the revenue assessed data is not available. According to the Mukhtiarkar, revenue recovered is equal to revenue assessed. Analysis of Sanghar revenue data is not conducted in detail. The analysis of Heran Distributary is only conducted to support per acre abiana recovered and analyzed from Tables 17, 18, 19, and 20. Some important findings from Table 21 are listed below.

- Mean per acre abiana assessed (or recovered) for nine years at Heran Distributary is Rs 4.53 (see pg. 2 of Table 21).
- Abiana recovered at Heran Distributary is 63% of the total revenue recovered, while at Bareji the recovered abiana was 68% of the total revenue recovered.

Results from Tables 17-21 and other analyses indicate that the mean per acre abiana assessed at Bareji Distributary for three years was Rs 45. A study of Tables 17-21 and its thorough analysis can be viewed as described below.

Mean (93-96) per acre abiana assessed by Irrigation department	= Rs 46 (Table 18)
Mean (93-96) per acre abiana assessed through GoS crop rates	= Rs 46 (Table 19)
Mean (93-96) per acre abiana assessed (or recovered) by Sanghar Revenue Dept.	= Rs 44.53 (Table 21)
Average abiana assessed from Tables 18, 19 and 21	<hr/> = Rs 45.51
Mean (93-96) per acre abiana assessed by Revenue Dept. at Bareji	= Rs 35.00 (Table 17)
Difference in assessment	<hr/> = Rs 10.51
Mean (93-96) per acre abiana recovered (Revenue) in Bareji	Rs. 32.65.
Difference between Average Abiana assessed from Tables 18, 19 and 21 and Abiana recovered by Revenue dept. At Bareji	<hr/> Rs 45.51- 32.65 = Rs 12.86

Thus, from the above discussion it can be inferred that:

- Abiana assessed by the Revenue Department at Bareji is 30% lower than that of other sources (Tables 18,19 and 21);
- *Abiana recovered by the Revenue Department at Bareji is 39% lower than assessed by other sources (Tables 18,19 and 21); and
- The difference between average assessed abiana (Rs 45.51) and recovered abiana (Rs 32.65) is Rs 10.51. This difference could be treated as related charges collected by the staff of the Revenue Department.

**(This result almost complies with the study conducted by Associated Consulting Engineers (ACE) under the LBOD Stage I project).*

3.5.6 Other Water-related Charges

These are the unofficial charges paid by the WUs to the Irrigation staff to buy extra water for their farms. The mechanism and collection of these charges were reported in IIMI's April 97 Monthly Progress Report. Also, when the Financial Survey of WUs was conducted, at that time the data on water-related charges were collected. Table 22 in Annexure D depicts the extract from this Survey for Bareji Distributary. Table 22 indicates that for this sample size, the total water-related charges paid by the WUs are Rs 69,165 for the year. For this Survey, 24 WUs were interviewed from various watercourses of the Bareji Distributary. According to Table 22, per acre water-related charges paid by WUs to the Irrigation staff is Rs 53.80 acre for the year.

As mentioned above, another study about water-related charges was conducted by the IIMI staff and its results were documented in IIMI's April 97 MPR. According to this study, WUs pay between Rs 20,000 to 40,000 per watercourse (WC) per year as water-related charges.

The CCA for Bareji Distributary is 14,300 acres (IIMI Phase II Report) and actual annual cropping intensity (CI) of Bareji is 62% (IIMI Phase II Report); thus, the area cultivated would be 8866 acres for the year.

If the water-related charges are Rs 20,000 per WC, then the total water related charges for Bareji would be $24 \text{ WCs} \times 20,000 = \text{Rs } 480,000$.

Therefore, per acre water-related charges based on area cultivated would be $480,000/8866 = \text{Rs } 54.1$

Thus, the above two independent analyses suggest that the per acre water-related charges paid by the WUs at Bareji distributary is Rs 54 per acre.

From the above analysis and discussion, it can be concluded that the total per year water charges (including abiana and related charges) paid by the WUs at Bareji are:

Mean official per acre abiana paid	Rs 32.65
Mean per acre related charges paid to Revenue Department	Rs 10.51
Mean per acre water-related charges paid to Irrigation Department	Rs 54.00
	<hr/>
Mean total water charges per cropped acre	Rs 97.16 /acre
Mean total water charges per CCA acre	Rs.60/CCAcree
Mean total water charges per CCA hectare	Rs.150/CCA ha
If water-related charges per WC is	Rs. 40,000
Then,	
Mean total water charges per CCA hectare	Rs. 230/CCA ha

Thus, it is safe to assume that, on average for three years (93-96), the minimum per year total water charges paid by the WUs at Bareji is Rs 60/CCA acre or Rs 150 /CCA ha.

3.6 MAIN FINDINGS OF STEP 2

- Actual irrigation O&M Costs in 1995/96 borne by the Irrigation Department was Rs 80 / CCA hectares/year
- Reasonable requirements for irrigation O&M costs in 1995/96 that were Rs 198/CCA ha/year.
- Reasonable requirements in 1995/96 for Irrigation and Drainage O&M costs were Rs 276/CCA ha/year.
- Mean total water charge (abiana and water-related charges) is at least Rs 150 /CCA ha/year and could be as much as Rs. 230/CCA ha/year.

4. ABILITY OF WATER USERS ORGANIZATIONS TO PAY

4.1 OBJECTIVES

The objectives of this step (Step 3) are to consolidate the findings of Step 1 and Step 2 and to evaluate the ability of the WUs to pay for the O&M costs for irrigation and drainage infrastructure. This step will also summarize the reports of IIMI's short-term consultants who had analyzed the ability of the WUs to pay for these O&M costs. LBOD O&M costs are also summarized in this step.

4.2 CURRENT SITUATION

The main findings from Step 2 revealed that currently the Irrigation Department is spending about Rs 80/ CCA hectare on irrigation O&M, while the recovery against this O&M is only Rs 33 /CCA ha. This shows that the recovery rate is only 40%. This, in fact, demonstrates the failure to address the needs of the system, both for client farmers and the general welfare of the nation.

However, the main questions that need to be addressed here is the utilization of this actual amount (Rs 80/ CCA ha) incurred by the Irrigation Department and how it is benefiting the WUs. Analysis of actual per CCA hectare Irrigation O&M expenses reveal that of the total O&M expenses, Rs 48 are accounted against for Establishment and Rs 32 for the Irrigation Works. This means that 60% of the actual O&M expenses are fixed costs (Establishments) and 40% is for variable costs.

The Financial Feasibility Analysis (Figure 1) consists of three steps. The final step is an evaluation of the water users organizations (WUOs) ability to pay the operation and maintenance costs for the irrigation and drainage facilities.

4.3 BENCH MARKS FOR IRRIGATION AND DRAINAGE O&M COSTS

An Irrigation Yardstick was used to identify the minimum level of O&M costs required maintaining the efficiency in the Irrigation system. Table 23 in Annexure E depicts a Consolidated Statement of Reasonable Requirements for Operation and Maintenance of Irrigation Infrastructure. According to this statement in 1986/87, reasonable requirements for Irrigation O&M was Rs 25.16/ Acre of CCA and for Irrigation and Drainage O&M was Rs 38.03 /Acre of CCA These figures were translated in 1995/96 prices and Bench Mark figures for both the Irrigation and Drainage O&M costs. The main findings of Step 2 depicts that reasonable requirements for O&M of Irrigation in 1995/96 prices is Rs 198/ CCA hectare, while requirements for both Irrigation and Drainage O&M is Rs 276 / CCA hectare.

4.4 COSTS RECOVERY AND O&M BENCH MARKS

However, the recovery against these O&M Bench Mark figures is very low. The official recovery is only Rs 32/ acre, which is only quite low when compared with the Bench Marks. However, the total cost recovery figures indicate that water users are paying a minimum of Rs. 150/CCA cropped hectare, while the maximum amount is about Rs. 230/CCA hectare. This amount

includes official recovery as well as related charges. Thus, if the total recovered cost (official as well as related charges) is considered and then compare with the Bench Marks, the following inferences can be made:

- The total amount recovered (between Rs 150/CCA hectare and Rs. 230/CCA hectare) is 76-116 percent of the Irrigation O&M Bench Mark (Rs 198/CCA hectare)
- The total amount recovered (between Rs 150/CCA hectare and Rs. 230/CCA hectare) is 54-83 percent of the Irrigation and Drainage O&M Bench Mark (Rs 276/CCA hectare).

4.5 WUS ABILITY TO PAY THE IRRIGATION O&M DIFFERENCE

The above facts indicate that in order to pay for the reasonably required Irrigation O&M, the WUs are either short by Rs 48/CCA hectare, or have an excess of Rs. 32/CCA hectare. The current total cost recovered is roughly 5-8 percent of the mean net farm income of Rs 3000/CCA hectare. The reasonable level of Irrigation O&M would be 6.6% (198/3000). Thus, the WUs are presently paying the required costs for an effective program of Irrigation O&M.

The real question is whether the funds presently being paid by the WUs can be applied to Irrigation O&M. If so; this would have a significant impact on the WUs net value of production. For example, if the Adequacy, Reliability and Equity (ARE) of the water delivered to the WUs is improved, and then very large increases in crop yields will follow. This issue can be addressed by the WUOs. The efficient functioning of the WUOs and its sustainability will ensure the ARE of water. It can also be assumed here that once ARE is achieved, there will be a very positive impact on the net value of the agricultural production. Thus, it is safe to assume that collectively the WUOs should be able to bear the full costs of Irrigation O&M costs. However, the difference between Bench Mark O&M costs of Irrigation and Drainage is quite high and is also a point of concern for the agencies as well as the WUOs.

4.6 WUS ABILITY TO PAY THE IRRIGATION & DRAINAGE O&M DIFFERENCE

In order to pay for the reasonably required costs for Irrigation and Drainage O&M, the WUs are either short by Rs 126/CCA hectare (Rs 276 - 150), or Rs. 46/CCA hectare (276-230). The current total cost recovered is 5-8 percent of the mean net farm income of Rs 3000/CCA hectare. The reasonably required level of Irrigation and Drainage O&M is 9% (276/3000) of the net farm income. Clearly, an increase of 1-4 percent in total water charges will be accepted by the WUs if they perceive significant increases in crop yields. During the course of data collection from the pilot sites and interviews/meetings with WUs, it was observed that WUOs know very little about Drainage O&M. Also, they know that the capital costs for drainage is quite high; therefore, O&M costs for drainage is also high.

4.7 O&M COSTS OF DRAINAGE IN LBOD AREA

Table 24 in Annexure E depicts 1984 LBOD-Stage I project estimated annual recurrent O&M costs for its sub-areas and overall Stage I project. Table 24 shows that the O&M costs are composed of personnel costs, power costs, other maintenance costs, and capital replacement costs. The main findings from Table 24 are:

- Total 1984 O&M costs of Drainage in LBOD Stage-I was Rs. 343.7 million , of which 8.5% of this amount was for personnel costs, 32% was for power costs, 38% was for other maintenance costs, and 20% was the Capital replacement cost; and
- O&M costs for drainage in LBOD Stage-I area was Rs 666/CCA hectare.

According to recent estimates of Mott MacDonald (LBOD consultants), the O&M costs for LBOD Stage I is about Rs 570 million per year. If the CCA of LBOD Stage I is 500,000 hectares, then the O&M costs for drainage is about Rs 1200 per hectare per year.

These figures prove that once the O&M of Drainage are added to the Irrigation O&M, the total cost of O&M becomes quite high. Similar results were derived by the IIMI's short term consultants who visited the pilot sites and documented their results.

4.8 FINDINGS OF IIMI'S CONSULTANTS

IIMI engaged the services of two short-term consultants who conducted their studies at the pilot sites focusing on the analysis of O&M costs and WUs ability to pay the costs. Exhibit 7 in Annexure E depicts the consultancy report of Mr. Christopher Perry, Deputy Director General of IIMI and Exhibit 8 in Annexure E is the consultancy report of Mr. Laurnce Smith, Lecturer at Wye College, London.

Mr. L. Smith conducted his consultancy during December 1996. He conducted his study at the Heran Distributary (and Khadwari Minor) and developed a Cash Flow (CF) model (Exhibit 8) to identify current and future O&M costs of Irrigation and Drainage. The principal observations from the Cash Flow (CF) model are:

- Estimates of CFs indicate that it should be financially feasible for the WUOs to assume responsibility for the irrigation O&M activities envisaged; and
- Once the drainage costs are included, the net CF per season turns negative in Year 5; the deficit however is manageable and given the number of WUs on the distributary, drainage O&M contributions could be increased to cover the cost.

Mr. C. Perry conducted a study of pilot sites in July 1997. The main findings of Mr. Perry's report are:

- The current Irrigation O&M costs below the distributary head regulator is Rs 46 per CCA hectare, while above the distributary the costs are Rs 34 per CCA hectares;
- Estimated required Irrigation O&M expenditure below the distributary head regulator is Rs 106 per CCA hectare, while above the distributary head regulator the costs are Rs 94 per CCA hectares; and
- Estimated full O&M of Irrigation and Drainage infrastructure is between Rs 1200 - 2000 per CCA hectares

5. CONCLUSIONS

From the above detail it is quite clear that, at this point, financially it will be feasible for the WUOs to bear the O&M costs of Irrigation. However, various facts, figures and analysis reveal that the full costs for Irrigation and Drainage O&M are high.

6. RECOMENDATIONS

The most immediate need is to clarify the O&M costs for various drainage technologies available in the three pilot distributaries. At this time, the estimated O&M drainage costs prepared by the LBOD consultants will be used to refine the Financial Feasibility Analysis reported herein. This will allow initial Business Plans to be prepared.

An evaluation of irrigation and drainage facilities is underway at the three pilot sites. An initial evaluation of the surface water hydrology and groundwater hydrology will be completed in late 1997. For the Dhoro Minor command area, including field evaluations of tubewell drainage facilities and surface drains. Similar work will be completed during 1998 for the other two pilot distributaries. This will provide the necessary information for preparing a Proposed Business Plan as shown in Figure 1 for each Water Users Federation.

REFERENCES

Bandaragoda, D. J. 1995. "Inception Report and Implementation Plan" Inception Report on Pilot Project for Farmer-Managed Irrigated Agriculture Under the Left Bank Outfall Drain Stage I Project, Pakistan. Report P-1 Pakistan National Program, International Irrigation Management Institute.

Bandaragoda, D.J and Memon, Yameen 1995. "Moving Towards Participatory Irrigation Management". Phase II Report on the Project for Farmer-Managed Irrigated Agriculture Under the Left Bank Outfall Drain Stage I Project, Pakistan. Report R-26, Pakistan National Program, International Irrigation Management Institute.

Gittinger, J. Price. 1992. " Economic Analysis of Agricultural Projects" The Johns Hopkins University Press: Baltimore.

IPD. 1993. "Operation and Maintenance Manual, Volumes I&II", Irrigation and Power Department, Government of Sindh.

IPD. 1988. "Operation & Maintenance Yard-Sticks For Irrigation Infra-Structure In Sindh", Irrigation and Power Department, Government of Sindh.

ANNEXURE A

**PLAN OF ACTION
FOR DEVELOPING
A BUSINESS PLAN**

Plan of Action Prepared by Financial Analyst

Introduction

The plan of Action (POA) highlights the initial investigation to be undertaken by the Financial Analyst of IIMI regarding the Financial Management and Operations (FM&Os) of the Water Users Organizations (WUOs). It will also outline a plan for formulating the strategies to develop and execute the Business Plan for the WUOs.

Plan of Action (PoA)

The PoA is divided into four phases: Initial Investigation; Feasibility Analysis; Formation of Business Plan and the implementation of the Business Plan.

Phase One

Initial Investigation Report

The main focus of Phase One is to collect the financial data and facts related to the management activities of water users and the Irrigation Department. To precisely define the activities of Phase One, the following questions have been developed. These questions will provide qualitative and quantitative answers that will help determine the logical sequence of the activities in Phase One and will lead Phase Two.

General

- What are the major objectives of IIMI?
- What is the purpose and role of WUOs?
- At each command area under the pilot projects, what is the condition of water distribution at the distributary/minor and watercourse levels?
- Identify the O&M problems and other management problems at the distributary/minor and watercourse levels?
- Evaluate and quantify the production losses and other economic and financial losses due to these problems?
- Are there any actual WUAs at the watercourse level?
- What is the structure of these WUAs?
- What are the strengths and weaknesses of WUAs?
- What are the FM&O procedures of these WUAs?

Irrigation Dept.

- How is the Irrigation Department managing the water distribution at the distributary/minor level?

- What are the various activities conducted by the Irrigation Dept. as far as O&M and the management of distributaries/minors are concerned?
- What are various costs associated with these activities?
- What is the formal cost structure for O&M at the Irrigation Dept.?
- How is the budget allocated by the Irrigation Dept. for O&M and the management of distributaries/minors?
- In the Irrigation Dept., who is responsible for the management at the distributaries/minors level?

Water Users

- What are the various inputs required by the farmers for the effective & efficient production of crops?
- What are the various costs associated with these inputs?
- Who is the decision-maker as far as costs of inputs are concerned?
- What is the income of water users related to their operational costs?
- Water being one input for crop production, how much does it cost?

These are very basic questions, and answers to some of these questions may be redundant. Some of the questions can be addressed by evaluating the outcome of the baseline survey. However, there may be other questions that need to be answered by contacting the right individual or agency. The outcome of Phase One will be an Initial Investigation Report that will respond to the above questions and other issues that may arise during the fieldwork.

Phase Two

Feasibility Analysis

In this phase, the facts and data that are collected from Phase One will be used to conduct a feasibility analysis for FM&Os of the WUOs. Following are the main questions that will help to define the activities for Phase Two:

Cost Analysis

- How much it will cost each water user to conduct the O&M and the management of the distributary/minor?
- Can the water users afford this cost?
- Will the overall production cost be affected?
- What will be the group cost to maintain the O&M and the management of the distributary/minor?
- What will be the return on this cost to each individual water users?
- Whether the return would be value-added or simply monetary?
- How should the cost of O&M and the management of the distributary/minor be allocated?
-

- What is the estimated cost of water to each individual water user before and after the formation of WUOs?

Irrigation Dept. & WUOs

- What should be the structure of the WUOs?
- What will be the nature of responsibilities for each member of the WUOs?
- What will be the role of the Irrigation Dept.?
- What will be their financial, technical and economic contribution towards the WUOs?
- What will be the overall effect of WUOs on the Irrigation Dept.?
- What will be the strength of WUOs?
- What will be the weaknesses of WUOs?
- What are the opportunities that will arise from the formation of WUOs?
- What are the threats that need to be addressed by the WUOs?
- How can the WUOs be sustained?

Phase Three and Four

Formulation and Implementation of the Business Plan:

The analysis of Phase Two will be documented and used in Phases Three and Four to formulate the Business Plan and outline its Implementation. Phase Three and Four will overlap each other because there will be several modifications and enhancements in the Business Plan. Result of the feasibility analysis will be shared with various individuals, groups, teams and agencies so that the input from all of the parties concerned with the WUOs can be obtained to form a Business Plan. A team effort will be required to identify the proper mechanism for the Implementation of the Business Plan and training for the members of WUOs.

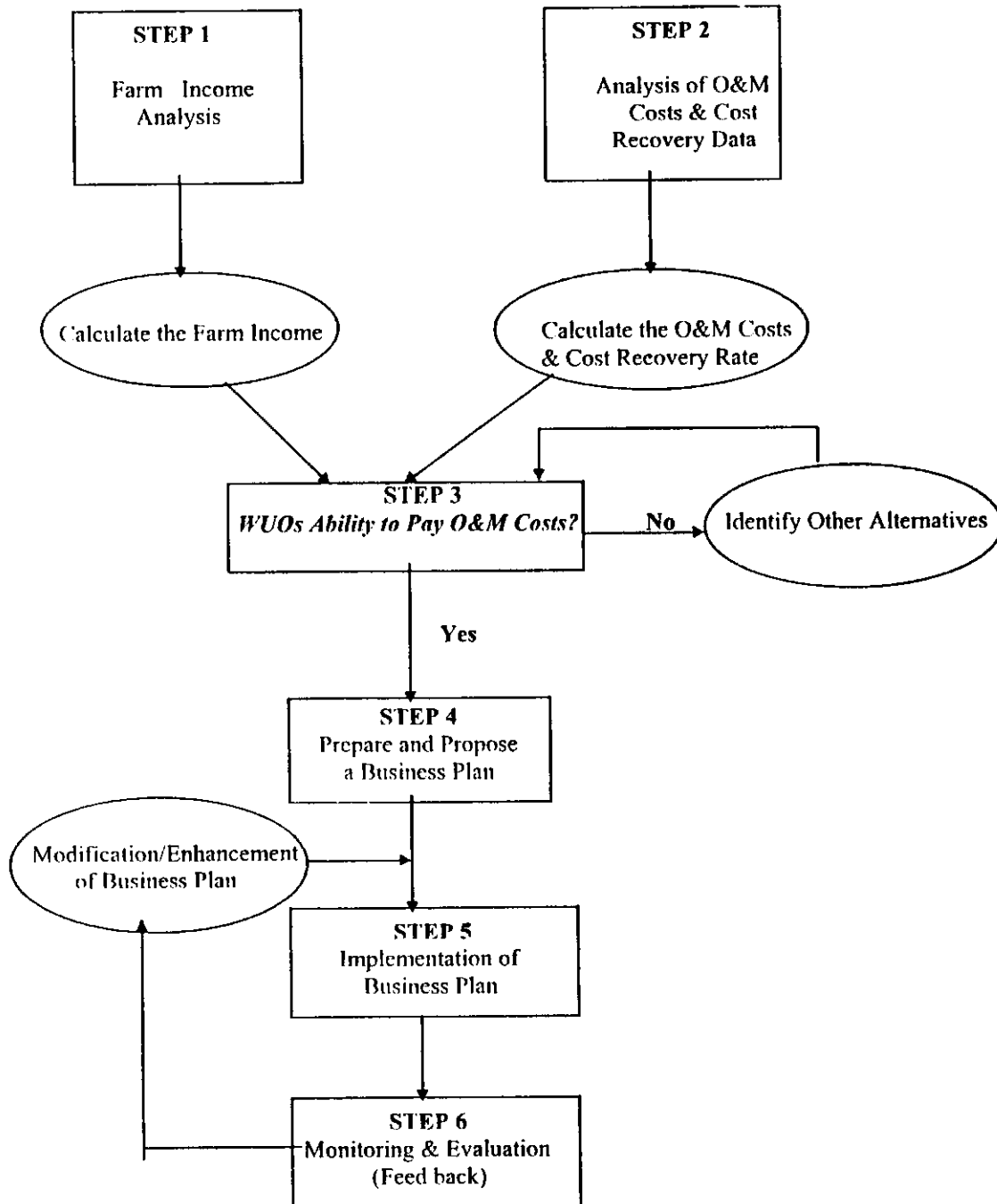
The basic financial and accounting principles, software programs and the modern financial management & operations methods will be used to formulate the Business Plan in Phase Three. A FM&Os manual will be developed that will describe the procedures for the financial management of the WUOs. Thus, the feasibility analysis of Phase Two and the finance, accounting and management concepts will primarily drive the activities of phases Three and Four.

