Report No. R-38

SOCIAL ORGANIZATION FOR IMPROVED SYSTEM MANAGEMENT AND SUSTAINABLE IRRIGATED AGRICULTURE IN SMALL DAMS

# BASELINE SURVEY FOR FARMERS ORGANIZATIONS OF MIRWAL AND SHAHPUR SMALL DAMS, PUNJAB, PAKISTAN

MUHAMMADASGHARCHEEMA
DON JAYATISSA BANDARAGODA

DECEMBER 1997

PAKISTAN NATIONAL PROGRAM
INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE.
PAKISTAN

# CONTENTS

# TABLES

# FIGURES

## FOREWORD

This baseline survey report is related to an action research activity conducted by IIMI in collaboration with the Water Resources Research Institute (WRRI), at two selected small dams in northwestern Punjab. The financial support for the activity comes from the Department for International Development (DfID, formerly known as **ODA)** of UK. The small dams study is one of three pilot efforts by IIMI for establishing effective water users organizations. The other two are in: (1) the Hakra 4-R Distributary in the Fordwah Eastern Sadiqia (FES) irrigation and drainage system in southeastern Punjab, funded by the Royal Netherlands Government; and (2) three selected pilot distributaries in the Lert Bank Outfall Drain Stage I Project area in the Sindh, funded by the World Bank and the Swiss Development Cooperation.

Of the six pilot sites, the Hakra **4-R** Distributary is a very large secondary canal, with a design discharge of about 5.46 cubic meters per second (193 cusecs) at the head, and serving a command area of about 17.570 hectares belonging to 4,690 landowners. The three secondary canal systems selected in the Sindh Province are relatively small, having an average design discharge of 1.3 cubic meters per second (48 cusecs). and *a* total command area of about 17,250 hectares belonging to 1,150 landowners. Relative to these canal systems, the two small dam pilot sites are very small in size and are two independent small reservoir systems (Mirwal and Shahpur), each serving about 450 hectares belonging to about 125 water users, through small gravity canals of about 0.3 cusecs design discharge.

The major objectives of all three pilot projects were to test the viability of social organization in the context *of* a strong and well established irrigation culture, and **the** viability organized water users managing parts of the irrigation systems so that more efficient and equitable allocation and use of water can be achieved in that context. To achieve these objectives, IIMI was basically engaged in a number of project activities, of which, one major item was to gain an understanding of the ground situation in the pilot site by way of collecting baseline information. While this information has already been used in planning and implementing pilot project activities, this report presents an analysis of the main items of baseline data related to the two small dams sites.

D.J. Bandaragoda
Senior Management Specialist
Pakistan National Program
International Irrigation Management Institute

## ACKNOWLEDGEMENTS

The authors wish to thank Dr. Shahid Ahmad. Director, Water Resources Research Institute of the National Agriculture Research Centre, and his staff for their support and guidance to IIMI Field Staff at Fateh Jang in the conduct **of** project activities. The authors are grateful to Mr. M. Aslam Quereshi, Project Director, Mr. Khalid Mehmood. Executive Engineer, **Mr.** Rana Asif, Sub-Divisional Officer and other staff *of* the Small Dams Organization, for their cooperation in providing basic information and in undertaking some field activities. Thanks are also due to the IIMI staff, Muhammad Akram and Shabbir Ahmad, at the Fateh Jang Field Station, and the enumerators, Asif Zahoor, Khalid Mehmood and Zahid Sarfraz, for the collection of field data under very cold climatic conditions of the 1996 winter in northern Punjab.

The authors wish to thank Professor Gaylord V. Skogerboe, Director IIMI Pakistan for his guidance that helped greatly in completing this report.

The authors also wish to thank Mr. Asghar Hussain and Miss Tabassum (GIS) for developing maps *of* Mirwal and Shahpur irrigation network and Mr. Manzoor Hussain **for** his excellent job in developing graphs and figures and formatting the report. Finally, the authors acknowledge the financial assistance for this work from the Department for International Development (former ODA) of U.K.

# CHAPTER 1

# INTRODUCTION

## 1.1 Background

Most of the small dams in Pakistan are located in Pothwar area, that lies between the Jhelum and Indus Rivers in Rawalpindi Division of the Punjab Province, and covers an area of about 16,800 sq. kms (Zaidi. 1995). The Government of Punjab. with financial assistance from the Asian Development Bank, launched a scheme of Small Dams during 1986 in this barani (rain-fed) area to improve economic and social conditions of the people in the area. The objectives envisaged in the project were to provide an assured perennial water supply to irrigate developed land, increase crop production and provide drinking water to nearby towns and villages. The indirect benefits of these small dams are development of aqua culture, improvement of aquifer and hydrology, livestock. soil conservation, etc. (Government of Punjab, 1980; Shahid et al, 1995).

The investigations for the construction of water storages for this area were first started during 1954 by the Irrigation Department. During 1960, a Small Dam Organization, headed by a Chief Engineer and placed under the control of the Provincial Governor, was established for this purpose. At present, the Organization is under the control of the Irrigation and Power Department of the Government of Punjab and is headed by a Project Director. The Small Dam Organization is entrusted with the tasks of identification, investigation and construction of small dams of low and medium heights for improving the agricultural economy of barani areas of the Punjab Province. The total cost of the Small Dams Project was Rs. 7811.2 million with a foreign exchange cost component of Rs. 220.432 million (Shahid and Ashraf 1989; Iqbal and Khan, 1991). Until 1995. 31 small dams had been constructed by Government of the Punjab Irrigation and Power Department in Pothwar area of Rawalpindi Division to provide irrigation to about 35,700 acres of land.

A pilot action research project titled "Social Organization for Improved System Management and Sustainable Irrigated Agriculture in Small Dams" was designed to be undertaken in the Small Dam Project area. This action research program is being supported financially by the Department for International Development (former ODA) of U.K. and is being conducted by the International Irrigation Management Institute (IIMI) Pakistan in collaboration with the Water Resources Research Institute (WRRI) of the National Agriculture Research Centre (NARC) and the Small Dams Organization (SDO). Keeping in view the difficulties faced by the farmers and the condition of the dams and the water channels, a representative area was selected (i.e Mirwal and Shahpur Small Dams) for a pilot study on participation of farmers organizations in operation and maintenance of their irrigation systems. This selection was made with the collaboration of WRRI-NARC officials who have been working in the area for quite a long period and also have established field stations.

As a preliminary activity of this action research program, a baseline survey was designed to cover the Small Dam Project area in District Attock, focusing on Mirwal and Shahpur Small Dams (Figures 1.1, 1.2 and **1.3).**

The Shahpur Small Dam is about 46 km from Rawalpindi/Islamabad on Fateh Jang-Hussan Abdal Road and **is** about 14 km from Fateh Jang town, while Mirwal Small Dam is located 41 km from Fateh Jang on the Fateh Jang - Kohat Road.

## 1.2 Objectives of the Study

The main purpose of the survey was to have first hand information on the socio-economic status of the farmers to form a basis for planning, with an ultimate aim of defining directions and strategies for the future.

The baseline survey had the following specific objectives:

1. To study the socio-economic conditions of the current and potential water users in the command areas of Shahpur and Mirwal Small Dams;

2. To identify characteristics of the communities located in the command areas of Shahpur and Mirwal Small Dams;

**3.** To study the existing conditions of irrigation practices, water management, cropping patterns, and cropping intensities in the project area;

**4.** To investigate the existing organizational behavior of farmers, as well as the physical conditions of small dams, the water channels and water distribution; and

5. To assess the potential performance of services provided by various government agencies in the command areas of the selected dams.

## 1.3 Methodology

The baseline survey was proposed to be completed before undertaking other activities, such as helping farmers in organizing themselves as **a** Farmers Organization (FO).

To collect information from farmers of Mirwal and Shahpur Small Dams, a structured questionnaire was prepared and pre-tested at the actual site. During pre-testing, it was found that some of the questions on cropping pattern, water management, etc. needed some changes and thus were modified accordingly, keeping in view the cultural and situational factors of the area.

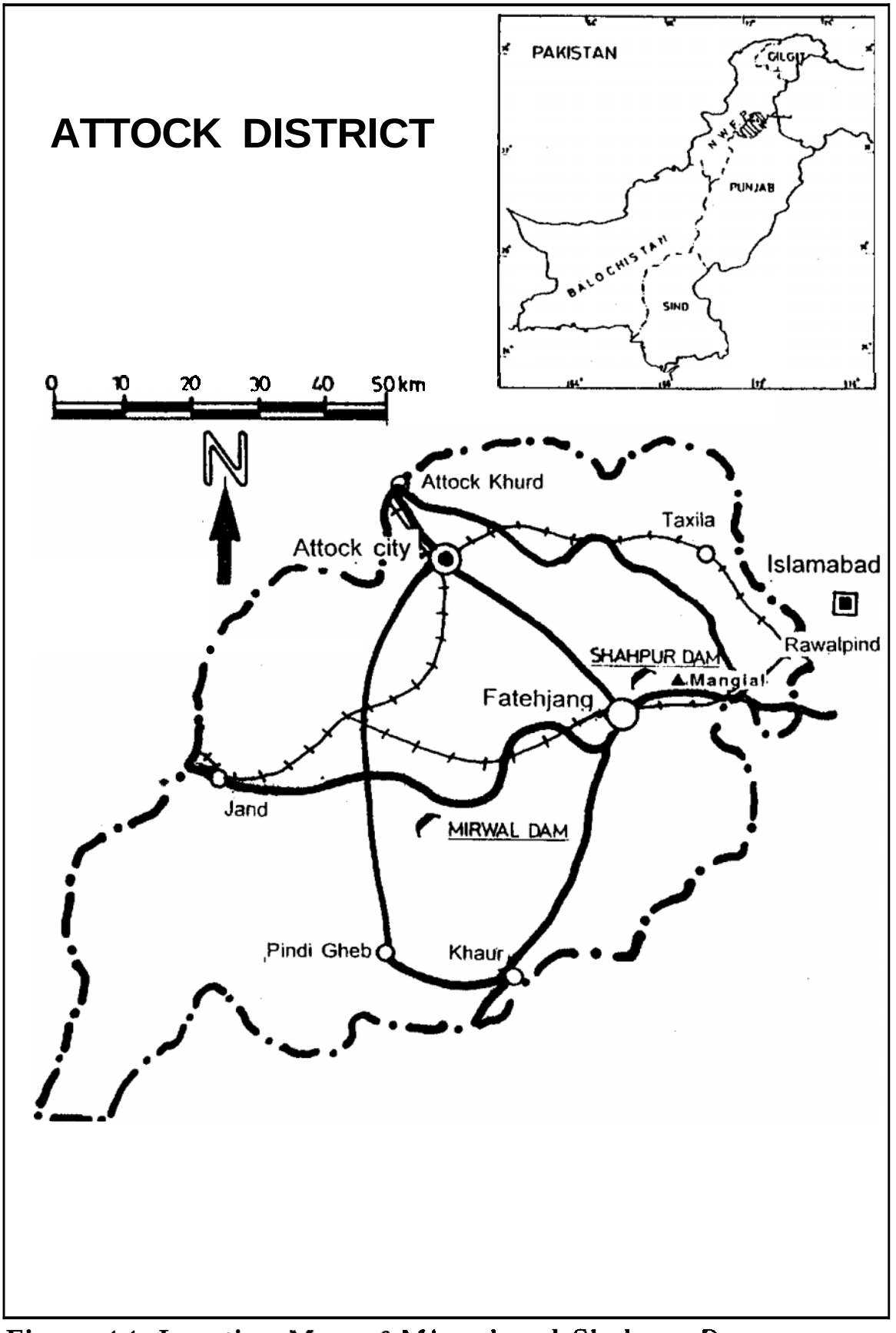



**Figure 1.1 Location Map of Mirwal and Shahpur Dams.**

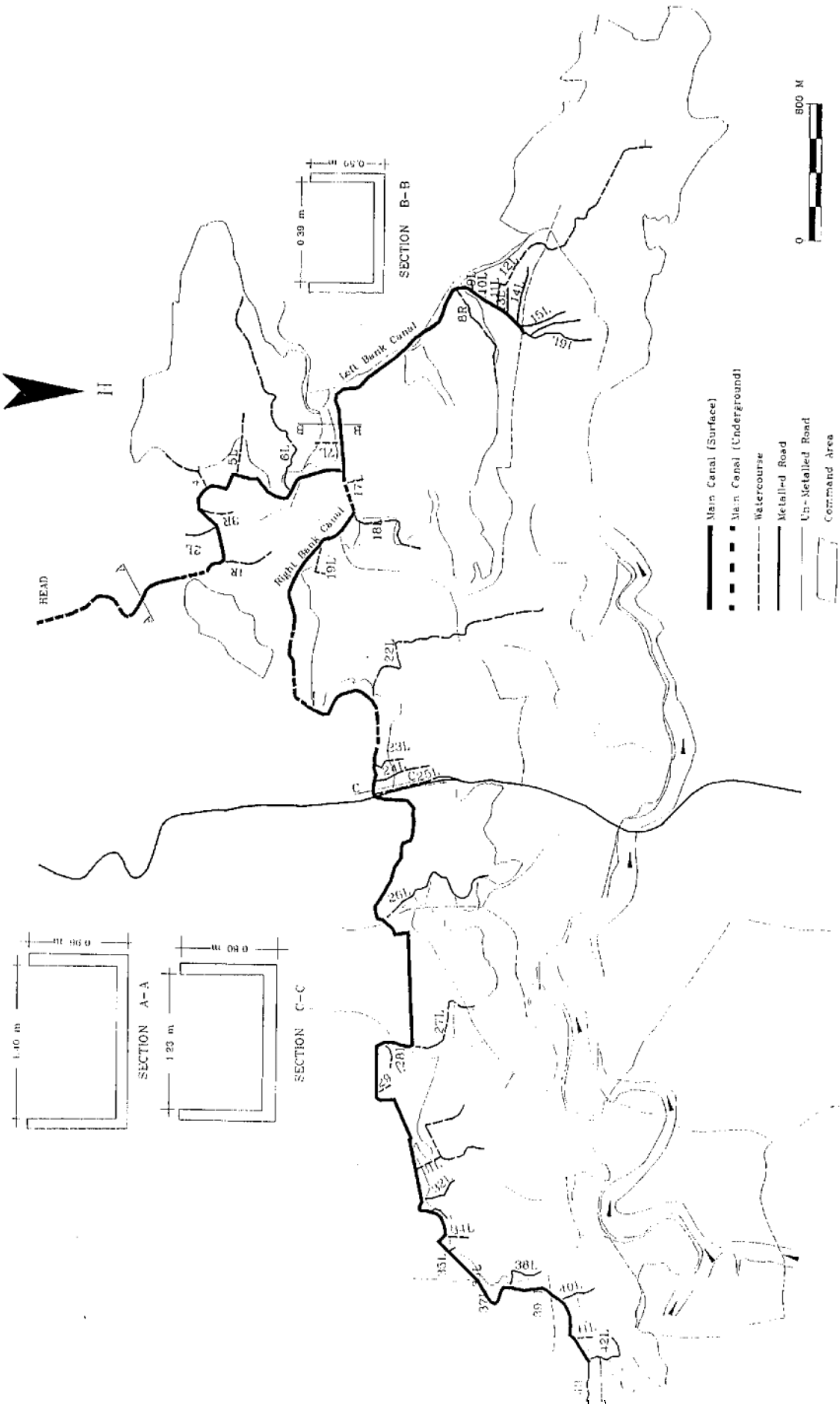



Figure 1.2 Irrigation System Network of the Mirwal Dam.


Figure 1.3 Irrigation System Network of the Shahpur Dam.

Because of the small number of current and potential water users of Mirwal and Shahpur Small Dams, it was decided to interview all of them. In addition, it was also decided to collect information from those farmers who have land in the command areas (pilot project) but presently have no access to water of the dams because of the high elevation of their land. Development of land in the area is still in progress and farmers are hopeful to have more land under irrigated agriculture in the near future.

Information was collected through the questionnaire by a team of 5 trained enumerators (3 were recruited on a daily basis in addition to two Social Organizers from the IIMI-Pakistan Fateh Jang Field Station). Overall, **194** farmers were interviewed from both of the small dams. The distribution of the respondents according to their village is presented in Table 1.1 and are categorized into Irrigated and Barani farmers in Table 1.2. Barani farmers are those who have land in the dam command area, but have no access to the water from the dam.

The total number of current and potential water users/respondents for the current survey was 59 from Mirwal Dam and 135 from the Shahpur Dam.

The farmers at the Mirwal Dam are located in six villages. A majority of them (91.5%) belong to only three villages; namely Mirwal. Nathein and Kamelpur Sherjang. The remaining farmers (8.5%) live in the other three villages of Mithial, Kisran, and Traggar.

At Shahpur Dam, around 83 per cent of the farmers live in the villages of Amir Khan and Dhok Balouch. The other 17 per cent are evenly located in Kareema and Sahahpur villages.

At both of the dams, almost three out of four farmers are irrigating the land. This proportion was slightly higher for bhe Mirwal Dam (75%) compared to that of the Shahpur Dam (72%).

**Table 1.1 Distribution of Respondents According to Their Village.**

| Village | Mirwal (N=59) | Shahpur (N=135) | Overall(N=194) |
|---|---|---|---|
| Mirwal | 22 (37.3) | - | 22 |
| Nathein | 24 (40.7) | - | 24 |
| Kamelpur Sher Jang | 8 (13.5) | - | 8 |
| Kisran | 1 (1.7) | - | 1 |
| Amir Khan | - | 63 (46.7) | 63 |
| Kareema | - | 25 (8.5) | 25 |
| Shahpur | - | 120 (8.9) | 12 |
| Dhok Balouch | - | 35 (25.9) | 35 |
| Mithial | 3 (5.1) | - | 3 |
| Traggar | 1(1.7) | - | 1 |

| Irrigated/Barani | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| **Irrigated (Including** Well) | 74.6 **(44)** | 71.9 (97) | 72.7 (141) |
| **Barani** | 25.4 (15) | 28.1 (38) | 27.3 (53) |
| **Total** | 100.00 | 100.00 | 100.00 |

The information collected was then processed and analyzed on a personal computer by using Lotus 123 and SPSSPC+ software. Different statistical techniques were employed to analyze and describe data for deriving inferences about phenomena represented by the information.

## **1.4** Organization **of the Report**

This introductory chapter is followed by Chapter 2, which discusses the characteristics of the community and the respondents. Chapter 3 contains information about irrigation practices, water management and irrigation system performance, while Chapter **4** deals with institutional development. Chapter 5 discusses agronomic practices, farm output, cropping intensities, income, etc. Chapter 6 discusses the emerging issues, like ensured dam water supply, water rights, water conveyance network, etc.

# CHAPTER-2

# CHARACTERISTICS OF THE COMMUNITY AND THE RESPONDENTS

This chapter contains information about the characteristics of the community and the respondents as well. The information pertains to the facilities available in the communities living in the command areas of Mirwal and Shahpur Small Dams. The characteristics of the respondents, such as residential status, caste, educational level, landholding, tenurial status, ownership of machinery. average household size and literacy rates (calculated) are also presented in Chapter 2.

## 2.1 Community **Characteristics**

This section of the report discusses the basic amenities available in the villages, as reported by the local key informants from various villages located in the command areas of Mirwal and Shahpur Small Dams. This will give the readers a sense of understanding of the area and the people living there. There are a lot of villages where residents do not have access to a road and other facilities, like medical, education, marketing, etc. In some parts of the area, to catch a bus, they have to travel on foot a distance from 2 km to 5 km.

### 2.1.1 Mirwal Small Dam

Mirwal Small Dam is located on the Rawalpindi-Kohat Road and is about 93 km from Rawalpindi and 41 km from Fateh Jang. The live storage capacity of the dam is 2726 acre-feet (AF), and it has a designed command area of 1050 acres. The water channel has a design discharge of 11 cusecs and passes under the ground at some places, while the rest of the canal is open. All of the water channel is lined and supplying water to about 95 farmers as indicated in the inception report (IIMI, 1996). The dam was constructed on Durban Kas and was completed during 1990 (Annex-2). This is a multi-purpose dam that not only supplies irrigation water, but is also used for aqua culture.

Information regarding community characteristics was collected from Mirwal, Nathein, Kisran ad Kamelpur Sherjang villages, located in the Mirwal Dam command area. Table 2.1 shows that for the population of 10,000 in the villages (1225 families) in the command area of Mirwal Small Dam, only one hospital and one veterinary hospital is available. The educational facilities available in all of the four villages are only up to elementary (primary) school level, Kisran being an exception where a high school for boys and a high school for girls is available. Although the post office and electricity are available in all of the villages, there is no telephone facility. There are no marketing facilities at the local level. however, three of the four villages have farm to market roads. Only one village has an access to safe drinking water, while sewerage facilities are not present. In two of the four villages, bus stands are available, but there is no bank. It is

interesting to note that in two of the four villages, cooperative societies have been established and in the same two villages punchayats are working, indicating that they already have some kind of collective action.

**Table 2.1 Characteristics of Communities in Mirwal Small Dam Area.**

| Facilities | Name of the Village | | | |
|---|---|---|---|---|
| | Mirwal | Kisran | Nathein | Kamelpur Sherjang |
| Hospital/dispensary | No | Yes | No | No |
| Veterinary hospital | No | Yes | No | No |
| School (Males) | Primary | High | Primary | Primary |
| School (Females) | Primary | High | Primary | Primary |
| Farm to Market road | Yes | No | Yes | Yes |
| Electricity | Yes | Yes | Yes | Yes |
| Telephone | No | No | No | No |
| Safe drinking /tap water | Yes | No | No | No |
| Post Office | Yes | Yes | Yes | Yes |
| Marketing facilities | No | No | No | No |
| Bus Station | Yes | No | Yes | No |
| Bank | No | No | No | No |
| Cooperative Society | | | | |
| a. Formal | Yes | No | No | Yes |
| b. Informal | Yes | No | No | Yes |
| Sewerage System | No | No | No | No |
| Total Households | 225 | 700 | 150 | 150 |
| Total Population | 1800 | 6000 | 1200 | 1000 |
| Punchayat System | Yes | No | No | Yes |

### 2.1.2 Shahpur Small Dam

Shahpur Small Dam is located in Kala Chitta Range, about 8 km north of Fateh Jang Town and 47 km from Rawalpindi/Islamabad on Fateh Jang-Hussan Abdal Road off-taking from the main Rawalpindi-Kohat Road. It is constructed on Nadna Kas stream and has a storage capacity of 4095 AF. It was completed during 1986 and has a designed command area of 4308 acres. The designed discharge of the channel is shown as 43 cusecs (Annex-2). The designed command area information provided by WRRI (Annex-2) is higher than what has been reported by the Lumberdar (Headman of village Amir Khan) of the area, i.e., 1250 acres as the designed command area. Similarly, to him, the design discharge of the channel is 15 cusecs instead of 43 cusec. Afler checking with the Project Director, Small Dams Organization, the figures reported by the Lumbardar were found correct. Still this discrepancy can be rectified under a hydrological study. This is also a multi-purpose dam. Beside supplying irrigation water to barani land, it is used for rearing fish and supplying drinking water to nearby towns and villages, like Hattor, Qutbal and Fateh Jang Town. There are four villages, Amir Khan, Kareema. Shahpur and Dhok Balouch from where farmers are benefitting from this water. The facilities that residents of these villages are having in Shahpur Dam command area are presented in Table 2.2.

Table 2.2 Characteristics of Communities in Shahpur Small Dam Area.

| Facilities | Name of Villages | | | |
|---|---|---|---|---|
| | Amir Khan | Kareema | Shahpur | Dhok Balouch |
| Hospital/dispensary | No | No | No | No |
| Veterinary hospital | No | No | No | No |
| School (Males) | Primary | Middle | Primary | Primary |
| School (Females) | Primary | Primary | Primary | Primary |
| Industrial Home (Females) | No | No | No | No |
| Farm to Market road | Yes | Yes | No | No |
| Electricity | Yes | Yes | Yes | Yes |
| Telephone | Yes | Yes | No | No |
| Safe drinking water/tape water | Yes | No | No | No |
| Post Office | Yes | Yes | Yes | Yes |
| Marketing facilities | No | No | No | No |
| Bus Station | Yes | No | No | No |
| Bank | No | No | No | No |
| Cooperative Society | | | | |
| a. Formal | No | Yes | No | No |
| b. Informal | No | Yes | No | No |
| Sewerage System | No | No | No | No |
| Total Households | 400 | 150 | 135 | 122 |
| Total Population | 3500 | 1300 | 1050 | 1300 |
| Punchayat System | No | Yes | Yes | Yes |

Table 2.2 shows that for the population of over 7000 in the villages, and over 800 families, in the command area of Shahpur Small Dam, no hospital or veterinary hospital is available. In all of the four villages, the educational facilities are only up to elementary (primary) school level, Kareema being an exception where a middle school for boys is available. Post offices and electricity are available in all of the villages, but there is no telephone facility in two of the villages. There are no marketing facilities at the local level, but in two out of the four villages. farm to market roads have been constructed. Only one village has access to safe drinking water, but sewerage facilities are not present. Only one the four villages has been provided a bus stand, but there is no bank in any of the villages. In one *of* the four villages, cooperative societies have been organized. One of the villages lacks the punchayats. which existed in the other three villages.