Planned output

Following is a tentative list of the outputs that is expected to be compiled during and after the execution of the PoA:

- a) Initial Investigation report;
- b) Feasibility Analysis Report;
- c) Business Plan;
- d) Financial Management and Operations Manual; and
- e) Implementation Plan.

Figure 1. Process for developing a Business Plan.



ANNEXURE B

SUPPORTING INFORMATION FOR FARM INCOME ANALYSIS

Table 1. Differences between Farm Income Analysis, Funds Flow Analysis, and Farm Investment Analysis

Item	Farm income analysis	Funds flow analysis	Farm investment analysis
General objective	Check current performance of farm	Check farmer's liquidity	Check attractiveness of additional investment
Period usually analyzed	Individual years	Loan repayment period	Useful life of investment
Prices used	Current prices	Current prices	Constant prices
Treatment of capital	Annual depreciation charge	Cash purchases and sales	Initial investment, residual value
Off-farm income	Excluded	Cash portion included	Cash and non cash included
Home-consumed farm production	Included	Excluded	Included
Performance criteria	Return to capital and labor engaged on farm	Cash available to farm family	Return to additional resources engaged
Time value	Undiscounted	Undiscounted	Discounted
Performance indicators	Profit as a percentage of net worth, family income	Cash surplus or deficit	Net present worth, internal rate of return, benefit-cost ratio, net benefit-investment ratio, net benefit increase

Source: Schaefer-Dehnert (1980)

Exhibit 1. Sample Questionnaire

Financial Data of the Water Users
Initial Investigation Survey for the Business Plan
Pilot Project for Farmer Managed Irrigated Agriculture Under Left Bank Outfall
Drainage (LBOD) Stage I Project, Sindh Pakistan

Interview Date: (month/day/year) _____

Name of water user: (Last, First) _____

Distributary/Minor: _____

Watercourse No. & Location (H/M/T) _____

Sanctioned discharge at the watercourse: _____

Time allocated to irrigate your land (hours & minutes): _____

Farm location at the WC (H/M/T): _____

Land ownership Status:

Acres

- 1) Owner-operator (No. Hari) _____
- 2) Land owner(with Hari) _____ (50% or 25%)
- 3) Lessee (on cash) _____
- 4) Tenant (share cropper) _____ (50% or 25%) _____
- 5) Others _____

Kharif 1996 Data

Total Land Cultivated during Kharif 1996 (acres) _____

Net area cultivated & irrigation details for Kharif 1996 (acres)

Crop	Area sown a Acres	Area destroyed b Acres	Area destroyed because 1 or 2 1.Shortage of water 2. Other (specify)	Net area cultivate C= a-b Acres	Time required to irrigate one Acre (hours & minutes per acre)	Number of irrigation this season (Actual)
Cotton						
S. cane						
Rice						
Maize						
Fodder						
Orchard						
V.table						

Cost of Seed for Kharif 1996

Crop	Quantity of seed sown Kg or Mds or Bags per Acre	Price of Seed per Kg or Mds or Bags	Interest if Paid on seed purchase	Total Cost of Seed
Cotton				
S.cane				
Rice				
Maize				
Fodder				
Orchard				
V.table				

Cost of Fertilizer for Kharif 1996

Crop	Quantity of Type 1 Bags	Price & Interest per Bag	Quantity of Type 2 Bags	Price & Interest per Bag	Quantity of Type 3 Bags	Price & Interest per Bag	Other (Eg Natural) cost per Acre	Total cost
Cotton								
S.cane								
Rice								
Maize								
Fodder								
Orchard								
V.table								

Cost of Pesticides for Kharif 1996

Crop	Quantity of Type 1	Price & Interest per unit	Quantity of Type 2	Price & Interest per unit	Other Cost per Acre	Total cost
Cotton						
S.cane						
Rice						
Maize						
Fodder						
Orchard						
V.table						

Taxes and Cesses for Kharif 1996

Crop	Total Land Cultivated	<u>Dhal</u> Usher + Abiana for season	Drainage Cess for season	Misc and other charges paid for season	Total Taxes Paid
Cotton					
S.cane					
Rice					
Maize					
Fodder					
Orchard					
V.table					

Approximate Cost of Manual Labour Shared between Zamindar & Hari for the Year

Crop	Ploughing/Land leveling		Picking / cutting		Threshing		Others		Total Cost per acre
	Z	H	Z	H	Z	H	Z	H	
Cotton									
S.cane									
Rice									
Maize									
Fodder									
V.table									
Wheat									
Oil Seed									
Orchard									
Other									

** If paid in Kg/Mds get the market price and than calculate cost per acre*

Production and Transportation details Kharif 96

Crop	Total Production (Maunds)	Hari's Share (Maunds)	Selling price per Maunds	Transportation (tool tax, etc.) per Maunds	% of Transportation shared by Hari & Zamindar Z=?, H=?
Cotton					
S.cane					
Rice					
Maize					
Fodder					
Orchard					
V.table					

Rabi 95/96 Data

Total Land Cultivated during Rabi 95/96 (acres) _____

Net area cultivated & irrigation details for Rabi 95/96 (acres)

Crop	Area sown a Acres	Area destroyed b Acres	Area destroyed because 1 or 2 1.Shortage of water 2. Other (specify)	Net area cultivate C= a-b Acres	Time required to irrigate one Acre (hours & minutes per acre)	Number of irrigation this season (Actual)
Wheat						
S. cane						
Grams						
Fodder						
Oil Seed						
Orchard						
V.table						

Cost of Seed for Rabi 95/96

Crop	Quantity of seed sown Kg or Mds or Bags per Acre	Price of Seed per Kg or Mds or Bags	Interest if Paid on seed Purchase	Total Cost of Seed
Wheat				
S.cane				
Grams				
Fodder				
Oil Seed				
Orchard				
V.table				

Cost of Fertilizer for Rabi 95/96

Crop	Quantity of Type 1 Bags	Price & Interest per Bag	Quantity of Type 2 Bags	Price & Interest per Bag	Quantity of Type 3 Bags	Price & Interest per Bag	Other (Eg Natural) cost per Acre	Total cost
Wheat								
S.cane								
Grams								
Fodder								
Oil Seed								
Orchard								
V.table								

Cost of Pesticides for Rabi 95/96

Crop	Quantity of Type 1	Price & Interest per unit	Quantity of Type 2	Price & Interest per unit	Other cost per Acre	Total cost
Wheat						
S.cane						
Grams						
Fodder						
Oil Seed						
Orchard						
V.table						

Taxes and Cesses for Rabi 95/96

Crop	Total Land Cultivated	Dhal Usher + Abiana for season	Drainage Cess for season	Misc and other charges paid for season	Total Taxes Paid
Cotton					
S.cane					
Rice					
Maize					
Fodder					
Orchard					
V.table					

Production and Transportation details Rabi 95/96

Crop	Total Production (Maunds)	Hari's Share (Maunds)	Selling price per Maunds	Transportation (tool tax, etc.) per Maunds	% of Transportati on shared by Hari & Zamindar Z=?, H=?
Wheat					
S.cane					
Grams					
Fodder					
Oil Seed					
Orchard					
V.table					

Orchard- Total amount received from Contractor for the last year (Mangoes) _____
 Other(s) _____
 Total _____

Other sources of Cash Inflow for Kharif 96 and Rabi 95/96

Sale of livestock _____
Sale of livestock products (Milk & dairy products etc.) _____
Income from Labour _____
Remittances/Govt payments _____
Other sources (Employment of other family member etc.) _____
Total **Rs.** _____

O&M Expenses:

Have you participated in O&M activities at WC level: **Yes** **No**

If yes than what was your contribution for Kharif 96 (Labour, cash, equipment, others)

Detail of activity (eg. Silt Cleaning) _____

Total time (hour/day) _____, Total amount _____ paid by Hari and Zamindar _____

What was your contribution for Rabi 95/96 (Labour, cash, equipment, others)

Detail of activity (eg. Silt Cleaning) _____

Total time (hours/day) _____, Total amount _____ paid by Hari and Zamindar _____

Have you ever participated in O&M activities at Distributory/Minor level: **Yes** **No**

If yes than what was your contribution for Kharif 96 (Labour, cash, equipment, others)

Detail of activity _____

Total time (hours/day) _____, Total amount _____ paid by Hari and Zamindar _____

What was your contribution for Rabi 95/96 (Labour, cash, equipment, others)

Detail of activity (eg. Silt Cleaning) _____

Total time (hour/day) _____, Total amount _____ paid by Hari and Zamindar _____

Other Cash Outflow for Kharif 1996 and Rabi 95/96

Other Farm equipments & Power Usage (fuel, lubricants, rapairs) _____

Livestock Expenses (veterinary expense, hired labour) _____

Feed purchased for livestock _____

Livestock purchase
 Equipment Rent (other than tractor)
 Utilities House per month (gas + electric other) (____, _____, _____) X12
 Farm related repairs (eg Outlets etc.) _____
 Interest payments on loans _____
 Capital purchase (Assét) _____
 Family living (food, education, medical etc.) _____
 Other expenses _____
Total **Rs.** _____

Comments: _____

Interview conducted by _____ Signature _____

Checked by _____ Date _____ Signature _____

Exhibit 2. Definitions of Variables used in various Tables and Figures of Supporting Information (Page 1 of 2).

SN-Serial number respondents.

WCNO-Water course number

WCLC-Water course location at the distributary/minor

FLWC-Farm location at the water course

ACRS-Sum of Total acres owned (including acres leased) in the last year

TLCK-Total land (acres) cultivated in Kharif 96

TSCK-Total seed cost in Kharif 96

TFCK-Total fertilizer cost in Kharif 96

TECK-Total pesticide cost in Kharif 96

TXCK-Total tax cost in Kharif 96

TCLK-Total labour cost in Kharif 96

TTCK-Total transportation cost in Kharif 96

TFCK-Total farm cost in Kharif 96

TDAK-Total area destroyed in Kharif 96

LOS-Land owner ship status

LOS 1= Owner operator (self-cultivator)

LOS 2= Land Owner (Zamindar sharing crop with Hari-share tenant)

LOS 3= Land owner cum self cultivator

LOS 4= Owner operator cum tenant

LOS 5= Lessee cum Land owner

LOS 6= Lessee cum self cultivator

(Note: mostly LOS was either 1 or 2 or 5)

TFRK-Total farm revenue in Kharif 96

NTCK-Net total cost in Kharif 96

HRSK-Hari's revenue share for Kharif 96

KTFI-Kharif 96 total Farm income

PACIK-Per acre farm cost in Kharif 96

PAFIK-Per acre farm income in Kharif 96

TZCK-Total Zamindar cost in Kharif 96

KTL-Kharif 96 Total loss (due to area destroyed)

TLCR-Total land (acres) cultivated in Rabi 95/96

TSCR-Total seed cost in Rabi 95/96

TFCR-Total fertilizer cost in Rabi 95/96

TECR-Total pesticide cost in Rabi 95/ 96

TXCR-Total tax cost in Rabi 95/96

TCLR-Total labour cost in Rabi 95/96

Exhibit 2 (Page 2 of 2).

TTCR-Total transportation cost in Rabi 95/96
TFCR-Total farm cost in Rabi 95/96
TDAR-Total area destroyed in Rabi 95/96
TFRR-Total farm revenue in Rabi 95/96
NTCR-Net total cost in Rabi 95/96
HRSR-Hari's revenue share for Rabi 95/96
RTFI-Rabi 95/96 total Farm income
PACIR-Per acre farm cost in Rabi 95/96
PAFIR-Per acre farm income in Rabi 95/ 96
TZCK-Total Zamindar cost in Rabi 95/ 96
RTL-Rabi 95/96 Total loss (due to area destroyed)
TLCY-Total land (acres) cultivated for the year
TADY-Total area (acres) destroyed for the year
TYFC-Total Farm cost for the year
NYFI-Net yearly farm income (for both seasons)
PAYC-Per acre farm cost for the year
PAFIY-Per acre farm income for the year
TYL-Total loss for the year (because of area destroyed)

Table 2b. Basic Data of the Water User (Dhoro Naro Minor Nawabshah).

SN	WCNO	WCLC	FLWC	ACRS	
201	1AL	H	T	260	
202	1AL	H	H	98	
203	1R	H	T	31	
204	1R	H	H	38	
205	2L	H	H	26	
206	2L	H	T	18	
207	3R	H	H	7	
208	3R	H	T	23	
209	3L	MD	MD	36	
210	3L	MD	T	21	
211	4L	MD	T	54	
212	4L	MD	H	90	
213	4R	MD	T	60	
214	4R	MD	MD	20	
215	5R	MD	T	20	
216	5R	MD	MD	14	
217	6L	T	MD	4	
218	6L	T	T	12	
219	7R	T	H	175	
220	7L	T	MD	12	
221	7R	T	MD	30	
222	7L	T	T	97	
223	10L	T	MD	200	
224	10L	T	T	120	
225	11L	T	T	60	
226	11L	T	H	30	
SN-details					
201-226	Farmers interviewed at Dhoro-Naro Minor of Nawabshah				
	H=head, MD=middle, T=tail, m=missing				

Table 2c. Basic Data of the Water User at Heran Distributary and Khadwari Minor, Sanghar.

SN	WCNO	WCLC	FLWC	ACRS	
301	1L	H	H	16	
302	4R	H	H	32	
303	4R	H	T	48	
304	5L	H	T	48	
305	5L	H	MD	90	
306	7L	H	T	32	
307	7L	H	T	32	
308	9AR	H	H	30	
309	8AL	MD	H	7	
310	8AL	MD	T	32	
311	9AR	MD	T	32	
312	10R	MD	MD	30	
313	10R	MD	MD	16	
314	14L	MD	MD	16	
315	14L	MD	MD	16	
316	16R	MD	MD	32	
317	16R	MD	MD	16	
318	17AL	MD	MD	7	
319	16AR	T	T	32	
320	16AR	T	MD	32	
321	17AL	T	T	32	
322	17AT	T	T	32	
323	17AT	T	MD	45	
324	18R	T	MD	32	
325	18AT	T	H	32	
326	18R	T	MD	48	
327	18AT	T	T	100	
401	1L	H	T	32	
402	2R	MD	T	32	
403	2R	MD	H	24	
404	5T	T	MD	24	
405	5T	T	H	16	
SN-details					
301-327	Farmers interviewed at Heran Distributary at Sanghar				
401-405	Farmers interviewed at Khadwari Minor at Sanghar				
H=head, MD=middle, T=tail, m=missing					

Table 2d. Summary of the Basic Data.

Description	Barejl	D'naro	Heran	K'warl	Total/Max/Min/Mean
No. of WUs interviewed(sample size)	24	26	27	5	82
Total No. of water course	24	26	24	7	81
No. of WCs in sample	16	13	15	3	47
% of WCs in sample	67%	50%	63%	43%	58%
% of WUs from Head of dist/min	33%	31%	30%	20%	30%
% of WUs from Middle of dist/min	33%	31%	37%	40%	34%
% of WUs from Tail of dist/min	33%	38%	33%	40%	35%
Max No. of acres owned in sample	275	260	100	32	275
Min No. of acres owned in sample	8.5	4	7	16	4
Mean acres owned in sample	87.6	59.8	35	25.6	52.0

Table 3. Financial Data Analysis Bareji Distributary.

SN	TLCK	TLCR	TDAK	TADR	TADY	TFRK	TFCK	KTFL	PAFIK	TFRR	TFCR	RTFL	PAFIR	TYFR	TYFC	NYFL	PAFYI
101	33	26	M	M	M	304700	223240	81460	2468.48	284300	219307	65193	2507.42	589200	442547	146653	4975.9
102	92	43	8.5	5	13.5	1409500	1001869	407631	4430.77	253000	173395	79605	1851.28	1662500	1175264	487236	6282.05
103	12	9.5	M	M	M	188850	147352	41498	3458.17	26750	30576.3	-3826.25	-402.763	215600	177928	37671.8	3055.41
104	37	28	M	M	M	779000	452532	326468	8823.45	262320	216275	46045	1644.46	1041320	668807	372513	10467.9
105	12.5	36.5	M	3	M	292250	202894	89356.3	7148.5	270500	201425	69075	1892.47	562750	404319	158431	9040.97
106	17.5	27	M	2	2	421600	276366	145234	8299.11	242250	187521	54729	2027	663850	463887	199963	10326.1
107	12	9	1	2	3	228500	150908	77592.5	6466.04	54025	52886.5	1138.5	126.5	282525	203795	78730.5	6592.54
108	44	22	6.75	8	14.75	455600	316240	139360	3167.27	154800	101045	53755	2443.41	610400	417285	193115	5610.68
109	22	17	M	M	M	726800	114235	612565	27843.9	78875	45246	33629	1978.18	805675	159481	646194	29822.1
110	12	11.5	M	M	M	229000	145111	83889.5	6990.79	157038	106993	50044.3	4351.67	386038	252104	133933	11342.5
111	27	39	3	M	3	327300	319685	7615	282.037	313800	322670	-8870	-227.436	641100	642355	-1255	54.601
112	16	16	1	2	3	415280	246002	169278	10579.9	86200	65272.5	20927.5	1307.97	501480	311275	190206	11887.9
113	13	16	1	2	6	162000	115640	46360	3566.15	70625	58377.5	12247.5	765.469	232625	174018	58607.5	4331.62
114	34	46	4	2	6	198600	180896	17704	520.706	461350	329653	131698	2862.99	659950	510549	149402	3383.7
115	25.5	19.5	M	M	M	268000	198209	69791.3	2736.91	127200	94030.5	33169.5	1701	395200	292240	102961	4437.91
116	8	8.5	M	M	M	409000	51240	357760	44720	99600	24485	75115	8837.06	508600	75725	432875	53557.1
117	12	15.5	M	M	M	96160	60748	35412	2951	156480	122841	33639.5	2170.29	252640	183589	69051.5	5121.29
118	13.5	16	M	3	3	178750	131200	47550	3522.22	45200	47635	-2435	-152.188	223950	178835	45115	3370.03
119	28	21	2	M	2	549800	366358	183443	6551.52	145630	129084	16546	787.905	695430	495442	199988	7339.43
120	24	10	M	M	M	376650	255633	121018	5042.4	81000	53244	27756	2775.6	457650	308877	148773	781.8
121	89	11.5	10	M	10	929100	626660	302440	3398.2	47500	31163.8	16336.3	1420.54	976600	657824	318776	4818.74
122	102	46	24	10	34	1207725	1080474	127251	1247.56	187200	173610	13590	295.435	1394925	1254084	140841	1543
123	24	20	M	M	M	649750	403713	246038	10251.6	145540	102452	43088	2154.4	795290	506165	289125	12406
124	61	M	7	M	7	956800	894120	62680.5	1027.55	M	232500	M	M	956800	1126620	M	M
Summary																	
MEAN	32.125	22.3696	6.20455	3.9	7.66071	490030	331722	158308	7312.26	163104	130070	37486.8	1874.72	646337	461792	199952	9460.23
MAX	102	46	24	10	34	1409500	1080474	612565	44720	461350	329653	131698	8837.06	1662500	1254084	646194	53557.1
MIN	8	8.5	1	2	2	96160	51240	7615	282.037	26750	24485	-8870	-402.763	215600	75725	-1255	54.601
SUM	771	514.5	68.25	39	104.25	1.2E+07	7961325	3799395	M	3751383	3121687	862195	M	1.6E+07	1.1E+07	4598905	M
M=Zero/not incurred applicable																	
Respondent 124 did not cultivate any acres in rabi 95/96 season																	
Abbreviation used																	
SN-Serial Number																	
TLCK-Total land cultivated in Kharif 96																	
TLCR-Total land cultivated in Rabi 95/96																	
TDAK- Total area destroyed in Kharif 96																	
TDAR- Total area destroyed in Rabi 95/96																	
TDAY-Total area destroyed for the year																	
TFRR-Per acre Farm Income in Kharif 96																	
TFCK-Total for cost in Kharif 96																	
KTFL-Kharif (96) Total Farm Income																	
TFRR-Total farm revenue in Rabi 95/96																	
TFCR-Total for cost in Rabi 95/96																	
RTFL-Rabi (95/96) Total Farm Income																	
PAFIK-Per acre Farm Income in Kharif 96																	
PAFIR-Per acre Farm Income in Rabi 95/96																	
TYFR-Total Farm revenue for the year																	
TYFC-Total Farm cost for the year																	
NYFL-Net Farm Income for the year																	
PAFYI-Per acre Farm Income for the year																	

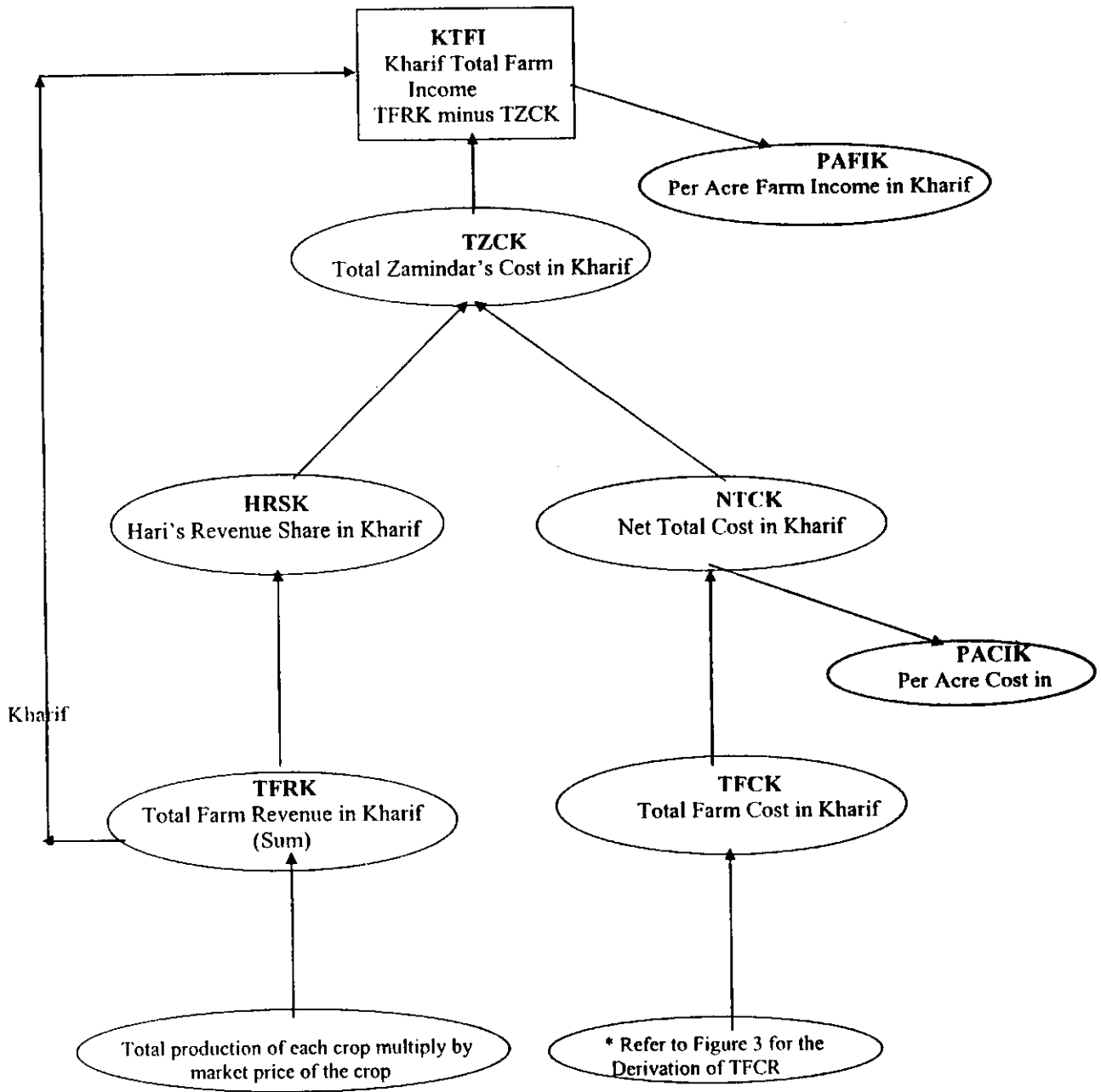
Table 4. Financial Data Analysis Dhoro Naro Minor.

SN	TLCR	TLR	TDAR	TADR	TADY	TFRK	TFCK	KTFI	PAFIK	ITFR	TFCR	RTFI	PAFIR	TYFR	TYFC	NYFI	PAFYI
201	72	112	28	9	37	276800	245396.7	31403.306	713.7115	207000	304030.2	-97030.24	-942.041	483800	549426.9	-65626.9	-228.33
202	64	60	7	M	7	544420	410370.2	134049.83	2351.751	186800	182915	3885	64.75	731220	593285.2	137934.8	2416.501
203	14.5	10.5	1	M	1	87340	50695.29	36644.707	2714.423	33000	19665.5	13334.5	1269.952	120340	70360.79	49979.21	3984.375
204	21	15	4	M	4	141000	94957.29	46042.707	2708.395	60000	50765	9235	615.6667	201000	145722.3	52277.71	324.061
205	7	9	4	M	4	28000	7793.143	20206.857	6735.619	23600	20602.94	2997.065	333.0072	51600	28396.08	33203.92	7068.626
206	11	3	M	M	M	78810	33990	3090	3090	11664	11206.5	457.5	152.5	124464	90016.5	34447.5	3242.5
207	6	6	M	M	4	50001	8140	41861	10465.25	42250	235440	-193190	-32198.3	92251	243580	-151329	-21733.1
208	8	5	M	M	M	61800	22415	39385	6564.167	12600	10641	1959	391.8	74400	33056	41344	6955.967
209	14	13	5.5	M	M	90000	59678	30322	3790.25	55000	39024	15976.004	1228.923	145000	98702	46298	5019.173
210	8	9.5	M	M	5.5	16400	6579.546	9820.4536	1155.347	49200	14336	34864	3669.895	65600	20915.55	44684.45	4825.242
211	29	40	M	M	M	277000	200787	76213	9526.625	142800	129347.8	17592.28	336.3063	419800	330134.8	89665.25	8862.931
212	38	50	4	1	1	41964	90194	48230	-1663.1	68800	151200.7	17599.28	359.169	210764	241394.7	-30630.7	-1303.93
213	29.5	30.5	10	13	23	118350	100931.3	17418.75	512.3162	168000	54216.54	13283.463	759.055	185850	155147.8	30702.21	1271.371
214	9	8	4.5	M	10	26720	25220.3	1499.7034	76.90787	25800	20122	5678	709.75	52520	45342.3	7177.703	786.6579
215	14	11	M	M	6	132640	26438.85	106201.15	17700.19	30000	32895	-2895	-263.182	162640	59333.85	103306.2	17437.01
216	7	7	M	M	4.5	131250	72695.5	58554.5	13012.11	12800	16847.5	-4047.5	-578.214	144050	89543	54507	12433.9
217	1.5	1	M	M	M	11600	3105	8495	606.7857	4000	1010	2990	2990	15600	4115	11485	3596.786
218	5.25	7	0.25	M	M	48800	16616	32184	4597.714	16400	20270	-3870	-552.857	63200	36886	28314	4044.857
219	120	135	44	32	32	480000	454750	25250	16833.33	441600	402926.9	38673.111	375.4671	921600	857676.9	63923.11	17208.8
220	4.25	5	0.25	M	0.25	17600	5510.476	12089.524	2417.905	17260	8149	9111	1822.2	34860	13659.48	21200.52	4240.105
221	20	21	6	7	13	38400	35888.33	2511.6667	33.04825	46000	42713.33	3286.6667	234.7619	84400	78601.67	5798.333	267.8102
222	26	38	11	21	32	56700	67802.35	-11102.35	-2775.59	62600	35660.63	26939.368	1584.669	119300	103463	15837.02	-1190.92
223	27	33	12	10	22	57600	59972.6	1627.4	116.2429	220800	142223.6	78576.364	3416.364	278400	198196.2	80203.76	3532.606
224	8	52	4	M	11	39120	24475.38	14644.615	976.3077	141900	117157.5	24742.5	475.8173	181020	141632.9	39387.12	1452.125
225	12	17	6	9	9	44000	38740	5260	292.2222	27200	26495.29	704.70588	88.08824	71200	65235.29	5964.706	380.3105
226	18	23	M	1	1	295200	167349.9	127850.14	8523.343	121200	92045.65	29154.348	1325.198	416400	259395.5	157004.5	9848.54
Summary																	
MEAN	22.8	27.8	8.912	11.44	11.4	124057.9	91204.31	32853.6	4272.13	85683.6	83919.5	1764.09	-474.3	209741.5	175123.8	34617.67	3797.846
MAX	120	135	44	32	37	544420	454750	134049.83	17700.19	441600	402926.9	78576.364	3669.895	921600	857676.9	157004.5	17437.01
MIN	1.5	1	0.250	1	6.3	11600	3105	-48230	-2775.59	4000	1010	-193190	-32198.3	15600	4115	-151329	-21733.1
SUM	594	721.5	151.5	103	227.25	3225505	2371312.2	854193	M	2227774	2181907.6	45866.386	M	5453279	4553220	900059.42	M
M=Zero/not incurred applicable																	
Respondent 124 did not cultivate any acres in rabi 95/96 season																	
Abbreviation used																	
SN-Serial Number																	
TLCR-Total land cultivated in Kharif 96																	
TLCK-Total land cultivated in Rabi 95/96																	
TFCK-Total area destroyed in Kharif 96																	
TFRR-Total area destroyed in Rabi 95/96																	
TFCR-Total area destroyed for the year																	
RTFI-Rabi (95/96) Total Farm Income																	
TFRK-Total farm revenue in Kharif 96																	
TFCK-Total for cost in Kharif 96																	
KTFI-Kharif (96) Total Farm Income																	
ITFR-Total farm revenue in Rabi 95/96																	
TFRR-Total farm cost for the year																	
NYFI-Net Farm Income for the year																	
PAFYI-Per acre Farm Income for the year																	

Table 5. Financial Data Analysis Heran Distributory.

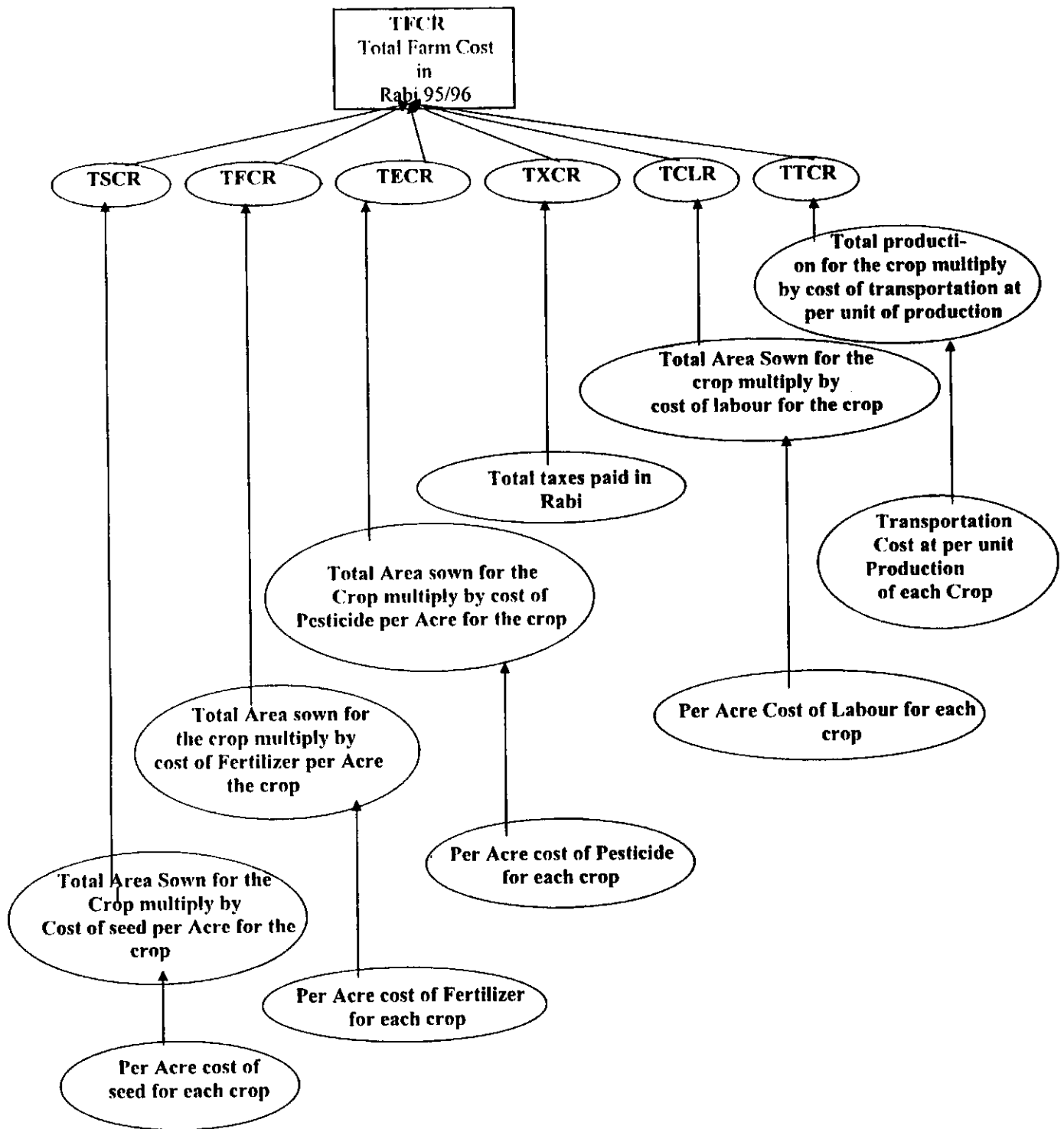
SN	TLCK	TLCR	TDAK	TADR	TADY	TFRK	TFCK	KTFI	PAFIK	TFRR	TFCR	RTFI	PAFIR	TYFR	TYFC	NYFI	PAFIY
301	16	16	M	M	M	127680	50140	77540	4846.25	42840	37720	5120	320	170520	87860	82660	5166.25
302	20.5	22	M	M	M	86900	83156.3	3743.7	182.6195	147600	104639.5	42960.5	1952.75	234500	187795.8	46704.2	2135.37
303	27	26	M	M	M	233500	171225	62275	2306.481	87300	79712	7588	291.8462	320800	250937	69863	2598.328
304	24	26	3	2	5	311400	219177	92223	3842.625	80000	67249	12751	490.4231	391400	286426	104974	4333.048
305	59	49	8	M	8	234900	265800	-30900	-523.729	124350	109260	15090	307.9592	359250	375060	-15810	-2013.633
306	19	20	M	2	2	139000	106754	32246	1697.158	64550	58220.5	6329.5	310.475	203550	164974.5	38575.5	2013.633
307	11.5	16.5	M	M	M	34800	35266.8	-466.8	-40.5913	33295	33799.5	-504.5	30.5758	68095	69066.3	-971.3	-71.1671
308	13	10	M	M	M	38500	47308	-8808	-677.538	34250	28273.5	5977	597.7	72750	75581	-2831	-79.8385
309	7	5	M	M	M	8000	24350	-16350	-2335.71	40800	17430	23370	4674	48800	41780	7020	2338.288
310	32	32	M	7	7	177600	153958	23642	738.8125	346700	251775	94925	2966.406	524300	405733	118567	3705.219
311	5	9	M	M	M	26400	21712.5	4687.5	937.5	19700	17325	2375	263.8889	46100	39037.5	7062.5	1201.389
312	19	18.5	M	2	2	69300	40529	28771	1514.263	31548	31847	-299	-16.1622	100848	72376	28472	1498.101
313	12.5	12	M	M	M	88000	65391	22609	1808.72	30700	34916	-4216	-351.333	118700	100307	18393	1457.387
314	16	11	2	M	2	96500	67896	28604	1787.75	29000	25695	3305	300.4545	125500	93591	31909	2088.205
315	12	7	M	M	M	112200	72704	39496	3291.333	26500	22345	4155	593.5714	138700	95049	43651	3884.905
316	16	14	3	M	3	140000	111376	28624	1789	41500	45637	-4137	-295.5	181500	157013	24487	1493.5
317	11.5	11	M	M	M	106276	61504	44772	3893.217	29750	26306	3444	313.0909	136026	87810	48216	4206.308
318	7	7	M	M	M	79500	28115	51385	7340.714	88600	52625	35975	5139.286	168100	80740	87360	12480
319	19	20	3	2	5	56800	47730	9070	477.3684	139600	32244	107356	5367.8	196400	99974	116426	5845.168
320	18.5	20.5	0.5	M	0.5	58400	44445	11955	646.2162	69000	51680	17320	844.878	125400	96125	29275	1491.094
321	15.5	16	M	M	M	187000	126840	60160	3881.29	53500	48107.5	5392.5	337.0313	240500	174947.5	65552.5	4218.322
322	13	16	M	M	M	96000	71834	24166	1858.923	59500	47520	11980	748.75	155500	119354	36146	2607.673
323	25	24	M	M	M	311680	145193	66487	2659.48	97400	72385	25015	1042.292	309080	217578	91502	3701.772
324	21	23.5	M	M	M	334150	202468	131682	6270.571	99486	76797	22689	965.4894	433636	279265	154371	7236.061
325	18	21	M	M	M	280500	98465	182035	10113.06	126020	58930	67090	3194.762	406520	157395	249125	13307.82
326	26	29	M	M	5	351600	259315	92285	2366.282	111800	111532.5	267.5	6.079545	402000	278101	123899	4682.667
327	39	44	5	M	5	185720	130470	55250	1973.214	63750	64295	-545	-19.4643	463400	370847.5	92552.5	2372.362
401	28	28	M	M	2	146500	59227	87273	3422.471	45850	48605	-2755	-108.039	192350	194765	54705	1953.75
402	25.5	25.5	2	M	M	255000	101272	153728	7686.4	86700	68740	17960	898	341700	107832	84518	3314.431
403	20	20	M	M	M	146000	98285	47715	2579.189	81500	56480	25020	1668	227500	154765	72735	4247.189
404	18.5	15	M	M	M	59040	45181	13859	1979.857	34000	29235	4765	397.0833	93040	74416	18624	2376.94
405	7	12	M	M	M												
Summary																	
SUM	622	626.5	26.5	15	41.5	4768646	3243768.6	1522877.4	M	2479289	1902745.5	576543.5	M	7245935	5146514.1	2099420.9	M
MIN	5	5	0.5	2	0.5	8000	21712.5	-30900	-2335.71	19700	17325	-4216	-351.333	46100	39037.5	-15810	-215.77
MAX	59	49	8	7	8	351600	265800	182035	10113.06	346700	251775	107356	5367.8	524300	405733	249125	13307.82
MEAN	19.4375	19.57813	3.3125	3	3.772727	148957.7	101367.8	47589.92	2571.228	77477.78	59460.8	18016.96	1059.172	226435.5	160828.6	65606.9	3630.4
M=Zero/not incurred applicable																	
Respondent 124 did not cultivated any acres in rabi 95/96 season																	
Abbreviation used																	
SN-Serial Number																	
TLCK-Total land cultivated in Kharif 96																	
TLGR-Total land cultivated in Rabi 95/96																	
TDAR-Total area destroyed in Kharif 96																	
TDAR-Total area destroyed in Rabi 95/96																	
TDAY-Total area destroyed for the year																	
TFRR-Total farm revenue in Kharif 96																	
TFRR-Total farm revenue in Rabi 95/96																	
TFRCR-Total for cost in Rabi 95/96																	
RTFI-Per acre Farm Income																	
PAFIK-Per acre Farm Income in Kharif 96																	
PAFIR-Per acre Farm Income in Rabi 95/96																	
TYFR-Total Farm revenue for the year																	
TYFC-Total Farm cost for the year																	
NYFI-Net Farm Income for the year																	
PAFIY-Per acre Farm Income for the year																	

Figure 2. Kharif 96 Farm Income Derivation.



** Cost Derivation for Kharif and Rabi is the same.*

Figure 3. Total Farm Cost Derivation for Rabi 95/96. *



* Cost Derivation for Rabi95/96 and Kharif 96 is the same.

Figure 4. Rabi 95/96 Farm Income Derivation.

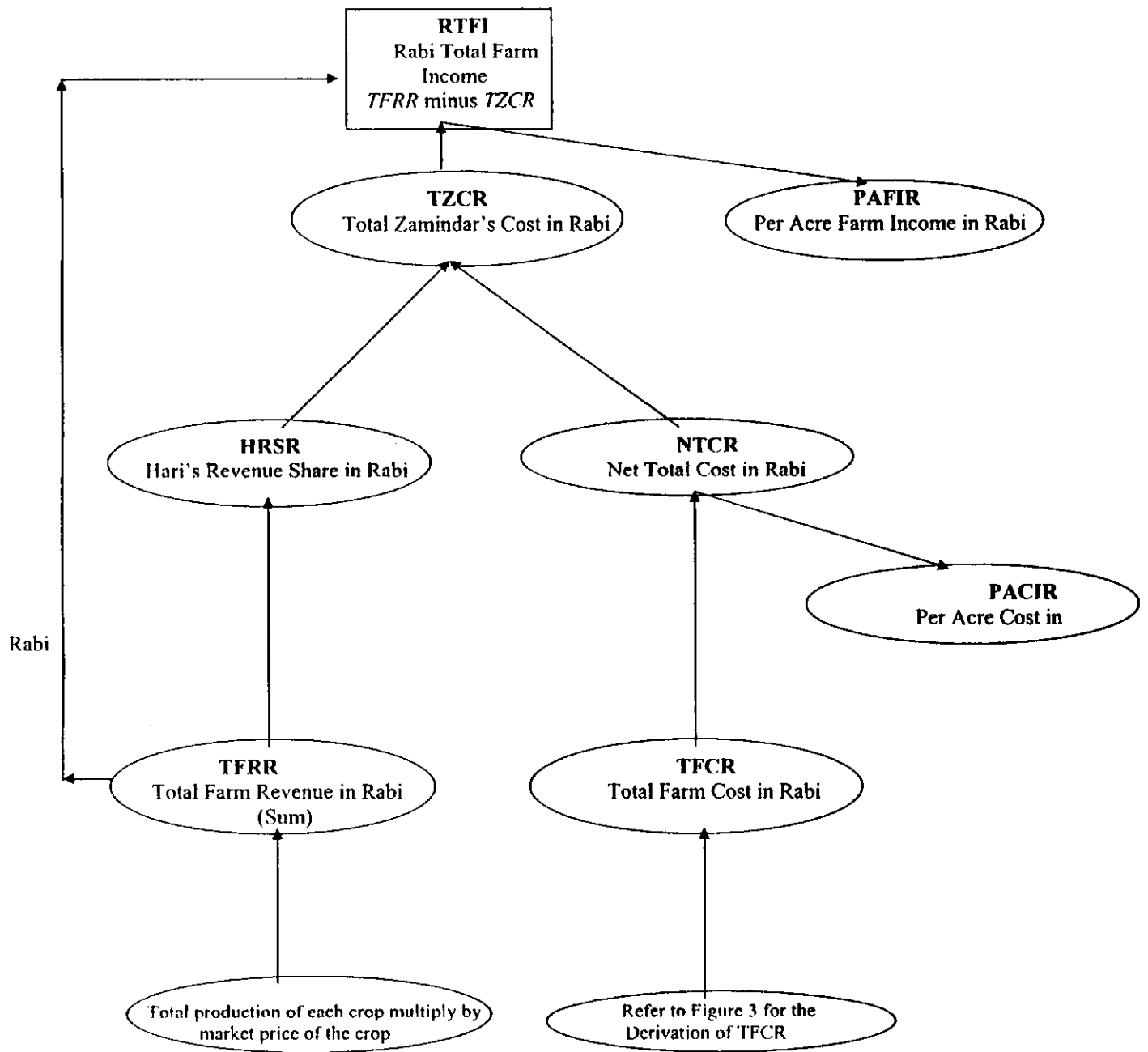


Figure 5. Annual Farm Income Derivation for Rabi 95/96 & Kharif 96.

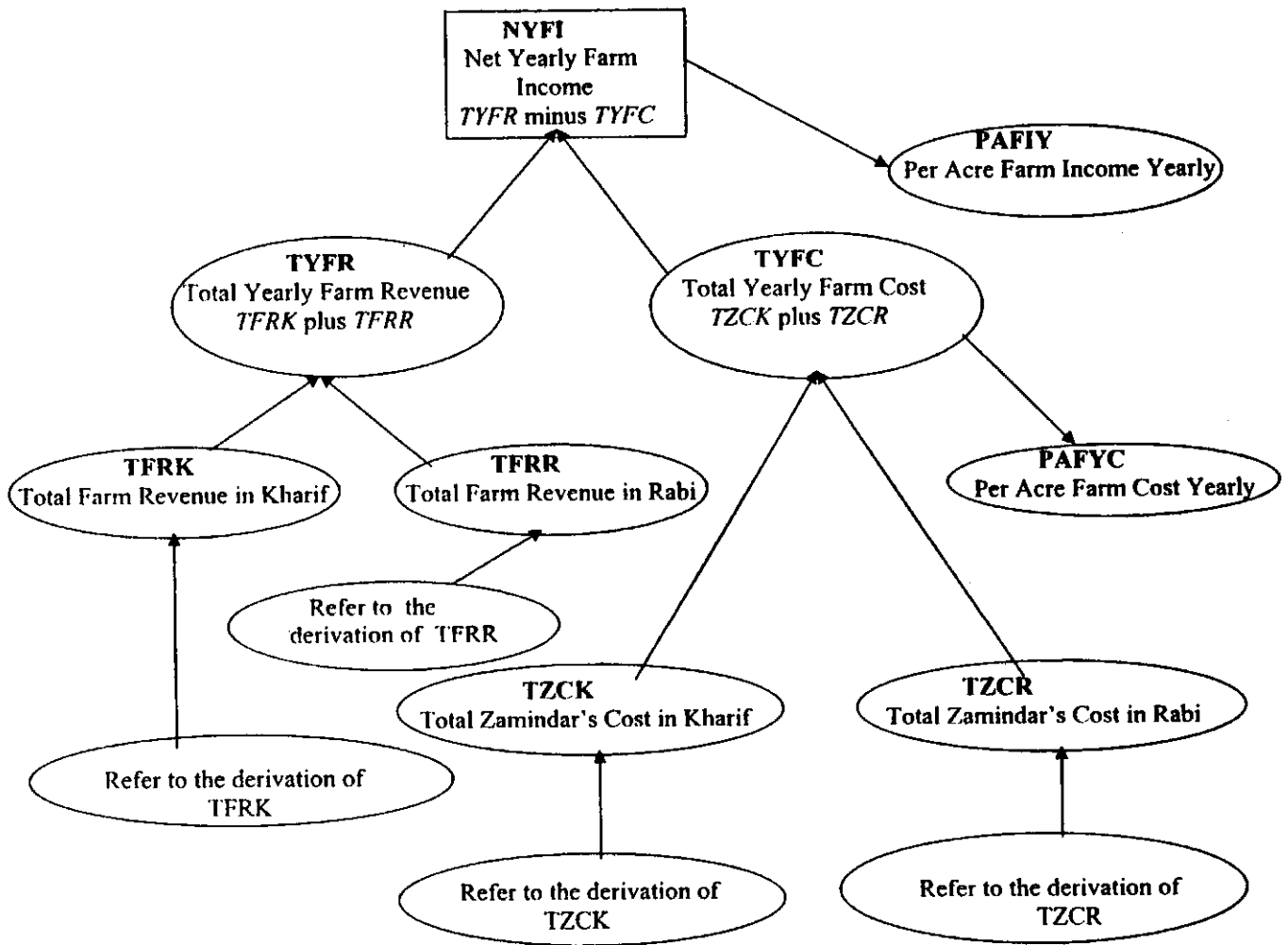


Table 6. Farm Income Analysis (Mean figures).