## 2.2 Residential Status of the Respondents

Residential status means respondent's place of origin. If the respondent was born in the same area, he is termed as local and a settler otherwise. Data presented in Table 2.3

shows that a large majority **(97.4%)** of the respondents were local residents, while just 2.6 percent of them were settlers. The respondents who were settlers in Shahpur Small Dam Area, some of them migrated from North West Frontier Province, while others were reported to be settled from Chakwal District. It can be noted that the share of settlers was slightly higher in the case of Mirwal Dam as compared to that of the Shahpur Dam.

| **Residential Status** | **Mirwal** (N=59) | Shahpur **(N=135)** | Overall (N=194) |
|---|---|---|---|
| Local **respondent** | **94.9** | **98.5** | **97.4** |
| **Settler** | **5.1** | **1.5** | **2.6** |
| Total | 100.0 | 100.0 | 100.0 |

## **2.3** Caste Structure **of** the Respondents

In this study, caste is referred to as any exclusive social class in the society that forms the basis of kinship among various individuals of the society. The two pilot small dams are located in the Pothwar area of District Attock (Rawalpindi Division), close to the border of Nowshera and Peshawar Districts of the North West Frontier Province, which is best known as the province of Pukhtun or Pathans. Quite a number **of** the respondents from Shahpur Dam reported either Pathan or Khattar (a sub-caste of Pathan) as their caste. Being close to the North West Frontier Province, their forefathers might have settled in Shahpur Dam Command Area.

Table **2.4.** Caste Structure **of** the Respondents.

| **Caste** | **Mirwal (N=59)** | **Shahpur (N=135)** | **Overall (N=194)** |
|---|---|---|---|
| Pathan | - | 11.9 | 8.2 |
| Khathar | 8.5 | 16.3 | 13.9 |
| Maliar | 1.7 | 5.2 | 4.1 |
| Rajput | 40.7 | 5.2 | 16.0 |
| Awan | 37.3 | 37.0 | 37.2 |
| Others | 11.8 | 24.4 | 20.6 |
| Total | 100.0 | 100.0 | 100.0 |

Information presented in Table **2.4** reveals that in the Shahpur Dam command area, Awans and Pathans are more common, while in Mirwal Dam command area, Rajput and Awan are dominant. Over all, Awan are about 37 percent, Rajput were 16 percent and Pathan (and sub-caste Kathar) are found to be over 22 percent in the study area. Almost every fifth respondent belonged to "other" castes. It can also be noticed that the Awans are more or less equally spread in both of the pilot projects. The graphic illustration of caste structure has been presented in Figure 2.1.

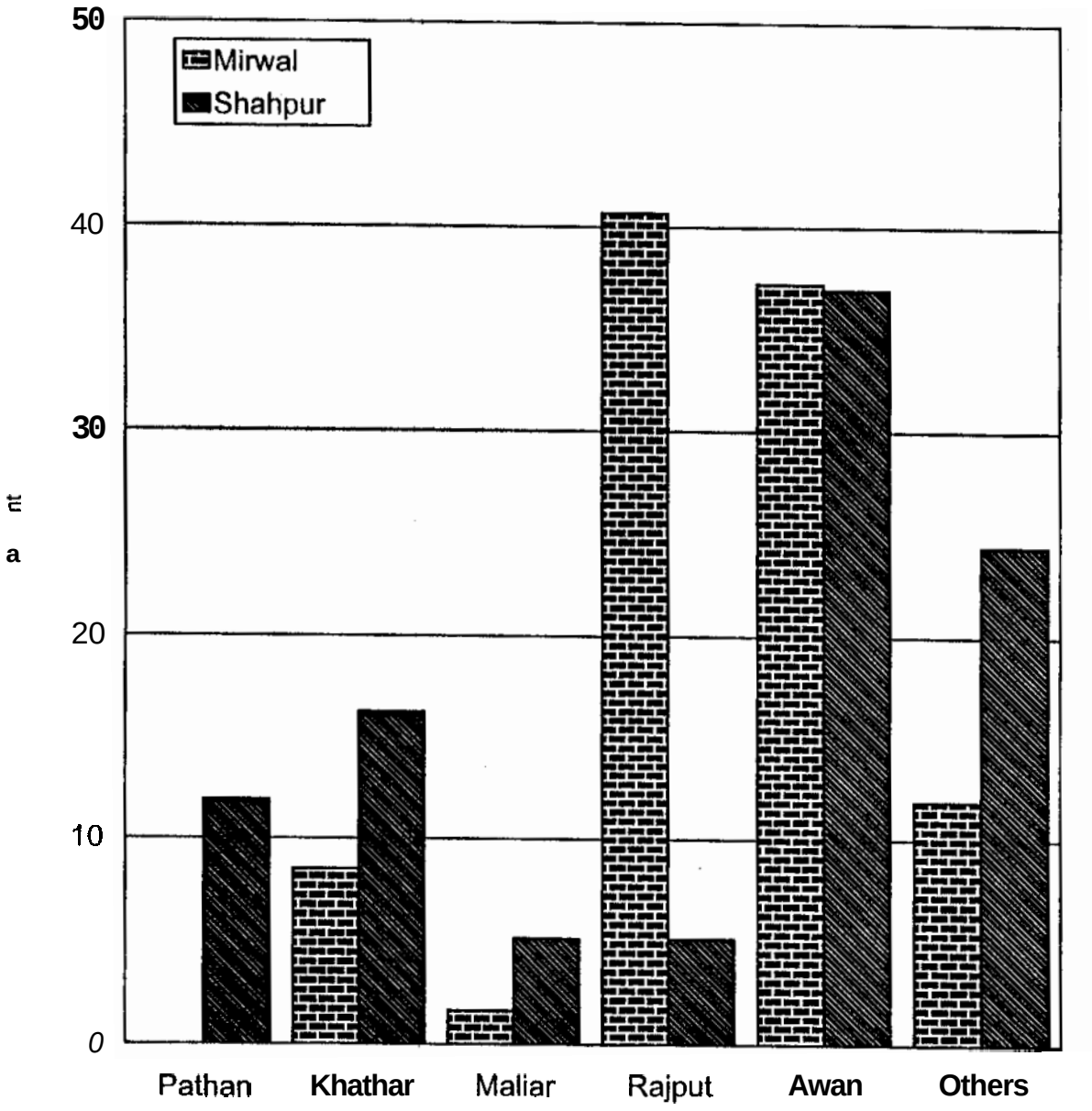



**Figure 2.1 Caste Structure *of* the Respondents.**

| Father's occupation | Mirwal (N-59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Same **as** Respondent's occupation | 91.5 | 97.5 | 95.9 |
| Different from respondent's oocupation | 8.5 | ***2.5*** | **4.1** |
| Total | 100.0 | 100.0 | 100.0 |

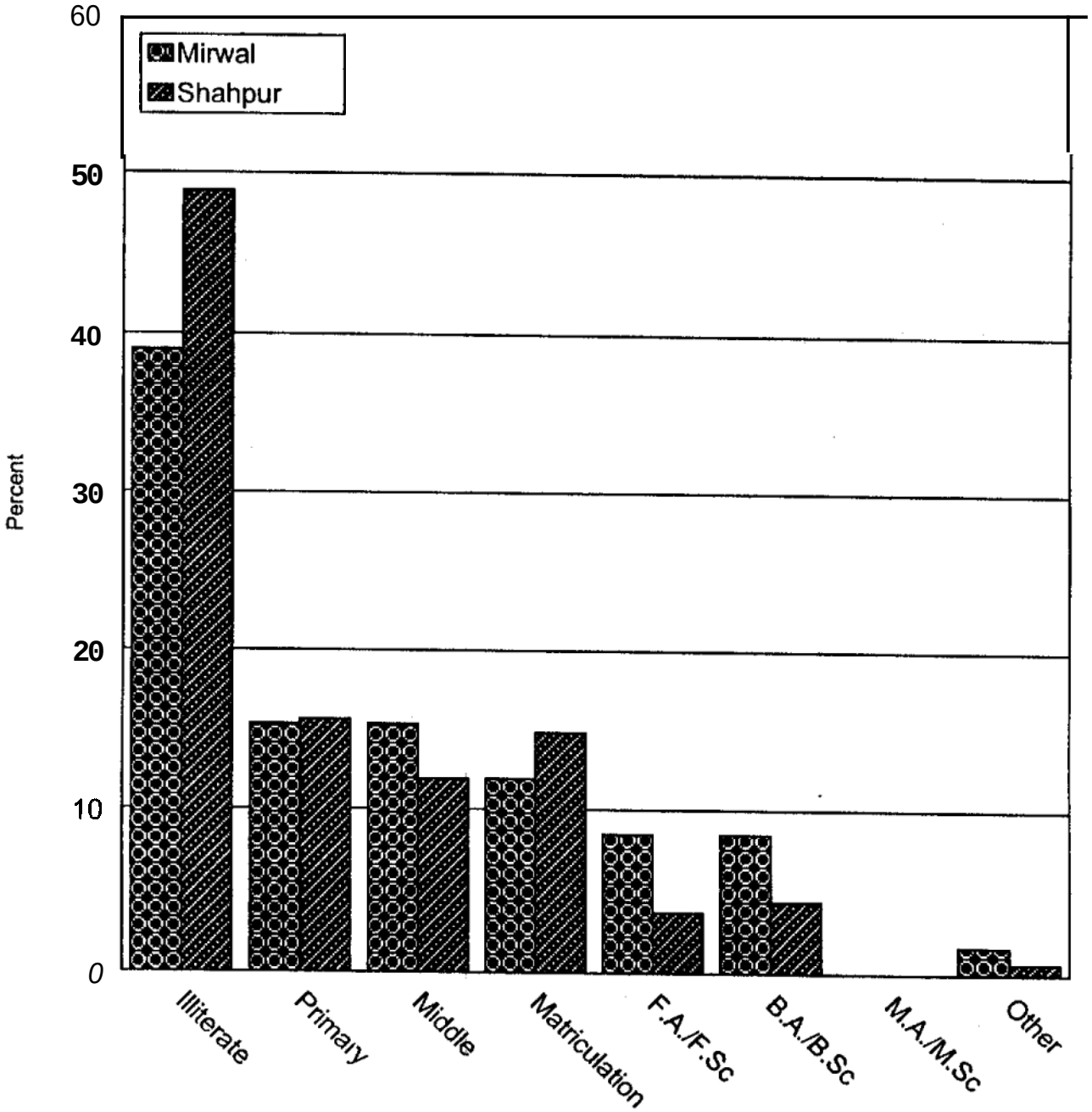



**Figure 2.2 Distribution of Respondents Regarding Educational Attainment.**

**Table 2.6 Distribution *of* Respondents with Regard to Educational Attainment.**

| Education | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Illiterate | 39.0 | 48.9 | 45.9 |
| Primary | 15.3 | 15.6 | 15.5 |
| Middle | 15.3 | 11.9 | 12.9 |
| Matriculation | 11.9 | 14.8 | 13.9 |
| F.A./F.Sc | 8.4 | 3.7 | 5.2 |
| B.A/B.Sc | 8.4 | 4.4 | 5.6 |
| M.A./M.Sc | - | - | - |
| Other | 1.7 | 0.7 | 1.0 |
| Total | 100.0 | 100.0 | 100.0 |

When literacy rates for both the pilot projects were calculated, it was found that they were very close to that of the literacy rate for Pakistan. The literacy rate for the overall project area was 32.4 percent, while for male it was about 49 percent and for female it was found to be around 16 percent. The literacy rate was found slightly higher in Mirwal Dam area than that in Shahpur Dam area. The same difference is found when comparing literacy rate with respect to gender. The details are presented in Table 2.7.

## 2.6 Household Size of the Respondents

In this report, a household refers to the members eating from the same kitchen and the family members living outside the village who are contributing towards the family purse (or income) in any form. Table 2.7 contains information about the average number of family members in the project area. On an average, the number of family members per household is slightly higher in Shahpur Dam area (9.13) than that of Mirwal Dam area (8.36). On an overall basis, the mean number of family members were around nine.

The mean number of family members in school were reported to be just above **2,** with a slight difference in the two pilot projects. Like other parts of the country, the number of females in school were about half *of* their counterparts (males). The mean number of females, who passed their primary education, were found less than one-third that of the males. Considering the fact that the educational facilities upto primary education are similar for males and females (see Tables 2.1 and 2.2), this difference can be ascribed to either a higher drop out rate for females or under-utilization of the educational facilities. **A** preferential treatment from the parents towards their male children in every

walk of life in a sex segregated society cannot be over looked, as the male children are treated as future bread winners and security for old aged parents, and as a result, are provided with better education and training than females.

**Table 2.7 Mean Number of Family Members by Age, Schooling Status and Literacy Rates.**

| Age Group | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Less than 5 (Male) | 0.56 | 0.70 | 0.66 |
| Less than 5 (Female) | 0.59 | 0.75 | 0.71 |
| **Less than 5** | **1.15** | **1.48** | **1.38** |
| 5 to less than 15 (Male) | 1.12 | 1.14 | 1.13 |
| 5 to less than 15 (Female) | 1.00 | 0.75 | 0.82 |
| **5 to less than 15** | **2.12** | **1.89** | **1.96** |
| 15 to less than 65 (Male) | 2.39 | 2.74 | 2.03 |
| 15 to less than 65 (Female) | 2.17 | 2.53 | 2.42 |
| **15 to less than 65** | **4.56** | **5.27** | **5.05** |
| 65 and above (Male) | 0.27 | 0.30 | 0.29 |
| 65 and above (Female) | 0.25 | 0.23 | 0.24 |
| **65 and above** | **0.54** | **0.51** | **0.53** |
| **Total** | **8.36** | **9.13** | **8.89** |
| Less than 5 (Males in school) | 0.10 | 0.10 | 0.10 |
| Less than 5 (Females in Schools) | 0.03 | 0.10 | 0.08 |
| 5 to less than 15 (Males in school) | 0.88 | 0.98 | 0.95 |
| 5 to less than 15 (Female in school) | 0.64 | 0.51 | 0.55 |
| 15 and above (Male in school) | 0.20 | 0.27 | 0.25 |
| 15 and above (Female in School) | 0.07 | 0.14 | 0.12 |
| **Total in school** | **1.95** | **2.12** | **2.07** |
| Primary passed (Male) | 2.03 | 2.54 | 2.39 |
| Primary passed (Female) | 0.78 | 0.61 | 0.66 |
| **Literacy rate (Male)** | **47%** | **45.3%** | **48.8%** |
| **Literacy rate (Female)** | **19.3%** | **14.3%** | **15.7%** |
| **Literacy rate** | **33.5%** | **31.9%** | **32.4%** |

## 2.7 Working Family Members

Table 2.8 presents some details of household members' involvement in farming. Females were also reported to be working full-time as well as part time on farms in both of the pilot areas. The mean number of full-time working household members were around 1.77 (1.97 in Mirwal Dam and 1.69 in Shahpur Small Dam). Similarly, the mean number of part-time working household members were reported to be 0.47 in Mirwal

Dam, whereas this figure is 1.1 in Shahpur Dam area. The mean household members working abroad were 0.03, whereas the mean males were found to be more in number in the armed forces in Mirwal Dam area than in Shahpur Dam area. Besides, the mean number of household members, who were reported working in other agencies, were 0.47 (0.22 in Mirwal Dam area and 0.57 in Shahpur Dam Area).

Table **2.8.** Mean Number **of** Working Family Members and their Enterprise

| Statement | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| **Less than** 15 **working full time on fatm (Male)** | **0.10** | **0.03** | **0.05** |
| **Less than 15 working** full **time on farm (Female)** | **0.12** | **0.0** | **0.04** |
| **Less than 15 to** *65* **working** full **time on** farm **(Males)** | **1.14** | **1.38** | **1.31** |
| **15** to **less than** *65* **working full time on farm (Female)** | **0.46** | **0.22** | **0.29** |
| **65 and above workina full time on farm (Males)** | 0.12 | 0.11 | 0.11 |
| 65 and above working full time on farm (Female) | 0.03 | 0.0 | 0.01 |
| Total working full time on farm | 1.97 | 1.69 | 1.77 |
| Less than 15 working part time (Male) | 0.02 | 0.07 | 0.06 |
| Less than 15 working part time (Female) | 0.02 | 0.01 | 0.01 |
| 15 to less than 65 working part time (Males) | 0.41 | 0.50 | 0.47 |
| 15 to less than 65 working par time (Female) | 0.19 | 0.48 | 0.39 |
| 65 and above working part time (Males) | 0.0 | 0.03 | 0.02 |
| 65 and above working part time (Female) | 0.0 | 0.01 | 0.03 |
| Total working part time on farm | 0.47 | 1.10 | 0.91 |
| Working abroad (Male) | 0.03 | 0.030 | 0.03 |
| Working in Armed Force (Male) | 0.44 | 0.29 | 0.31 |
| Working in other agencies (male) | 0.22 | 0.54 | 0.44 |
| Working in other agencies (Female) | 0.0 | 0.02 | 0.015 |
| Working in other agencies (Total) | 0.22 | 0.57 | 0.47 |

## **2.8** Tenurial Status **of** the Respondents

Tenure refers to an arrangement between the land owners, who rent out a portion of their land on cash or kind, and tenants who rent land in return for an agreed amount of rent **or** rental share of the product in return for the right to cultivate the **land** and appropriate its output (Shahid and Ashraf. **1989).**

Table **2.9.** Tenurial Classification **of** the Respondents.

| Tenurial Status | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Owners (Absentee) | 5.1 | - | 1.5 |
| Owners-cum-operators | 57.6 | 88.2 | 78.9 |
| Tenants | 13.6 | 4.4 | 7.2 |
| Lessees | 10.2 | 1.5 | 4.1 |
| Owners-cum-tenants | 5.1 | 4.4 | 4.6 |
| Owners-com-lessees | 8.4 | 1.5 | 3.6 |
| Total | 100.0 | 100.0 | 100.0 |

Table 2.9 delineates information about the tenurial classification of the respondents. In a few cases, where tenants were not available for an interview, the information was obtained by the owners. It was reported that the absentee landlords or non-operator owners, were just 1.5 percent of the total respondents. A majority of the respondents were reported as owners operators (78.9%). This proportion was higher at Shahpur Dam as compared to that of Mirwal Dam, and conversely, the proportion of tenants and lessees was less at Shahpur, indicating that the farmers having land at Shahpur are more interested in farming. Because of the small size of holdings, a majority of the farmers were operating their own lands. Some of the owner-operators (roughly 8 per cent of total) had leased or rented out some piece of land on a cash or share basis. The proportion of owner-cum-lessees and owner-cum- tenants was high in the case of Mirwal compared to that of the Shahpur Dam. About 11 percent of the respondents were found farming either as tenants or as lessees. Graphic illustration of tenurial status of the respondents is shown in Figure 2.3.

## 2.9 Size of Landholding

According to Sharif et. al. (1986), land is the main determinant of income under the prevailing socio-economic conditions in rural areas. The size of landholding has been found highly correlated with the adoption of new farming practices (Lionberger, 1960; Cheema et al 1992).

In the pothwar area, the holdings are generally small and sub-units of an acre are used to indicate the size. Therefore, in this study, landholding is expressed in kanals (one-eighth of an acre). Average landholding is very low and unlike in the lower Punjab or Sindh, people express their holding in kanals. Further, the value of land expressed in terms of production index points are considered half in this area as compared to that *of* irrigated areas.

For comparing the landholding, the respondents were grouped into four classes; i.e. less than 40 kanals (2 ha); 40 to 100 kanals ( 2 to 5 ha), 100 to 200 kanals (5 to 10 ha), 200 to under 2000 kanals (10 to 100 ha), and above 2000 kanals (100 ha). The results are presented in Table 2.10. Size of the landholding of the respondents at both the small dams is also indicated in Figure 2.4.

**Table 2.10. Classification of the Respondents with Respect to Size of Holding.**

| Land Holding (Kanals) | Mirwal Dam (N=43) | Shahpur Dam (N=128) | Overall (N=170) |
|---|---|---|---|
| Less than 40 | 7.0 | 41.7 | 32.9 |
| 40 to 100 | 25.6 | 33.9 | 31.8 |
| 101 to 200 | 20.9 | 16.9 | 17.6 |
| 201 to 1999 | 34.9 | 7.5 | 14.7 |
| 2000 and over | 11.6 | - | 3.0 |
| Total | 100.0 | 100.0 | 100.0 |