Summary for the pilot areas				
Item	Barejl	Dhoro Naro	Heran	Total/Max/Min/Mean
Basic Data				
No. of WUs interviewed (sample size)	24	26	32	82
Total No. of watercourses	24	26	31	81
No. of Watercourses in sample	16	13	18	47
% of watercourses in sample	67%	50%	58%	58%
% of WUs interviewed from Head of dist/min	33%	31%	28%	31%
% of WUs interviewed from middle of dist/min	33%	31%	38%	34%
% of WUs interviewed from Tail of dist/min	33%	38%	34%	35%
Max No. of hacters owned in sample	110	104	40	85
Min No. of hacters owned in sample	3.4	1.6	0.4	2
Mean hacters owned in sample	35.0	23.9	13.0	24
Farm Income Summary				
Mean Land cultivated in Kharif 96 (hacters)	12.85	9.12	7.7	10
Mean Land cultivated in Rabi 95/96 (hacters)	8.9	11.12	7.8	9
Mean Total Land cultivated in Year (hacters)	22	20	16	19
Mean area destroyed in Kharif 96 (hacters)	2.48	3.56	1.32	2
Mean area destroyed in Rabi 95/96 (hacters)	1.56	5.1	1.2	3
Mean area destroyed in year (hacters)	3.06	5.96	1.48	4
Mean Farm revenue in Kharif 96	490029	124058	148958	254348
Mean Farm cost in Kharif 96	331721.9	91204	101367	174764
Mean kharif 96 farm income	158307.1	32854	47590.7	79584
Mean per hacter farm income in Kharif 96	12320	3602	6181	7368
Mean farm revenue in Rabi 95/96	163103.6	85683.6	77477.8	108754.9933
Mean Farm cost in Rabi 96	130070.3	83919.5	59460.8	91150
Mean Rabi 95/96 Farm income	33033.3	1764.1	18017	17605
Mean per hacter farm income in Rabi 95/96	3712	159	2310	2060
Mean Farm revenue for the year	653132.6	209741.6	226435	363103
Mean annual Farm revenue per cropped hacter	30029	10363	14609	18334
Mean annual Farm revenue per CCA hacter*	18536	5757	9018	11104
Mean Farm cost for the year	461792.2	175123.5	160828	265915
Mean annual Farm cost per cropped hacter	21232	8652	10376	13420
Mean annual Farm cost per CCA hacter*	13106	4807	6405	8106
Mean Net Farm income for the year	191340.4	34618.1	65607.7	97189
Mean per Cropped hacter farm income for the year	8797	1710	4233	4913
Mean per CCA hacters farm income for the year*	5430	950	2613	2998
Farm Income Analysis (Based on Mean data)				
Cropping Intensity for Kharif 96	37%	38%	59%	41%
Cropping Intensity for Rabi 95/96	25%	46%	60%	39%
Mean Annual Cropping Intensity	62%	85%	119%	
% of area destroyed in year	9%	25%	11%	15%
Kharif 96 Farm Cost as % of Kharif 96 gross revenue	68%	74%	68%	69%
Rabi 95/96 Farm Cost as % of Rabi 95/96 gross revenue	80%	98%	77%	84%
Annual Farm cost as % of annual revenue	71%	83%	71%	73%
Kharif 96 Farm Income as % of Kharif 96 gross revenue	32%	26%	32%	31%
Rabi 95/96 Farm Income as % of Rabi 95/96 gross revenue	20%	2%	23%	16.19%
Annual Farm Income as % of annual revenue	29%	17%	29%	27%
* Actual annual Cropping Intensity of Nara Canal (for Barejl & Heran) is 62% and for Rohri Canal (for Dhoro Naro Minor) is 80% (Phase II report Pg 24)				

Table 7. Farm Income Analysis (Actual Figures).

Summary for the pilot areas				
Item	Barejl	Dhoro Naro	Heran	Mean
Land Cultivated in a Year (ha)	514	526	499	513
Actual CI of Nara and Rohri Canal	62%	80%	62%	68%
Annual Farm Revenue	15512098	5453279	7245935	9403771
Per Cropped hacter Farm Revenue	30179.18	10609.49	14097.15	18295.27
Per CCA hacter Farm Revenue	18629	5894	8702	11075
Annual Farm Cost	11083012	4553220	5146514	6927582
Per Cropped hacter Farm Cost	21562	8656	10314	13511
Per CCA hacter Farm Cost	13310	4809	6366	8162
Annual Farm Income	4429086	900059	2099421	2476189
Per Cropped hacter Farm Income	8617	1953	3783	4785
Per CCA hacter Farm Cost Income	5319	1085	2335	2913

ANNEXURE C

IRRIGATION OPERATION AND MAINTENANCE COSTS

**Exhibit 3. Form-64 Schedule of Works Expenditure 52000 Irrigation
Non-Development 523000-459 M&R (June 1989).**

- 1) Govt Vehicles Maintenance
- 2) Electricity charges
- 3) Filling Gaps
- 4) Constructing double groynes
- 5) Closing leaks and breaches
- 6) Datsun Pickup Hired
- 7) Telephone charges
- 8) Non-Residential building
- 9) Abkalani material
- 10) R/S Banks of Jamrao Canal
- 11) Advertisement charges
- 12) Earth work
- 13) Regulator bridges
- 14) Constructing Bunna
- 15) Repairs to modules
- 16) Berm Trimming
- 17) Restoration to channel section to "D" design
- 18) Rehandelling of earth work
- 19) Closure material
- 20) Silt Clearance of Jamro & Dim (by machinery)
- 21) Silt Clearance of Jarwar Minor
- 22) Repair to gate and gear (by machinery party)
- 23) Dumping stones
- 24) Removing of Bottle Necks
- 25) Repair to residential building
- 26) Repair to duplicate (machinery)

Table 8. Statement Showing the M&R, E&I and Establishment Expenditure Incurred on Bareji Distributary During the Years 1985/86 to 1995/96.

Year	Expenditure incurred on M&R	Extension and improvement				Expenditure on establishment side
		1	2	3	4	
1985-86	Nil					50574
1986-87	Nil					55002
1987-88	Nil	92545				64086
1988-89	Nil		29250	49832		75720
1989-90	Nil					79326
1990-91	Nil				49248	90540
1991-92	Nil			57168		109086
1992-93	Nil					123030
1993-94	Nil					132378
1994-95	Nil					147888
1995-96	Nil					164532

Note:

- 1.) Reconditioning of bank
- 2.) Earth work maintenance of bank
- 3.) Rehandling of Spoil
- 4.) Resectioning of Soil

Table 9. Statement Showing the Expenditure Incurred For E&I of Bareji Distry from the year 1985-86 to 1995-96.

S.no	Year	Reconditioning of Bank	Earth work Maintenance	Rehandling of spoil	Resectioning	Total
1	1985-86	0	0	0	0	0
2	1986-87	0	0	0	0	0
3	1987-88	92545	0	0	0	92545
4	1988-89	0	29250	49832	0	79082
5	1989-90	0	0	0	0	0
6	1990-91	0	0	0	49248	49248
7	1991-92	0	0	57168	0	57168
8	1992-93	0	0	0	0	0
9	1993-94	0	0	0	0	0
10	1994-95	0	0	0	0	0
11	1995-96	0	0	0	0	0
Total		92545	29250	107000	49248	278043
Source		<i>Executive Engineer Jamrao Division</i>				

S.no	Year	Reconditioning of Bank	Earth work Maintenance	Rehandling of spoil	Resectioning	Total
1	1985-86	0	0	0	0	0
2	1986-87	0	0	0	0	0
3	1987-88	0	0	0	0	0
4	1988-89	0	0	0	0	0
5	1989-90	0	0	0	0	0
6	1990-91	0	0	0	0	0
7	1991-92	0	0	0	0	0
8	1992-93	0	0	0	0	0
9	1993-94	0	0	0	0	0
10	1994-95	0	0	0	0	0
11	1995-96	0	420200	0	0	420200
Total		0	420200	0	0	420200
Source		<i>Executive Engineer Ther Division Mirpurkhas</i>				

S.no	Year	Reconditioning of Bank	Earth work Maintenance	Rehandling of spoil	Resectioning	Excavation	Total
1	1985-86	0	0	0	0	0	0
2	1986-87	0	0	0	0	0	0
3	1987-88	0	0	0	0	0	0
4	1988-89	0	0	0	0	0	0
5	1989-90	0	100000	0	0	0	100000
6	1990-91	0	0	0	0	0	0
7	1991-92	0	0	0	0	0	0
8	1992-93	0	0	0	0	0	0
9	1993-94	0	152012	0	0	0	152012
10	1994-95	0	0	0	0	0	0
11	1995-96	0	0	0	0	100000	100000
Total		0	252012	0	0	100000	352012
Source		<i>Collected by IIMI's staff at Nawabshah from ID</i>					

Exhibit 4. Statement showing the staff of all categories of Jamrao Division, Mirpurkhas.

	<u>Name of Staff</u>	<u># of staff</u>	<u>Scale B.P.S</u>
1	Executive Engineer	1	18
2	Assistant Engineer	10	17
3	Sub-Engineer	21	11-16
4	Canal Assistant	10	6-7
5	Abdar	49	5-7
6	Darogha/Sub-Darogha	67	4
7	Beldar	283	1-2
8	Tyndel	43	2-3
9	Khalsi	27	1-2
10	Fero Khalsi	1	1
11	Gauge Reader	6	5
12	Telephone Operator	41	5-7
13	Peons	17	1-3
14	Chowkidar	39	1-2
15	Malhi	25	1-2
16	Head Malhi	3	5
17	Driver	7	4-5
18	Launch Driver	1	4
19	Lab. Assistant	1	6
20	Plumber	1	5
21	Electrician	1	5
22	Launch Attendent	2	1
23	But man	2	1
24	Fero printer	1	5
25	Government Mistri	6	5
26	Dak Runner	1	1
27	Sweeper	7	1
28	Malhi Cooli	11	1
29	Khansama	1	5
30	Cook	2	2

**Executive Engineer
Jamrao Division**

Exhibit 5. Name of Sub-divisions under Jamrao Canal.

- 1 Khadro Sub-Division-I
- 2 Khadro Sub-Division-II

- 3 Jhul Sub-Division-I
- 4 Jhul Sub-Division-II

- 5 Mirpurkhas Sub-Division-I
- 6 Mirpurkhas Sub-Division-II

- 7 Kot Ghulam Mohammad Sub-Division-I
- 8 Kot Ghulam Mohammad Sub-Division-II

- 9 Digri Sub-Division-I
- 10 Digri Sub-Division-II

Exhibit 6. Statement showing the Name and Number of Distributaries in Jamrao-Division.

- 1 D.Os Ex: Nara canal
- 2 D.Os Ex: Jamrao canal
- 3 Sadrat Minor I
- 4 Feeder Ex: Sadrat Minor
- 5 Sadrat Minor No: II
- 6 Mohammad Khan Feeder Ex: Sadrat II
- 7 Jam Sahib Minor
- 8 D.Os Ex: Dim Branch
- 9 Rawatiani Minor
- 10 Hyderi Minor
- 11 Bhiri Minor
- 12 Chundan Minor
- 13 Sanghar Minor
- 14 Shahdad Minor
- 15 Mohammad Ali Wah
- 16 Mahi Minor
- 17 Rind Minor
- 18 Sinjhoru Minor
- 19 D.Os Ex: Shahu Branch
- 20 Duthro Minor Ex: Shahu
- 21 Kunro Minor
- 22 Bitoor Minor
- 23 Liari Minor
- 24 Sarki Minor
- 25 Bijar Minor
- 26 Jhol Minor
- 27 Bhiri Minor
- 28 Thahim Minor
- 29 Tail Minor
- 30 Duthro Minor
- 31 Delore Distry
- 32 Patayon Distry
- 33 Mari Minor
- 34 D.Os Ex: West Branch
- 35 Delore Minor
- 36 Lakhaki Distry
- 37 Mithro Minor
- 38 Bhitaro Minor

Exhibit 6. (page 2 of 2).

- 39 Sangro Distry
- 40 Jarwar Minor
- 41 Chahu Minor
- 42 Daulat pur Minor
- 43 Bellaro Distry
- 44 Khumbri Minor
- 45 Nir Minor
- 46 Gorchani Minor
- 47 Digri Distry
- 48 Digri Minor
- 49 Photo Minor
- 50 Murid Distry
- 51 Murid Minor
- 52 Khatian Minor
- 53 Tando Minor
- 54 Mirpur Distry
- 55 Piro Minor
- 56 Mirpur Minor
- 57 Doso Dhararo Minor
- 58 Old Doso Minor
- 59 Kahu Minor
- 60 Kahu Visro Minor
- 61 Sanhro Minor
- 62 Sanhro Minor
- 63 Bareji Distry
- 64 Puran Distry
- 65 Puran Feeder
- 66 Puran Minor
- 67 Dabko Minor
- 68 Dangan Distry
- 69 Daleri Distry
- 70 Daleri Minor
- 71 Jamsabad Minor
- 72 Jurissar Distry
- 73 Barar Minor
- 74 Dajhoro Minor
- 75 Budhani Minor
- 76 Lakho Minor
- 77 Silore Distry
- 78 Bagi Minor

Table 10. Statement Showing the Year-wise Expenditures Under the Head of Establishment of Jamrao Division.

Year	In Rs Estb. Expenditure	Per CCA Acre
85-86	4075500	4.45
86-87	5257896	5.74
87-88	5781624	6.32
88-89	7380588	8.06
89-90	7884192	8.61
90-91	8303940	9.07
91-92	10179948	11.12
92-93	12746868	13.93
93-94	14106072	15.41
94-95	16461876	17.99
95-96	19148628	20.92
Mean	10120648.36	11.06
Per CCA ha		28

Table 11. Extract from Annual Administration Report of Jamrao Division.

S.no	Year	Abvaya (K)	Abvaya (R)	Other rev	Total rev	Capital	Ext. imp	M&R	E&I+M&R	Total exp	Surplus/deficit	
1	1993-94	12288536	3222595	0	20511131	40901685	1947326	6067259	8014585	48916270	-28405139	
2	1991-92	10826075	496142		18322217	7975166	633935	16908939	17342874	25518040	-7195823	
3	1990-91	10769891	7113901	469796	18353588	1040512	1656841	83174446	9831287	13871799	4481789	
4	1989-90	11147947	6658986	799106	18606039	4682553	1891115	8513862	10404977	15087530	3518509	
5	1988-89	11194441	7292713	932201	19419355	0	2040627	9395700	11436327	11436327	7983028	
6	1987-88	11249687	7205715	610090	19065492	2863257	4061082	9459049	1320131	16383388	2682104	
7	1986-87	11573904	7218793	698200	19490897	320787	1818920	9412210	11231130	11531917	7938980	
8	1985-86	10253350	6706282	616332	17575964	1308064	1117293	10187318	11304611	12612675	4963289	
9	1984-85	10469396	6329763	740506	17739665	19190624	1557319	8308139	9865458	29056082	-11316417	
10	1983-84	10140138	6547593	676391	17364122	16944189	1456827	6396109	7852936	24797125	-7433003	
Summary												
	Mean	10991336.5	7099248.3	615846.8889	18644847	9822683.7	1818128.5	9282303.1	11100432	20923115.3	-2278268.3	
	Max	12288536	3222595	932201	20511131	40901685	4061082	16908939	17542874	48916270	7983028	
	Min	10140138	6529763	0	17364122	0	633935	6067259	7852936	11436327	-28405139	
	Sum	109913365	70992483	5842622	186448470	98226837	18181285	92823031	111004316	209231153	-22782683	
	Per CCA acre	12.01	7.76	0.67	20.37	10.73	1.99	10.14	12.13	22.86	-2.49	
	Per CCA ha	30.02	19.39	1.68	50.93	26.83	4.97	25.36	30.32	57.15	-6.22	
Length of Channel and per km expenditure(JAMROA)												
S.no	Year	Main Canal	Branches (km)	Mjr distry	Mnr distry (km)	Supply	Escapage (km)	Total (km)	Rev/km	M&R/km	Est. Imp/km	Capital/km
1	1993-94	209.46	168.01	285.4	345.3	31.7	31.7	1039.87	19724.70693	5834.6322	1872.662929	2073.627007
2	1991-92	209.46	168.01	285.36	344.62	31.7	31.7	1039.15	17631.92706	16271.894	610.0514844	452.3139175
3	1990-91	209.46	168.01	285.36	344.62	31.7	31.7	1039.15	17662.11615	7866.4736	1594.419477	228.7671514
4	1989-90	209.46	168.01	285.36	344.62	31.7	31.7	1039.15	17905.05606	8193.1021	1819.867199	261.2512701
5	1988-89	209.46	168.01	285.36	344.62	31.7	31.7	1039.15	18687.73036	9041.7168	1963.746331	0
6	1987-88	209.46	168.01	285.36	344.62	31.7	31.7	1039.15	18347.19915	9102.6791	3908.080643	156.0596239
7	1986-87	209.46	168.01	285.36	344.62	31.7	31.7	1039.15	18756.57701	9057.6048	1750.392147	17.10264084
8	1985-86	209.46	168.01	285.36	344.62	31.7	31.7	1039.15	16913.78915	9803.5106	1075.198961	77.33713528
9	1984-85	209.46	168.01	285.36	344.62	31.7	31.7	1039.15	17071.32272	7993.1297	1498.646971	1124.143941
10	1983-84	209.46	168.01	285.36	344.62	31.7	31.7	1039.15	16709.92831	6155.1354	1401.941009	1014.012552
Summary												
	Mean	209.46	168.01	285.364	344.688	31.7	31.7	1039.222	17941.03529	8932.1879	1749.300715	540.4891939
	Max	209.46	168.01	285.4	345.3	31.7	31.7	1039.87	19724.70693	16271.894	3908.080643	2073.627007
	Min	209.46	168.01	285.36	344.62	31.7	31.7	1039.15	16709.92831	5834.6322	610.0514844	0

Table 12. Irrigation Works (E&I + M&R) Costs in 1996 Rs.

Year	Works Distributa Rs	Works 1996 Rs	Per CCA Rs/ha	Works Division Rs	Works 1996 Rs	Per CCA Rs/ha
85-86				1.1E+07	1.1E+07	22.6901
86-87				1.1E+07	1.1E+07	23.5612
87-88	92545	92545	18.1207	1.4E+07	1.5E+07	31.0902
88-89	79082	86685.5	16.9734	1.1E+07	1.4E+07	28.5563
89-90				1E+07	1.3E+07	27.657
90-91	49248	62399	12.218	9831287	1.4E+07	29.5466
91-92	57168	81898.4	16.0361	1.8E+07	2.8E+07	58.0329
92-93						
93-94				8014585	1.5E+07	32.5164
94-95						
95-96						
Mean			16			32

Table 13. Establishment Costs, 1986-95.

Year	Establishm Distributary	Establishm 1996 Rs	Establishm Division	Establishm 1996 Rs	Per CCA Acre
86-87	55002	55002	5257896	5257896	5.744934
87-88	64086	70247.68	5781624	6337510	6.924553
88-89	75720	90126.41	7380588	8784811	9.598547
89-90	79326	100508.9	7884192	9989557	10.91489
90-91	90540	129706.9	8303940	11896156	12.9981
91-92	109086	172015.8	10179948	16052583	17.53953
92-93	123030	210823.5	12746868	21842956	23.86627
93-94	132378	256013.8	14106072	27280583	29.80758
94-95	147888	326507.7	16461876	36344597	39.71119
95-96	164532	400678	19148628	46631861	50.95137
Mean	99287	169093	10120648	17665257	19

Division Estt = Estt above distry + Estt below distry

48 = 18 + 30

Table 15. Operation & Maintenance Costs
(Based on Yard Stick and Actual Establishment).

Year	GDP-Deflator	Index	Per CCA acre of Irrigation O&M W/o Estt	Per acre Establishment	Total Per CCA acre O&M Cost of Irrigation W/ Estt	Total per CCA acre Irrigation & Drainage O&M w/o Estt	Total Per CCA acre O&M of Irrigation & Drainage W/ Estt
86-87	142	1	25	4	30	38	42
87-88	156	1.1	28	6	33	42	47
88-89	170	1.2	30	6	36	45	52
89-90	181	1.3	32	8	40	48	56
90-91	204	1.4	36	9	45	54	63
91-92	225	1.6	40	9	49	60	69
92-93	244	1.7	43	11	54	65	76
93-94	276	1.9	49	14	63	74	87
94-95	315	2.2	56	15	71	84	99
95-96	347	2.4	61	18	79	93	111
<i>1995-96 Per CCA hacter basis</i>			<i>153</i>	<i>45</i>	<i>198</i>	<i>232</i>	<i>276</i>

ANNEXURE D

REVENUE ASSESSED AND RECOVERED

Table 16. Deh-wise acres at Bareji Distributary, Mirpurkhas.

S.no	Deh #	Total Land (acres)	
1	137	2886.9	
2	224	1090.725	
3	225	1896.875	
4	226	1174.825	
5	227	1247.05	
6	228	1511.5	
7	229	775.25	
8	236	977.725	
9	237	1637.55	
10	238	1305.175	
11	239	1984.1	
12	240	1730.1	
Sum		18217.775	<i>Some of the Deh area in Bareji Distry overlaps with neighbouring area.</i>

Source: Mukhtiarkar Office, Mirpurkhas.

Table 17. Analysis of Revenue Assessed and Recovered for Barejji Distributary.

Summary for Last 11 years		Tot.Acrs		Cult. Acr		%Cult.		Abi.Ase		Abi.Rec		Abi% Rec.		Abi/a Ase		Abi/a Rec		Ot.Rv Ase		Ot.Rv Rec		Ot.%Rec		Tot.Rv.Ase		Tot.Rv.Rec		% Tot.Rec		P/a Rv Ase		P/a Rv Rec	
1985-86	18216.7	10244.87	56%	300218	234889	78%	29.30	27.93	56932	49137	86%	357130	384046	80%	34.86	27.73																	
1986-87	18216.7	10914.275	60%	320709	320709	100%	29.38	29.38	72755	75194	103%	393464	395903	101%	36.05	36.27																	
1987-88	18216.7	9356.475	51%	273234	273234	100%	29.20	29.20	62341	62341	100%	335575	335575	100%	35.87	35.87																	
1988-89	18216.7	9259.95	51%	265144	93035	35%	28.63	10.05	65270	40670	62%	330414	133705	40%	35.68	14.44																	
1989-90	18216.7	8078.475	44%	242565	225749	93%	30.03	27.94	83107	79607	96%	325672	305356	94%	40.31	37.80																	
1990-91	18216.7	7944.4	44%	241369	79841	33%	30.38	10.05	104835	55153	53%	346204	134994	39%	43.58	16.99																	
1991-92	18216.7	8414.65	46%	241621	243124	101%	28.71	28.89	96914	126914	131%	338535	370038	109%	40.23	43.98																	
1992-93	18216.7	7813.8	43%	224669	3658	2%	28.75	0.47	140772	22329	16%	365441	35987	7%	46.77	3.33																	
1993-94	18216.7	8462.425	46%	253950	302636	119%	30.01	35.76	242769	285264	118%	496719	587900	118%	58.70	69.47																	
1994-95	18216.7	8781.625	48%	325958	198873	61%	37.12	22.65	269486	161522	60%	595444	360395	61%	67.81	41.04																	
1995-96	18218.0	10766.95	59%	420882	425856	101%	39.09	39.55	132445	132445	100%	553327	558301	101%	51.39	51.85																	
Consolidated Analysis for 11 years																																	
Sum	200385.04	100037.9	50%	3110319	2401604	77%	31.09	24.01	1327626	1090596	82%	4437945	3492200	79%	44.36	34.91																	
Mean	18216.821	9094.3541	50%	282756.27	218327.64	75%	30.97	23.35	120693.27	99145.0909	84%	403449.545	317472.727	77%	44.66	34.43																	
Max	18218.035	10914.275	60%	420882	425856	119%	39.09	39.55	269486	285264	131%	595444	587900	118%	67.81	69.47																	
Min	18216.7	7813.8	43%	224669	3658	2%	28.63	0.468	56932	22329	16%	325672	25987	7%	34.86	3.33																	
Notes:	Recovery above 100% indicates arrears recovered in that year																																
Total No. of Dehls in Barejji are 12 some of which overlaps with other command area																																	
Source	Mukhtarkar office Mirpurkhas																																

Table 18. Statement Showing Cropwise Cultivation figures Kharif&Rabi for year with Assessed Abiana Recovered through Revenue Dept. (three years).

Item/Year	1993-94	1994-95	1995-96			
Kharif data						
Cotton Cult acr	1417	1078	1004			
Jantar (fodder) acr	1250	704	1776			
Chillies acrs	316	473	612			
S.cane acr	617	382	461			
Rice acr	100	2	46			
Banana	0	8	0			
Jawar acr	100	0	154			
Oil seed acr	0	0	0			
Kacha Garden acr	301	283	0			
Vegetables	0	0	6			
Pakka Garden acr	94	46	433			
Total acrs	4195	2976	4492			
Abiana recovered	187058.3	155517.28	255828.45			
Per acre abiana	44.59077473	52.2571505	56.9520147			
Rabi data						
Wheat acrs	2554	2356	2103			
Barseem (fodder)	495	305	574			
oil seed	0	23	23			
Onion acrs	19	228	516			
Vegetable acrs	0	22	0			
Hurries	0	7	8			
Banana	0	8	0			
Kacha Garden acr	330	142	0			
Pakka Garden acr	49	228	424			
Total acrs	3447	3319	3648			
Abiana recovered	102734.2	129308.51	194092.9			
Per acre abiana	29.80394546	38.9600813	53.2052906			
Total acrs cult. for year	7642	6295	8140			
Total abiana year	289792.50	284825.79	449921.35			
Per acre for year	37.92	45.25	55.27			
Source	Assistant Executive Engineer Assessment Sub-Division Mirpurkhas.					

**Table 19. Abiana Assessed for Bareji Distributary Based on per acre Rates Provided by GoS (three years)
And Crop wise cultivation provided by Assistant Executive Engineer, Assessment Sub-division, Mirpurkhas.**

Item/Year	1995-96			1994-95			1993-94		
		Rate/Acr	Abi. Asse		Rate/Acr	Abi. Asse		Rate/Acr	Abi. Asse
Kharif data									
Cotton Cult acr	1004	64.75	65009	1078	51.78	55818.84	1417	45.03	63807.51
Jantar acr (fodder)	1776	27.7	49195.2	704	22.14	15586.56	1250	19.25	24062.5
Chillies acrs	612	52.4	32068.8	473	41.9	19818.7	316	36.44	11515.04
S.cane acr	461	126.5	58316.5	382	101.2	38658.4	617	88	54296
Rice acr	46	61.75	2840.5	2	49.4	98.8	100	42.96	4296
Banana	0	98.85	0	8	79.06	632.48	0	68.75	0
Jawar acr	154	27.7	4265.8	0	22.14	0	100	19.25	1925
Oil seed acr	0	37.05	0	0	41.9	0	0	36.44	0
Kacha Garden acr	0	98.85	0	283	79.06	22373.98	301	68.75	20693.75
Vegetables	6	98.85	593.1	0	79.06	0	0	68.75	0
Pakka Garden acr	433	98.85	42802.05	46	79.06	3636.76	94	68.75	6462.5
Total acrs Kharif	na	na	4492	na	na	2976	na	na	4195
Mean rate/Acre(K)	na	na	72.113636	na	na	58.790909	na	na	51.124545
Abiana Assessed	na	na	255090.95	na	na	156624.52	na	na	187058.3
Abiana recovered	na	na	255828.45	na	na	155517.28	na	na	187058.3
Per Acre Assesses	na	na	56.787834	na	na	52.629207	na	na	44.590775
Per Acre Recovered	na	na	56.952015	na	na	52.257151	na	na	44.590775
Rabi data									
Wheat acrs	2103	37.05	77916.15	2356	29.65	69855.4	2554	25.78	65842.12
Barseem (fodder)	574	37.05	21266.7	305	22.14	6752.7	495	19.25	9528.75
oil seed	23	37.05	852.15	23	41.9	963.7	0	36.44	0
Onion acrs	516	98.85	51006.6	228	79.06	18025.68	19	68.75	1306.25
Vegetable acrs	0	98.85	0	22	79.06	1739.32	0	68.75	0
Ilurries	8	37.5	300	7	15.02	105.14	0	13.06	0
Banana	0	98.85	0	8	79.06	632.48	0	68.75	0
Kacha Garden acr	0	98.85	0	142	79.06	11226.52	330	68.75	22687.5
Pakka Garden acr	424	98.85	41912.4	228	79.06	18025.68	49	68.75	3368.75
Total Acres rabi	na	na	3648	na	na	3319	na	na	3447
Mean rate/Acre(R)	na	na	71.433333	na	na	56.001111	na	na	48.697778
Abiana Assessed	na	na	193254	na	na	127326.62	na	na	102733.37
Abiana recovered	na	na	194092.9	na	na	129308.51	na	na	102734.2
Per Acre Assesses	na	na	52.975329	na	na	38.362947	na	na	29.803705
Per Acre Recovered	na	na	53.205291	na	na	38.960081	na	na	29.803945
Total acrs Cult. for year	na	na	8140	na	na	6295	na	na	7642
Cult % chg from last yr	na	na	0.2930898	na	na	-0.176263	na	na	na
Mean rate/Acre(Y)	na	na	71.773485	na	na	57.39601	na	na	49.911162
% Rate chg from last yr	na	na	0.2504961	na	na	0.1499634	na	na	na
Abiana Assessed(Y)	na	na	448344.95	na	na	283951.14	na	na	289791.67
Abiana recovered (Y)	na	na	449921.35	na	na	284825.79	na	na	289792.5
Difference (%)	na	na	-0.003516	na	na	-0.00308	na	na	-2.864E-06
Per Acre Assesses(Y)	na	na	55.08	na	na	45.11	na	na	37.92
Per Acre Recovered(Y)	na	na	55.27	na	na	45.25	na	na	37.92
P. acr % chg in a Yr	na	na	22%	na	na	19%	na	na	na

**Table 20. Summary of Abiana Assessed that was recovered for Bareji Distributary.
Based on per acre rates provided by GoS.**

	1995-96	1994-95	1993-94
Total acrs Cult.for year	8140	6295	7642
Cult % chg from last yr	0.293089754	-0.176262758	na
Mean rate/Acre(Y)	71.77348485	57.3960101	49.911162
% Rate chg from last yr	0.250496066	0.14996342	na
Abiana Assessed(Y)	448344.95	283951.14	289791.67
Abiana recovered (Y)	449921.35	284825.79	289792.5
Difference (%)	-0.003516043	-0.003080283	-2.86E-06
Per Acre Assessed(Y)	55.1	45.1	37.9
Per Acre Recovered(Y)	55.3	45.2	37.9
P. acr % chg in a Yr	22%	19%	na

Table 21. Revenue Assessed and Recovered of Heran Distributary (Deh-wise acre Data 1987-1996).

DEH	ITEM	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	Sum
Mithrao	Non-cul	11240	11341	11322	11545	12136	10317	10930	10930	10668	11068	100257
	Cul.land	4523	4424	4443	4220	3629	5448	4835	4835	5097	4697	41628
	Land Rev	na	328	333	336	342	349	113	113	130	130	2174
	Abiana	na	160726	161567	162139	162354	162512	154593	178715	208522	245852	1596980
	Mut.Fess	na	1075	975	1520	1705	2180	8848	8128	200	150	24781
	Local.ces	na	28671	29065	29216	58003	57944	57455	50660	58470	54470	423954
	W.mgmt	na							29140	51790	69898	150828
	Usher	62026	62488	35607	46421	39524	39850	17000	3240	35000	39390	318520
	Total	na	253288	227547	239632	261928	262835	238009	269996	354112	409890	2517237
	Abian.PA	na	36.33	36.36	38.42	44.74	29.83	31.97	36.96	40.91	52.34	
Khadwari	Non-cul	4377	4319	4193	4365	4621	4615	4606	3972	4127	2127	36945
	Cul.land	4434	4492	4618	4446	4190	4196	4206	4839	4684	4684	40355
	Land Rev	na	4005	4106	5214	2165	2173	5805	5979	5571	5570	40588
	Abiana	na	192211	192404	192658	192665	192757	186643	207117	212736	255920	1825111
	Mut.Fess	na	7404	598	1625	3165	30595	7310	7500	150	80	58427
	Local.ces	na	34895	34755	33605	63040	63139	60425	54179	53140	53140	450318
	W.mgmt	na							67628	147542	46934	262104
	Usher	77720	78152	52476	56576	53455	51750	11900	40000	41100	51920	437329
	Total	na	316667	284339	289678	314490	340414	272083	382403	460239	413564	3073877
	Abian.PA	na	42.79	41.66	43.33	45.98	45.94	44.38	42.80	45.42	54.64	
Kundho	Non-cul	1968	1504	2590	2084	2210	2251	2252	2516	2367	2374	20148
	Cul.land	4363	4827	3741	4247	4121	4080	4079	3815	3964	3957	36831
	Land Rev	na	4562	4599	4618	4788	4840	4733	5025	4720	4725	42610
	Abiana	na	190225	190944	191037	191092	187285	189284	204027	282448	314781	1941123
	Mut.Fess	na	1110	810	80	634	3210	1575				7419
	Local.ces	na	27467	27905	27925	56040	56200	56226	53430	55750	55680	416623
	W.mgmt	na							16623	36624	25693	78940
	Usher	72874	75016	45279	49465	48203	49310	24137	43435	44435	47183	426463
	Total	na	298380	269537	273125	300757	300845	275955	322540	423977	448062	2913178
	Abiana.PA	na	39.41	51.04	44.98	46.37	45.90	46.40	53.48	71.25	79.55	

Table 21. (Pg 2 of 2).

Dim	1705	2128	2113	2052	2376	1643	1910	2009	1886	2190	18307
Non-cul	2982	2559	2574	2635	2311	3044	2777	2678	2801	2497	23876
Cul.land	na	2276	2405	1846	2408	1621	2413	1770	1840	1850	18429
Land Rev	na	101229	102545	101899	102959	98181	103044	109210	125591	145890	990548
Abiana	na	168	142	560	150	340	20531	1430	60	60	23441
Mut.Fess	na	15862	18088	18050	34970	36110	35090	26780	25130	32170	242250
Local.ces	na							28558	21033	17857	67448
W.mgmt	na							30815	33350	36350	295137
Usher	62029	62488	24397	38411	22076	32920	14330	30815	33350	36350	295137
Total	na	182023	145172	158920	160155	167551	172995	196793	205164	232327	1621100
Abian.PA	na	39.56	39.84	38.67	44.55	32.25	37.11	40.78	44.84	58.43	
Bakhor											
Non-cul	3523	3374	3516	3425	3448	3524	3769	4451	4054	4150	33711
Cul.land	2620	2769	2627	2718	2695	2619	2374	1692	2089	1993	21576
Land Rev	na	6472	7825	7746	7894	6483	8515	6490	5989	5988	63402
Abiana	na	101224	102748	102687	103752	101368	102908	97992	118413	131055	962147
Mut.Fess	na	320	6221	340	218	11569	3029	4121	300	90	26208
Local.ces	na	19282	19470	18711	35611	33057	35157	24278	27410	26630	239606
W.mgmt											0
Usher	49076	49734	34271	36146	24852	35677	10340	21000	21900	26900	260820
Total	na	177032	162710	157884	164433	181671	151434	147391	168023	-184675	1495253
Abian.PA	na	36.56	39.11	37.78	38.50	38.70	43.35	57.91	56.68	65.76	
Total Abiana for last 9 years			7315909								
Total Land cultivated for last 9 yrs			164260								
Average per acre abiana for last 9 yrs			44.54								

Table 22. Taxes and Cesses for Kharif and Rabi 95/96 (consolidated).

SN	LOS	UATK	RCTK	MCTK	TTPK
101		7500	M	M	7500
102		18000	M	400	18400
103		1000	M	500	1500
104		1229	M	4000	5229
105		11000	M	2155	13155
106		10000	M	610	10305
107		1800	M	2000	3800
108		1500	M	2300	3800
109		4500	M	10500	15000
110		2000	M	1600	3600
111		6000	M	4400	10400
112		5000	M	3800	8800
113		1500	M	M	1500
114		5500	M	4000	9500
115		6000	M	4000	10000
116		600	M	2700	3300
117		3000	M	M	3000
118		3000	M	M	3000
119		6000	M	5200	11200
120		2000	M	4500	6500
121		15000	M	4000	19000
122		15000	M	5000	20000
123		4000	M	5500	9500
124		M	M	2000	2000
Sum		131129		69165	199989
Acres cultivated in a year					
for sample (771 +514.5)					
		1285.5		1285.5	1285.5
Per acre				53.80	155.57

ANNEXURE E

IRRIGATION AND DRAINAGE O&M REQUIREMENTS

**Table 23. Consolidated Statement of Reasonable Requirements
for Operation & Maintenance of Irrigation Infra-Structure.**

	Facility	Qty: or No.	Unit Yard-Stick Rate	Amount (Million) Rs.	Remarks.
1	IRRIGATION (6-520) WORKS.				
	Flow Irrigation (Including Irrigation colonies).	14865 Virtual miles.	13333	198.195	
	II. Repair & Replacement of Barrage Gates & other E & I Works.	.05 X 1659		82.95	
2	Life Irrigation (Small Irrigation Schemes):-				
	(a) On River.	1750 H. Power	4963	8.685	
	(b) On Canals.	3155 H. Power	4834	15.251	
3	Flood Embankments:-				
	(a) Main Bunds (River).	935	27470	25.684	
	(b) Loop Bunds (River)	339	21131	7.164	
	(c) Hill Torrent Bunds	198.5	19967	3.963	
		<u>1472.5</u>			
	(d) M & R Kinjher Lake (Bund).	12.5	54940	0.687	At twice the Yard-Stick Rate of Mian River Bund.
			Total Irrigation ((6-520)	<u>342.579 million.</u>	
	LAND RECLAMATION (6-520) WORKS.				
	SCARP Tubewells.	3101 Nos.	1782 per H.P.	113.587	See Annexure-VI.
	SCARP & other Pumps.	172 Pumps	1719 " " "	12.429	
	SCARP & Other Surface Drains	4018.7 Virtual miles.	7585 per V: mile.	2.734	
	SCARP Colonies.	11 Nos.	Varies.	159.24	
			Sub Total:	<u>188.784</u>	
	II. Add 10% Provision for E & I and othr works			15.924	
	Total Land Reclamation (6-530)			<u>Rs. 175.164 million</u>	
	Therefore GRAND TOTAL IRRIGATION & LAND RECLAMATION.			Rs. 517.743 million	
	Now C.C.A. of three barrages including Inundation, Canals & Life Irrigation Schemes.		13.615	million acres.	
	Therefore Rate per Acre of C.C.A. (with Drainage cover)		Rs. 38.03		
	Therefore Rate per Acre of C.C.A. (without Drainage cover)		Rs. 25.16		

Table 24. LBOD-Stage I Project Estimated Annual Recurrent (O&M) Costs*
Subareas and Overall Stage I Project (MID-1984 Constant Prices)

Cost Item	Spinal Drain & Outfall System**		Nawabshah Subarea		Sanghar Subarea		Mirpurkhas Subarea		Stage I Project		
	No.	Rs(000)	No.	Rs(000)	No.	Rs(000)	No.	Rs(000)	No.	Rs(000)	US\$(000)
A. Personnel											
1. Supervisory	23	735.6	21	684.8	21	684.8	31	994.3	96	3,099.50	229.6
2. Workshop	23	330.7	28	400.7	28	400.7	34	506.7	113	1,638.80	121.4
3. Maintenance Operatives	192	2790	68	977.3	57	810.9	60	867.1	377	5,445.30	403.3
4. Pump Operators***	-	-	480	6,477.70	527	7,111.50	294	3,954.90	1301	17,554.10	1,299.60
a. Tubewells	-	-	26	350.9	29	391.1	39	526.8	94	1,268.80	94
b. Interceptor Drains	-	-	-	-	-	-	26	350.9	26	350.9	26
c. Tile Drains	-	-	-	-	-	-	-	-	-	-	-
Sub-total	238	3856.3	623	8,891.40	662	9399	484	7,200.70	2,007	29,347.40	2173.9
B. Power****											
Sub-total				25,698.60				30,381.00		112,038.20	8,299.10
C. Other Maintenance											
1. Buildings		44.5		60.4		60.4		76.3		241.6	17.9
2. Maintenance Workshops		68.9		115.5		115.5		116.6		416.5	30.8
3. Fuel & Lubrication		8998.3		2113.6		1660		1992.8		14764.7	1093.7
4. Structures		5753.7		1072.7		875.6		1050.5		8752.5	648.3
5. Spares		18241.6		13865.6		22656.4		23172.7		77756.3	5759.7
6. Switchgear		85.9		113.4		256.5		173.8		543.7	40.3
7. Miscellaneous		28745.1		80.6		80.6		116.6		363.7	26.9
8. Nara Irrigation System										28745.1	2129.3
Sub-total		61938		17241.8		25705		26699.3		131589.1	9746.9
D. Capital Replacement (Average, Years 11-40)		15137		12243		27240		16127		70747	5240.5
TOATAL O&M COST RS(000)		80931.3		64075		118302		80408		343716.3	25460.4
CCA (Cropped Area) 000 ha		516(555)		224(246)		147(202)		145(123)		516(555)	49.3
Rs/ha of CCA		156		286		805		555		666	45.9
Rb/cropped ha		145		260		585		655		620	45.9

* As of about 1995 onwards.

** In event tubewells are automated, personnel costs would be reduced.

*** Based on power tariff of Rs. 0.75 per KWH.

**** O&M cost for Nara system (Nara/Jamrao Canals, Chotiari Reservoir).

Exhibit 7. Status Report on Financial Feasibility Analysis.

This report summarises available evidence relating to:

- Current O & M Expenditures
- Required O & M Expenditures below and above Distributary level
- Current Water Charges Assessment and Recoveries
- Schedule of increases in water charge recoveries to meet full cost recovery in 7 years below Distributary, and 10 years above distributary
- Farmer capacity to pay.
- General Issues Arising
- Issues and recommendations relating to financial plan for Water Users Federations

July 1997
Pakistan National Program
International Irrigation Management Institute

Current O&M Expenditures

Table 1 summarises information gathered from Bareji distributary on actual expenditures over the last 10 years on O&M. Maintenance expenditures were erratic—in some years, nothing was spent—and probably reflect emergency repairs rather than a routine, planned maintenance program. Expenditures on Establishment form a relatively high proportion of total costs, a common phenomenon as O&M funding is squeezed and the fixed costs of staff cannot be adjusted. Data were adjusted to 1996 rupees using the Retail Price Index. Costs of establishment were cross-checked with data on actual staffing levels and known pay scales, and are consistent.