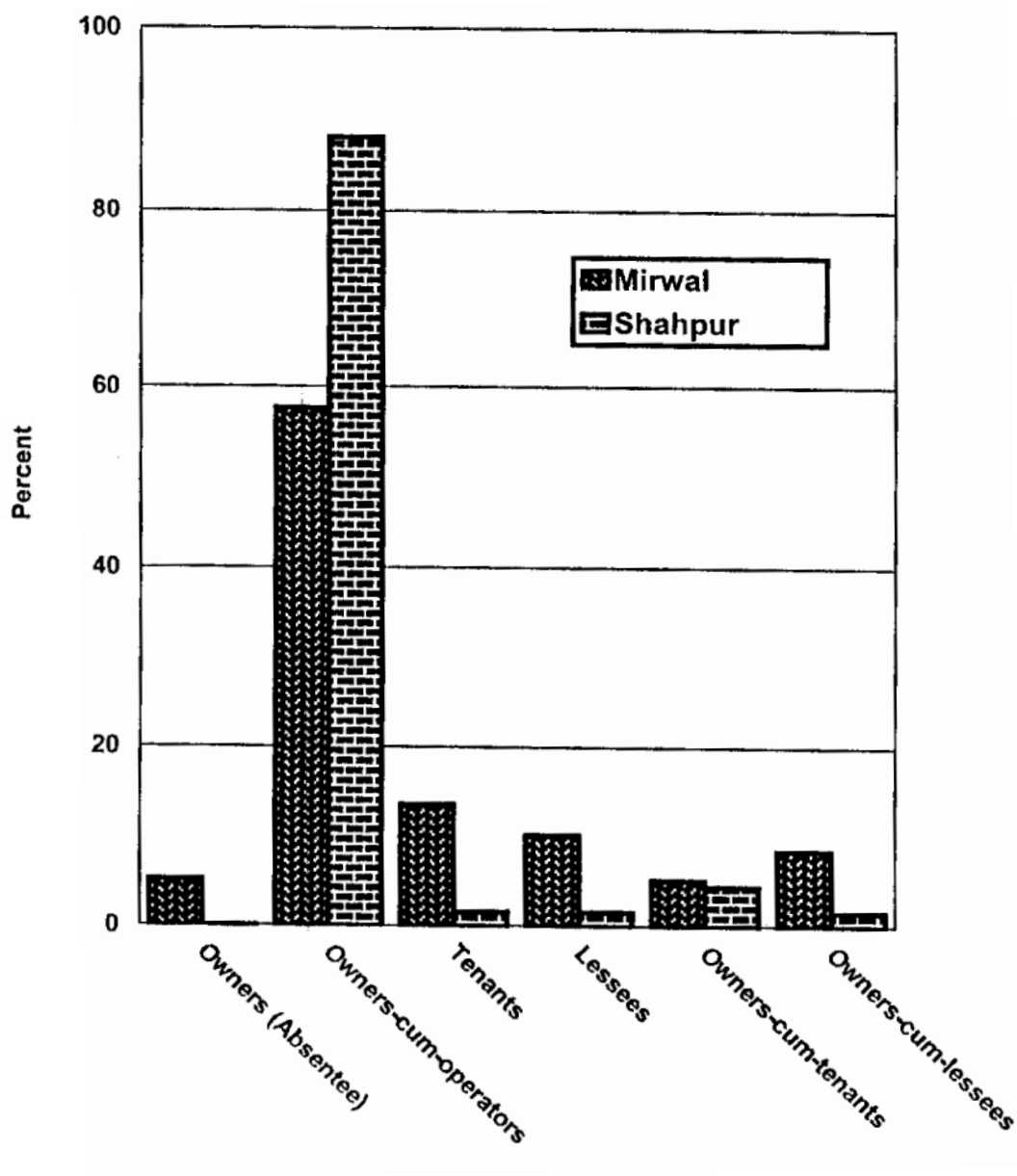



**Figure 2.3 Tenurial Classification of the Respondents.**

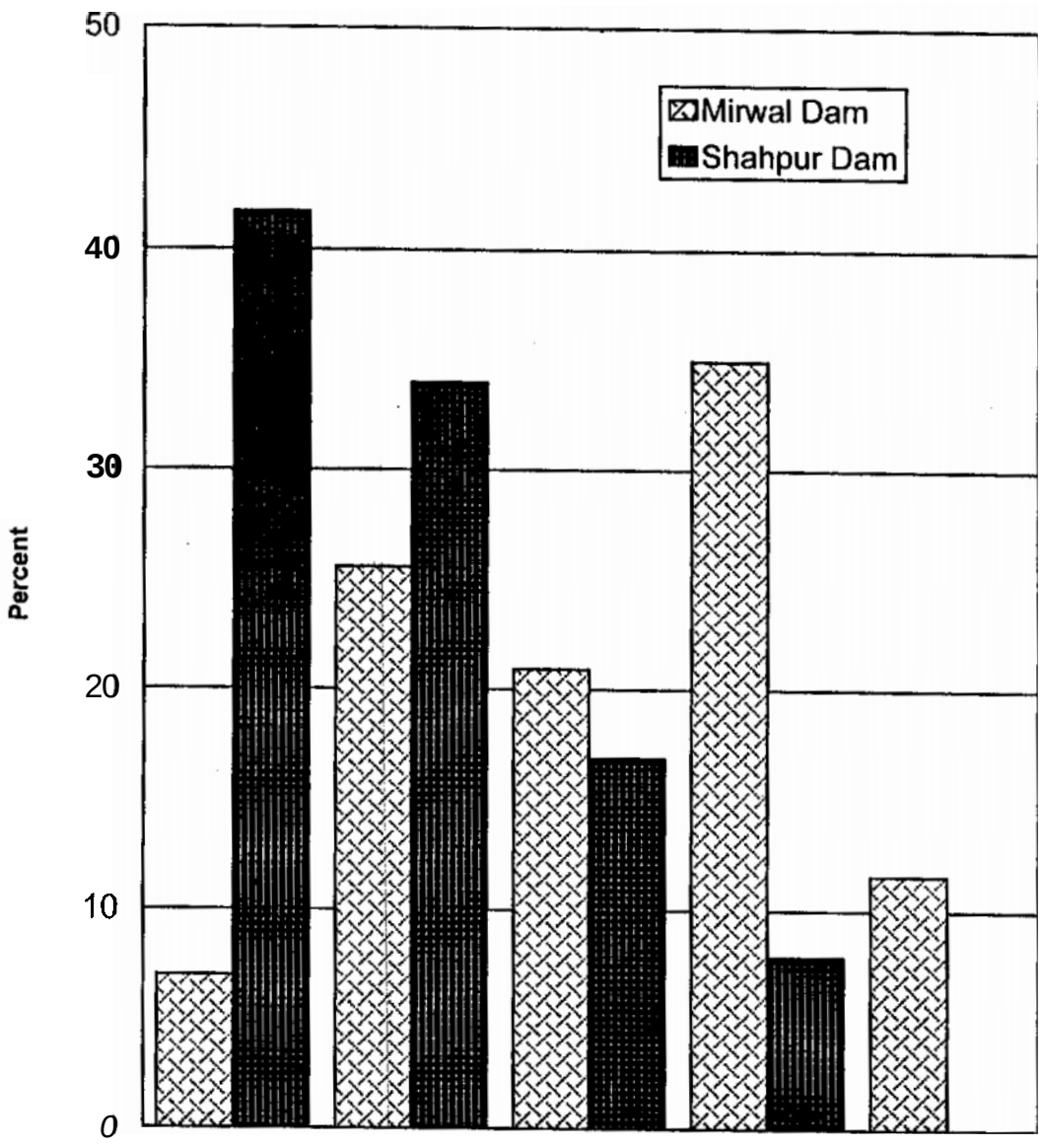



**Figure 2.4 Classification of the Respondents with Respect to Size of Holding (Kanals).**

Table 2.10 shows that the pattern of land distribution among the farmers of Shahpur Dam is more even compared to that of the Mirwal Dam. The proportion of small farmers is about six times more at Shahpur Dam than the proportion of small farmers at Mirwal Dam. There is no big land owner at Shahpur Dam. Around 65 percent of the owners were found to have 100 kanals or below (or under 12.5 acres). In irrigated areas, a holding of 12.5 acres is considered as a subsistence holding. Like South Punjab, big landlords are also found in Pothwar area. Some of them are quite big and had land holdings over 16,000 kanals. In this case, 5 respondents were found to have 2,000 kanals of land and over in the pilot project area. One of them had over 16,000 kanals and was a retired army officer. Being known as a progressive farmer, almost all of the government agencies working in the area had approached him for one reason or the other.

The size of ownership can, nevertheless, be a misleading indicator in this area as a large proportion of the land has not yet been levelled for cultivation and using irrigation water due to its uneven topography. Therefore, an analysis of landholding with respect to source of irrigation also becomes important.

Table 2.11 shows that almost all of the area that could be brought under irrigation is being operated at both of the Dams, while the barani area has not yet been fully exploited. This can further be supported by the fact that the levelled area forms only one-sixth to one-third of the total area owned at Mirwal and Shahpur Dams, respectively, indicating a huge potential for intensive use of unexploited land resources. The last row in the table indicates the potential area for levelling.

Table 2.11. Area Owned, Operated, Levelled and Potential for Levelling by Type of Irrigation.

| Type of Area | Mirwal Dam | Shahpur Dam | Overall |
|---|---|---|---|
| Owned | | | |
| 1. Irrigated | 29.79(38) | 20.31(127) | 22.50(165) |
| 2. Barani | 254.53 | 73.11 | 114.89 |
| 3. Total | 384.32 | 93.18 | 137.20 |
| Operated | | | |
| 1. Irrigated | 29.28(54) | 17.33(135) | 20.75(189) |
| 2. Barani | 148.43 | 55.85 | 80.85 |
| 3. Total | 183.96 | 76.44 | 106.34 |
| Levelled | 60.71(38) | 32.54(127) | 39.03(165) |
| Potential for levelling | 105.84(38) | 28.76(127) | 46.51(165) |

ite: Figures in parenthesis are the number of reporting respondents.
**Five respondents having 2000 kanals and over are not included in mean figure for comparison sake.**

## 2.10 Machinery

Farm production is highly associated with farm mechanization. By better utilization of machinery, farmers can improve their productivity. Use of tractors, ploughs, threshers and other implements help farmers in saving time and better prepare fields for sowing than that by using animal draught power. Table 2.12 contains information about the ownership of tractors and other implements/tools. The farmers owned threshers, seed drills, reapers for wheat harvesting, ridgers, spray machines, etc. About 19 percent of the respondents possessed tractors, 12 percent had threshers and about 15 percent owned a seed drill. Farmers used a seed drill for the sowing of wheat and maize crops. The seed drill method helps to attain good seed germination, thus resulting in good crop production. One rarely can observe the broad cast method by farmers for sowing wheat and maize crops. It can be seen that apart from tractors and reapers, there were no major differences in ownership of machinery between the respondents from both of the dams. Nevertheless, the ownership of machinery, like that of land is more skewed at Mirwal, where a retired army officer possessed most of the machinery mentioned in the table.

**Table 2.12. Percentage of Respondents Owning Tractor and Other Implements.**

| Type of Farm Machinery | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Tractor | 23.7 | 17.0 | 19.1 |
| Thresher | 13.8 | 11.1 | 11.9 |
| Seed Drill | 15.3 | 14.8 | 14.9 |
| Reaper | 5.2 | 2.2 | 3.1 |
| Ridger | 1.7 | 1.5 | 1.6 |
| Spray Machine | 1.7 | 2.2 | 2.1 |
| Others (Trolley, Ground nut digger, Raja plough) | 18.6 | 18.5 | 18.6 |
| Does not arise | 20.0 | 32.7 | 28.7 |
| Total | 100.0 | 100.0 | 100.0 |

# CHAPTER-3

# IRRIGATION PRACTICES, WATER MANAGEMENT AND IRRIGATION SYSTEM PERFORMANCE

## 3.1. Irrigation Practices

### 3.1.1 Sources of Irrigation

Source of irrigation in this study means a system from where farmers are receiving water for irrigation of crops sown by them. Mainly, there are three sources of irrigation water i.e. dam, lift pump, and dug-wells. The Small Dam is the main source for irrigation water, Water from the dam is supplied to farmers through watercourses off-taking from the main water channel. Some farmers who can afford to buy a pump, lift water from streams and in some areas, where there is no stream, or dam, or farmers cannot afford to buy a lift pump, they are using dug-wells for irrigation purpose. Table 3.1 shows that about 80 percent of the respondents from both of the small dams were using dam water for irrigation. Where dam water is not available, dug-wells are the main source of water. About *6* percent of the respondents under Shahpur Dam were found running dug-wells to irrigate their fields. Under the Mirwal Dam, the use of dug-wells have been abandoned. Because of the relatively high input of labour, irrigation using a dug-well **is** becoming obsolete in the area. The conjunctive use of dam and dug-well is also noticeable and reflects that whenever **the** water from the dam is unavailable. people supplement their water supply through dug-wells. Sources of irrigation of the respondents are also presented in Figure 3.1.

**Table 3.1 Sources of Irrigation.**

| Sources of Irrigation | Mirwal (N=44) | Shahpur (N=97) | Overall (N=141) |
|---|---|---|---|
| Dam | 84.4 | 61.0 | 73.0 |
| Lift Pump | 0.0 | 1.0 | .7 |
| Dam + Lift Pump | 4.5 | 8.2 | 7.1 |
| Well | 0.0 | 6.2 | 4.3 |
| Dam + Well | 9.1 | 17.6 | 14.9 |
| Total | 100.0 | 100.0 | 100.0 |

### 3.1.2 Extent of Satisfaction

Data presented in Table 3.2 reveal that over 41 percent of the water users under Shahpur were not satisfied at all with the current source(s) of water, as it was not supplying enough water for irrigation purposes. While 42 percent were found to be satisfied to some extent with their source of irrigation water, the rest of the respondents (16.5%) had shown their satisfaction to a large extent. Under the Mirwal Small Dam, the

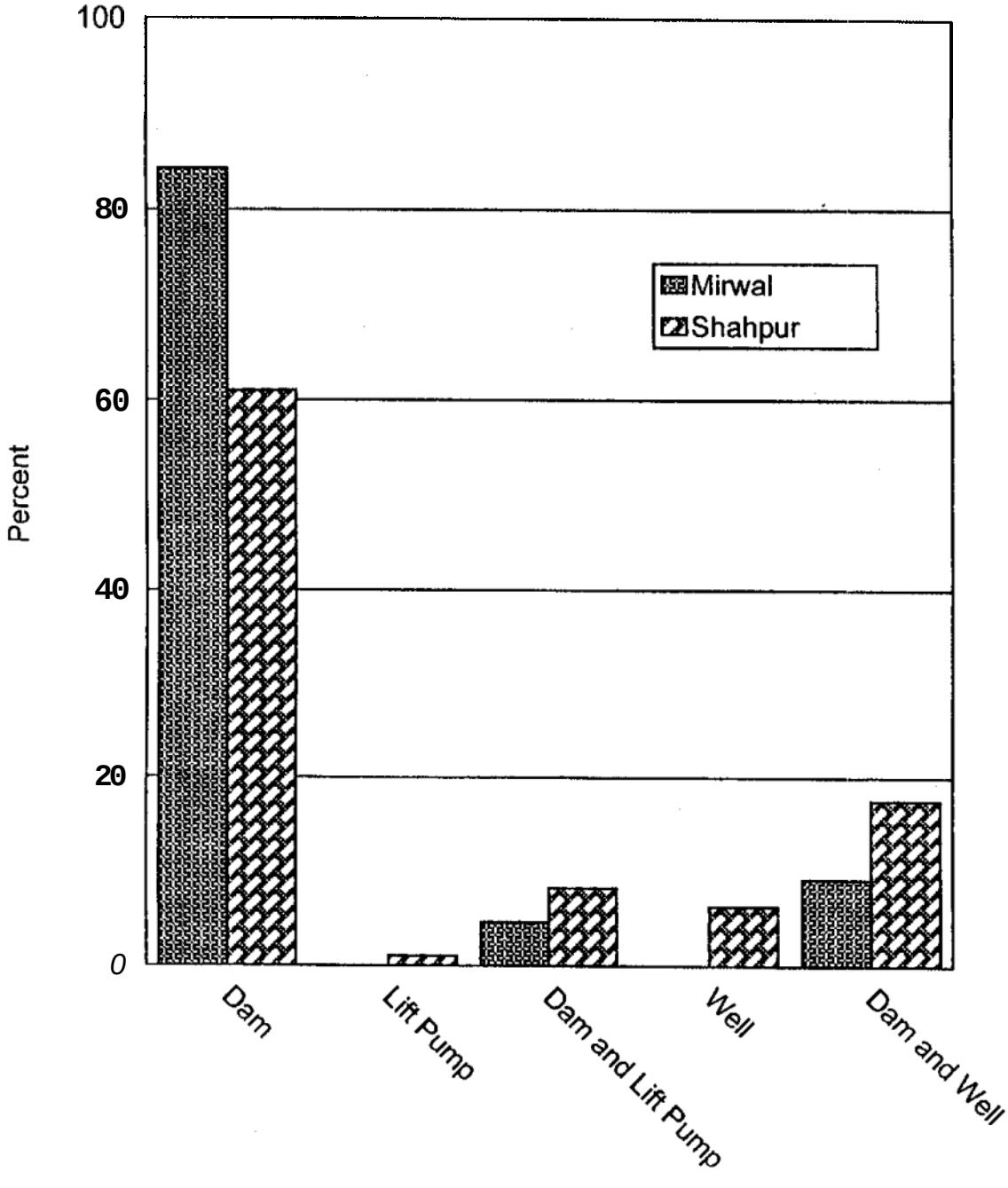



Figure **3.1 Sources** of Irrigation.

situation is viewed as quite satisfactory. Around 61 percent of the farmers from Mirwal Dam were found satisfied to a large extent with the supply of water from their current source(s) for meeting irrigation purposes. Only 4.5 percent of the respondents showed their dis-satisfaction.

Table **3.2.** Extent of Satisfaction From Sources of Irrigation.

| Extent of satisfaction | Mirwal (N=44) | Shahpur (N=97) | Overall (N=141) |
|---|---|---|---|
| Not at all | 4.5 | 41.2 | 29.8 |
| **To some** extent | 34.1 | 42.3 | 39.7 |
| **To** large extent | 61.4 | 16.5 | 30.5 |
| Total | 100.0 | 100.0 | 100.0 |

| S.No. | Methods used for overcoming deficiency | Mirwal (N=44) | Shahpur (N=97) | Overall (N=141) |
|---|---|---|---|---|
| 1. | Grow corp with less water requirement | | 1.7 | 0.7 |
| 2. | Private lift pump | 2.3 | 3.1 | 2.8 |
| 3. | Traditional well | | 1.0 | 0.7 |
| 4. | Request other farmers | | 1.7 | 0.7 |
| 5. | Do nothing | 4.5 | 3.1 | 3.5 |
| 6. | Wait for rain | 29.5 | 74.2 | 60.3 |
| 7. | Not applicable | 63.7 | 16.2 | 31.3 |
| Total | | 100.0 | 100.0 | 100.0 |

The Irrigation Methods that were generally practiced by the respondents are presented in Table 3.4. A majority of them (almost 3 out of 4 respondents) reported that they were using the basin irrigation method. About one-fifth of the respondents were using a mixture of basin and furrow methods. Wild flooding is almost non-existent in the area. Irrigation methods practiced by the respondents are also indicated in Figure 3.2.

**Table 3.4. Irrigation Methods Practiced by the Water Users.**

| Irrigation Methods | Mirwal (N=44) | Shahpur (N=97) | Overall (N=141) |
|---|---|---|---|
| Basin | 70.5 | 75.3 | 73.8 |
| Furrow | 2.3 | 3.1 | 2.8 |
| Basin + Furrow | 27.2 | 20.6 | 22.7 |
| Wild Flooding | - | 1.0 | 0.7 |
| Total | 100.0 | 100.0 | 100.0 |

## 3.2. Irrigation System Performance

Equity, as related *to* the water delivery system, can be defined as the delivery of fair shares of water to users throughout the system. Equitable water distribution is attained when the ratio of water delivery through outlets at the head reach of the water channel to that of outlets at the tail reach equals one (Cheema et al 1997). In this survey, the perceptions of the farmers were obtained about the water distribution.

### 3.2.1. Equity in Water Distribution

To a majority of the respondents **(57%)** at Shahpur Dam, the water distribution was inequitable and at the Mirwal Dam, just half of the respondents perceived that the water was equitably distributed. As water rights are not fixed and there is no strict water allocation and distribution system in practice under either of the dams, everyone starts using dam water as soon as it is available in the channel. Farmers at the head and middle reaches have better access and the farmers at the tail reach usually receive water from Mirwal Dam only during night time. The respondents that are counted in the row "Not applicable" are those who are currently not using the water from the dam.

In Shahpur Small Dam, the situation is worse than at Mirwal Dam. Because of the poor physical condition of the water channel, a sizeable quantity of water is lost before it actually reaches the farmers. Enormous water losses, due to poor maintenance, has created problems for the farmers and was reported as the main factor in inequable distribution of water. It has been reported by the farmers that almost all of the farmers from two villages (Kareema and Amir Khan) have refused to pay water charges as they are not receiving dam water at all.

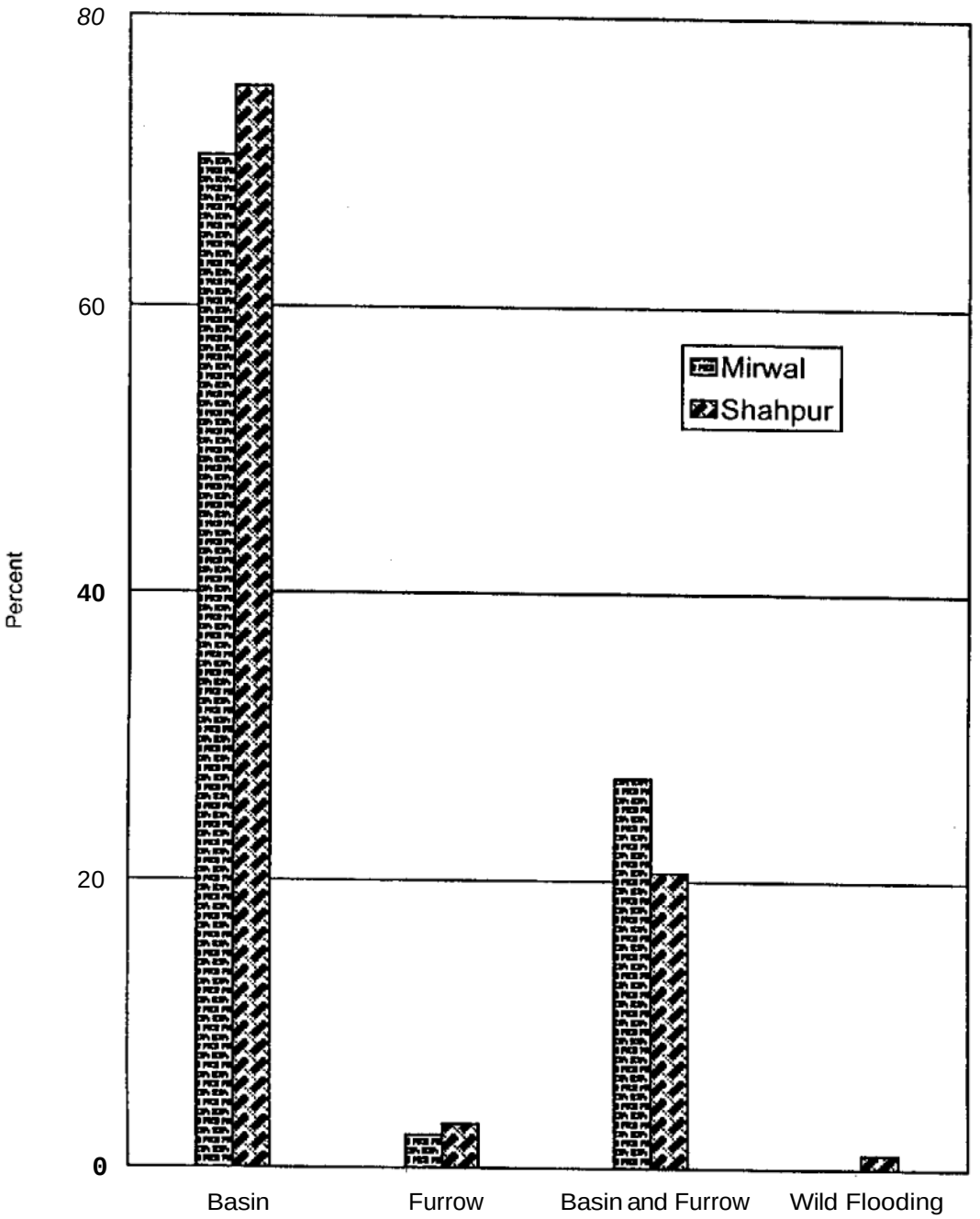



**Figure 3. 2 Irrigation Methods Practiced by the Water Users.**

Table **3.5.** Perceptions About Equity in Distribution **of** Water.

| Equitable Distribution of water | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Yes | 50.8 | 11.1 | 23.2 |
| No | 22.1 | 57.0 | 46.4 |
| Not applicable | 27.1 | 31.9 | 30.4 |
| Total | 100.0 | 100.0 | 100.0 |

The underlying reason for this, as explained by the farmers, is the point where the canal divides into portions. Because of a substantial mistake in construction (or design), the right branch is constructed at a comparatively higher elevation. Because of a steep slope on the left portion, water rushes to the left side, and a small quantity of water enters into the right branch **of** the canal. This situation has prevailed for the last three years. This point of bifurcation has become a source of dispute among the farmers of three villages. According to the local farmers, they have reported the design mistake to the concerned agency, but the problem has not be resolved so far.

Table 3.6 presents reasons forwarded by the respondents, who were of the view that small dam water is not equitably distributed among the farmers. Most of the respondents expressed that the main reasons for inequitable distribution of water are, "poor maintenance of water channel**"**. "influential farmers", and "location **of** the farm" (farms at the tail receive less water).

| Reason for **Inequity** | **Mirwal Dam (N=13)** | **Shahpur Dam (N=77)** |
|---|---|---|
| **1. Location of farm (tail)** | **71.4** | **90.9** |
| **2. Farm size** | **33.3** | **33.3** |
| **3. Tenancy status** | | **33.3** |
| **4. Influential farmer** | **77.6** | **93.5** |
| **5. Poor maintenance of water channel** | **60.0** | **97.0** |

About 90 percent of the farmers were of the view that influential farmers were a factor fostering inequity in water distribution under the small dams. About *86* percent of the farmers expressed that the location of their farm (tail reach of the water channel) was another reason for not having equitable distribution of dam water. Farmers at the head and middle reaches, as there exists no water rights, are the main beneficiaries **of** dam water, while farmers at the tail reach of the water channel are deprived of dam water. This was found true during the survey.

A majority of the respondents at Shahpur Small Dam reported poor maintenance (97%). influential farmers (93.5%) and locational factors (91%) as major causes for inequity, while at Mirwal, influential farmers (78%), locational factors (71%) and poor maintenance (60%) were reported as the reasons for inequity. Nevertheless, these factors are inter-twined with each other. The influential farmers exert political influence to get more water than they deserve, which makes it unavailable for the downstream farmers (or other branch of the stream). They also do not pay water charges and, thus, the funds are not available for maintenance. Graphic illustration of perception of the respondents about inequitable water distribution is presented in Figure 3.3.

### 3.2.2. Adequacy of Irrigation Water from Small Dams

Tables 3.7 and 3.8 contain information about the responses regarding the sufficiency of irrigation water from the dams during the last kharif and rabi seasons. A majority of the respondents at Mirwal were satisfied with the supply and are of the view that it was sufficient during last kharif and, conversely, a majority under the Shahpur Dam were dissatisfied. For about 59 per cent of the respondents at Mirwal Dam and 15 per cent at Shahpur Dam, the water was sufficient during the last kharif season. "Not applicable" contains those respondents who were not using water from the dam.

**Table 3.7. Sufficiency of Irrigation Water During Kharif 1996.**

| Sufficient water | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Yes | 59.3 | 14.8 | 28.4 |
| No | 13.6 | 53.3 | 41.2 |
| Not applicable | 27.1 | 31.9 | 30.4 |
| Total | 100.0 | 100.0 | 100.0 |

The situation was almost similar for the rabi season with only one difference; almost half of the respondents who reported water to be insufficient during the last kharif season opined that it was sufficient during rabi season.

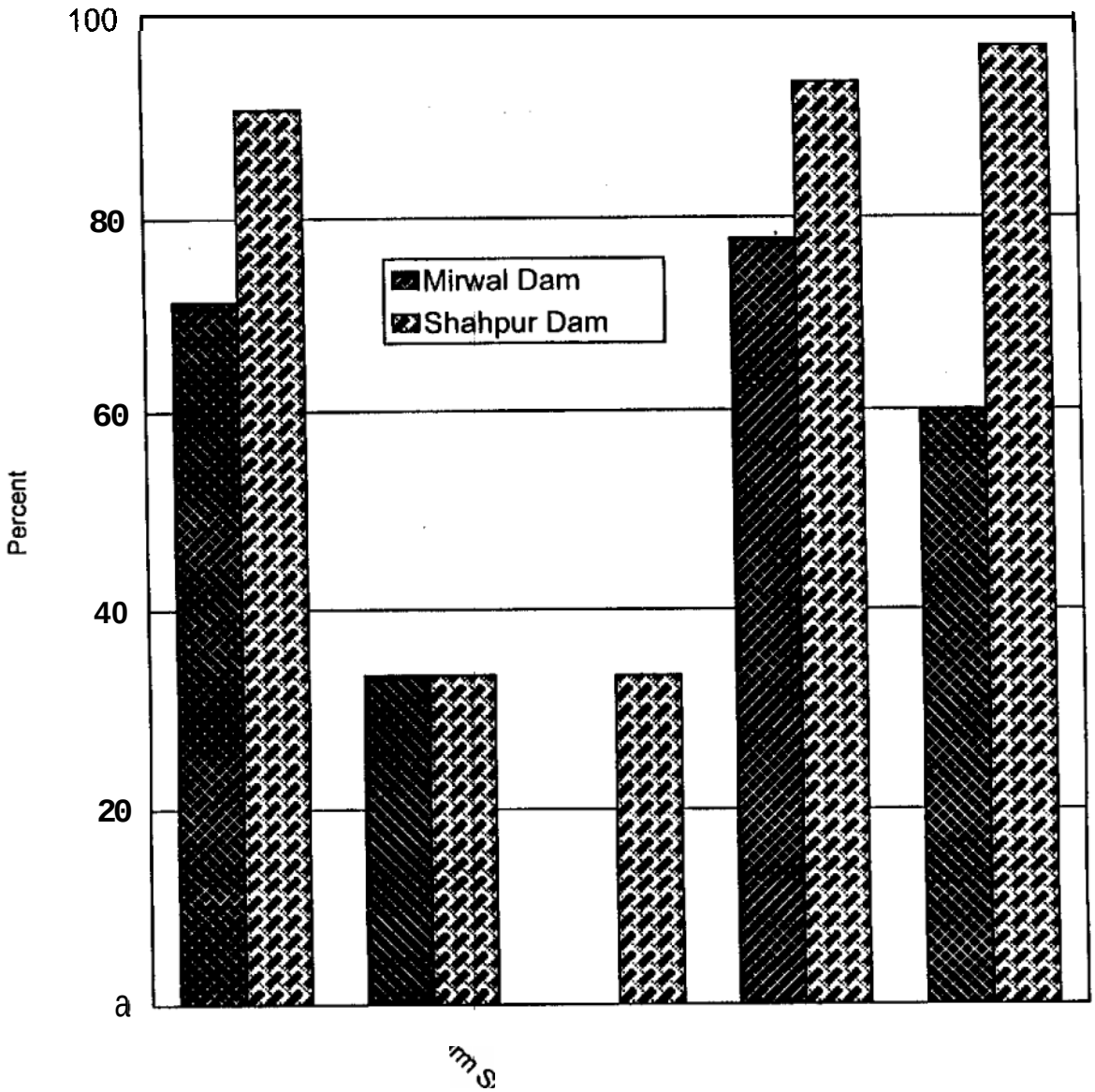



**Figure 3.3 Perceptions About Inequitable Water Distribution.**

**Table 3.8. Sufficiency of Irrigation Water During Rabl 1995-96.**

| Sufficient Water | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Yes | 66.1 | 39.3 | 47.4 |
| No | 6.8 | 28.8 | 22.2 |
| Not applicable | 27.1 | 31.9 | 30.4 |
| Total | 100.0 | 100.0 | 100.0 |

By comparing the responses for the two seasons, it can be asserted that the situation was comparatively better during the rabi season compared **to** that of kharif season. The probable reasons could be low water requirements for the rabi crops due to cool climate, low cropping intensity, etc.

Table 3.9 contains information about the extent of satisfaction, particularly with reference to the small dam water. Almost similar responses were given by the respondents as in the case of sufficiency from the current source(s) of irrigation (Table 3.2). The claim of the unsatisfied or partially satisfied water users can be seen in relation to the fact that they had not received water from the Shahpur Dam for about three months, from January to 3rd week of March 1997, because one of the pillars that supported the main water channel from below had collapsed. Farmers were dissatisfied even with the construction of other parts of the water channel. Further, the leakage of water from the channel can be clearly observed at many places, indicating that the construction and maintenance have been ignored severely. Being in bad shape, a very high percentage of farmers from Shahpur Dam **(44%)** were not satisfied at all with the supply of dam water, while the information from Mirwal Dam was just the opposite. The reason for satisfaction with the supply of Mirwal Dam water might be that it was constructed 5 years later than Shahpur Dam. **Also,** the topographic conditions are different at both the dams. The water channel at Mirwal is still in good shape and supplying sufficient water to the farmers.

**Table 3.9. Extent of Satisfaction from Small Dam Water Supply.**

| Extent of satisfaction | Mirwal (N=54) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Not at all | 13.6 | 43.7 | 34.5 |
| to some extent | 15.3 | 14.8 | 14.9 |
| To large extent | 44.0 | 9.6 | 20.2 |
| Not applicable | 27.1 | 31.9 | 30.4 |
| Total | 100.0 | 100.0 | 100.0 |

Because of huge water losses and poor maintenance, dam water **is** not reaching the tail end farmers. Though Mirwal Darn Water Channel is also not maintained properly either, and despite heavy water losses, a majority of the respondents were satisfied.

In response to a question about the name of agencies/organizations that were capable of bringing improvement in water distribution, a majority of the farmers were of the view that both Small Dam Organization (SDO) and Farmers Organization jointly can improve the situation. Because of the different nature of the problem with the Shahpur Dam water channel, a high percentage of the respondents were found in favour of a Government Agency, which could be capable and is in a position to solve water distribution problems. The perception of the farmers for improving water distribution at Shahpur by the government may be attributed to their view that the channel needs **a** re-designing of the bifurcation structure, construction of which can only be undertaken by a government agency such as the Small Dam Organization.

The percentage of farmer who were in favour of establishing a farmers organization alone to improve water distribution was low. For details see Table 3.10. These results were in accordance with those reported by an earlier study on Hakra **4-R** Distributary (Cheema eta **al, 1997).**

| Agency/Organization | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| **Government Agency** | **3.4** | **25.2** | **18.6** |
| **Farmer Organization** | **6.8** | **18.5** | **14.9** |
| **Both** | **62.7** | **24.4** | **36.1** |
| Not **applicable** | **27.1** | **31.9** | **30.4** |
| **Total** | **100.0** | **100.0** | **100.0** |

## 3.3. Functional Condition *Of* Dam, Water Channels and Watercourses

This section contains information regarding the present functional condition of the dam, water channels, and watercourses as compared to their functional condition five years ago. Table **3.11,** which gives responses from those who are using water, reveals that the functional condition of the irrigation system, *to* a majority of farmers, has not improved over the years. It has either deteniorated with the passage of time, especially in the case of Shahpur Dam, or remained in the same condition as in the case of Mirwal Dam.

**Table 3.11. Present Functional Condition of Dams, Water Channels and Watercourses as Compared to 5 Years Earlier.**

| Functional condition | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Dam | | | |
| Same condilion | 64.4 | 68.1 | 67.0 |
| Deteriorated | 3.4 | 2.2 | 2.6 |
| Improved | | | |
| Does not arise | 32.2 | 29.7 | 30.4 |
| Water Channel | | | |
| Same Condition | 64.4 | 0.7 | 20.1 |
| Deteriorated | 8.5 | 69.6 | 51.0 |
| Improved | | | |
| Does not arise | 27.1 | 29.7 | 28.9 |
| Watercourse | | | |
| Same condition | 49.2 | 3.0 | 17.0 |
| Deteriorated | 18.6 | 67.4 | 52.6 |
| Improved | - | - | - |
| Does not arise | 32.2 | 29.6 | 30.4 |

Regarding the functional condition of small dams, over 96 percent of the respondents, using dam water, were of the view that these were in the same functional condition, while about 4 percent of them thowght that it has deteriorated. About water channels, the exasperated respondents presented a different picture. About 99 percent of the respondents were of the opinion that water channels at Shahpur Dam were in very bad shape as compared to that of 5 years ago, whereas about 88 percent of the respondenls of Mirwal Dam thought that the functional condition has not changed.

About the functional condition of the watercourses, the water users of Shahpur Dam were found to be very critical. To about 96 percent of them, like the water channel, these watercourses started deteriorating just after the dam started functioning because the watercourses were not properly constructed and the material used for the construction of watercourses was not of a good standard. The bed of the watercourses, like the water channel, has been washed away by water. On physical examination, one can find cracks as well as growth of bushes in them, resulting in excessive water losses through seepage from these cracks.

The physical deterioration of the Shahpur Dam has severe implications. Already, the collection of abiana has declined, mainly because dam water is not available to farmers of two villages. The farmers from these two villages applied to the Small Dam Organization (SDO) for declaring their land barani as they were no longer being supplied with dam water. Their application was accepted and the lands of these two villages were declared rain-fed. Even for other villages, the water is not properly distributed among

farmers, resulting in less rather no further land development. The water channel is not properly maintained by the government, because of a paucity of funds. The financial allocations by the Department of Irrigation and Power for the operation and maintenance for the small dams are very low. Further, because of non-existence of a warabandi system, water disputes are increasing in the Project area.

Mirwal Small Dam, constructed during 1990, seems to be in a better physical condition and its water channel and watercourses are yet in good condition, which was endorsed by the water users. One can, nevertheless, still find water losses, if the water supply is measured at different points along the water channel/watercourses, as cracks have also developed and bushes have almost covered the water channel at certain places.

# CHAPTER-4

# INSTITUTIONAL DEVELOPMENT

An institution is an organization whose purpose is to further public welfare and learning. It is also known as an established custom, law or relationship in a society or community. The view of Farmers Organizations (FOs) as an institution is of special relevance to the context in which FOs have to be considered in Pakistan's irrigation systems. This chapter covers the importance of the Water Users Associations (WUAs) in the project area, usefulness of WUAs as perceived by the respondents, existing patterns of their organizational behavior, willingness to work with others, perceived advantages of Farmers Organizations (FOs) at the small dam level, benefits drawn from representatives of various government agencies, etc.

## 4.1 Water Users Association

### 4.1.1 Existence of WUA

Excluding the respondents who possessed only barani land in the command area, around 96 percent of the water users reported about the non-existence of the WUAs in the area. Water Users Association were formed on the pattern of the On Farm Water Management (OFWM) program in other canal irrigated areas of the country for the purpose of lining watercourses to save water losses. Even those who reported about the existence of WUAs (2.6 %), were of the view that WUAs might be present on papers, but, in fact, these were non-functional at the moment. Details of the responses are presented in Table **4.1.**

| Water Users Association Present | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| **Yes** | 3.4 | 2.2 | 2.6 |
| No. | 69.5 | 65.9 | 67.0 |
| Not applicable | 27.1 | 31.9 | 30.4 |
| Total | 100.0 | 100.0 | 100.0 |

### 4.1.2 Membership of WUA

All of the persons who reported about the existence of a WUA, also reported that they were members of the said WUA as mentioned in Table 4.2. To farmers, the WUAs were non-functional as nobody from the concerned department contacted them afterwards. Once a watercourse was lined, the WUA became non-functional. To them, WUAs did not take part in any activity other than the lining of watercourses.

| Member WUAs | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Yes | 3 4 | 2.2 | 2.6 |
| No | 69.5 | 65.9 | 67.0 |
| Not applicable | 27.1 | 31.9 | 30.4 |
| Total | 100.0 | 100.0 | 100.0 |

## 4.2. Organizational Behavior

In order to organize farmers with an intention to serve farmers' interests at the small dam level, such as to have control over O&M of the irrigation system, it is quite logical to assess farmers' existing organizational behavior in the project area. Information presented in Table 4.3 reveals that the highest participation of the farmers was in construction /maintenance of the mosque. All of the respondents at Shahpur and over 86 per cent at Mirwal had participated in construction/maintenance of the village mosque, perhaps considering it as a moral and religious duty.

| Organizational behavior | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| ConstructionlMaintenance of Mosque | 86.4 | 100.00 | 95.9 |
| ConstructionlMaintenance of School | 42.4 | 41.5 | 41.0 |
| Settlement of land dispute | 8.5 | 10.4 | 9.8 |
| Purchase of inputs | 8.5 | 4.5 | 5.7 |
| Marketina of crop produce | 11.9 | 3.0 | 5.7 |
| Maintenance of watercourse | 8.5 | 3.7 | 5.2 |
| ConstructionlMaintenance of village streets | 10.2 | 2.2 | 4.7 |
| ConstructionlMaintenance of village well | | 3.7 | 2.6 |

Similarly, around four out of ten participated in construction/maintenance of the village school. In general, the Education Department ensures that the community donates land for the village schools. Here, people of the area managed to donate land for a school and contribute funds according to their status for construction, or later repair, of the

school building as well. Some experience regarding collective behaviour for dispute resolution was also reported under both of the dams. Around 3 to 6 percent of the respondents had participated in collective action for the sale of produce, purchase of inputs, maintenance of watercourse, and construction/maintenance of the village street. They participated by sharing labor, or money, or both.

One observation during the survey was that farmers in the area do not depend solely on farming, rather they are also having another job to supplement their family income. Farming is a part time job for ordinary farmers. Only the big land owners can afford time to keep themselves in touch with other people of the area and the various government agencies and look for new farming practices. Living in a barani area and doing a side business, common farmers hardly find any time to sit together and discuss where they might join together for any common interest. This can be described as a low intensity of collective action among farmers.

### 4.3. Willingness to Work with Other People

The views about respondents' willingness to work with other people, a willingness to constitute a Farmers Organization at the level of the small dams, is presented in Tables 4.4 to 4.9. After a discussion about the respondent's past organizational behavior, they were asked about their willingness to join hands with other people to do some collective work, in the best interest of the farming community. Information presented in Table 4.4 reveals that about 97 of them showed a willingness to work jointly with one another for any type of work which would prove good for the welfare of the farming community.

When checked (from those who showed their willingness to work in a group) how they perceive their contribution to working with other people, about 43 of them were found willing to share labor, about 6 peroent to contribute funds, while about 52 percent agreed on sharing labor and funds as well (Table **4.5).**

| Willingness to work with one another | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| **Yes** | 96.6 | 97.0 | 96.9 |
| No | 3 4 | 3.0 | 3.1 |
| Total | 100.0 | 100.0 | 100.0 |

**Table 4.5. How Farmers Perceive Their Contribution in Working with Other People.**

| Farmer's Perception | Mirwal (N=57) | Shahpur (N=131) | Overall (N=188) |
|---|---|---|---|
| Contribute Labor | 52.6 | 38.2 | 42.6 |
| Contribute funds | 10.5 | 3.8 | 5.9 |
| Both | 36.9 | 58.0 | 51.5 |
| Total | 100.0 | 100.0 | 100.0 |

## 4.4 Types of Organization Initiated

Table **4.6** contains information about initiating any organization by the respondents. About **4** percent of them claimed that they had initiated/formed an organization in their area. This proportion was higher at Mirwal Dam compared to that at Shahpur.

Over **62** percent of those who had initiated an organization had initiated a cooperative society (Table **4.7).** Twenty five percent had participated in a Masjid (Mosque) Committee, while **12.5** percent **of** them initiated a Zakat Committee in their area.

| Initiation of Organization | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Yes | 6.8 | 3.0 | 4.1 |
| No | 9312 | 97.0 | 95.9 |
| Total | 100.0 | 100.0 | 100.0 |

**Table 4.7. Type of Organization Initiated.**

| Type of Organization | Mirwal (N=4) | Shahpur (N=4) | Overall (N=8) |
|---|---|---|---|
| Cooperative Societv | 75.0 | 50.0 | 62.5 |
| Masjid Committee | 25.0 | 25.0 | 25.0 |
| Zakat Committee | | 25.0 | 12.5 |
| Total | 100.0 | 100.0 | 100.0 |

About 98 percent of the respondents (according to Table 4.8) agreed that organized people work effectively.

| Organized People work effectively | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Yes | 96.6 | 98.5 | 97.9 |
| No | 3.4 | 1.5 | 2.1 |
| Total | 100.0 | 100.0 | 100.0 |

## 4.5 Advantages of Farmers Organization at Small Dam Level

The advantages that farmers perceived if they are organized at the small dam level (Table 4.9) were; collective dispute resolution; development work, such as land levelling; solving water shortage problems; collective input supply etc.

| Advantage of FO | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| 1.Can do development work, like land leveling | 15.3 | 18.5 | 17.5 |
| 2. Solve water shortage problem | 15.3 | 17.0 | 16.5 |
| 3 Solve water disputes | 33.9 | 28.1 | 29.9 |
| 4 Get maintenance of watercourse | 1.7 | 8.1 | 6.2 |
| 5. Linkage with other Government Aaencies | 5.1 | 0.7 | 2.0 |
| 6. Proper utilization of funds | 6.8 | 5.2 | 5.7 |
| 7. Solve provision of inputs, like fertilizer, machinery etc. | 13.4 | 18.0 | 16.5 |
| 8. Can do nothing | 8.5 | 4.4 | 5.7 |
| Total | 100.0 | 100.0 | 100.0 |

The conclusion is that the respondents from the project area are willing to work together for a common cause in the best interest of the community. Further, they are aware of, and believe in, the fact that union is strength, (i.e., they can accomplish work with collective efforts what they cannot do individually). Data presented in Table **4.9** reveals that 30 percent of the respondents mentioned "solution of water disputes" as one of the main advantages of forming a Fairmers Organization at the small dam level. About 18 percent of the respondents were of the view that, through an FO, it would become easy to have development work (i.e., laind levelling in the area). Another advantage, counted by 16.5 percent of farmers was the solution of water shortage problems, while the same percentage of farmers felt that the FO may help in the timely provision of inputs, like fertilizers, pesticidelinsecticide, improved seeds for a variety of crops, machinery etc. Other advantages of a farmers organization, as perceived by the respondents, are a solution to the problem of watercourse maintenance, proper utilization of funds, and development of linkages with government agencies. Only about 6 percent of them did not see a potential for a farmers organization to benefit the welfare of the farming community.

## 4.6. Land Levelling

One of the main problems of the Pothwar tract is that most of the area is still unlevelled. Though the Agency for Barani Area Development **(ABAD)** had provided tractors and bulldozers at subsidized rates to farmers in the past in the study area, but still a major part of the land needs to be levelled. With the construction of small dams in the area, farmers became aware of the advantages of land levelling. Clearly, judged from the faces of farmers during the interviews, they are very anxious to have machinery at the subsidized rates for land development. Some of them were doing it at their own expense, by using their own tractors or hiring tractors from private agencies to serve this purpose.

| | | | |
|---|---|---|---|
| No | **20.3** | **25.2** | **23.7** |
| Total | **100.0** | **100.0** | **100.0** |

In response to a question about whether they have had their land levelled as a whole, or a part of it, about 76 percent of the respondents responded positively, while about 24 percent of them replied in the negative. When asked the reasons for not getting their land levelled, about **72** percent of the respondents had no sources to do so. About 17 percent complained about the non-availability of bulldozerltractor, while about 11 percent who did not get their land levelled, said there was no use of land levelling at present, as it seemed difficult, to them, to get dam water to their high elevated land. Details can be seen in Table **4.10** and **4.11.**

| Reasons | Mirwal (N=12) | Shahpur (N=34) | Overall (N=46) |
|---|---|---|---|
| **No** resources | **66.6** | **73.6** | **71 8** |
| bulldozerltractor **not** available | **16.7** | **17.6** | **17.4** |
| **No** use for land levelling | **16.7** | **0.8** | **10.8** |
| | | | |

To a question about the awareness of precision land levelling, 5.2 percent of the respondents were found aware of this method. Forty percent **of** them heard about

precision land levelling through **ABAD** representatives, 50 percent through visitors/relatives from Central Punjab and 10 percent were aware through radio/T.V. For details see Tables 4.12 and 4.13.

**Table 4.12. Distribution of Respondents Who Had Heard About Precision Land Levelling.**

| Heard about precision land levelling | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| Yes | 11.9 | **2.2** | **5.2** |
| No | 88.1 | 97.8 | 94.8 |
| Total | 100.0 | 100.0 | 100.0 |

| Source of information | Mirwal (N=7) | Shahpur (N=3) | Overall (N=10) |
|---|---|---|---|
| Through Extension Agent | | | |
| Through ABAD Representative | 57.1 | | 40.0 |
| through Radio/TV | 14.3 | | 10.0 |
| Through visitor from central Punjab | 28.6 | 100.0 | **50.0** |
| Total | **100.0** | 100.0 | 100.0 |

## 4.7 Benefits from Representatives of Government Agencies

Various government agency staff are out in the field to help farmers for a variety of reasons, like providing extension services, pesticides, fertilizers, credit services and watercourse lining facilities. Information presented in Table 4.14 reveals that the visit of an extension agent was reported by 11 per cent of the respondents. Just 9 and 14 percent of them said that they had obtained information about new farming techniques and new seed varieties of wheat, respectively, from them. An On-Farm Water Management representative also visited 3.1 percent of the farmers in the project area and gave advice how to manage dam water in a better way. About 33 percent of them told about the advice that they had received from the OFWM representative on water management and another 16.7 percent had their watercourses lined.

A representative from the Small Dam Organization visited about **19** percent of the farmers and 9.5 percent of them received more water supply as a benefit from him. Representatives from **ABAD** also visited farmers (5.7%) and about 45 percent of them were benefited by having bulldozers/tractors on subsidized rate for land development.

**Table 4.14. Benefits From Representatives of Various Government Agencies (Percentage).**

| Government Agencies and the Benefil Drawn | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| 1. Agri. Extension Agent | 11.9 | 11.1 | 11.3 |
| - New Farming Techniques | 14.3 | 6.7 | 9.1 |
| - New Seed Varieties | | 20.0 | 13.6 |
| 3. Fertilizer Company Agent | | | |
| 4. Pesticide Company Agent | - | | |
| 5. OFWM Representatives | 3.4 | 3.0 | 3.1 |
| - Lining of W/C | | 0.7 | 16.7 |
| - Good Management | 50.0 | 25.0 | 33.4 |
| 6. Mobile Credit Officer | | 0.7 | 0.5 |
| 7. Small Dams Organization Representative | 8.6 | 7.4 | 10.8 |
| - Have more water | 9.1 | 10.0 | 9.5 |
| 8. Agency for Barani Area Development Representative | 8.5 | 4.4 | 5.7 |
| - Land Levelling | 80.0 | 16.7 | 45.4 |

After going through the information presented in Table **4.14,** it can be concluded that some government agencies are working in the area and have their offices and officials, but they have approached only a limited number of farmers.

During the survey, some farmers complained about pest attacks on their chili and onion crops, and so far no one from extension department reach them for their rescue. Similarly, many farmers were found anxious to have machinery at subsidized rates from **ABAD,** but according to their claim, machinery is meant for influentials of the area and not for a common farmer. Small' Dam Organization officials are also there in the field area, with an office of the Sub Divisional Officer in Fateh Jhang, but the rights to water have not so far been defined, which has deprived some of the farmers from receiving small dam water.

CHAPTER-5

# AGRONOMIC PRACTICES, CROPPING INTENSITY, FARM OUTPUT AND INCOME

This chapter discusses the cropping pattern. both in the irrigated and barani areas, in the command area of the two small dams. Land under various crops, seed rate and fertilizer used per unit are also touched upon. Further, this chapter also contains information about production and respective prices received by the farmers for various crops, as well as expenditures incurred per unit by the farmers. In the last sections of this chapter, cropping intensity, information about income from different sources, and ranking of the important factors, as perceived by the farmers, associated with crop production are discussed.