Table 1. Average Expenditures on Operation and Maintenance 1986-95

(1996 Rupees per hectare CCA)

	Above Distributary	Distributary and Below	Division
Establishment	18	30	48
Works	16	16	32
Total	34	46	80

Chart 1 shows recent records of Abiana assessment and recoveries—low figures correspond to years of crop failure and/of elections. High figures (in excess of 100%) occur after years of poor recovery, when some arrears are collected in addition to current dues. Overall recovery average about 70%, and in recent years amounts to some Rs. 50/ha of CCA>

Require O&M Expenditures below and above Distributary level

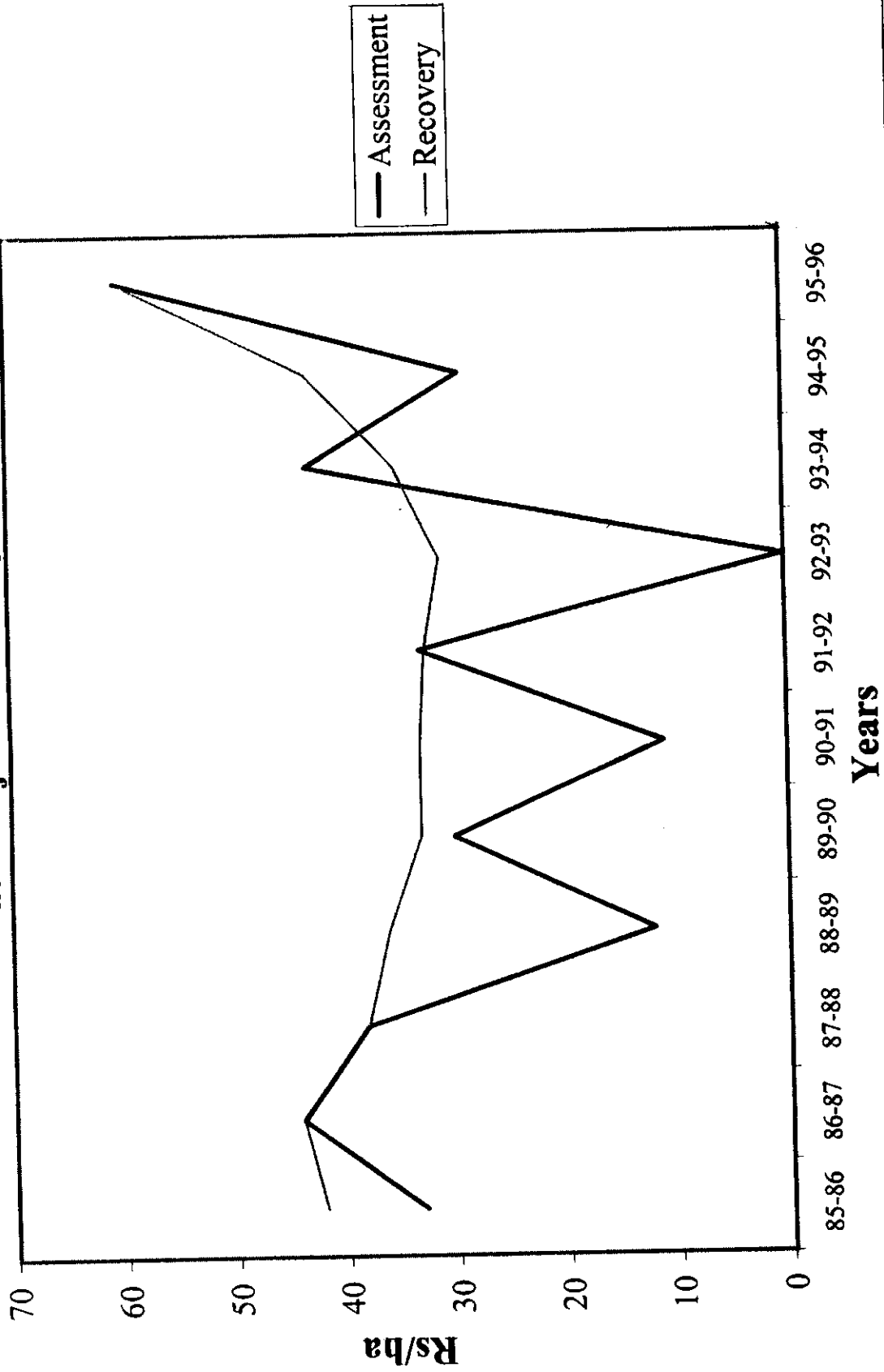
Table 2 shows an estimate of required O&M expenditures to meet maintain the system adequately to give the design service on a continuing basis. The data are based on a 1986 analysis by NESPAK, updated as above to 1996/7 prices. In IIMI's opinion, these figures are a minimum level—a similar study in north India, in a state with similar infrastructure¹ but where costs and wage rates are somewhat higher, indicated costs approximately double those indicated below—but no more detailed analysis on current needs in Sindh is available.

Table 2. Estimated Requirements for O&M Expenditures.

	Above Distributary	Distributary and Below	Division
Establishment	18	30	48
Works	76	76	152
Total	94	106	200

¹ Haryana Water Resources Consolidation Project, World Bank, 1995.

Average Abiana Assessment and Recovery at Bareji Distributary



In order to meet the requirement that water charges (Abiana) should correspond to full Recovery of O&M expenses, a number of assumptions are necessary:

1. Works costs unchanged from "Yardstick" targets
2. Establishment costs above Distributary unchanged from current levels.
3. Establishment costs below distributary are 50% of current levels after turnover
4. O&M reaches required level in 5 years

The rationale for 4, above is somewhat arbitrary, but based on experience in Mexico where after introduction of farmer management, the staffing levels within the farmer-operated areas declined by as much as two thirds, while pay rates for the residual staff increased sharply.

Targets:

Above Distributary: Rs. 91/ha CCA

Below Distributary: Rs. 91/ha CCA

Total: Rs. 185/ha CCA

Table 3, below, shows the schedule of water charges required over a 10-year period. It is assumed that expenditures on O&M rise to the required level over a five-year period. Hence the level of subsidy required initially increases as actual expenditures on O&M expenditures increase faster than farmer contributions.

Table 3. Required Schedule of Water Charges for full recovery of O&M within 7 years (below Distributory), and 10 years (above Distributory).

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cost of O&M											
Above Distributory	34	49	60	68	75	94	94	94	94	94	94
Farmer Share*	74%	76%	79%	81%	84%	87%	89%	92%	95%	97%	100%
Below Distributory	30	27	24	21	18	15	15	15	15	15	15
Establishment	16	28	40	52	64	76	76	76	76	76	76
Works	46	55	64	73	82	91	91	91	91	91	91
Total	54%	61%	67%	74%	80%	87%	93%	100%	100%	100%	100%
Farmer Share*											
Grand Total	80	104	124	141	157	185	185	185	185	185	185
Revenue	50	71	91	109	129	161	169	178	180	183	185
Water Charges	30	33	34	32	28	24	16	7	5	2	0
Subsidy											

* Note: Existing Water Charges of Rs. 50/ha assumed to be divided equally between Above and Below Distributory.

Farmer Capacity to Pay

Various income estimates exist, and they vary widely, as shown in table 4, below.

Table 4. Estimates of gross and net income/ha CCA.

	-----Rs/ha-----	
	Gross	Net
All-Pakistan	9,000	-
LBOD Baseline	13,000	-
IIMI various	8-25,000	4-15,000
Bareji Survey	18,000	12,000

Below, estimates of the proportion of net income which would be absorbed by current and required O&M charges are presented for various levels of net income towards the lower range of the available estimates.

Table 5. Proportion of Net Income Required for Full O&M Recovery.

Net Income (Rs/ha)	Present Charges (Rs 50/ha)	Future Charges (Rs 185/ha)	Of which Cash (Rs 94/ha)
4,000	1.2%	4.6%	2.3%
6,000	0.8%	3.0%	1.5%
8,000	0.6%	2.3%	1.2%

These charges are reasonable, but represent a significant increase over current levels. Even the higher estimates from Haryana would amount to considerably less than 10% of farm income, and farmers note that the present difficulties that are experienced below the distributary level in obtaining supplies correspond in their view to a significant financial cost. Thus the estimates required for full recovery of irrigation O&M are feasible. However, the costs implied by present estimates of drainage maintenance would not be supportable ___ amounting to 25% of the minimum estimated net farm income (and the lower incomes prevail in the areas requiring drainage) It is unlikely that such costs could be recovered in advance of demonstrating the associated benefits.

Issues and Recommendations:

General

- The above recovery levels exclude requirements for drainage infrastructure; WAPDA's present estimate for this (based on 2% of capital costs) are as much as Rs. 1,200/ha (US\$ 30/ha). In this connection it is relevant to note that full O&M of irrigation and drainage infrastructure in Egypt ___ where drainage works are also widespread ___ is \$ 50/ha (IIMI, 1995)
- Should irrigation and drainage service areas be the same?
In most countries, recognising the hydrological distinction between drainage and irrigation service areas, the entities managing the areas are district. This assists in ensuring that beneficiaries of drainage works (who may be at a distance from the infrastructure) are included in cost recovery programs. The present arrangement will cause problems in assigning costs and benefits, and cause difficulties in persuading farmers to pay for works that do not benefit them.
- Availability of accounting data for assessment of water charges.
Government accounts are not designed to facilitate clear definition, by geographical area, of costs of O&M. Rather they reflect administrative boundaries, and the full mix of O&M, construction, rehabilitation, regulatory and other functions that government agencies undertake. It will be necessary to establish new accounting procedures if WUF's are to be billed for services provided above the distributary.
- Definition of service at distributary head and linkage to payments
If WUFs are to pay for service provided, the nature of the service (volume, timing, flow rates, location) must be specified. Further, the penalties for failure to provide service must be set out and means devised for covering shortfalls in revenues due to such failure of services.
- Regulations for supply and charges for water for non-agricultural use.
Extensive water supply and drainage services are provided *within* distributary boundaries for non-agricultural use. How these services (which are often year-round and inconsistent with agricultural schedules) are to be met and paid for requires clarification.
- Drainage and disposal of effluents from non-agricultural use; regulation and enforcement.
As above, with regards to drainage.

- **Funding for emergency repairs**
WUFs will not initially have resources to deal with emergencies. This issue must be addressed in such a way as to avoid giving an incentive to allow infrastructure to collapse and be rehabilitated at government expense.
- **Sinking fund for major rehabilitation/replacements**
As above
- **Rehabilitation requirements and allocation of cost prior to turnover**
The present condition of infrastructure is seriously deteriorated. Hand over must take place with some specification of the responsibilities of the Government and the WUFs regarding rehabilitation, and the agreed standards of rehabilitation.

Issues in respect of WUF Financial Plan

- **Basis for charging at distributary head**
Charges at distributary head should be related to agreed service, with specified penalties for failure to deliver, and premiums for excess deliveries if utilised by farmers.
- **Fixed and variable costs of O&M**
Fixed element of O&M charges should be levied as flat rate/ha of CCA in advance of irrigation season.
- **Basis for charging at watercourse head**
If services at watercourse level is uniform (i.e. no differentiation among watercourses), then basis for charging should be same as at the distributary head.
- **Basis for charging at farm level**
If service at farm level is uniform, then basis for charging should be same as at distributary head. Farmers should be able to trade (sell or exchange) turns, subject to third party objections. Turns of farmers who do not pay will be auctioned on seasonal basis, and redistributed after specified number of years failure to pay.
- **Basis for charging for non-agricultural deliveries**
Non-agricultural deliveries should be charged at premium rates (a multiple of Abiana rates) to reflect the higher level of service provided.

Pilot Project for Farmer-Managed Irrigated Agriculture Under the Left Bank Outfall Drain Stage
I Project, Pakistan

Exhibit 8. Business Plan for Water User Organisations: Framework Document

WORKING DRAFT

December 1996
International Irrigation Management Institute,
Pakistan National Programme

Contents

Background

Purpose of the Business Plan

Emerging Institutional Framework

Definition of Roles and Responsibilities: Current and Future

Planning Horizon

Cost Assessment

Cost Recovery/Revenue Assessment

Project Financial Statements

Assessment of Farm Incomes and Ability to Pay

SWOT Analysis

Training Needs in Financial Management

Monitoring and Evaluation

Further Data Needs and Continued Planning

Background

The irrigated agricultural sector is vital to the economy of Pakistan and as a source of livelihood for the majority of the rural population. Both the Government and donor agencies recognise the need to improve the sector's performance in terms of output, farm incomes and the returns to investment in improved irrigation and drainage infrastructure. To this end major institutional changes are being introduced including promotion of increased involvement by water users in management of irrigation systems.

In Sindh interventions in social organisation at the distributary/minor level are being tested in a pilot project mode. Three pilot projects are being implemented in which Water Users Organisations (WUOs) are being established to operate and maintain irrigation and drainage facilities in distributary canal command areas.

These pilot projects relate closely to wider reforms in the policy and institutional environment for irrigation management. These will involve establishment of Provincial Irrigation and Drainage Authorities (PIDAs) and Area Water Boards (AWBs). PIDAs are intended to be financially autonomous authorities with accountability to Government and the people of the area served. AWBs are to be created under PIDAs to manage irrigation and drainage in designated canal commands. They are expected to be financially self-accounting, with farmers and senior professionals represented on the Board of Directors. Below the AWBs, farmers are to be encouraged to set up user organisations along the lines of the three pilot projects.

Implementation of the pilot projects has been based on a "participatory learning process" for all parties involved. Detailed work plans will emerge as the projects mature and as institutional development of the WUOs takes place, and hence no fixed ideas nor blueprints for implementation have been developed. Formation of the WUOs is at an early stage and their full range of responsibilities, activities and modus operandi, plus their relationship with the Provincial Irrigation and Power Department (IPD) have still to be determined. The key activities here are the development of a "Plan of Action" and conclusion of a "Joint Management Agreement" between each WUO and the IPD concerning its implementation. The agreed plan will relate to the division of responsibilities between the WUO and the agency, and the implementation schedule indicating the priorities for action, and mobilisation of resources. In the pilot projects it is envisaged that Action Plans for Joint Management of the distributaries will be in place by July 1997.

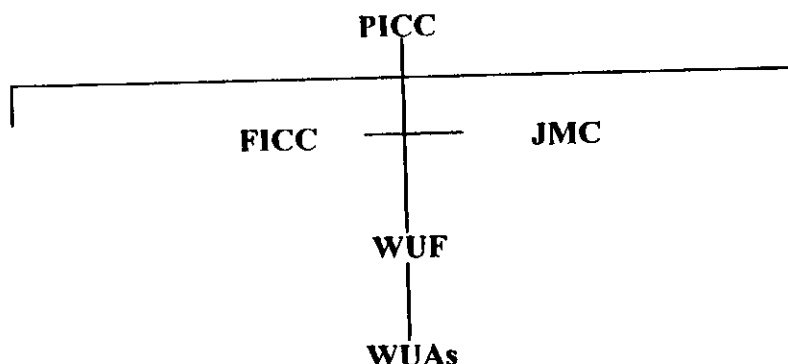
This business plan is thus intended as a working document that will evolve and be sharpened up over time as these institutional arrangements develop. In this initial form its production has concentrated on the development of a number of plausible scenarios that must be considered as only illustrative of the future possibilities. Continuing work will confirm the validity of given scenarios and develop financial planning statements with more accuracy and detail.

Purpose of the Business Plan

It is hoped that WUOs will operate and maintain their distributaries (and minors) and drainage infrastructure, thereby reducing the budgetary requirement of the IPD and improving irrigation performance through the positive effects of direct participation by water users. Specifically it is anticipated that WUOs can achieve a more equitable distribution of water, improved reliability and timeliness of delivery, and through collaboration with the extension department and OFWM increased adoption of improved irrigation and agricultural practices.

The purpose of this business plan is to assist WUOs in the achievement of these goals by developing a framework for sound financial planning and management, including mobilisation of resources and provision for capital replacement. In the short term the business plan will also inform negotiations between WUOs and the IPD regarding the scope, methodology and content of the proposed Action Plan and Joint Management Agreement.

Emerging Institutional Framework



PICC - Project Implementation Co-ordination Committee (Hyderabad)
Objective: to facilitate, monitor and evaluate the pilot projects for farmer managed irrigated agriculture in Sindh.
Membership: WAPDA, P&D - GoS, IIMI, local research organisations

FICCs - Field Implementation Co-ordination Committees (Nawabshah, Sanghar, Mirpurkhas)
Objective: to co-ordinate activities of all involved agencies at field level.
Membership: IPD, LBOD (WAPDA) and O&M Directorate, OFWM, IIMI field office, RADE consultants, Agricultural Extension, WUF representatives.

JMCs - Joint Management Committees
Objective: to agree and co-ordinate joint management of the irrigation and drainage system by IPD and WUOs
Membership: IPD, WUF

WUFs - Water User's Federations

Objective: to manage operation and maintenance of irrigation (and drainage?) facilities at the distributary level.

Membership: water users selected by the membership of WUAs.

WUAs - Water Users Associations

Objective: to manage operation and maintenance of irrigation (and drainage?) facilities at the watercourse level.

Membership: all water users on the watercourse.

WUOs - water users organisations is used to refer to both WUFs and WUAs together.

Definition of Roles and Responsibilities: Current and Future

Development of detailed and accurate business plans for the WUOs will require clear definition of their responsibilities and activities. This is not possible until the following major issues are resolved during the formulation of the Plan of Action and Joint Management Agreements.

1. Clarification of the legal status and authority of WUOs.
2. Commitment from the IPD to ensure current discharges are maintained, without reduction, until WUOs themselves negotiate with the IPD for appropriate changes in cropping intensities and water supplies. This is a vital but difficult issue. Water users express strong determination that current discharges should be maintained and any reduction may compromise their willingness to co-operate with IIMI field staff, yet control of discharge is the primary means for the IPD to exert influence and rent seeking over the landowners on the distributary. Each pilot area is also currently receiving a discharge considerably in excess of design figures, a situation that may not be equitable at the level of the whole system (even after canal re-modelling being completed in the LBOD project).
3. Responsibilities of WUOs for operation and maintenance of irrigation and drainage in the pilot command areas, specifically responsibilities for:
 - essential structural maintenance ESM urgently needed to improve reliability and equity of water distribution;
 - deferred maintenance; maintenance requirements which have accumulated due to long neglect but which can be attended to over time in a systematic manner;
 - regular canal system operations and organisational arrangements for implementing them;
 - mechanisms for monitoring and evaluation.
4. Mobilisation of resources by WUOs: including transfer to them of responsibility for assessment and collection of abiana (water charges), and collection of other contributions from water users as determined by them.
5. A clear transfer process identifying transfer of responsibilities according to a time scale and priorities.

In turn WUOs need to identify the following as a basis for organisation and planning:

- a set of continuing tasks;
- a set of their own rules to guide collective action;
- gainful outputs of collective action of common benefit to all water users;
- a sense of, and mechanisms for, accountability.

Current Irrigation O&M

In the current situation the only involvement of water users in the operation and maintenance of the distributary is the provision of labour for de-silting. Zamindars (landowners) typically provide two of their tenants (haris) as labour for de-silting of only the section of canal that immediately supplies their watercourse. The work may be initiated by water users themselves, or by the IPD, but the labour does not receive payment. Water users comment that this arrangement tends to be treated as a formality and the work is disorganised and not done to the required standard. Use of manual labour alone is often inadequate for the scale of work required and for removing major obstructions. Any de-silting does, however, tend to improve water flow and the practice is more common in tail reach areas. In some cases head reach zamindars may see no need to de-silt the canal and the work on their stretch may be carried out by those from the tail. De-silting of the watercourse is carried out in similar fashion, although the work is done more frequently and effectively.

The IPD regulates the discharge in the distributary and sanctions and monitors the withdrawal of water via the outlets. It should resolve conflicts over water and enforce the warabandi system where necessary. It should also respond to demands for water from water users subject to balancing competing demands during periods of scarcity. Very little maintenance work is in practice carried out at the level of the distributary. Beldars are responsible for routine maintenance which should include minor repairs to inspection paths, removal of fallen trees and other vegetation from the canal, and repair of minor rain and cattle cuts in embankments. The IPD aims to de-silt canals every three years, or less frequently for those with a high velocity of flow. However, small channels with low flow velocities may require silt clearance each year and this is mainly done by the water users themselves as described above. Channel maintenance completed by IPD may include silt clearance and re-sectioning, re-handling of spoil, earthworks and reconditioning of banks, and repair of inspection paths to motorable condition. Such work is done when needed, and not according to a preventative schedule. Gates may be lubricated and painted during the closure period, but other masonry and mechanical repairs to structures are similarly only done when urgently needed.

Future Irrigation O&M

In future it is envisaged that WUFs may take over the following responsibilities from the IPD:

- monitoring and regulation of canal supply in distributaries/minors including conflict resolution;
- identify and attend to maintenance needs of distributaries/minors (with technical assistance from IPD as required, e.g. to maintain channel slope and section);
- cost recovery for the above functions including collection of abiana;
- improve water management and agricultural practices with assistance of OFWM and Agricultural Extension;
- improve maintenance practices for irrigation and drainage facilities with assistance of IPD;

Feasible activities for the WUOs are set out in more detail in the table below.

Irrigation Operation and Maintenance: Feasible Water User Roles and Responsibilities

INFRASTRUCTURE	WATER USER RESPONSIBILITIES
Head regulators	<ul style="list-style-type: none"> • regular inspection and reporting of repair and maintenance needs to IPD, or employment of contractors • greasing of mechanisms
Distributaries	<ul style="list-style-type: none"> • regulation and monitoring of water distribution • regular inspection and minor repairs • vegetation control and clearance • annual de-silting and channel and embankment maintenance • maintenance of inspection path • repair of outlets or report to IPD • collection of water user contributions • collection of abiana including levy to be paid to IPD/PIDA for main system

This list needs to be developed in more detail in the Plan of Action. An illustrative guide to the anticipated process of transfer of responsibilities was given in the pilot project inception report (IIMI 1995). Further detail on the necessary operation and maintenance activities can be derived from the IPD's operation and maintenance manual (Irrigation and Power Department 1993).

Future Drainage Operation and Maintenance

As drainage has only recently been installed on a large scale by the LBOD project water users have had little or no experience in the operation and maintenance of drainage infrastructure. Current discussion with water users indicates that they are not ready to assume responsibility for drainage infrastructure in the immediate future as it is regarded as the responsibility of Government (see also findings of (SDSC 1995)). They are, however, willing to consider this once WUOs and their operation are fully established and they have seen the operation of the drainage. Clearly much depends on the delivery of sustained benefits by the drainage system.

Joint management of the drainage system is an objective of current policy and the Operation and Maintenance Directorate of the LBOD project are working to develop options and modalities in this regard, (WAPDA 1995). They envisage development of drainage beneficiary participation through three main stages or levels: provision of watchmen for pump houses, maintenance of disposal channels, and maintenance of sub-drains; though the last of these may be difficult. Beneficiaries would also monitor performance of the system, including performance of O&M contractors, and report problems to the Directorate. Established WUOs may even be able to employ O&M contractors themselves. It is expected that some form of drainage cess will be levied on beneficiaries though this has yet to be implemented. Participation in drainage O&M as described above would secure partial exemption from such a cess, helping to provide the incentive for such action. The possible future roles and responsibilities of drainage beneficiaries are shown in the table below.

Drainage Operation and Maintenance: Possible Beneficiary Roles and Responsibilities

TECHNOLOGY	POSSIBLE BENEFICIARY RESPONSIBILITIES
Drainage/scavenger well	<ul style="list-style-type: none"> • pump house security • monitor power supply • maintenance of disposal channel • monitor performance of O&M contractor • for scavenger wells, operate and maintain watercourse from well • collection of beneficiary contributions
Interceptor drain	<ul style="list-style-type: none"> • pump house security • monitor power supply • monitor performance of O&M contractor • (optional) operate and maintain watercourse for additional irrigation water supply • collection of beneficiary contributions
Tile drainage	<ul style="list-style-type: none"> • pump house security • manhole security • monitor power supply • maintenance of disposal channel • monitor performance of O&M contractor • monitor tile drain performance (waterlogging) • collection of beneficiary contributions
Surface sub-drains	<ul style="list-style-type: none"> • regular inspection and minor repairs • vegetation control and clearance • de-silting and channel and embankment maintenance • maintenance of inspection path • collection of beneficiary contributions including cess or levy to be paid to O&M Directorate for main system

Issues to be resolved relate to the more diffuse hydrological boundaries for the effects of drainage compared to irrigation supply. It may be difficult to identify all the beneficiaries of a given drainage facility, while these may not be exactly the same as the water users for the nearest distributary. Water users more remote from the drainage may be indifferent to its maintenance and unwilling to participate in joint action. Landowners may be very reluctant to pay a share of the costs of O&M of scavenger wells or interceptor drains if they do not receive a share of the irrigation water pumped. It is also necessary to establish both the ability and willingness to pay for all forms of drainage O&M.