## 5.1. Cropping Pattern

Cropping pattern for a farm indicates the relative allocation of area for various crops grown at the farm for the total cropped area in a crop year, and is closely associated with climatic conditions, sources of irrigation, nature *of* soils, etc. Table **5.1** presents the crops grown by the farmers in the irrigated and barani areas within the command areas of the small dams.

Table **5.1.** Cropping Pattern in **Irrigated** and Barani Area.

| Crops | Irrigated (Kanals) | | | Barani (Kanals) | | |
|---|---|---|---|---|---|---|
| | Mirwal | Shahpur | Overall | Mirwal | Shahpur | Overall |
| **Kharif** Peanut | 9.0(2) | - | 9.0(2) | 115.69(29) | - | 115.59 (29) |
| Oilseed | 6.0(1) | 9.0(2) | 8.0(3) | 63.73(11) | 13.0(3) | 52.86(14) |
| Maize | 10.56(23) | 13.55(39) | 12.44(62) | 18.50(6) | 23.12(50) | 22.62(56) |
| Fodder | 5.58(12) | 8.63(4) | 6.34(16) | 81.58(12) | 19.44(17) | 45.15(29) |
| Orchard | 696.0(1) | 19.25(4) | 54.60(5) | - | - | - |
| Vegetable | 13.56(8) | 6.94(39) | 8.06(47) | 10.0(2) | 21.0(4) | 17.6(6) |
| Chili | 8.03(30) | 4.72(29) | 6.41(59) | - | - | - |
| Sugar Cane | 39.67(3) | - | 39.67(3) | - | - | - |
| **Rabi** | | | | | | |
| Wheat | 45.62(33) | 22.68(64) | 30.62(97) | 99.6(45) | 41.60(113) | 58.12(158) |
| Gram | - | - | - | 110.67(6) | - | 110.67 (6) |
| Fodder | 4.1(5) | 14(2) | 6.98(7) | 32.71(7) | 12.67(3) | 26.7 (10) |
| Vegetable | 5.25(4) | 8.42(12) | 7.63(16) | - | 101.0(2) | 101.0(2) |
| Onion | - | 20.0(1) | 20.0(1) | - | - | - |
| Oat | 1.0(1) | - | 1.0(1) | - | - | - |

Note: Figures in the parentheses are the number of reporting respondents.

As reported by the farmers, the cropping pattern for irrigated and barani areas differ from each other. In the irrigated areas, farmers usually grow maize, vegetables, chili and fodder during the kharif season with an average area under these crops of **12.44,** 8.06, **6.41** and **6.34** kanals, respectively, whereas the farmers in the barani areas grow

peanuts, oilseed, maize, and fodder as the main crops grown during the kharif season with an average area of 115.29, 52.86, 22.62 and 45.15 kanals, respectively.

During the rabi season, farmers usually grow wheat, vegetable and fodder crops in irrigated areas. The mean area under these crops was reported as 30.62, 7.63 and 6.98 kanals, respectively. In Barani Areas, wheat, gram, and fodder were the crops grown on mean areas of 58.12, 110.67 and 26.7 kanals, respectively, while two farmers mentioned a mean area of 101.0 kanals under rabi vegetables.

The comparison between the irrigated and barani cropping patterns reveals that maize was found equally common among irrigated as well as barani farmers. Farmers in the project area treat maize as a staple food and used it as fodder as well for the animals. Groundnuts (peanuts) were found common among barani farmers, while vegetables and chili crops were commonly grown by farmers who used irrigation water from the dams, indicating that an ensured water supply would further shifl their cropping patterns towards higher value cash crops. Graphic presentation of cropping pattern is shown in Figures 5.1 to **5.4.**

The project area is basically known as a barani area, but with the construction of the small dams, farmers do grow crops that need more water. Citrus plants grown by some farmers were found loaded with fruit, which could be signalling a step forward towards the prosperity of the area. Farmers are growing quality citrus fruit which are expected to bring good returns. It was interesting to note the sugarcane grown by three farmers and they were making Gur (brown sugar) while the survey was being conducted. It appears that with the construction of small dams in the area, farmers are shifling their cropping choices from traditional crops to high value crops. like chili, sugarcane, orchards, and vegetables from wheat, maize and peanuts. The diversity of crops grown by the farmers on the same farm indicates that yet they do not consider themselves out of risk due to poor management of the irrigation water supplies.

## **5.2.** Agronomic Practices in Irrigated Area

### **5.2.1.** Seed Rate Used

The use of recommended seed rates play a significant role for achieving high crop production. Table 5.2 shows information about seed rates used for different crops grown in the project area. **As** has already been discussed, the landholdings in the project area are stated by farmers in kanals. so the seed rates used are also mentioned on a per kanal basis. Further, in some cases seed rates used are not reported in weight, due to the difficulty in making measurements. Instead, these are expressed in the value or price needed to purchase the seed or even the number of nursery plants needed for transplanting purposes in their fields. For orchards, the plants transplanted in the field are taken as the seed rate. In the case of sugarcane, the seed rate is reported in kg per kanal.

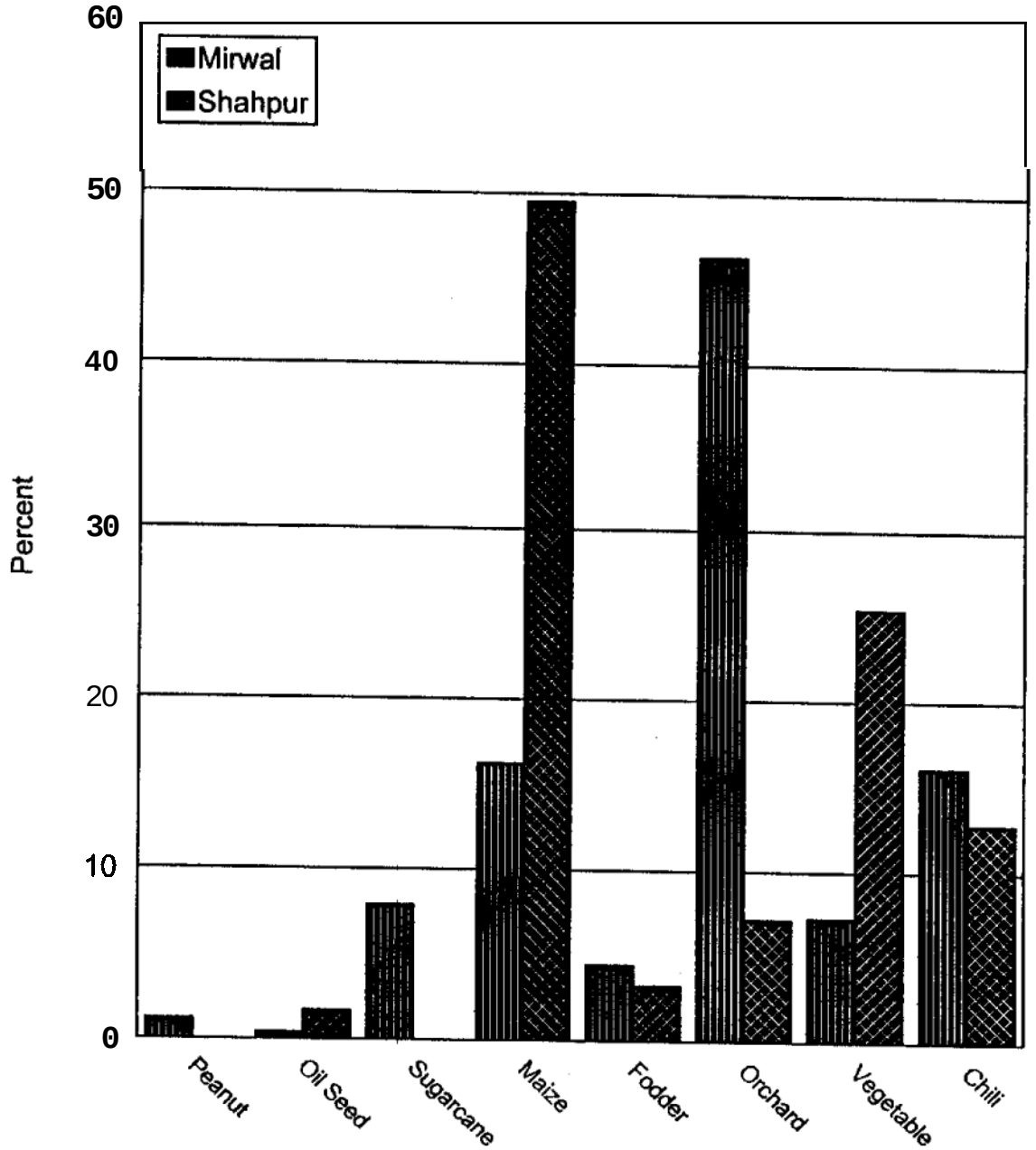



**Figure 5.1. Cropping Pattern Irrigated (Kharif Season).**

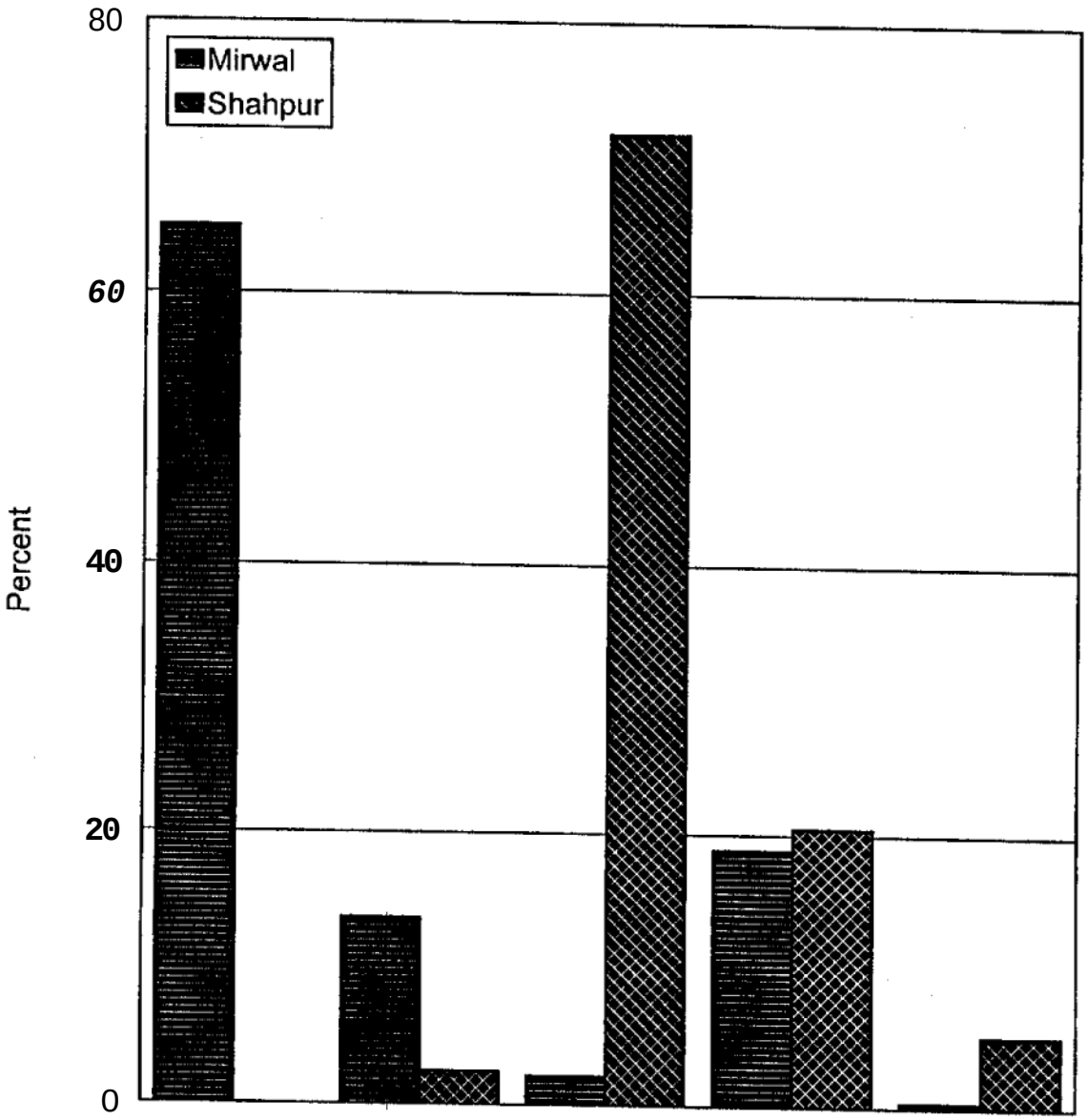



**Figure 5.2. Cropping Pattern Barani (Kharif Season).**

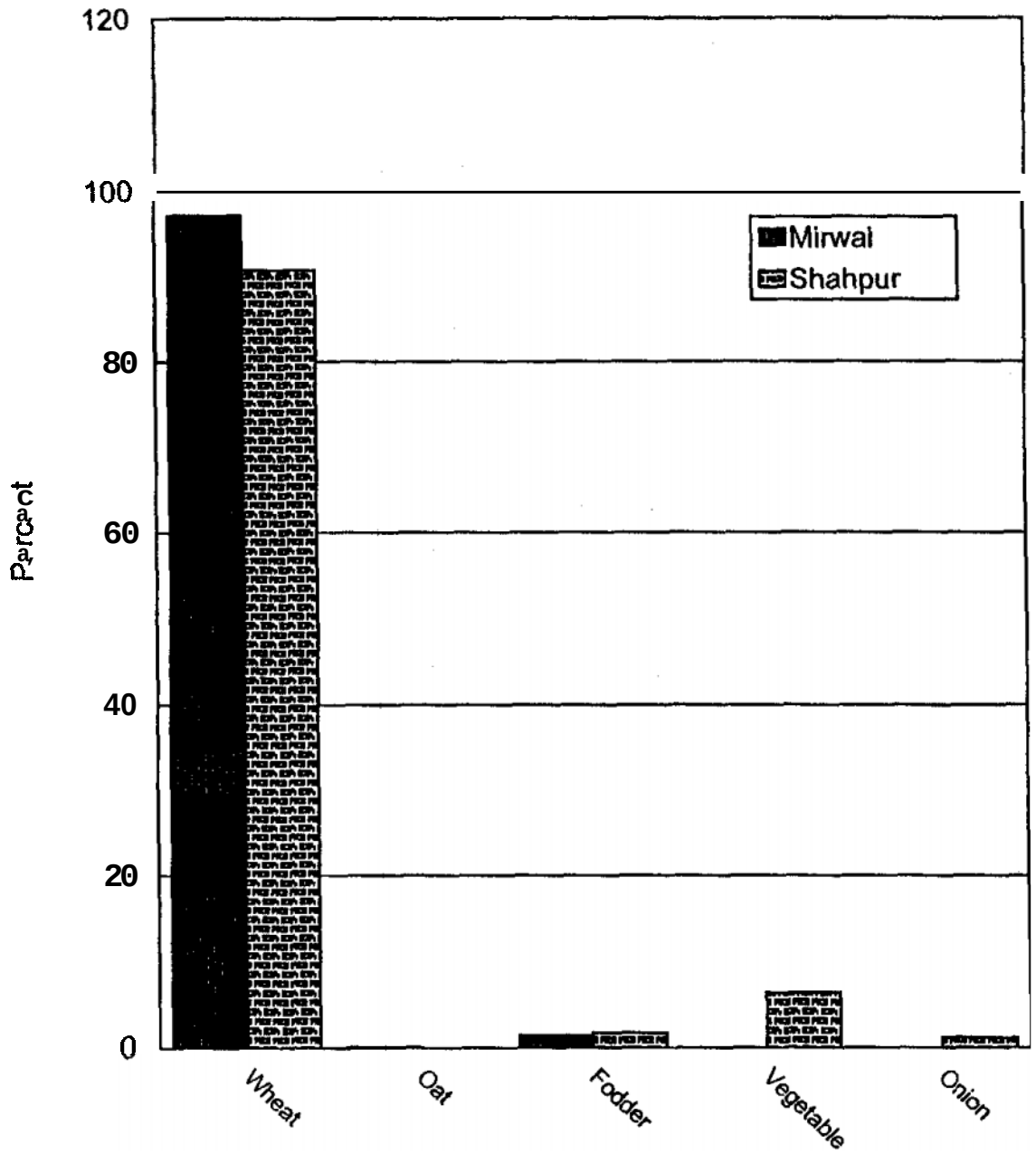



**Figure 5.3. cropping Pattern Irrigated (Rabi Season).**

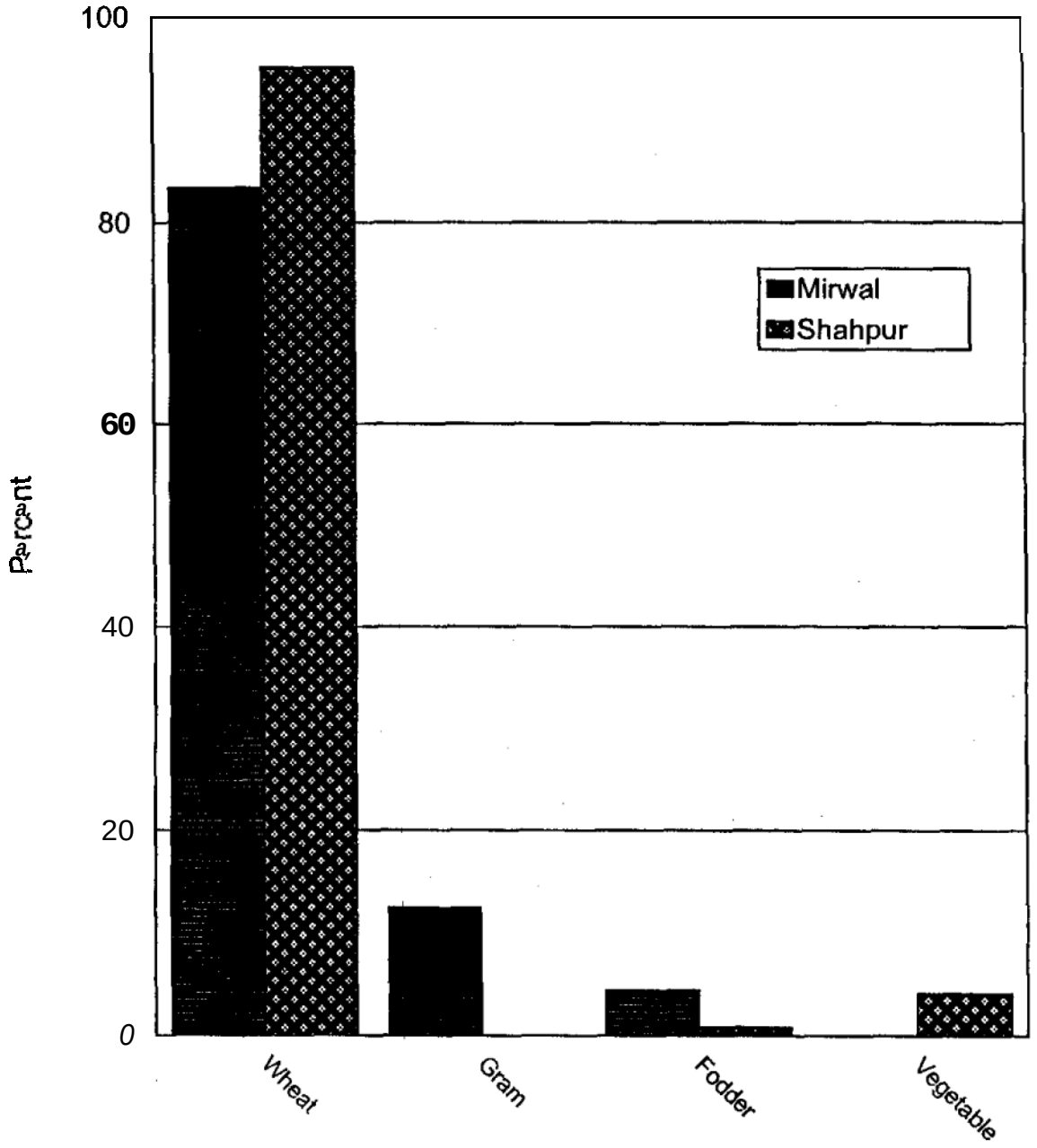



**Figure 6.4. Cropping Pattern Barani (Rabi Season).**

**Table 5.2. Mean Seed Rates Used Per Kanal for Various Crops (Irrigated).**

| Crops | Mirwal Dam | Shahpur Dam | Overall |
|---|---|---|---|
| **Kharif** | | | |
| Peanut (Kg) | 2.25 (2) | - | 2.25(2) |
| Oil Seed (Kg) | 0.50 (1) | 0.25 (2) | 0.33 (3) |
| Sugarcane (Kg) | 387.6 (3) | - | 387.6 (3) |
| Maize (Kg) | 3.19 (23) | 2.51 (39)* | 2.76 (62) |
| Fodder (kg) | 3.90 (12) | 3.38 (4) | 3.77 (16) |
| Orchard (Plants) | 14.0 (1) | 18.75 (4) | 17.80 (5) |
| Vegetable (Rs) | 170.37 (8) | 197.05 (39) | 192.51 (47) |
| Chili (Rs) | 112.83 (30) | 134.17 (29) | 123.32 (59) |
| **Rabi** | | | |
| Wheal (Kg) | 5.49 (33) | 4.76 (64)' | 5.00 (97) |
| Oat (Kg) | 6.0 (1) | | 6.0 (1) |
| Fodder **(Kg)** | 4.2 (5) | 2.0 (2) | 3.57 *(7)* |
| Vegetable (Rs.) | 142.50 (4) | 180.58(12) | 171.06(16) |
| Onion (Rs.) | | 80(1) | 80(1) |

Data presented in Table 5.2 reveal the mean seed rate used. For maize, tne mean seed rate was reported as 2.76 kg per kanal, while for kharif fodder it was about 4 kg per kanal. For sugarcane, farmers used about 400 kg of sugarcane as seed per kanal, whereas on average, they used about 18 citrus plants per kanal.

Table **5.3.** Mean Fertilizer Used Per **Kanal** For Various **Crops** (Irrigated) in Kilograms.

| Crops | Mirwal Dam | Shahpur Dam | Overall |
|---|---|---|---|
| **Kharif** | | | |
| Peanut | - | - | - |
| Oil seed | 0.0 (1) | 5.0 (2) | 3.33 (3) |
| Sugarcane | 29.83 (3) | - | 29.83 (3) |
| Maize | 8.90 (23) | 10.54 (39) | 9.93 (62) |
| Fodder | 7.04 (12) | 3.0 (4) | 6.03 (16) |
| Orchard | 6.25(1) | 64.63 (4) | 52.95 (5) |
| Vegetable | 14.22 (18) | 19.50 (39) | 18.60 (47) |
| Chili | 31.05 (30) | 25.26 (29) | 28.21 (59) |
| **Rabi** | | | |
| Wheat | 10.65 (33) | 12.24 (64) | 11.70 (97) |
| Oats | 10.0(1) | | 10.0 (1) |
| Fodder | 7.6 (5) | 2.0 (2) | 6 0 (7) |
| Vegetable | 23.7'5 (4) | 15.08 (12) | 07.25 (16) |
| Onion | - | 10 (1) | 10 (1) |

Note: Figures in the parentheses are the number of reporting respondents.

In case of kharif vegetables, they usually grow mixed vegetables. Vegetable seeds cost them on average over **Rs** 192.00 per kanal. Chili was found to be one of the cash crops in the area. On average, farmers spent **Rs.** 123 per kanal on seed. In rabi. wheat was the dominant crop, though in some cases, vegetables, fodder, oats and onions were also reported. For wheat, farmers used 5 kg of seed per kanal, while for rabi vegetables they spent **Rs.** 171 per kanal to buy vegetable seeds.

### **5.2.2.** Fertilizer Used

Chemical fertilizer is one of the major inputs used by the farmers to obtain high crop production. In this study, fertilizer used by farmers is reported in kilograms per kanal of the area sown with the crop. Farmers do not use chemical fertilizer of one type, but they use a combination of various types of fertilizers (like Urea, DAP, Nitrophos, etc). According to Table 5.3. for kharif crops like sugarcane, maize, and orchard, the farmers

used 29.83, 9.93 and 52.95 kg per kanal of chemical fertilizers, respectively. For vegetables and chili, the mean fertilizer used was 18.60 and 28.21 kg per kanal, respectively, by the farmers. For rabi crops, wheat and vegetables are worth mentioning, where farmers used, on average, 11.70 and 17.25 kg of fertilizer per kanal, respectively.

### **5.2.3.** Production **of** Various Crops

Per unit yield for various crops is an outcome of production factors such as seed, fertilizer, labour, water, fertilizer and machinery by the farmers. Proper mix and use of the inputs results in good crop yields. Information presented in Table 5.4 shows the average output reaped by the farmers per kanal for various crops grown in irrigated area. Production is taken in kilograms, but in some cases the value of the crop is reported in rupees as farmers had no knowledge about the weight of this crop.

| Crops | Mirwal Dam | Shahpur Dam | Overall |
|---|---|---|---|
| **Kharif** | | | |
| Peanut (Kg) | 116.0 (2) | - | 116.0 (2) |
| Oil Seed (Kg) | 20.0 (1) | 7.2 (2) | 11.6 (3) |
| Sugarcane (Kg) | 1666.8 (3) | - | 166.8 (3) |
| Maize (Kg) | 79.6 (23) | 73.2 (39) | 75.6 (62) |
| Fodder (Rs) | 359.0 (12) | 358.0 (4) | 358.75 (16) |
| Orchard (Rs) | 86.0 (1) | 328 (4) | 279.60 (5) |
| Vegetable **(Rs)** | 1027.75 (8) | 1363.33 (39) | 1306.21 (47) |
| Chili (Rs) | 1553.50 (30) | 1467.41 (29) | 1511.19 (59) |
| | | | |
| Wheat (Kg) | 96.8 (33) | 82.8 **(64)** | 87.6 (97) |
| Oat (Kg) | 80.0 (1) | | 80.0 (1) |
| Fodder (Rs) | 309.14 (5) | 290.0 (2) | 303.67 **(7)** |
| Vegetable **(Rs)** | 1332.0 (4) | 1337.41 (12) | 1336.06 (16) |
| Onion (Rs) | | 2000 (1) | 2000 (1) |

The yield of maize per kanal was around 80 kg, which is a little higher as compared to what was reported by Shahid and Ashraf (1989). The average production of sugarcane per kanal was around 1680 kq, which is quite low when compared with the national average for sugarcane (2336 kg per kanal during 1994-95).

Vegetables and chili, in particular, are the two main cash crops of the area. According to the available data, farmers earned over rupees 1511 per kanal by selling chili during rabi 1996. Wheat production per kanal stood around 80 kg. which is lower than the average wheat production at the national level. The value of rabi vegetables produced per kanal was reported to be around 1336 rupees during 1994-95, and for kharif. this value stood around 1306 rupees per kanal. These estimates are quite close to those reported by the Government of Pakistan (1996), for kharif vegetables. Production of main crops per kanal (irrigated) is indicated in Figure 5.5.

### 5.2.4. Prices of Various Crops Received by the Farmers

Prices of crops, as reported by the respondents, are the prices at which they have sold their produce, whether locally or in the market. Prices for some of the crops are missing, as farmers first mentioned the value of their whole produce, which is reported in Table 5.5. Table 5.6 contains information on prices for various crop, which was almost equivalent to those at the national level.

**Table 5.5. Mean Price (in Rs.) of Various Crops Per *40* Kg (Irrigated).**

| Crops | Mirwal Dam | Shahpur Dam | Overall |
|---|---|---|---|
| **Kharif** | | | |
| Peanut | 340 (2) | - | 340 (2) |
| Oil Seed | 300 (1) | 925 (2) | 716 (3) |
| Sugarcane | 24.0 (3) | - | 24.0 (3) |
| Maize | 183.26 (23) | 184.51 (39) | 184.05 (62) |
| Fodder | - | - | - |
| Orchard | - | - | - |
| Vegetable | - | - | - |
| Chili | - | - | - |
| **Rabi** | | | |
| Wheat | 185.48 (33) | 178.05 (64) | 180.58 (97) |
| Oat | 190.0 (1) | - | 190.0 (1) |
| Fodder | - | - | - |
| Vegetable | - | - | - |
| Onion | - | - | - |

Note: Figures in the parentheses are the number of reporting respondents.

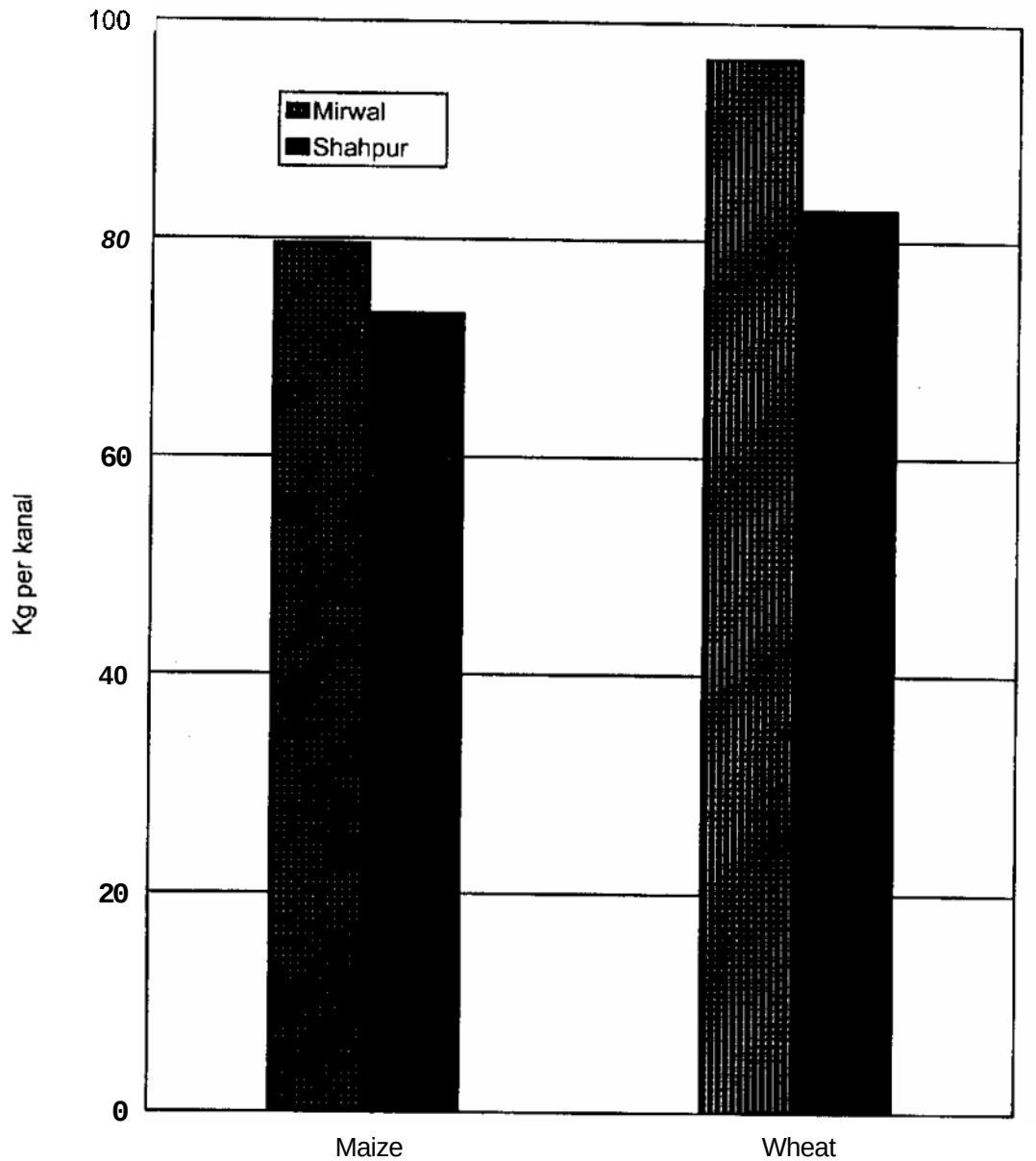



**Figure 5.5 Mean Production of Main Crops Per Kanal (Irrigated).**

**Table 5.6. Mean Expenditure (in Rs.) Per Kanal for Various Crops (Irrigated).**

| Crops | Mirwal Dam | Shahpur Dam | Overall |
|---|---|---|---|
| **Kharif** | | | |
| Peanut | 175 (2) | - | 175 (2) |
| Oil seed | 120 (1) | 125 (2) | 123 (3) |
| Sugarcane | 450 (3) | - | 450 (3) |
| Maize | 218.52 (23) | 185.67 (39) | 197.85 (62) |
| Fodder | 20.04.83 (12) | 125.0 (4) | 184.88 (16) |
| Orchard | 150.0 (1) | 212.50 (4) | 200.00 (5) |
| Vegetable | 386.37 (8) | 529.56 (39) | 505.9 (47) |
| chili | 664.20 (30) | 557.24 (29) | 611.63 (59) |
| **Rabi** | | | |
| Wheat | 208.55 (33) | 251.47 (64) | 236.87 (97) |
| Oat | 200.0 (1) | - | 200.00 (1) |
| Fodder | 202.28 (5) | 125 (2) | 180.20 |
| Vegetable | 518.75 (4) | 501.58 (12) | 505.88 (16) |
| Onion | - | 430.00 (1) | $430_{(1)}$ |

Note: Figures in the parentheses are the number of reporting respondents.

### 5.2.5. Crop Expenditures

Data on crop expenditures for various crops are presented in Table 5.6. Cost estimates in this study are based on money spent on seed and fertilizer used per kanal, plus expenditures on tractor use for preparation of land. The cost of labour used, as reported by the respondents, is also added in the crop expenditures.

On average, expenditures on maize per kanal stood around **Rs.** 198. whereas the expenditures on production of vegetables and chili was reported as Rs. 505 and 612, respectively. Similarly, the cost of sugarcane production per kanal was Rs. 450 and that for fodder was around Rs. 185 per kanal.

For the rabi season, the expenditures on production of wheat was calculated as Rs. 237 per kanal, whereas the cost of production of rabi vegetables was reported as Rs. 506 per kanal. This information on expenditures, incurred by farmers for raising crops, is quite useful for calculating net benefits to farmers for various crop enterprises and can help in understanding the decision making by the farmers regarding crop choices.

## 5.3. Agronomic Practices in Barani Area

As the project area was known as barani before the construction of the small dams, yet a lot of area is not irrigated by water from the dam due to constraints imposed by unfavorable topography. The cropping pattern and farm incomes from such areas are also important. The area under crops that are rain-fed is much higher than for the

irrigated area supplied by small dams. This section is reserved for information regarding agronomic practices in the barani area.

### 5.3.1 Seed Rates Used

Data presented in Table 5.7 reveal that the farmers in the project area on average used 2.7 kg of seed per kanal for the peanut crop. For the maize crop, it was found to be 2.25 kg per kanal, which is less than for the irrigated area. For kharif fodder, the mean seed rate was around 3.5 kg and for vegetables the mean value of seed or young plants was Rs. 155 per kanal. In case of barani wheat, the mean seed rate was reported as 4.7 kg per kanal. whereas for gram it was reported as 4 kg per kanal.

The seed rates for major crops were found higher in the irrigated areas than the seed rate for the same crops in the barani areas. This difference may be attributed to the fact that farmers know that since the frequency of rain is uncertain, the plants will not wilt due to competition for moisture in the rain-fed fields if there is a lower number of plants and these will use moisture optimally and yield more.

**Table 5.7. Mean Seed Rates Used Per Kanal For Various Crops (Barani).**

| Crops | Mirwal Dam | Shahpur Dam | Overall |
|---|---|---|---|
| **Kharif** | | | |
| Peanut (Kg) | 2.71 (29) | | 2.71 (29) |
| Oil Seed (Kg) | 1.54 (11) | 0.33 (3) | 1.28 (1.4) |
| Maize (Kg) | 2.52 (6) | 2.22 (50) | 2.25 (56) |
| Fodder (Kg) | 3.82 (2) | 3.32 (17) | 3.53 (29) |
| Vegetable (Rs) | 130.00 (2) | 167.50 (4) | |
| **Rabl** | | | |
| Wheat (Kg) | 4.75 (45) | 4.71 (113) | 4.73 (158) |
| Gram (Kg) | 4.08 (6) | | 4.08 (6) |
| Fodder (Kg) | 4.21 (7) | 3.67 (3) | 4.05 (10) |
| Vegetable (Rs) | | 102.5 (2) | 102.5 (2) |

Note: Figures in the parentheses are ti-e number of reporting respondents.

### 5.3.2. Fertilizer Used

Data presented in Table 5.8 reveal that, on average, fertilizer used per kanal was higher for maize (10.92 Kg) as compared to irrigated maize. For the remaining crops grown in

the barani areas, fertilizer used per kanal was reported lower as compared to the same crops produced in irrigated areas. For example, mean fertilizer use for wheat was 8.87 kg in the barani areas, whereas it was reported as 11.70 kg per kanal of wheat in the irrigated areas. The same was found to be true in the case of vegetables, both in rabi and kharif seasons.

Major differences are also found for the fertilizer application for maize, kharif fodder, and wheat under the two dams.

| Crops | Mirwal Dam | Shahpur Dam | Overall |
|---|---|---|---|
| | | | |
| Oil Seed | 1.18(11) | 1.0(3) | 1.14(14) |
| Maize | 2.17(6) | 11.97(50) | 10.92(56) |
| Fodder | 1.00(12) | 2.80 (17) | 2.06(29) |
| Vegetable | | 15.13(4) | 10.08(6) |
| | | | |
| Wheat | 5.09(45) | 10.38(113) | 8.87(158) |
| Gram | 3.50(6) | | 3.50(6) |
| Fodder | 2.43(7) | 2.17(3) | 2.35(10) |
| Vegetable | | 5.65(2) | 5 65 (2) |

### 5.3.3. Production of Various Crops

As expected, the production of various barani crops grown in the pilot project areas was lower compared with production of crops grown in irrigated areas. 'The reason for this higher production may be attributed to the fact that, in irrigated areas, farmers used higher applications of inputs such as seed and fertilizer. Further, water inputs could be applied at proper times in irrigated areas.

Table 5.9 contains information about crop yields expressed in kilograms and rupees per kanal in the barani area. Maize production, on average, was reported as 52 kg per kanal. Maize is used as a staple food in the Pothwar area, and various maize varieties have been developed by the researchers for irrigated as well as for barani areas. The yield

of all crops, expressed in terms of either quantity or value, were higher in the case of irrigated areas than those of barani areas. Average yields of wheat grown in barani areas (70.8 kg per kanal) was found lower than that of the irrigated area (87.6 kg per kanal). The same situation was found for vegetables and fodder (kharif and rabi). i.e., the value of the output realized by these crops was found higher for irrigated areas than that of barani areas. The prices of various crops are reported in Table 5.10, which were found to be the same as reported at the national level (Government of Pakistan, 1996).

Except for kharif oilseed and rabi fodder, where the converse is true, the barani farms under Shahpur Dam realized better yields among all of the rain-fed crops. Production of main crops per kanal (barani) is also presented in Figure ***5.6.***

Table **5.9.** Mean Production **of** Various **Crops** Per **Kanal** (Barani).

| Craps | Mirwal Dam | Shahpur Dam | Overall |
|---|---|---|---|
| **Kharif** | | | |
| Peanut (Kg) | 59.6 (29) | - | 59.6 (29) |
| Oil Seed (Kg) | 19.10 (11) | 0.58 (3) | 15.13 (14) |
| Maize (Kg) | 28.8 (6) | 54.8 (50) | 52.0 (56) |
| Fodder (Rs.) | 205.50 (12) | 287.53 (17) | 253.59 (29) |
| Vegetable (Rs.) | 500.00 (2) | 937.50 (4) | |
| **Rabi** | | | |
| Wheat (Kg) | 65.6 (45) | 72.8 (113) | 70.8 (158) |
| Gram (Kg) | 34.8 (6) | - | 34.8 (6) |
| Fodder (Rs.) | 271.43 (7) | 122.2 (3) | 226.67 |
| Vegetable (Rs.) | - | 495.0 (2) | 495.0 (2) |

Note: Figures in the parentheses are the number of reporting respondents.

### **5.3.4.** Crop Expenditures

Expenditures for various barani crops were calculated and are presented in Table 5.10. The farmers use the same inputs but in slightly lower quantities for the barani areas. The only difference apart from lower quantities of inputs between the irrigated and barani farms **is** the irrigation. Hence, lesser expenditures are expected to be incurred by farmers in barani areas as compared to expenditure incurred in irrigated areas. Peanuts are sown as a barani crop for which the average expenditure was around **Rs.** 231 per kanal. Similarly, gram is also cultivated as a barani crop because it needs less irrigation water. Average expenditures for gram was found to be around 188 rupees per kanal. For

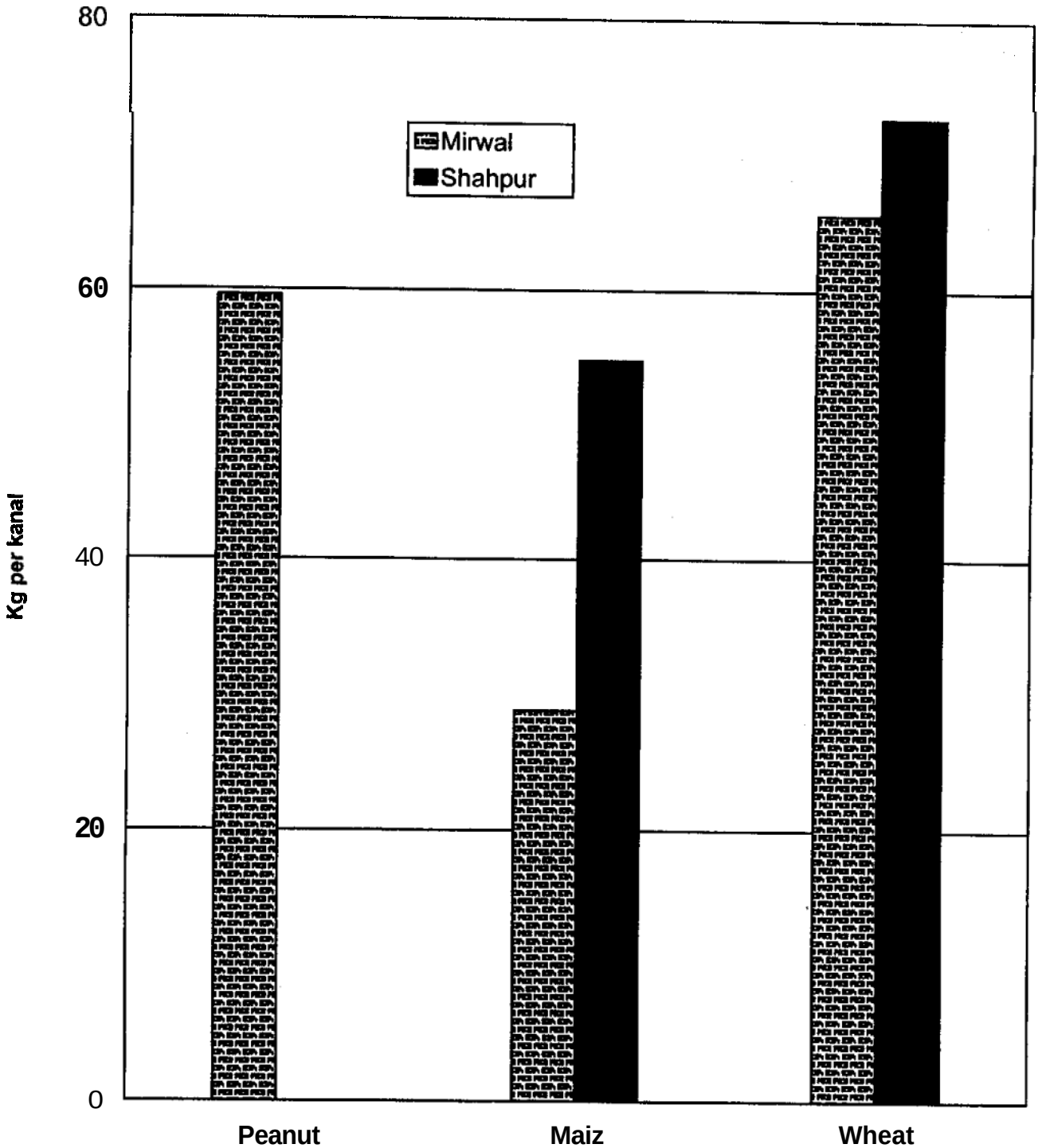



**Figure 5.6 Mean Production of Main Crops (Barani).**

all other crops mentioned in Table 5.11, the mean expenditures were found to be less for barani areas than that of the irrigated areas.

Table **5.10.** Mean Price **(in Rs.)** of Various Crops Per 40 Kg (Barani).

| Crops | Mirwal Dam | Shahpur Dam | Overall |
|---|---|---|---|
| **Kharif** | | | |
| Peanut | 485.17 (29) | - | 485.17 (29) |
| Oil seed | 900.00 (11) | 1000 (3) | 921.43 (14) |
| Maize | 165.00 (6) | 186.2 (50) | 183.93 (56) |
| Fodder | - | - | - |
| Vegetable | - | - | - |
| **Rabi** | | | |
| Wheat | 180.18 (45) | 181.50 (113) | 181.13 (158) |
| Gram | 341.67 (6) | - | 341.67 (6) |
| Fodder | - | - | - |
| Vegetable | - | - | - |

Note: Figures in the parentheses are the number of reporting respondents.

| | | | |
|---|---|---|---|
| | | | |
| Peanut | 230.69 (29) | | 230.69 (29) |
| Oil Seed | 166.81 (11) | 81.67 (3) | 148.57 (14) |
| Maize | 141.67 (6) | 147.26 (50) | 146.67 (56) |
| Fodder | 92.92 (12) | 94.41 (17) | 96.72 (29) |
| Vegetable | 137.50 (2) | 483.25 (4) | 368.0 *(6)* |
| Rabi | | | |
| Wheat | 172.30 (45) | 217.43 (113) | 204.58 |
| Gram | 188.33 (6) | | 188.33 (6) |
| Fodder | 137.14 (7) | 96.0 (3) | 124.80 (10) |
| Vegetable | | 325.0 (2) | 325.0 (2) |

## 5.4. Cropping Intensity

Cropping intensity is defined as the ratio between the area under crops and the area operated by the farmers and is reported as a percentage. For the purpose of this report, cropping intensity is calculated separately for irrigated and barani (rain-fed) areas. This is true for both Mirwal and Shahpur Small Dams.

The cropping intensity for Mirwal Small Dam was calculated as 123 percent for irrigated areas, which is close to what was found for Hakra 4-R Distributary Command Area (Cheema et al 1997). For barani areas, the cropping intensity was calculated as 51.1 percent. Cropping intensity on sample farms for Mirwal Small Dam was calculated as 100.3 percent by Shahid and Ashraf (1989).

In the case of Shahpur Small Dam, the cropping intensity was calculated as 117.7 percent for the irrigated area, whereas it was found to be 47.4 percent for the barani area. Iqbal (1989). in his study of Shahpur Small Dam, reported 121.3 percent cropping intensity, which is higher than the cropping intensity found for even the irrigated area. Details are contained in Table 5.12. Graphical presentation of cropping intensities is given in Figure 5.7.

| | | |
|---|---|---|
| Irrigated | **123.4** | **117.7** |
| Barani | **51 1** | **47.4** |

## 5.5. Land Use Intensity

Land use intensity is the ratio of gross cropped area (cultivated area) to farm area (culturable area) and is expressed as a percentage. Land use intensity was calculated both for irrigated and barani areas in Mirwal and Shahpur Small Dams. Information presented in Table 5.13 reveals that land use intensity under Mirwal Small Dam for the irrigated area was 63.5 percent and for the barani area it was found to be 62.4 percent. Total land use intensity on sample farms under Mirwal Dam was calculated as 78.0 percent in a study conducted by Shahid and Iqbal (1989). Land use intensity has also been indicated in figure 5.8.

**Table 5.13. Land Use Intensity for Mirwal and Shahpur Small Dams.**

| Area | Mirwal Dam LUI % | Shahpur Dam LUI % |
|---|---|---|
| Irrigated | **63.5** | **90.0** |
| Barani | **62 4** | **83 1** |

In the case of Shahpur Small Dam, land use intensity was calculated as 90.0 percent for the irrigated area and 83.1 percent for the barani area. Total land use intensity on sample farms under Shahpur Dam was calculated as 85.0 percent by Iqbal (1989).