Planning Horizon

This document has adopted a planning horizon from the Rabi 1996/97 season for five years. This season is taken as the starting point because the imminent canal closure period provides an important opportunity to mobilise WUOs by encouraging them to take on the work of channel de-silting in a more organised and effective way. At least three years will be required as a development or management transfer phase, and within five years the full roles of WUOs may be established (5 years may be rather optimistic, experience with irrigation management transfer in other countries suggests at least 10 years may be required for the necessary institution building to take place).

Cost Assessment

Irrigation

Data obtained from the IPD on actual maintenance costs is incomplete and not very useful in attempting to estimate future O&M costs. Data has been obtained for actual expenditure on "maintenance and repairs" for two of the three pilot distributaries. This shows that actual maintenance by the IPD has been minimal and infrequent, while it is likely that expenditure recorded does accurately reflect the real cost of the work done. (Data obtained from the IPD to date and further observations on its usefulness are documented in Appendix 1). It is concluded that for smaller distributaries and minors water users already bear the bulk of actual maintenance expenditure by undertaking the de-silting works described above.

Given this and that WUOs will do the work from now on, for the purposes of planning it is sensible to use water user estimates as the basis for assessing actual future costs. Estimates gained to date have been used in the financial projections shown below and are documented in the list of assumptions given. They focus on the costs of de-silting as this is the main activity that WUOs envisage undertaking and for which they have past experience. In the projections an attempt has been made to progressively include other recurrent costs for O&M, but all estimates will need to be continually revised and improved as the pilot projects progress. In particular, field teams have been instructed to collect detailed data on actual labour contributions and other expenditure for maintenance work conducted by WUOs in the coming closure period, which will provide a sounder basis for future planning.

Attention has so far focused only on the recurrent costs of irrigation O&M as there is no basis for the estimate of future capital investment or replacement. WUOs currently are neither planning, nor believe themselves capable or willing, to undertake major investments in rehabilitation, other than improvement of the condition of the channel itself. (Rehabilitation needs, particularly for head regulators, can be identified from the findings of the "walk-thru" survey (IIMI 1996)).

Other capital expenditure such as establishment of a permanent office or purchase of own equipment such as a tractor or excavator is also not yet envisaged by WUFs in the short to medium term. Provisions for this can be incorporated into the business plan as the WUOs themselves develop and determine their requirements.

More consideration needs to be given to whether it is necessary to establish emergency or contingency funds and water user's views should be sought on this. These funds would be to provide for unexpected operating or maintenance costs during the course of a financial year, for example, floods and canal breaches. Estimates are needed of the actual costs of such events. The impression gained so far is that WUFs may prefer to respond to such events when they happen, as they have in the past, with costs shared on an improved basis to be determined by the WUF, rather than to ask for further contributions from members in advance. This needs to be kept under review.

At present all WUO office bearers express a willingness to act on a voluntary basis. There is also an inevitable tendency, at least initially, for these positions to be dominated by the larger landowners for whom payment may be regarded as relatively insignificant and inappropriate. While these voluntary inputs must be accepted and encouraged initially, experience elsewhere suggests that office bearers are more accountable, reliable and effective when paid for their time. This situation must be kept under review, and office bearers encouraged to adopt a professional approach with, for example, expenses incurred in performing their duties paid by the WUOs.

As a general principle it is recommended that WUOs should be encouraged to keep fixed costs and overheads as low as possible, at least during their development phase.

The potential for WUOs to develop into multi-functional community organisations is recognised by IIMI and by water users. However, none of the WUOs are currently interested in looking that far ahead and no planning for this has been attempted at this stage.

Drainage

Estimates of drainage O&M costs were obtained from the O&M Directorate of the LBOD Stage I project, WAPDA. Figures should be regarded as provisional and illustrative as the Directorate is in the process of assessing actual costs and O&M procedures.

Cost Recovery/Revenue Assessment

WUOs will recover costs/raise revenue from water users in three ways.

1). A subscription or membership fee paid to the watercourse WUA with a proportion forwarded to the WUF. This is primarily to cover routine administration costs of the organisations and to create a sense of commitment to and participation in the organisation. (There has been some initial discussion of this proposal with WUF office bearers and it has been initially well received. Field teams will continue to discuss this with WUFs and appropriate fee levels will emerge, starting from a modest level).

2) Direct recovery of the costs of seasonal maintenance operations, according to the actual costs incurred. Water users will contribute to these costs on a basis to be determined by the WUOs but it is expected that this will be in proportion to the area of land owned or duration of irrigation turn (in practice these are equivalent).

3) Direct collection of abiana from water users, with a proportion of this to be forwarded to the IPD or PIDA for O&M of the main system.

(It is noted that on December 8th 1996 the caretaker Sindh Cabinet decided to amend the Agriculture Income Tax, Stamp Act 1899 and Registration Act 1908. It was decided that the assessment of abiana will revert back to the Revenue Department from the Irrigation Department from kharif 1997. The revenue department will thus be responsible for both assessment and collection of abiana, as was the case prior to kharif 1994. The issue of whether this responsibility can be transferred to the WUOs for the pilot areas needs to be urgently addressed).

Initial assumptions or estimates for 1) and 2) above have been made based on consultation with WUFs and are used in the cash flow projections below. It is well known that assessment and collection of abiana and other land based taxes in Sindh are subject to widespread under reporting and corruption. Attempts have been made to obtain data on assessment and collection for the pilot areas and the information obtained is documented in Appendix 2. For the purposes of planning it is assumed, however, that WUFs, when given responsibility, would collect abiana fairly and accurately according to the official schedule. Abiana figures in the projections below are therefore based on official rates per crop per acre, and an estimate of the cropping pattern in pilot areas based on sample survey data for 1995/96.

Projected Financial Statements

The financial statements developed here are cash flow budgets for the WUOs. As the activities of the WUOs evolve in more detail it may also be useful to prepare balance sheets and trading accounts. Given the uncertainty regarding WUO operations and approximate cost and revenue estimates the cash flows presented here must be considered only illustrative. They have been developed as a spreadsheet model that can be used to test different assumptions and scenarios for the future activities and financing of the WUOs. The figures shown here represent the first run,

but are presented without modification because of limitations on time and available data, and also because they usefully highlight a number of key issues, including the relatively high cost of drainage O&M.

Assumptions made in preparing cash flow projections:

1. Projections are for Heran Distributary and Khadwari Minor using available data for this pilot area. Similar projections need to be made using the same spreadsheet model for the other two pilot areas.
2. Although Heran and Khadwari have agreed to work closely together, water users from Khadwari have emphasised that they want to have their own association and manage their own affairs. It was thus thought necessary to prepare separate projections for each. In addition water users currently envisage allocating the costs of O&M of irrigation and drainage infrastructure to the watercourse and WUA where that infrastructure is located. For example, each WUA will be responsible for maintaining its reach of the distributary, i.e. the upstream reach from that watercourse to the next (or head regulator). The need for some adjustment is recognised, for example, a watercourse with lower costs contributing to one with higher costs, but the potential for inequities and conflicts is clear. This is particular so in the case of drainage, see examples below.
3. The projections are based on 1996/97 prices with inflation taken to be 10% per year.
4. The first table shows an illustrative cash flow for a typical WUA at the water course level. There are assumed to be 23 water users on the watercourse, the total number for Heran and Khadwari (718) divided by the number of outlets (31).
5. Water users are assumed to pay a subscription of Rs100 per season to the WUA.
6. Watercourse operation and maintenance consists of de-silting and other minor works on the watercourse channel. The cost estimate is derived from survey data and the contribution by each water user is made only in the form of labour (haris), equivalent to Rs800 per season.
7. General administration costs for the WUA are assumed to be Rs1000 per season. This estimate needs to be reviewed and updated.
8. The WUA passes on a subscription of Rs1000 per watercourse to the WUF. This figure was suggested by WUF office bearers in the Nawabshah pilot area, but needs to be reviewed and determined by water users in each area.
9. The second and third tables show illustrative cash flows for the Heran and Khadwari WUFs.
10. Income initially consists of the subscription received from each watercourse plus contributions in the form of labour and cash for seasonal de-silting and other maintenance for the distributary or minor. The latter figures are based on rough estimates made by the WUFs (see detail in Appendix 1) but are very uncertain at this stage. Khadwari water users hired an excavator to de-silt their minor in October 1996. It is assumed that less work will be needed in the closure this rabi so the cost has been taken at 30% of that estimated for Heran in the first season. The full cost is assumed for subsequent seasons. A higher cost, the cost of de-silting by excavator is assumed for rabi 1998/99. Khadwari has a high rate of siltation and water users there suggest that they might hire an excavator for this work every three years.

This information is very uncertain at this stage but is illustrative of the type of detail that needs to be developed. Apart from these points the same de-silting costs have been assumed for rabi and kharif season for both Heran and Khadwari. De-silting during kharif takes place on a more ad hoc basis during rotational closures. Costs may in practice be lower, particularly if in future the work done during the rabi closure is to a higher standard.

11. It is assumed that the WUF will be able to collect abiana from kharif 1998, though the timing of this is arbitrary at this stage. Abiana has been calculated using the official rates for 1995/96 adjusted for inflation and an estimate of the cropping pattern using 1995/96 survey data. It may thus be an underestimate.
12. Administration costs for the WUF are assumed to be Rs3000 per season. This may be too low, or may need to be increased over time as WUOs develop.
13. From kharif 1998, coinciding with the collection of abiana, it is assumed that WUFS would employ their own beldars to oversee channel operation and an abdar to assess and collect abiana. Accurate wage rates need to be established.
14. A budget of Rs5000 per season in 1996/97 prices has been entered for tools for beldars and other materials such as grease for regulators, etc..
15. Also from kharif 1998 it is assumed that 50% of the abiana collected is forwarded to the IPD/PIDA for main system O&M. This is a rather arbitrary estimate at this stage, but one which identifies an important policy issue which needs to be addressed. It is not known, for example, whether the same rate would apply to all areas in future, or whether this would vary with the distance and hence cost of supply.
16. The fourth and fifth tables repeat the cash flows with regard to irrigation O&M for Heran and Khadwari and also include the estimated costs of drainage O&M.
17. Costs for different items of O&M are included progressively as discussed above. The timing of inclusion of these is again rather arbitrary at this stage. More detail on the basis for the estimates is given in Appendix 1. At the time the costs are included, water users start to make an additional contribution for drainage O&M. In this first run this has been set at Rs1000 per water user per season, but will need to be increased substantially, either initially or progressively over time, if the costs of drainage are to be fully covered.
18. Costs for maintenance of a stretch of sub-drain have been included in year 5. In practice this may be difficult to implement in the pilot areas where water users will have no guarantee that maintenance downstream will be to the required standard, even assuming agreement can be reached on how to share the costs within the pilot area.
19. Payment of a cess or levy to contribute to O&M of the main drain system has been included from rabi 2000/2001. This has arbitrarily been set at 20% of abiana collected by the WUF and is purely illustrative at this stage.

Water User Federation - Financial Projections - Heran Dy. And Khadwari Minor										
Sheet 2: Illustrative Cash Flow Budgets - Irrigation Costs only										
Water Users Association - watercourse level										
	Year 1		Year 2		Year 3		Year 4		Year 5	
	R96/97	K1997	R 97/98	K 1998	R 98/99	K 1999	R 99/00	K 2000	R 00/01	K 2001
Receipts										
WUA subscription	2300	2300	2530	2530	2783	2783	3061	3061	3367	3367
WC O&M cont. labour	18400	18400	20240	20240	22264	22264	24490	24490	26939	26939
WC O&M cont. cash	0	0	0	0	0	0	0	0	0	0
Cash inflow	20700	20700	22770	22770	25047	25047	27552	27552	30307	30307
Expenditure										
WC O&M labour	18400	18400	20240	20240	22264	22264	24490	24490	26939	26939
WC O&M other	0	0	0	0	0	0	0	0	0	0
Administration	1000	1000	1100	1100	1210	1210	1331	1331	1464	1464
WUF subscription	1000	1000	1100	1100	1210	1210	1331	1331	1464	1464
Cash outflow	20400	20400	22440	22440	24684	24684	27152	27152	29868	29868
NET CASH FLOW	300	300	330	330	363	363	399	399	439	439
Opening bank balance	0	300	600	930	1260	1623	1986	2385	2785	3224
Closing bank balance	300	600	930	1260	1623	1986	2385	2785	3224	3663
Index number	1.00	1.00	1.10	1.10	1.21	1.21	1.33	1.33	1.46	1.46
Inflation	0.10									

Water User's Federation - distributary level - Heran Distributary										
	Year 1		Year 2		Year 3		Year 4		Year 5	
	R96/97	K 1997	R 97/98	K 1998	R 98/99	K 1999	R 99/00	K 2000	R 00/01	K 2001
Receipts										
WUF subscription	24000	24000	26400	26400	29040	29040	31944	31944	35138	35138
Dy de-silt cont. labour	61440	61440	67584	67584	74342	74342	81777	81777	89954	89954
Dy de-silt cont. cash	108000	108000	118800	118800	130680	130680	143748	143748	158123	158123
Abiana				595358	574295	654894	631724	720384	694897	792422
Cash inflow	193440	193440	212784	808142	808357	888957	889193	977852	978112	1075638
Expenditure										
Administration	3000	3000	3300	3300	3630	3630	3993	3993	4392	4392
Dy de-silting labour	61440	61440	67584	67584	74342	74342	81777	81777	89954	89954
Dy de-silting cash	108000	108000	118800	118800	130680	130680	143748	143748	158123	158123
Beldars				79200	87120	87120	95832	95832	105415	105415
Beldars tools etc.				5500	6050	6050	6655	6655	7321	7321
Abdar				20439	22483	22483	24731	24731	27204	27204
Abiana to IPD				297679	287174	327447	315862	360192	347448	396211
Cash outflow	172440	172440	189684	592502	611452	651752	672598	716927	739857	788620
NET CASH FLOW	21000	21000	23100	215641	196905	237205	216595	260925	238255	287018
Opening bank balance	0	21000	42000	65100	280741	477645	714850	931445	1192370	1430625
Closing bank balance	21000	42000	65100	280741	477645	714850	931445	1192370	1430625	1717643

Water User's Federation - distributary level - Khadwari Minor										
	Year 1		Year 2		Year 3		Year 4		Year 5	
	R 96/97	K 1997	R 97/98	K 1998	R 98/99	K 1999	R 99/00	K 2000	R 00/01	K 2001
Receipts										
WUF subscription	7000	7000	7700	7700	8470	8470	9317	9317	10249	10249
Mr. de-silt cont. labour	5376	17920	19712	19712	1355	21683	23852	23852	26237	26237
Mr. de-silt cont. cash	9450	31500	34650	34650	134673	38115	41927	41927	46119	46119
Abiana				148357	143108	163193	157419	179512	173161	197463
Cash inflow	21826	56420	62062	210419	287606	231461	232514	254607	255765	280068
Expenditure										
Administration	3000	3000	3300	3300	3630	3630	3993	3993	4392	4392
Mr. de-silting labour	5376	17920	19712	19712	1355	21683	23852	23852	26237	26237
Mr. de-silting cash	9450	31500	34650	34650	134673	38115	41927	41927	46119	46119
Beldars				26400	29040	29040	31944	31944	35138	35138
Beldars tools etc.				1320	1452	1452	1597	1597	1757	1757
Abdar				5961	6557	6557	7213	7213	7934	7934
Abiana to IPD				74179	71554	81596	78709	89756	86580	98732
Cash outflow	17826	52420	57662	165522	248262	182074	189235	200281	208158	220310
NET CASH FLOW	4000	4000	4400	44897	39345	49387	43279	54326	47607	59758
Opening bank balance	0	4000	8000	12400	57297	96642	146029	189308	243634	291241
Closing bank balance	4000	8000	12400	57297	96642	146029	189308	243634	291241	350999

Water User's Federation - distributary level - Heran Distributary										
	Year 1		Year 2		Year 3		Year 4		Year 5	
	R96/97	K 1997	R 97/98	K 1998	R 98/99	K 1999	R 99/00	K 2000	R 00/01	K 2001
Receipts										
WUF subscription	24000	24000	26400	26400	29040	29040	31944	31944	35138	35138
Dy de-silt cont. labour	61440	61440	67584	67584	74342	74342	81777	81777	89954	89954
Dy de-silt cont. cash	108000	108000	118800	118800	130680	130680	143748	143748	158123	158123
Abiana				595358	574295	654894	631724	720384	694897	792422
Drainage O&M contrib.					667920	667920	734712	734712	808183	808183
Cash inflow	193440	193440	212784	808142	1476277	1556877	1623905	1712564	1786295	1883821
Expenditure										
Administration	3000	3000	3300	3300	3630	3630	3993	3993	4392	4392
Dy de-silting labour	61440	61440	67584	67584	74342	74342	81777	81777	89954	89954
Dy de-silting cash	108000	108000	118800	118800	130680	130680	143748	143748	158123	158123
Beldars				79200	87120	87120	95832	95832	105415	105415
Beldars tools etc.				5500	6050	6050	6655	6655	7321	7321
Abdar				20439	22483	22483	24731	24731	27204	27204
Abiana to IPD				297679	287147	327447	315862	360192	347448	396211
Pumphouse watch man					174240	174240	191664	191664	210830	210830
Pump O&M					290400	290400	319440	319440	351384	351384
Pump electrincity							255552	255552	281107	281107
Disp. Channel O&M					9433	9433	10376	10376	11414	11414
SW/Int. WC O&M					#					
Sub-drain O&M									124802	124802
Main drain cess									138979	158484
Cash outflow	172440	172440	189684	592502	1085525	1125825	1449630	1493960	1858374	1926642
NET CASH FLOW	21000	21000	23100	215641	390752	431052	174275	218605	-72079	-42821
Opening bank balance	0	21000	42000	65100	280741	671492	1102544	1276819	1495424	1423345
Closing bank balance	21000	42000	65100	280741	671492	1102544	1276819	1495424	1423345	1380524

Water User's Federation - distributary level - Khadwari Minor										
	Year 1		Year 2		Year 3		Year 4		Year 5	
	R 96/97	K 1997	R 97/98	K 1998	R 98/99	K 1999	R 99/00	K 2000	R 00/01	K 2001
Receipts										
WUF subscription	7000	7000	7700	7700	8470	8470	9317	9317	10249	10249
Mr. de-silt cont. labour	5376	17920	19712	19712	1355	21683	23852	23852	26237	26237
Mr. de-silt cont. cash	9450	31500	34650	34650	134673	38115	41927	41927	46119	46119
Abiana				148357	143108	163193	157419	179512	173161	197463
Drainage O&M contrib.					194810	194810	214291	214291	235720	235720
Cash inflow	21826	56420	62062	210419	482416	426271	446805	468898	491485	515788
Expenditure										
Administration	3000	3000	3300	3300	3630	3630	3993	3993	4392	4392
Mr. de-silting labour	5376	17920	19712	19712	1355	21683	23852	23852	26237	26237
Mr. de-silting cash	9450	31500	34650	34650	134673	38115	41927	41927	46119	46119
Beldars				26400	29040	29040	31944	31944	35138	35138
Beldars tools etc.				1320	1452	1452	1597	1597	1757	1757
Abdar				5961	6557	6557	7213	7213	7934	7934
Abiana to IPD				74179	71554	81596	78709	89756	86580	98723
Pumphouse watch man					479160	479160	527076	527076	579784	579784
Pump O&M					798600	798600	878460	878460	966306	966306
Pump electrincity							702768	702768	773045	773045
Disp. Channel O&M					14893	14893	16383	16383	18021	18021
SW/Int. WC O&M					#					
Sub-drain O&M									0	0
Main drain cess									34632	39493
Cash outflow	17826	52420	57662	165522	1540915	1474727	2313922	2324968	2579946	2596958
NET CASH FLOW	4000	4000	4400	44897	-1048456	-1058499	-1867117	-1856070	-2088460	-2081170
Opening bank balance	0	4000	8000	12400	57297	-1001202	-2049658	-3916775	-5772845	-7861305
Closing bank balance	4000	8000	12400	57297	-1001202	-2049658	-3916775	-5772845	-7861305	-9942475

Observations on Cash Flows

These cash flows are extremely tentative at this stage but indicate that it should be financially feasible for WUOs to assume responsibility for the irrigation O&M activities envisaged. This can be done with relatively modest contributions in cash and in labour by water users which can be considered affordable (see more detail in analysis of farm incomes and ability to pay below).

Once drainage costs are included the picture changes. For Heran distributary, assuming the figures are accurate and appropriate, the net cash flow per season turn negative in year 5 once full drainage costs are included. The deficit is, however, manageable and given the number of water users on the distributary drainage O&M contributions could be increased to cover the cost. (Again this is only a very tentative conclusion at this stage).

For Khadwari the net seasonal cash flow becomes negative much earlier and to a much greater extent. Khadwari command area contains 22 tubewells/scavenger wells despite being much smaller than that of Heran, and it may not be feasible for the smaller number of water users to bear the full O&M costs of these (though the additional benefits of irrigation water from scavenger wells must be taken into account). This is a useful illustration as it clearly raise the issue of how drainage O&M costs should be allocated and shared across the whole LBOD command area.

Work plans or schedules in the form of time scaled bar charts need to be developed for each WUF to complement these cash flow projections. It is planned that this work will start with work plans drawn up with WUFs for the de-silting to be done in the coming closure period.

Assessment of Farm Incomes and Ability to Pay

to be completed following full entry and validation of survey data

note that

On December 8th 1996 the caretaker Sindh Cabinet decided to amend the Agriculture Income Tax, Stamp Act 1899 and Registration Act 1908. Agricultural income tax is to be collected under a "3-slab" system as follows:

for barrage areas	
<12.5 acres	exempt
12.5-25acres	Rs100 per acre
26-50 acres	Rs125 per acre
>50 acres	Rs250 per acre
mature orchards	Rs300 per acres

Account of bribes to IPD to be included

SWOT Analysis

SWOT analysis involves brainstorming with concerned participants to quickly list ideas under each of the four themes: Strengths, Weaknesses, Opportunities and Threats. The ideas are reviewed and consensus reached on which are critical to the success of the project, organisation or business. The resultant list helps crystallise thoughts on strategies for development or for improved management. An initial SWOT analysis was conducted with IIMI senior staff and the three SSOs of the pilot projects (the results are given below). This analysis could be repeated and extended to include participation by water users, IPD staff and other concerned agencies.

The SWOT analysis focused on WUOs and, in particular WUFs, assuming these have the objectives of improving the efficiency, equity and sustainability of irrigation management in the pilot areas.

Strengths

1. Unity: WUOs in the pilot projects have the potentials to act in unison and to achieve the benefits from collective action. This may enhance WUOs power and negotiating position in dealing with other agencies and will create the ability to resolve disputes.
2. Water users in the pilot projects are believed to have sufficient faith and trust in each other to form the basis of unity and collective action.
3. Water users have the ability to identify common problems and solutions, based on a system-wide understanding of the irrigation infrastructure, the dependent upon it and their objectives and resources. They have an intimate knowledge of the system, superior to most outsiders.
4. WUOs can mobilise resources of labour and capital.
5. WUOs have the potential to achieve financial autonomy and sustainability in terms of irrigation operation and maintenance.
6. WUOs will be capable of vigilant monitoring of the system and the behaviour of individuals water users.
7. Water users (particularly tail-enders) have strong incentives to improve the performance of the system, given the current low standards.