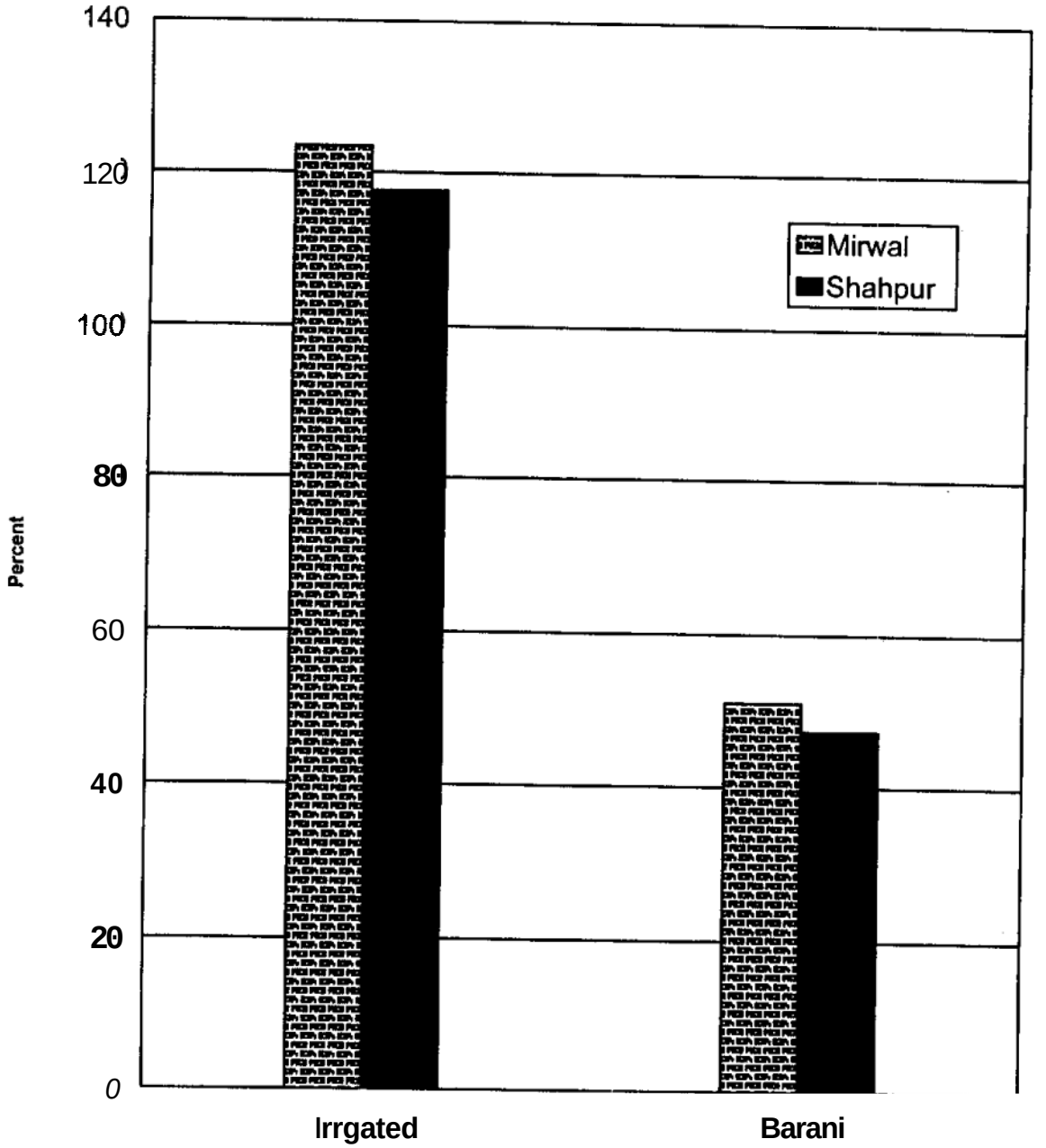



**Figure 5.7 Cropping Intensities For Irrigated and Barani Lands Under Mirwal and Shahpur Small Dams.**

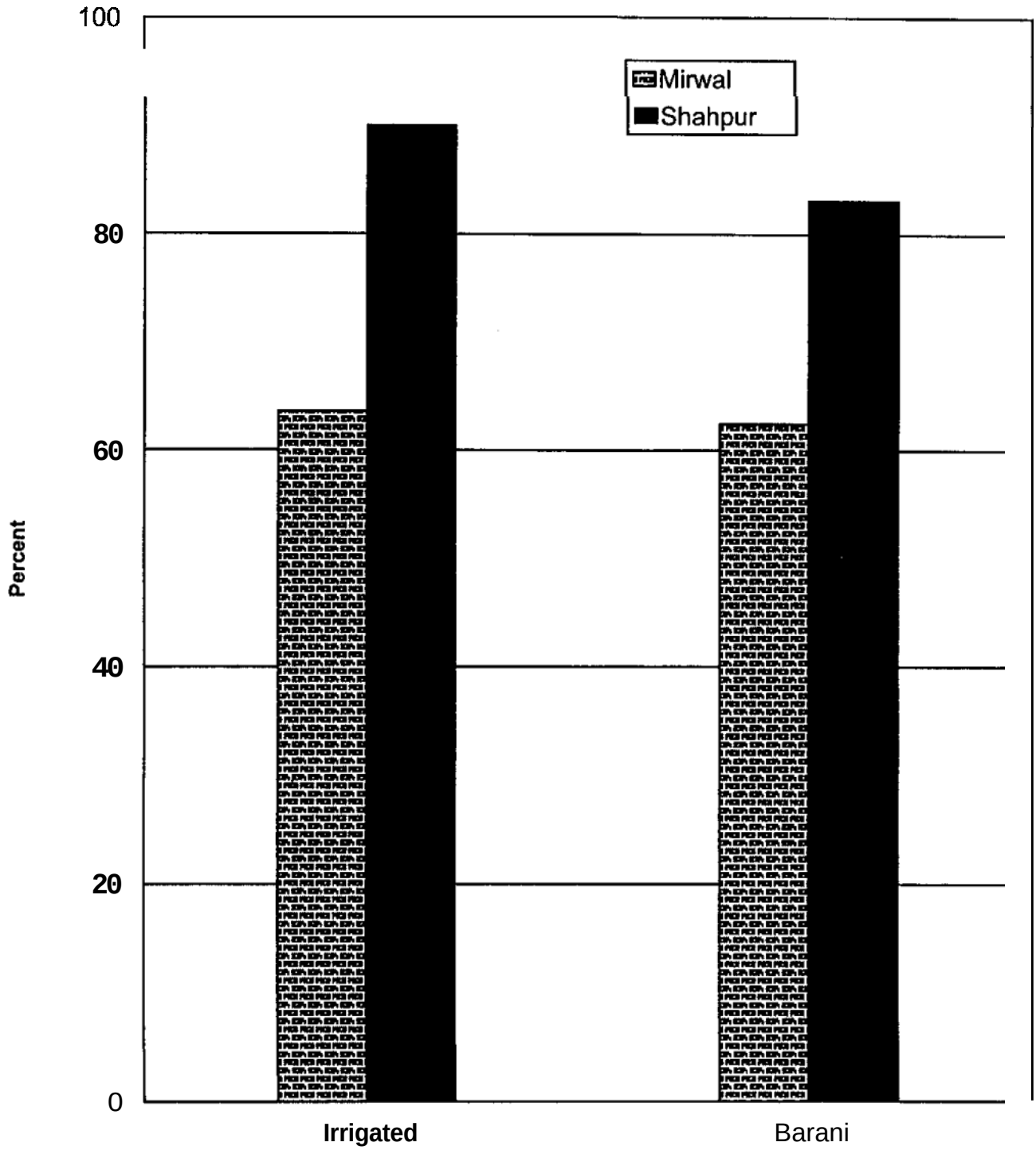



**Figure 5.8 Land Use Intensity for Irrigated and Barani Lands Under Mirwal and Shahpur Small Dams.**

## 5.6. Livestock

Information on the average number of different animals assessed for the project area is presented in Table **5.14.** Being a barani area, farmers are depending not only on farming but also on their livestock. Cows, goats and buffaloes were commonly reared by the farmers and are used for milking. Besides, they also reported having bullocks, camels, horses and donkeys, which are used for draught power, such as ploughing and carrying a load (like fodder, fuel wood, crops, etc).

| Livestock | Mirwal (N=59) | Shahpur (N=135) | Overall (N=194) |
|---|---|---|---|
| | | | |
| | | | |
| Camels | 0.0 | .06 | 0.04 |
| Buffaloes | 1.56 | 1.38 | 1.43 |
| Sheep | 2.90 | 0.06** | 0.92 |
| Goats | 3.30 | 1.20 | 1.90 |
| Donkeys | 0.44 | 0.35 | 0.38 |
| Horses | 0.14 | 0.02 | 0.05 |
| Poultry | 6.44 | 3.31' | 4.26 |

The average number of cows were reported as 2.7 per household, while buffaloes were reported as **1.4** per household. Similarly, the mean number of goats were found to be 1.9, while sheep were calculated as 0.9. The mean number of bullocks were reported as 0.43, while donkeys were found as 0.38. The mean number of poultry birds, as reported by the respondents, were found to be **4.26.** Analysis of variance for sheep and poultry was found significant, indicating a highly significant difference between means of sheep and poultry at Mirwal and Shahpur Dams. Table **5.14** also shows that the average number of almost each category of livestock was higher at the Mirwal Dam as compared to that of Shahpur Dam.

## 5.7. Household Income

The income reported by the respondents is to be considered only as indicative due to the fact that most of the respondents do not report their income correctly. Data presented in Table 5.15 shows that the respondents have more than one source of income. They did not rely on crop income only, but is also supplemented with income from livestock, off-farm income, remittances and other sources.

As reported in Table 5.15, the mean income from crops was around Rs. **46,435** per household, while the mean income from livestock was about Rs. **8,500.** The mean income generated through off-farm working was reported as Rs. 3,109, while through remittances the households received an income to the tune of Rs. **1,057** rupees. From other sources **(job** in government or semi-government or private), the mean income was reported as Rs. 20,586 per year.

As already mentioned earlier in this report, almost all families have some members who have worked, or are presently working, either outside or inside Pakistan (in armed forces or in another agency). The average family income from all sources was calculated as Rs. **79,679** in the pilot project area, which seems quite close to the per capita income (at factor cost) at the national level (Government of Pakistan, **1996).** Analysis of variance was found significant in the case of crop income, income from live stock and total family income, showing a significant difference between means of these income at Mirwal and Shahpur Dams.

Table **5.15.** Mean Income From Various Sources (in **Rs.) of**

| Sources of income | Mirwal (N=59) | Shahpur (N=135) | |
|---|---|---|---|
| Crops | 95436 | 25020** | 46435 |
| Livestock | 11890 | 7018* | 8499 |
| Working on other farms | 3958 | 2739 | 3109 |
| Remittances | 1220 | 985 | 1057 |
| Other sources | 21693 | 20102 | 20586 |
| Total family income | 134136 | 55872** | 79679 |

'Analysis of Variance (ANOVA) is significant at .05 level.
** Analysis of Variance (ANOVA) is significant at .01 level.

The respondents under Mirwal Small Dam area reported their family mean income (from all sources) to be more than two times than what respondents under Shahpur Small Dam

area had reported. This difference in yearly family income of farmers in both of the small dams may be due to the fact that certain farmers having landholdings, from 2000 to over 16000 kanals, from Mirwal Small Dam area are also included, while from Shahpur Small Dam, no one reported landholdings of 2000 kanals or above. Average income of the farmers from Mirwal Dam area, when included, has raised the averages to a large extent.

Average income of the respondents (minus farmers owning 1600 kanals and above) was also calculated and is presented in Table 5.16. Afler eliminating income of these landlords, the mean income of Mirwal Small Dam farmers was still higher than the income of farmers from Shahpur Small Dam. This may be due to the fact that the farmers living under Mirwal Dam command area are satisfied with the supply of dam water and are utilizing it efficiently and effectively as an input, thus resulting in more crop production. Graphic illustration of mean income of the respondents from all sources has been presented in Figures 5.9 and 5.10.

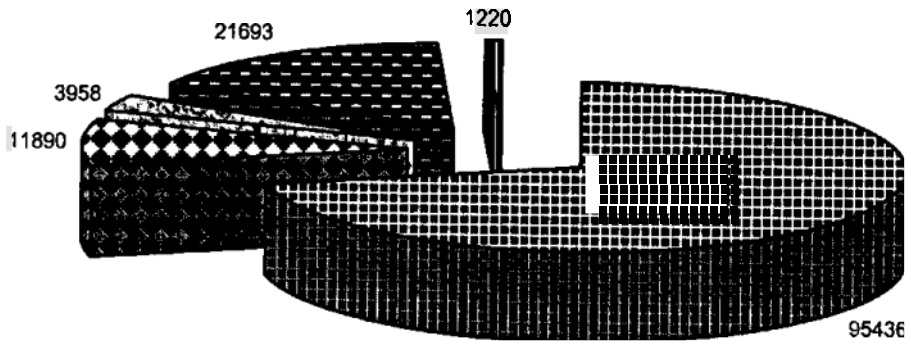
**Re**

| Sources of income | Mirwal (N=53) | Shahpur fN= 134) | Overall (N=187) |
|---|---|---|---|
| Crops | 53560 | 23444** | 31980 |
| Livestock | 7915 | 7070 | 7310 |
| Working on other farms | 4405 | 2759 | 3226 |
| Remittances | 1358 | 993 | 1358 |
| Other sources | 21941 | 19876 | 20462 |
| Total family income | 89113 | 54150** | 64059 |

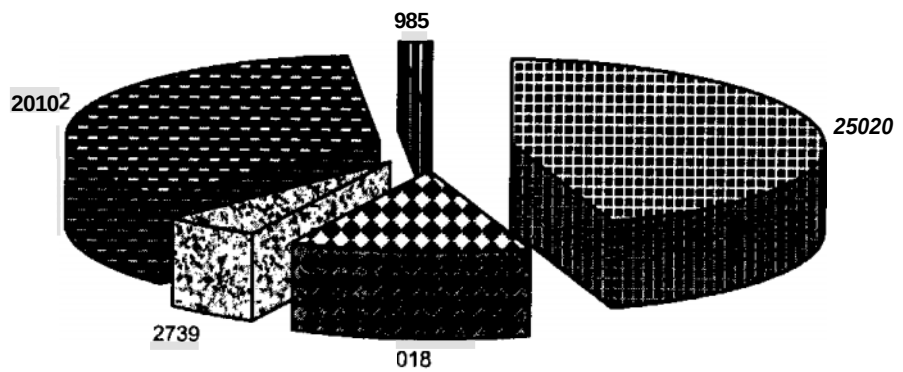
* OVA is significant at .01 level.

## 5.8. Ranking of Factors Responsible for Crop Production Increases

A list of factors (inputs) responsible for increased agricultural production was prepared and read to the respondents in order to prioritize three out of ten main factors responsible for increased crop production. Information presented in Table 5.17 reveals that ensured dam water supply, timely availability of chemical fertilizer, good quality seed, and machinery at reduced rate were stated by the respondents to be the main factors responsible for increased crop production. Ensured dam water was considered as the most important factor by about 29 percent of the farmers, second most important by about 10 percent and third most important by another 8.2 percent of the farmers.



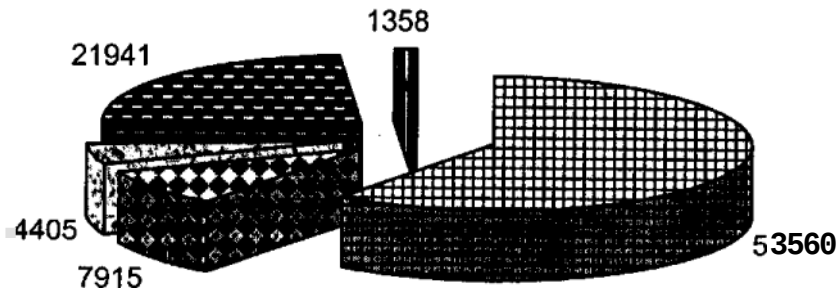

Mirwal Dam



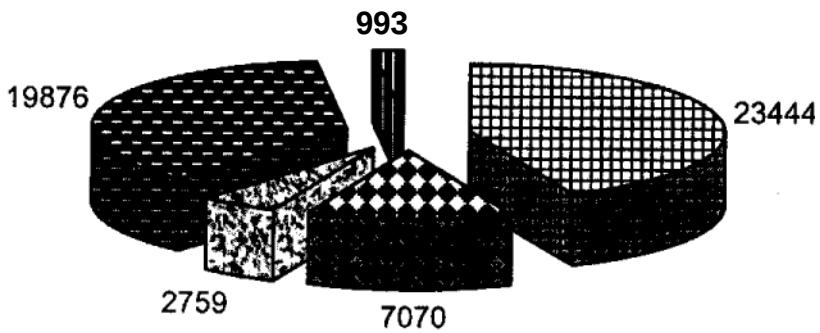

Shahpur Dam

Crops Livestock Working on other farms Other Sources Remittances

**Figure 5.9. Mean Income From Various Source** (in **Rs.)** of the **Respondents.**




Mirwal Dam




Shahpur Dam

Crops Livestock Working on other farms Other Sources Remittances

Figure 5.10. Average Income From Various Source (in Rs.)of the Respondents (Farmers having land of 1600 kanals and above not included.)

of good quality seed was ranked no. 1 by 3.6 percent the farmers, no. 2 by about 21 percent, while 22.2 percent of them ranked it as no. 3. For chemical fertilizers, 17.5 percent of the farmers ranked it no. 1, about 31 percent as no. 2 and about 30 percent of the farmers ranked chemical fertilizers as no. 3.

Machinery used for land development at subsidized rates, was ranked as no. 1 by about 23 percent of the farmers, no. 2 by about 24 percent, and 18.6 ranked it as no. 3. Some respondents **(15.5%)** did mention more dam water as no.1, about 3 percent of them ranked it as no. 2 and about 4 percent of the respondents ranked 'more dam water as no. 3 as an important factor associated with more crop production. There were some respondents, who ranked better extension services, credit facilities, improved water management and quality of pesticides/insecticides at no. 1 or no. 2 or at no. 3, but the percentage of the farmers who ranked these factors was negligible.

**Table 5.17. Ranking of Factors Associated with Increase in Crop Production.**

| Factors | Mirwal | | | Shahpur | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| More dam water | 8.5 | 5.1 | 8.5 | 18.5 | 1.5 | 1.5 | 15.5 | 2.6 | 3.6 |
| Ensured dam water | 8.5 | 8.5 | 6.8 | 37.8 | 11.1 | 8.9 | 28.9 | 10.3 | 8.2 |
| Improved water management | 3.4 | - | 1.7 | 1.5 | 3.0 | 1.5 | 2.1 | 2.1 | 1.5 |
| Better extension service | 1.7 | 6.8 | 1.7 | - | 0.7 | 2.2 | 0.5 | 2.6 | 2.1 |
| Good quality seed | 6.8 | 30.5 | 27.1 | 2.2 | 17.0 | 20.0 | 3.6 | 21.1 | 22.2 |
| Chemical fertilizer | 23.7 | 32.2 | 23.7 | 14.8 | 31.1 | 32.6 | 17.5 | 31.4 | 29.9 |
| Credit facilities | 6.8 | 5.1 | 11.9 | 2.2 | 4.4 | 4.4 | 3.6 | 4.6 | 6.7 |
| Machinery at reduced rates | 35.6 | 10.2 | 16.9 | 17.8 | 30.4 | 19.3 | 23.2 | 24.2 | 18.6 |
| Quality pesticide | 3.4 | - | 3.4 | 0.7 | 1.5 | 5.2 | 1.5 | 1.0 | 4.6 |
| Quality weedicide | - | 1.7 | - | - | - | 2.2 | - | 0.5 | 1.5 |

# CHAPTER 6

# ISSUES

The following are the main issues, as stated by the respondents, of the irrigation system network and the command area at Mirwal and Shahpur Small Dams.

## 6.1 Ensured Dam Water Supply

The issue of ensured water supply is arising due to lack of a proper warabandi system in the area. Though there exists an agreed warabandi in both of the pilot small dams, yet farmers are not strictly following it. Whenever crops need water, the farmers just unplug the nakka and start irrigating their fields. During this process, farmers at the tail reach of the canal are deprived of dam water. This is true under both the Mirwal and Shahpur Small Dams. Therefore, the introduction of an effective warabandi system in the area is very much required in order to have equitable water distribution. This issue basically stems from a lack of clear water rights for the users.

## 6.2 Water Rights

With the construction of a small dam and the associated water channels/canals, a mogha was constructed for whosoever applied, without considering the size of the outlet and the area to be irrigated by that outlet. Presently, farmers of the area consider watercourses as their properly and are not allowing other farmers, who have developed their land in the recent past, to irrigate their fields through their watercourses. This point was raised by the sufferers in the process of awareness and consultation meetings with farmers in connection with the formation of Farmers Organizations at Mirwal and Shahpur Small Dams. Management of the irrigation system is not properly established and the influentials use more water than their authorized share of dam water. With water being such a crucial input, the issue of water rights (that every farmer in the command area should get water according to his share) will continuously be a source of problems unless it is resolved by the concerned agency, such as the Small Dam Organization, Department of Irrigation and Power, Government of the Punjab.

Further, to minimize land and water disputes, the Small Dam Organization (SDO) officials should demarcate passages for the official watercourse to fulfil the farmers' demand for dam water.

## 6.3 Water Conveyance Network

The water channel/canal, particularly of Shahpur Small Dam, is in miserable condition. The canal was constructed before it was actually linked to the dam. During the last rabi season, farmers remained without dam water for three months; from January *to* March,

**1997.** At one place, one **of** the pillars under the aqueduct collapsed and it took three month for its repair. The canal has not been very well maintained by the Small Dam Organization due to non-availability of funds and manpower. One can easily observe the ruined bed and the cracks appearing in the canal where bushes have grown and covered the canal at some places. This has resulted in waterlogging in Shahpur Small Dam command area due to continuous seepage and leakage of the water from the canal and the watercourses, that has made the surrounding land uncultivable.

### 6.4 Land Levelling

With the construction of small dams in the area, farmers have started investing in land levelling to optimally use irrigation water available through the aqueduct. Presently, only 25 to 30 percent of the Mirwal and Shahpur Dams command area has been developed by the farmers with the help of government agencies, like Agency for Barani Area Development, Soil Conservation, On Farm Water Management, etc. and by hiring private tractors. Still, a lot more of the command area needs land levelling. To attain maximum benefit from the small dams and the dam water, there is a need to bring more and more area under irrigated agriculture by levelling barani uneven/undulating fields by bulldozers or tractors. The machinery in this regard may be provided by the government agencies at the subsidized rates.

### 6.5 Farm Productivity

Where there is a question of inequitable distribution of water, farmers have concerns about lack of timely availability of other inputs, like fertilizer, pesticide, good quality seed for various crops, etc. Lack of timely availability of inputs, coupled with uneven land and inequitable distribution of water, have really hampered farm production to a large extent.

To lift water for irrigation through pumps, where land is at higher elevations and cannot be irrigated through gravity flow, schemes for providing lift pumps should be introduced in the project area. When the proper quantity of dam water is available, along with other inputs associated with crop production, better cropping patterns can be established and crop production can be increased in the area. One Can grow vegetables, chillis, orchards, etc., instead of growing conventional crops like wheat, maize and groundnuts.

## REFERENCES


1. Cheema, M., Iqbal, Z., Hussan, M.. and Bandaragoda, J., 1997." Socio-Economic Baseline Survey for a Pilot Project on Water Users Organizations in the Hakra 4-R Distributary Command Area, Punjab" Report No. R-37. International Irrigation Management Institute. Lahore.

2. Cheema. M.. Sharif. M., Longmire, J. and Farooq, U., 1992." Initial Sources of Information and the Pioneers in the Adoption of Recent Technologies for Rice B-385" Pakistan Agriculture Research Council Unit, Ayub Agriculture Research Institute, Faisalabad.

3. Government of Punjab, 1980. "PC-1 Feasibility Report and Project Estimates of Shahpur Dam" Small Dam Organization, Irrigation and Power Department, Agency for Barani Area Development, Rawalpindi/Islamabad.

4. Government of Pakistan, 1996. "Economic Survey 1995-96." Finance Division, Economic'Advisor's Wing, Islamabad.

5. Iqbal, W. M., 1991." Screening Survey of Potential Small Dam Sites in Punjab (Phase iv)" Publication No. 273, Punjab Economic Research Institute. Lahore.