Weakness

1. The poor condition of the irrigation infrastructure which means immediate maintenance or rehabilitation needs are relatively high cost. Dependence on IPD/Government remains for major works, such as replacement of head regulators.
2. Lack of data on irrigation system performance.
3. Lack of technical know how on some aspects of system design or performance and poor access to technical guidance.
4. The highly politicised and unequal social structure and the danger of exploitation within WUOs based on iniquities in wealth and influence.
5. Potentially disruptive competition for leadership in apparent.
6. A lack of self-confidence and surety given the absence of successful models in Pakistan for this activity.
7. Legal status and powers of WUOs not yet established and currently very weak.

Opportunities

1. A "window of opportunity" exists to establish viable and sustainable WUOs. The IPD is seen to have failed and a new irrigation policy is being put in place. There is an opportunity to establish the legal status of WUOs and to enable them to collect abiana etc.
2. WUOs to become multi-function organisations addressing a broader range of agriculturally related activities, and bringing wider benefits to communities.
3. The existence of the IIMI pilot projects and IIMI staff as committed catalysts.
4. Opportunity to gain limited donor support.
5. Wider policy reforms including market liberalisation may improve the policy environment for agriculture, and hence producer incentives.

Threats

1. A perception among water users that the price of water will increase to a level that they can't or won't pay.
2. Perceptions and fears stemming from rumours of irrigation privatisation and increases in charges/taxes related to the great uncertainty surrounding current changes in irrigation policy.
3. Non-cooperation or even hostile action by those with influence and power within the "feudal" political structure in rural areas.
4. Hostile attitudes within the IPD or other agencies, and in particular failure to resolve the issue of the future discharge supplied to pilot distributaries.

Training Needs in Financial Management

The illustrative cash flows above readily demonstrate the potential for WUOs to rapidly be handling large sums of money. This creates a clear need for correct and transparent procedures for financial management. WUO office bearers, and particularly treasurers, are likely to need training in appropriate procedures for accounting and maintenance of financial records. IIMI should seek to identify a local accountancy/consultancy firm capable of assessing training needs, and designing and implementing an appropriate training programme as a matter of priority.

Monitoring and Evaluation

Development of the cash flow budget projections and work plans described above in detail for each pilot area will provide target plans that will form a basis for monitoring and evaluation of progress. Once the detail of the plans has been refined, actual expenditure and work progress can be compared to the plans on a seasonal or monthly basis.

Further Data Needs and Continued Planning

Collection of actual de-silting and other channel maintenance costs incurred by the WUOs during the rabi 1996/97 closure period.

Keep all variables used in the cash flow projections under review and revise and update as more accurate information becomes available.

Assess need for and attitude of WUFs to emergency/contingency funds, and estimates for the required magnitude of these.

Translate relevant points from this plan into recommendations for action or guidelines (e.g. level of subscriptions) that can be communicated to WUOs by field teams.

Develop investment appraisal analysis to returns to investment in O&M by water users given likely increases in productivity.

As noted above this business plan is intended as working document that will evolve during the duration of the pilot projects and be tailored separately to the circumstances of each distributary. Whilst a planning horizon of five years has been adopted, a seasonal rolling review of each business plan will be needed to take account of analyses of progress and expenditure in previous years in planning activities for the succeeding period.

References:

- IIMI (1995). Inception Report and Implementation Plan: Pilot Project for Farmer-Managed Irrigated Agriculture Under the Left Bank Outfall Drain Stage I Project, Pakistan. Lahore, International Irrigation Management Institute.
- IIMI (1996). Results of Technical Baseline Survey of Pilot Projects for Farmer-Managed Irrigated Agriculture under the LBOD Stage I Project, Pakistan. Hyderabad, International Irrigation Management Institute, Pakistan.
- Irrigation and Power Department (1993). Operation and Maintenance Manual. Karachi, Government of Sindh.
- SDSC (1995). Operation and Maintenance and Cost Recovery: With Special Reference to Farmer Participation in Drainage Activities. Hyderabad, Sindh Development Studies Centre.
- WAPDA (1995). Five Year Business Plan for Operation and Maintenance. Hyderabad, Water and Power Development Authority, Government of Pakistan.

Appendix 1:

Data collected from IPD and Revenue Departments

Jamrao Division: Assessed Revenue and Expenditure

Total cca acres 960000
Total length of channels, km 1039

Year	Abiana assessed in Kharif	Abiana assessed in Rabi	Total Abiana	IPD direct receipts
1983-84	10140138	6547593	16687737	676391
1984-85	10469396	6529763	16999159	740506
1985-86	10253350	6706282	16959632	616332
1986-87	11573904	7218793	18792697	698200
1987-88	11249687	7205715	18455402	610090
1988-89	11194441	7292713	18487154	932201
1989-90	11147947	6658986	17806933	799106
1990-91	10769891	7113901	17883792	469796
1991-92	10826075	7496142	18322217	
1992-93				
1993-94	12288536	8222595	20511131	
1994-95			14252888	
1995-96				

Year	Capital expenditure	Extension & improvement	Maintenance & repairs	Total
1983-84	16944189	1456827	6396109	24797125
1984-85	19190624	1557319	8308139	29056082
1985-86	1308064	1117293	10187318	12612675
1986-87	320787	1818920	9412210	11551917
1987-88	2863257	4061082	9459049	16383388
1988-89		2040627	9395700	11436327
1989-90	4682553	1891115	8513862	15087530
1990-91	4040512	1656841	8174446	13871799
1991-92	7975166	633935	16908939	25518040
1992-93				
1993-94	40901685	1947326	6067259	48916270

Thar Division: Assessed Revenue and Expenditure

Total cca acres

Total length of channels, km 900

Year	Abiana assessed in Kharif	Abiana assessed in Rabi	Total Abiana	IPD direct receipts
1983-84				166329
1984-85				327688
1985-86				342871
1986-87				273190
1987-88				282096
1988-89				295196
1989-90			42854633	1100980
1990-91			40238627	429077
1991-92			52713052	398509
1992-93			69886723	196771
1993-94				
1994-95				
1995-96				

Year	Capital expenditure	Extension & improve	Maintenar & repairs	Total
1983-84				
1984-85				
1985-86				
1986-87				
1987-88				
1988-89				
1989-90	14460543	13085053	11707800	39253396
1990-91	35530924	6508055	18242856	60281835
1991-92	56762286	7052687	31657030	95472003
1992-93	1.18E+08	5711735	17794566	1.41E+08
1993-94				

Expenditure incurred for operation maintenance and establishment for Bareji Dy, 1986/87-1995/96

Year	Reconditioning of bank	Earth work maintenance of bank	Rehandling of spoil	Resectioning	Total	Establishment
1985-86						21882
1986-87						32106
1987-88	92545				92545	37692
1988-89		29250	49832		79082	43656
1989-90						46050
1990-91				49248	49248	53508
1991-92			57468		57468	65478
1992-93						74544
1993-94						78336
1994-95						84744
Total	92545	29250	107300	49248	278343	
Mean Annual exp. (10years)	9255	2925	10730	4925	27834	

Source: Executive Engineer, Jamrao Division

Abiana Recovered/assessed at the Distributory/Division Levels

Year	Distributory	Area, Acre Kharif	Abiana Kharif	Area, Acre Rabi	Abiana Rabi	Total Abiana
1993-94	Bareji	4195	187058	3447	102734	289792
1994-95	Bareji	2976	155517	3319	129308	284825
1995-96	Bareji	4492	255828	3658	194092	449920

Land revenue (Dhal) rates for Mirpurkhas Sundivision

<u>Crop</u>	<u>1 Acre</u>	<u>2.5-12 Acre</u>	<u>13-24 Acre</u>	<u>25-50 Acre</u>	<u>50 and above</u>
Cotton	8.55	12.82	17.1	25.65	34.2
Rice	3.4	5.1	6.8	76.95	136.8
S. Cane	3.75	5.62	7.5	11.25	15
Chillies	6.75	10.12	13.5	20.25	27
Vegetable	1.5	2.25	3	5.5	6
Other	3.75	5.625	7.5	11.25	15
Orchard (K)	1.5	3	3	4.5	6
Orchard(R)	2.25	3.375	4.5	6.75	9
	1.5	2.25	13.5	20.25	27

Water Rates (Abiana) Showing the year when the Rates were Revised Rates are shown for the area irrigated under Sukkur Barrage

Crop	1996-97	1995-96	1994-95	1982-83
Rice	77.2	61.75	49.4	31.25
Cotton	80.95	64.75	51.78	32.75
S. Cane	158.15	126.5	101.2	18.75
Wheat	46.35	37.05	29.64	18.75
Orchard	123.6	98.85	79.06	50
Fooder/Maiz	34.65	27.7	22.4	14
Chillies	65.5	52.4	41.9	26.5
Oil Seeds	65.5	52.4	41.9	26.5
Misc. Rabi				
Oil Seeds				
Fooder etc	46.35	37.05	29.65	18.75
Forest	53.75	43	34.39	21.75

1995-96 Land revenue (Dhal) Rates for Nawab Division

Crop	Rates/Acre
Cotton	10.35
S. Cane	3.75
Rice	1.75
Fodder	1.5
Wheat	6.35
Oil Seed	3.75
Lusin(Fodder)	1.5
Garden/Vegetable	3.75

1995-96 Usher Category "A" Type Land Nawabshah

Crop	Rates/Acre
Cotton	131.25
S. Cane	247.5
Rice	51
Wheat	65
Lusin(Kharif Fodder)	7.5
Lusin(Rabi Fodder)	20.62
Garden/Vegetable	168.75
Banana	125

1995-96 Usher Category "B" Type Land

Crop	Rates/Acre
Cotton	125
S. Cane	206.25
Rice	42.19
Wheat	58.39
Lusin(Kharif Fodder)	7.5
Lusin(Rabi Fodder)	20.62
Garden/Vegetable	168.75
Banana	125

Usher Rates for 1995-95 Taluka Mirpurkhas

Kharif		Rabi	
Crop	<u>Rate per Acre</u>	Crop	<u>Rate per Acre</u>
Cotton	225	Wheat	181.1
Rice	48	Oil seed	90
S. Cane	278.5	Onion	56.25
Chillies	600	Tomato	112.5
Millete	30	Lasin (Fodder)	225
Guwar	30	Vegetable	131.25
Maiz	37.5	Janter	262.5
Mung(Pulses)	75	Baari (fruit)	112.5
Bhusan (Fodder)	56.25	Fodder	112.5
Banana	562.5		
Peas	65.63		
Janter (Fodder)	15		
Vegetable	75		
Water melon	187.5		
Nursary	112.5		
Hatri	112.5		

Water Users Federations - Financial Projections - Heran Dy. And Khadwari Mr.
Sheet 1: Basic Data

Distributary name	Heran	Khadwari			
Number of Outlets	24	7	No. of water users	718	
allocation ratio	0.774	0.225806			
length of distributary, km	10.6	5.12	Landlords/zamindars	338	
Design discharge, cusecs	58	10.62	Owner cultivators	289	
CCA, acres	12336	3074	Lessees	91	
allocation ratio	0.801	0.199481			
Drainage type	TW	TW/SW			
No. pump/sump house	8	22	No. of tenants/haris	433	
Lengh of branch/main drain, km	20.73	0			
Lengh of sub-drain, km	23.29	0	irrign. Turn (per) in hours	3	
Discharge, cusecs	10	10	no. of turns per week	56	
Length of disposal channels, km	7.1	11.21			
Discharge, cusecs	3	3	Av. No. of users per wc	23	
(note: more detailed specification of pumps and drains needed)			Inflation	0.1	
			l RD=km	0.3048	
			Total Abiana, Kharif	676105	
			Total Abiana, Rabi	592895	
O&M unit costs	Heran	Khadwari	Income	Heran	Khadwari
			Subscription per water user	100	100
Irrigation			WUA sub. Per wc per season	2300	2300
WC O&M, labour/season/user	800	800	WC O&M lab/season/useer	800	800
WC O&M, Other cost/season/WC	0	0	WC O&M other/seas/useer	0	0
WUA Administration per season	1000	1000			
					Khadwari
WUF Administration per season	3000	3000	WUF sub. Per wc per season	1000	1000
Dy de-silt labour/season/WC	2560	2560	Dy. De-silt labour/season/WC	2560	2560
Dy de-silt cost/season/WC	4500	4500	Dy. De-silt other/season/WC	4500	4500
km of distributary per beldar	3	3	abiana estimate, Kharif, 95/96	541235	134870
No. of beldars needed	3	1	abiana estimate, Rabi, 95/96	474624	118271.2
Beldar salary per month	4000	4000	Drain O&M cont. per user	1000	1000
Beldar tools, etc. per season	5000	1200	Drain O&M/wc/season	23000	23000
% abiana paid to IPD	0.5	0.5	Bribes collected		
Abdar (one), salary per month	4000	4000			
Drainage			Water user contributions		
No. of pump house watchmen	8	22	WUF sub per turn/month		
Watchman salary per month	3000	3000	De-silting per turn/month		
TW/Tile/Int. pump O&M per month	5000	5000	De-silting per turn/year		
Electricity of pump per month	4000	4000	Dhal per acre, kharif		
D. channel O&M cusec/km/month	61	61	Dhal per acre, rabi		
SW/Int. w/c maint. Cusec/km/month	61	61	Drain O&M per turn/month		
Sub-drain O&M cusec/km/month	61	61			
Drain cess, % abiana	0.2	0.2			

IIMI-PAKISTAN PUBLICATIONS RESEARCH REPORTS

Report No.	Title	Author	Year
R-1	Crop-Based Irrigation Operations Study in the North West Frontier Province of Pakistan Volume I: Synthesis of Findings and Recommendations	Carlos Garces-R D.J. Bandaragoda Pierre Strosser	June 1994
	Volume II: Research Approach and Interpretation	Carlos Garces-R Ms. Zaigham Habib Pierre Strosser Tissa Bandaragoda Rana M. Afaq Saeed ur Rehman Abdul Hakim Khan	June 1994
	Volume III: Data Collection Procedures and Data Sets	Rana M. Afaq Pierre Strosser Saeed ur Rehman Abdul Hakim Khan Carlos Garces-R	June 1994
R-2	Salinity and Sodicy Research in Pakistan - Proceedings of a one-day Workshop	J.W. Kijne Marcel Kuper Muhammad Aslam	Mar 1995
R-3	Farmers' Perceptions on Salinity and Sodicy: A case study into farmers' knowledge of salinity and sodicy, and their strategies and practices to deal with salinity and sodicy in their farming systems	Neeltje Kielen	May 1996
R-4	Modelling the Effects of Irrigation Management on Soil Salinity and Crop Transpiration at the Field Level (M.Sc Thesis - published as Research Report)	S.M.P. Smets	June 1996
R-5	Water Distribution at the Secondary Level in the Chishtian Sub-division	M. Amin K. Tareen Khalid Mahmood Anwar Iqbal Mushtaq Khan Marcel Kuper	July 1996
R-6	Farmers Ability to Cope with Salinity and Sodicy: Farmers perceptions, strategies and practices for dealing with salinity and sodicy in their farming systems	Neeltje Kielen	Aug 1996
R-7	Salinity and Sodicy Effects on Soils and Crops in the Chishtian Sub-Division: Documentation of a Restitution Process	Neeltje Kielen Muhammad Aslam Rafique Khan Marcel Kuper	Sept 1996
R-8	Tertiary Sub-System Management: (Workshop proceedings)	Khalid Riaz Robina Wahaj	Sept 1996
R-9	Mobilizing Social Organization Volunteers: An Initial Methodological Step Towards Establishing Effective Water Users Organization	Mehmoodul Hassan Zafar Iqbal Mirza D.J. Bandaragoda	Oct 1996
R-10	Canal Water Distribution at the Secondary Level in the Punjab, Pakistan (M.Sc Thesis published as Research Report)	Steven Visser	Oct 1996
R-11	Development of Sediment Transport Technology in Pakistan: An Annotated Bibliography	M. Hasnain Khan	Oct 1996

Report No.	Title	Author	Year
R-12	Modeling of Sediment Transport in Irrigation Canals of Pakistan: Examples of Application (M.Sc Thesis published as Research Report)	Gilles Belaud	Oct 1996
R-13	Methodologies for Design, Operation and Maintenance of Irrigation Canals subject to Sediment Problems: Application to Pakistan (M.Sc Thesis published as Research Report)	Alexandre Vabre	Oct 1996
R-14	Government Interventions in Social Organization for Water Resource Management: Experience of a Command Water Management Project in the Punjab, Pakistan	Waheed uz Zaman D.J. Bandaragoda	Oct 1996
R-15	Applying Rapid Appraisal of Agricultural Knowledge Systems (RAAKS) for Building Inter-Agency Collaboration	Derk Kuiper Mushtaq A. Khan Jos van Oostrum M. Rafique Khan Nathalie Roovers Mehmood ul Hassan	Nov 1996
R-16	Hydraulic Characteristics of Chishtian Sub-division, Fordwah Canal Division	Anwar Iqbal	Nov 1996
R-17	Hydraulic Characteristics of Irrigation Channels in the Malik Sub-Division, Sadiqia Division, Fordwah Eastern Sadiqia Irrigation and Drainage Project	Khalid Mahmood	Nov 1996
R-18	Proceedings of National Conference on Managing Irrigation for Environmentally Sustainable Agriculture in Pakistan	M. Badruddin Gaylord V. Skogerboe M.S. Shafique (Editors for all volumes)	Nov 1996
R-18.1	Volume-I: Inauguration and Deliberations		
R-18.2	Volume-II: Papers on the Theme: Managing Canal Operations		
R-18.3	Volume-III: Papers on the Theme: Water Management Below the Mogha		
R-18.4	Volume-IV: Papers on the Theme: Environmental Management of Irrigated Lands		
R-18.5	Volume-V: Papers on the Theme: Institutional Development		
R-19	Detailed Soil Survey of Eight Sample Watercourse Command Areas in Chishtian and Hasilpur Tehsils	Soil Survey of Pakistan IIMI-Pakistan	Nov 1996
R-20	Unsteady Flow Simulation of the Designed Pehur High-Level Canal and Proposed Remodeling of Machai and Miara Branch Canals, North West Frontier Province, Pakistan	Zaigham Habib Kobkiat Pongput Gaylord V. Skogerboe	Dec 1996
R-21	Salinity Management Alternatives for the Rechna Doab, Punjab, Pakistan	Gauhar Rehman Waqar A. Jehangir Abdul Rehman Muhammad Aslam Gaylord V. Skogerboe	May 1997
R-21.1	Volume One: Principal Findings and Implications for Sustainable Irrigated Agriculture		
R-21.2	Volume Two: History of Irrigated Agriculture: A Select Appraisal	Gauhar Rehman Hassan Zia Munawwar Asghar Hussain	Jan 1997

Report No.	Title	Author	Year
R-21.3	Volume Three: Development of Procedural and Analytical Link	Gauhar Rehman Muhammad Aslam Waqar A. Jehangir Abdul Rehman Asghar Hussain Nazim Ali Hassan Zia Munawwar	Jan 1997
R-21.4	Volume Four: Field Data Collection and Processing	Gauhar Rehman Muhammad Aslam Waqar A. Jehangir Mobin Ud Din Ahmed Hassan Zia Munawwar Asghar Hussain Nazim Ali Faizan Ali Samia Ali	Jan 1997
R-21.5	Volume Five: Predicting Future Tubewell Salinity Discharges	Muhammad Aslam	Jan 1997
R-21.6	Volume Six: Resource Use and Productivity Potential in the Irrigated Agriculture	Waqar A. Jehangir Nazim Ali	Feb 1997
R-21.7	Volume Seven: Initiative for Upscaling: Irrigation Subdivision as the Building Block	Gauhar Rehman Asghar Hussain Hassan Zia Munawwar	Apr 1997
R-21.8	Volume Eight: Options for Sustainability: Sector-Level Allocations and Investments	Abdul Rehman Gauhar Rehman Hassan Zia Munawwar	Apr 1997
R-22	Salinisation, Alkalinisation and Sodification on Irrigated Areas in Pakistan: Characterisation of the geochemical and physical processes and the impact of irrigation water on these processes by the use of a hydro-geochemical model (M.Sc Thesis published as Research Report)	Nicolas Condom	March 1997
R-23	Alternative Scenarios for Improved Operations at the Main Canal Level: A Study of Fordwah Branch, Chishtian Sub-Division Using A Mathematical Flow simulation Model(M.Sc Thesis published as Research Report)	Xavier Litrico	March 1997
R-24	Surface Irrigation Methods and Practices: Field Evaluation of the Irrigation Processes for Selected Basin Irrigation Systems during Rabi 1995-96 Season	Ineke Margot Kalwij	March 1997
R-25	Organizing Water Users for Distributary Management: Preliminary Results from a Pilot Study in the Hakra 4-R Distributary of the Eastern Sadiqia Canal System of Pakistan's Punjab Province	D.J. Bandaragoda Mehmood Ul Hassan Zafar Iqbal Mirza M. Asghar Cheema Waheed uz Zaman	April 1997
R-26	Moving Towards Participatory Irrigation Management	D.J. Bandaragoda Yameen Memon	May 1997
R-27	Fluctuations in Canal Water Supplies: A Case Study	Shahid Sarwar H.M. Nafees M.S. Shafique	June 1997
R-28	Hydraulic Characteristics of Pilot Distributaries in the Mirpurkhas, Sanghar and Nawabshah Districts, Sindh, Pakistan	Bakhshal Lashari Gaylord V. Skogerboe Rubina Siddiqui	June 1997

Report No.	Title	Author	Year
R-29	Integration of Agricultural Commodity Markets in the South Punjab, Pakistan	Zubair Tahir	July 1997
R-30	Impact of Irrigation, Salinity and Cultural Practices on Wheat Yields in Southeastern Punjab, Pakistan	Florence Pintus	Aug 1997
R-31	Relating Farmers' Practices to Cotton Yields in Southeastern Punjab, Pakistan	P.D.B.J. Meerbach	Aug 1997
R-32	An Evaluation of Outlet Calibration Methods: A contribution to the study on Collective Action for Water Management below the Outlet, Hakra 6-R Distributary	Arjen During	Aug 1997
R-33	Farmers' use of Basin, Furrow and Bed-and-Furrow Irrigation Systems and the possibilities for traditional farmers to adopt the Bed-and-Furrow Irrigation Method.	Nanda M. Berkhout Farhat Yasmeen Rakhshanda Maqsood Ineke M. Kalwij	Sep 1997
R-34	Financial Feasibility Analysis of Operation and Maintenance Costs for Water Users Federations on three distributaries in Province of Sindh, Pakistan.	Amin Sohani	Sep 1997
R-35	Assessing the Field Irrigation Performance and Alternative Management Options for Basin Surface Irrigation Systems through Hydrodynamic Modelling.	Ineke Margot Kalwij	Oct 1997