6. Iqbal, *S.* M and Khan, S.A, 1991. "Benchmark Survey of Jabbi and Nikka Small Dams" Publication No. 275, Punjab Economic Research Institute, Lahore.

7. Iqbal, S.M. 1989. "Baseline Survey of Shahpur Small Dam". Publication No. 257, Punjab Economic Research Institute, Lahore.

8. IIMI-Pakistan 1996. "Social Organization for Improved System Management and Sustainable Agriculture in Small Dams" Inception Report No. P-5. International Irrigation Management Institute, Lahore.

9. Lionberger, H.F. 1961. "Adoption of New Ideas and Practices", The Iowa State University Press, Ames, Iowa.

10. Shahid, A. *S.*. M. Sharif, K. Ata and S. A. Namdar, 1995. "Evaluation of Small Dams Project in Punjab" Publication No. 315, Punjab Economic Research Institute, Lahore.

11. Shahid, A. and Ashraf, M., 1989. " Benchmark Survey of Mirwal Small Dam" Publication No. 262, Punjab Economic Research Institute, Lahore.

12. Sharif, M., Khan, M. and Sarwar, M., 1986. "Constraint Facing Small Farmers in Punjab" Publication No. 224. Punjab Economic Research Institute, Lahore.

13. Zaidi, A. H., 1995. "Institutional and Management Issues in the Development of Irrigation with Small Dams in Pothwar Area of Punjab" Paper presented at the International Conference on Irrigation Management Transfer, held in Wuhan, China during Sept 20-24, 1995.

# BASELINE SURVEY FOR FARMERS ORGANIZATIONS OF SHAHPUR AND MIRWAL SMALL DAMS

Name of the interviewer: _____

Farmer's I.D. _____

Date of interview: _____

Time started: _____
Finished: _____

Village _____

Dam Name _____

SDCA (Acres) _____

Farm location on the Water Channel. i) Head, ii) Middle, iii) Tail

**Characteristics of the Respondent**

1. Name of the respondent: _____

2. Father's name: _____

3. Age (years): [ ]

4. Resident local or a settler?
[Local=1, Settler=2] [ ]

5. Caste/Sub-caste _____

[Pathan=1, Malik=2, Khatar=3, Maliar=4,
Rajput= 5 Awan= 6, Any other=7] [ ]

6. Marital status _____

[Married=1, Single=2, Widower=3] [ ]

7. Father's occupation

[Same as respondent=1, Other=2] [ ]

8. Educational level [ ]

| | | | |
|---|---|---|---|
| i | illiterate | ii | Primary |
| iii | Middle | iv | Matriculation |
| v | F.A/F.Sc | vi | B.A/B.Sc |
| vii | M.A/M.Sc | viii | Any other (Sp) |

**9. Household size and composition**

| Particulars | < 5 Years | | | 5< >15 | | | 15< >65 | | | 65 and above | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | F | T | M | F | T | M | F | T | M | F | T |
| Number of members | | | | | | | | | | | | |
| How many are at school? | | | | | | | | | | | | |
| How many are working at farm? | | | | | | | | | | | | |
| a. Full time | | | | | | | | | | | | |
| b. Part time | | | | | | | | | | | | |
| How many are working? | | | | | | | | | | | | |
| a abroad | | | | | | | | | | - | - | - |
| b. in armed forces | | | | | | | | | | - | - | - |

**Persons up to primary education in the family.**

Males _____ Females _____ Total_____

**Irrigation Practices**

10. Years **of** experience with irrigated agriculture —— years. [ ]
Years **of** experience with agriculture _____ years. [ ]

11. Source of irrigation.

i. Dam
ii. Private **lifl** pump
iii. Dam + private **lifl** pump

iv. Well
v. Dam + well
vi. Any other (Sp) _____ [ ]

12. To what extent this source fulfills your **crop** water requirement?
i. Not at all
ii. To some extent
iii. To large extent [ ]

If answer is i or ii, then ask how do you overcome crop water deficiency?

_____

_____

13. Irrigation method.
i. Basin
ii. Furrow
iii. Basin + Furrow
iv. Wild flooding
v. Any other (Sp) _____ [ ]

**Water Management**

**14.** For how many hours a day small dam water runs into the water channel?
_____ hours.

15. At what time you usually open and close your nakka during:

a. Rabi
Open _____
Close _____

b. Khrif
Open _____
Close _____

**16.** How much time it takes to irrigate one kanal of land at your water channel? _____ minutes/kanal

## Irrigation Svstem Performance

### A. Eauitv in Water Distribution

17. Do you think that water is equitably distributed at your water channel? Yes/No
[Yes=1, No=2] [ ]

If no, state reason *(s)* responsible for unequitable distribution of water?

1. Location of farm (H - **M** - T) [ ]
2. Farm size [ ]
3. Tenancy status [ ]
4. Influential person [ ]
5. Poor maintenance [ ]
6. Any other (sp) [ ]
7. Not applicable [ ]

### B. Adequacy, Reliability and Variation in the Supply of Dam Water

**18.** Was Dam water sufficient for the crops you cuitivated in last Kharif season? Yes/No
[Yes=1, No=2] [ ]

If no, month of the most acute shortage of water.
_____ [ ]

19. Was Dam water sufficient for the crop you cultivated in last Rabi season ? Yes/No
[Yes=1, No=2] [ ]

If no, month of the acute shortage **of** water.
_____ [ ]

20. To what extent are you satisfied with the present distribution of water ?

I. Not at all
ii. To some extent
iii. To large extent [ ]

If not at **all,** who can improve water distribution?

i Government agency
ii Farmers organizations
iii Both
iv Any other (sp)
v Not applicable [ ]

**Institutional development**

21. Is WUA formed **at** your water channel **7**
YeslNo
[Yes=1, No=2] [ ]
If no, **ask** Q.29

22. **If** yes, are you a member of this WUA ? YeslNo
[Yes=1, No=2] [ ]

23. How many are the members of this WUA? ____ [ ]

24. How many are the members of the Executive Committee?
_____ [ ]

*25.* How the members of the Executive Committee are selected ?
_____

26. Number of persons Who did not contributed for improvement of WC ?
_____

Why ? _____

27. Has the WUA been useful to you ? YeslNo
[Yes=1, No=2] [ ]

If yes, how ?_____
_____

If no, what in your view **is** lacking in WUA ?_____
_____
_____

28. What activities has the WUA undertaken?

i. _____

ii. _____

29. **Existing Status of Oraanizational Behavior**

| | Areas of Collective Action | Yes/No [Yes=1,No=2] | If yes, how do you perform this action? |
|---|---|---|---|
| a. | Maintenancelconstructionof village mosque | | |
| b. | Maintenancelconstruction of village school | | |
| c. | Land and water disputes | | |
| d. | Purchase of inputs | | |
| e. | Marketing of crop produce | | |
| f. | Maintenance of Dam | | |
| g. | Maintenancelconstruction of water channel | | |
| h. | Maintenance/construction of mouza streets/roads | | |
| I. | Any other (sp) | | |

**30.** Has the Dam which delivers water to your water channel:

1) remained in about the same functional condition as it was 5 years ago.
2) deteriorated to worse condition than 5 years ago.
3) improved to a better condition than 5 years ago.
9) do not know.

31. Has the main channel which delivers water to your farm:

**1)** remained in about the same functional condition as it was 5 years ago.
2) deteriorated to worse condition than 5 years ago.
3) improved to a better condition than 5 years ago.
9) do not know.

32. Has the watercourse which delivers water to your farm:

1) remained in about the same functional condition as it was 5 years ago.
2) deteriorated to worse condition than 5 years ago.
3) improved to a better condition than 5 years ago.
9) do not know.

**Farmer's Perception**

33. Did following agents or representatives **of** the agencies visit your farm during the last two seasons?

| Agent | Yes/No [Yes=1, No=2] | If yes, what Benefit did you get? |
|---|---|---|
| 1. Agriculture Extension agent | | |
| 2. Fertilizer company agent | | |
| 3. Pesticides company agent | | |
| 4. OFWM representative | | |
| 5. Mobile credit officer | | |
| 6. SDO representative | | |
| 7. ABAD reoresentative | | |
| 8. Other (sp) | | |

34. **Tenancy status** [ ]

i. Owner (absentee)
ii. Owner-cum-operator
iii. Tenant
iv. Contractor/Lessee

| | A | B | Total | |
|---|---|---|---|---|
| 1. Area owned | | | | |
| 2. Area rented in | | | | |
| a. On cash | | | | |
| b. Share produce | | | | |
| c. Total | | | | |
| 3. Area rented out | | | | |
| a. On cash | | | | |
| b. Share produce | | | | |
| c. Total | | | | |
| 4. Area operated (1+2c-3c) | | | | |

* A = Irrigated B = Barani

35 a Acreage of levelled land _____ kanals
Potential land needed levelling _____ kanals

36. **Machinery**

| Statement | Yes/No |
|---|---|
| 1. Do you own tractor? | |
| 2. Do you own following modern equipments? | |
| a. Thresher | |
| b. Seed drill | |
| c Reaper | |
| d. Ridger | |
| e. sprayer | |
| f. Any other (sp) | |

**Soil and Water Status**

37, **Is** ground water available ? Yes/No [ ]
[Yes=1, No=2]

**38. Quality of ground water.**

i. Fit for irrigation [ ]
ii. Marginal fit for irrigation
iii. Unfit for irrigation

39. **A. Waterlogging.**
Number *of* acres affected by water-logging. _____ [ ]

**B. Salinity.**
Number of acres affected **by** salinity. _____ [ ]

**40. Method(s) used for reclamation of your land?**

| Action | Waterlogging Yes/No/N.A. [Yes=1, No=0] | Salinity Yes/No/N.A. [Yes=1, No=0] |
|---|---|---|
| a. No action | | |
| b. Use gypsum | | |
| c. Grow grass | | |
| d. Plant trees | | |
| e. Rice cultivation | | |
| f. Leaching | | |
| g. Field levelling | | |
| h. Any other (sp) | | |

## CROP, AGRICULTURAL PRACTICES AND INPUTS

### 41. Cropping pattern, production and marketing: (Irrigated)

| Season/ crop | Area under crop (kl) | Seed used/ kl | Fertilizer used/Kl | Total produce (Maund)/ kl or value/kl | Price Rs/40Kg | Total exp/Kl |
|---|---|---|---|---|---|---|
| **KHARIF** | | | | | | |
| Peanut | | | | | | |
| Oil Seed | | | | | | |
| Rice | | | | | | |
| Maize | | | | | | |
| Fodder | | | | | | |
| Tobacco | | | | | | |
| Orchard | | | | | | |
| Vegetable | | | | | | |
| **RABI** | | | | | | |
| Wheat | | | | | | |
| Pulses | | | | | | |
| Gram | | | | | | |
| Fodder | | | | | | |
| Oilseed | | | | | | |
| Orchard | | | | | | |
| Vegetable | | | | | | |

### 42. Cropping pattern, production and marketina: (Barani)

| Season/ crop | Area under crop (kl) | Seed used/ kl | Fertilizer usedlkl | Total produce (Maund)/kl or value/kl | Price Rs/40Kg | Total exp/kl |
|---|---|---|---|---|---|---|
| **KHARIF** | | | | | | |
| Peanut | | | | | | |
| Oil Seed | | | | | | |
| Rice | | | | | | |
| Maize | | | | | | |
| Fodder | | | | | | |
| Tobacco | | | | | | |
| Orchard | | | | | | |
| Vegetable | | | | | | |
| **RABI** | | | | | | |
| Wheat | | | | | | |
| Pulses | | | | | | |
| Gram | | | | | | |
| Fodder | | | | | | |
| Oilseed | | | | | | |
| Orchard | | | | | | |
| Vegetable | | | | | | |

**43.** Name three main factors (priority wise), from the followings, which help in increasing yield per acre?

| | Factors | Priority |
|---|---|---|
| 1. | More dam water supply | |
| 2. | Ensured dam water supply | |
| 3. | Improved water management practices | |
| 4. | Better extension services | |
| 5. | Availability of good quality seed | |
| 6. | Timely availability of chemical fertilizer | |
| 7. | Easy availability of credit facility | |
| 8. | Availability of machinery on subsidized rates | |
| 9. | Availability of quality pesticideslinsecticides | |
| 10. | Availability of quality weedicides | |

**44.** **Livestock inventory**

| Livestock | Number |
|---|---|
| 1. Bullocks | |
| 2. cows | |
| 3. Camels | |
| 4. Buffaloes | |
| 5. Sheep | |
| 6 Goats | |
| 7. Donkeys | |
| 8. Horses | |
| 9. Poultry | |

**45.** **Estimated Familv Income (per year)**

Income from crop _____
Income from livestock _____
Income from labor _____
(from outside farm)
Remittances _____
Any other _____
Total family income _____

Land Manaaement

46. Do you level your land to optimize the utilization of water efficiently ?
YeslNo [Yes=1, No=2] [ ]

If no, state reasons. _____

_____

_____

**47.** Have you heard about precision land levelling ? Yes/No
[Yes=1 , No=2] [ ]

If yes, how do you know ? _____

_____

_____

Attitude Towards Water Users Organization

48. Do you know that organized people work effectively for the development work ?
YeslNo
[Yes=1, No=2) [ ]

If yes, how do you perceive the farmers organization?

_____

_____

**49.** Are you willing to work with people for any kind of development ?
YeslNo [Yes=1, No=2] [ ]

If yes, how do you perceive your willingness in the organization ?

_____

_____

50. Have you ever initiated such kind of association in your area'? YeslNo
[Yes=1, No=2] [ ]

If yes, please explain about the formation of organization.

_____

_____

50.a Have you ever participated in any kind of association in you area? Yes/No
[ ]

51. Are you willing to contribute your labor or in case affordable money towards the work **to** be carried out by the organization for the development of your area?
Yes/No [Yes=1, No=2] [ ]

If no, state reason _____
_____

52. What kind of advantage you perceive by organizing farmers at small dam level?
_____
_____

**53.** Are you willing to give your services and or contribute if needed while maintaining and operating the irrigation system at the small dam level ?
YeslNo
[Yes=1, No=2] [ ]

How? _____

**Health Component**

54. State common illnessldiseases you had in your family during 1996, treated where and by whom ?

| Illness/diseases | Treated where? | By whom? |
|---|---|---|
| | | |
| | | |
| | | |

**56. Community Characteristics**

| S.No. | Facilities | Yes/No [Yes=1, No=2] | If no, state distance |
|---|---|---|---|
| | Hospital/dispensary | | |
| 2 | Veterinary hospital | | |
| 3 | School (Male) P/M/H | | |
| 4 | School (Female) P/M/H | | |
| 5 | Industrial home (Female) | | |
| 6 | Farm to market road | | |
| 7 | Electricity | | |
| 8 | Telephone | | |
| 9 | Safe drinking water/tape water | | |
| 10 | Post office | | |
| 11 | Marketing facilities | | |
| 12 | Bus station | | |
| 13 | Bank | | |
| 14 | Cooperative society<br>a. Formal<br>b Informal | | |
| 16 | Sewerage system | | |
| 17 | Any other (sp) | | |

57. Total number of households in the village.

_____

58. Total population in the village.

_____

59. Whether punchaayt system exists in the village to solve dispute among the villagers ? Yes/No

[Yes=1, No=2] [ ]

60. If yes, to what extent it is effective in solving disputes among villagers? [ ]

1. To large extent
2. To some extent
3. Not at all
9. Not applicable

| Item of Information | Name of Small Dam | | |
|---|---|---|---|
| | Mirwal | Shahpur | Bughtal |
| Name of Stream | Dubran Kas | Nadna Kas | Sirli Nallah |
| Storage Capacity Live | 3.36 MCM(2726 AF) | 5.1 MCM (4095 AF) | 0.8 MCM (675 AF) |
| Dead | 1.28 MCM (1039 AF) | 6 MCM (10241 AF) | 0.6 MCM (465 AF) |
| Design Discharge | 0.31 M3/sec (11 cusecs) | 1 M3/sec (43 cusec)* | 0.25 m3/sec (9 cusec) |
| Design Command Area | 7.11 ha (1,050 acres) | 1,364 ha** (4,308 acres) | 406 ha (600 acres) |
| Year of Completion | 1990 | 1986 | 1990 |
| O&M Cost 93/94 | P.Rs. 1,72,400 | P.Rs. 6,55,800 | P.Rs. 50,000 |
| 94/95 | P.Rs. 1,63,780 | P.Rs. 6,23,010 | P.Rs. 50,000 |
| Abiana Collected 92/93 | P.Rs. 6,070 | P.Rs. 7,027 | P.Rs. 22,713 |
| 93/94 | P.Rs. 15,647 | P.Rs. 20,132 | P.Rs. 23,572 |
| 94/95 | P.Rs. 19.786 | P. Rs. 17,901 | P.Rs. 24,080 |
| Number of Water Users | 95 | 157 | 200 |

*Actual discharge is 15 cusecs as reported by the Small Dams Organization.

**Actual command area is 1250 acre as reported by the Small Dams Organization.

[1] Information in this table was collected with the help of Dr. Shahid Ahmed and Mr. Mohammad Aslam of WRRI

# 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**<br>Volume I: Synthesis of Findings and Recommendations | Carlos Garces-R<br>D.J. Bandaragoda<br>Pierre Strosser | June 1994 |
| | Volume II: Research Approach and Interpretation | Carlos Garces-R<br>Ms. Zaigham Habib<br>Pierre Strosser<br>Tissa Bandaragoda<br>Rana M. Afaq<br>Saeed ur Rehman<br>Abdul Hakim Khan | June 1994 |
| | Volume III: Data Collection Procedures and Data Sets | Rana M. Afaq<br>Pierre Strosser<br>Saeed ur Rehman<br>Abdul Hakim Khan<br>Carlos Garces-R | June 1994 |
| R-2 | Salinity and Sodicity Research in Pakistan - Proceedings of a one-day Workshop | J.W. Kijne<br>Marcel Kuper<br>Muhammad Aslam | Mar 1995 |
| R-3 | Farmers' Perceptions on Salinity and Sodicity: A case study into farmers' knowledge of salinity and sodicity, and their strategies and practices to deal with salinity and sodicity 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<br>Khalid Mahmood<br>Anwar Iqbal<br>Mushtaq Khan<br>Marcel Kuper | July 1996 |
| R-6 | Farmers Ability to Cope with Salinity and Sodicity: Farmers' perceptions, strategies and practices for dealing with salinity and sodicity in their farming systems | Neeltje Kielen | Aug 1996 |
| R-7 | Salinity and Sodicity Effects on Soils and Crops in the Chishtian Sub-Division: *Documentation of a Restitution Process* | Neeltje Kielen<br>Muhammad Aslam<br>Rafique Khan<br>Marcel Kuper | Sept 1996 |
| R-8 | Tertiary Sub-System Management:<br>(Workshop proceedings) | Khalid Riaz<br>Robina Wahaj | Sept 1996 |
| R-9 | Mobilizing Social Organization Volunteers: An Initial Methodological Step Towards Establishing Effective Water Users Organization | Mehmoodul Hassan<br>Zafar Iqbal Mirza<br>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 |

| Repori No | Title | Author | Year |
|---|---|---|---|
| R-12 | Modelling of Sediment Transporl 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 lo Sediment Problems: Application to Pakistan (M.Sc Thesis published as Research Report) | Alexandre Vabre | Oct 1996 |
| R-14 | Government inlerventions in Social Organization for Water Resource Management Experience of a Command Water Management Proiect in Ihe Puniab. Pakistan | Waheed uz Zaman<br>D.J.Bandaragoda | Oct 1996 |
| R-15 | Applying Rapid Appraisal of Agricultural Knowledge Syslems (RAAKS) for Building inler-Agency Collaboration | Derk Kulper<br>Mushtaq A. Khan<br>Jos van Oostrum<br>M. Rafique Khan<br>Nathalie Roovers<br>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 Inigation Channels in Ihe 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<br>Gayiord V. Skogerboe<br>M.S. Shafique<br>(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: Environmenlal Managemenl of Irrigated Lands | | |
| R-18.5 | Volume-V Papers on ihe Theme: institutional Development | | |
| R-19 | Detailed Soil Survey of Eight Sample Walercourse Command Areas in Chishtiar and Hasilpur Tehsils | Soil Survey of Pakistan<br>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 Wesl Frontier Province, Pakislan | Zaigham Habib<br>Kobkiat Pongput<br>Gaylord V. Skogerboe | Dec 1996 |
| R-21 | Salinity Management Alternatives for the Rechna Doab. Punjab, Pakistan | Gauhar Rehman<br>Waqar A. Jehangir<br>Abdul Rehman<br>Muhammad Aslam<br>Gaylord V. Skogerboe | May 1997 |
| R-21.1 | Volume One: Principal Findings and Implications for Sustainable irrioaled Aarlculture | | |
| R-21.2 | Volume Two: History of Irrigated Agriculture: A Select Appraisal | Gauhar Rehman<br>Hassan Zia Munawwar<br>Asghar Hussain | Jan 1997 |

| Report No. | Title | Author | |
|---|---|---|---|
| R-21.3 | Volume Three: Development of Procedural and Analytical | Nazim Ali<br>Hassan Zia Munawwar | |
| R-21.4 | Volume Four: Field Data Collection and Processing | Gauhar Rehman<br>Muhammad Aslam<br>Waqar A. Jehangir<br>Mobin Ud Din Ahmed<br>Hassan Zia Munawwar<br>Asghar Hussaln<br>Nazim Ali<br>Faizan Ali<br>Samia Ali | 1997 |
| R-21.5 | Volume Five: Predicting Future Tubeweil Salinity Discharges | Muhammad Aslam | Jan 1997 |
| R-21.6 | Volume Six: Resource Use and Productivity Potential in the Irrigated Agriculture | Waqar A. Jehangir<br>Nazim Ali | Feb 1997 |
| R-21.7 | Volume Seven: Initiative for Upscaling: Irrigation Subdivision as Ihe Building Block | Gauhar Rehman<br>Asghar Hussain<br>Hassan Zia Munawwar | Apr 1997 |
| R-21.8 | Volume Eight: Options for Sustainability: Sector-Level Allocations and Investments | Abdul Rehman<br>Gauhar Rehman<br>Hassan Zia Munawar | Apr 1997 |
| R-22 | Salinisation, Alkalinisation and Sodlficalion on Irrigated Areas In Pakistan: Characterisation of Ihe geochemical and physical processes and the Impact of Irrigation water on Ihese 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 Operalions 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 Irrigalion Methods and Practices: Field Evaluation of Ihe Irrigation Processes for Selected Basin Irrigalion Systems during Rabi 1995-96 Season | Ineke Margot Kalwij | March 1997 |
| R-25 | Organizing Water Users for Distributary Management: Preliminary Results from a Pilot Sludy in the Hakra 4-R Distributary of the Eastern Sadiqla Canal System of Pakistan's Punjab Province | D.J. Bandaragoda<br>Mehmood Ul Hassan<br>Zafar Iqbal Mirza<br>M. Asghar Cheema<br>Waheed uz Zaman | April 1997 |
| R-26 | Moving Towards Participatory Irrigalion Management | D.J. Bandaragoda<br>Yameen Memon | May 1997 |
| R-27 | Fluctuations in Canal Water Supplies: A Case Study | Shahid Sarwar<br>H.M. Nafees<br>M.S. Shafique | June 1997 |
| R-28 | Hvdraulic Characteristics of Pilot Distributaries in the Mirpurkhas, Sanghar and Nawabshah Dislricts. Sindh. Pakistan | Bakhshal Lashari<br>Gaylord V. Skogerboe<br>Rubina Siddiqui | June 1997 |

| Report | Title | Author | Year |
|---|---|---|---|
| R-29 | Integration of Agricuilural Commodity Marketsi n the South Puniab. Pakistan | Zubair Tahir | July 1997 |
| R-30 | Impact of Irrigation. Salinity and Cultural Practices on Wheal Yields in Southeastern Punjab. Pakistan | Florence Pintus | Aug 1997 |
| R-31 | Relating Farmers' Practices to Cotton Yields in Southeastern Punlab, Pakislan | P.D.B.J. Meerbach | 1997 |
| R-32 | An Evaluation of Outlet Calibration Methods: A contribution to the study on Collective Action for Water Management below the Oullet. Hakra 6-R Distributary | Arien Durina | Aug 1997 |
| R-33 | Farmers' use of Basin, Furrow and Bed-and-Furrow Irrigation Systems and the possibilities for tradltional farmers to adopt the Bed-and-Furrow Irrigation Method. | Nanda M. Berkhout<br>Farhal Yasmeen<br>Rakhshanda Maqsood<br>Ineke M. Kalwii | Sep 1997 |
| R-34 | Financial Feasibility Analysis of Operation and Maintenance Costs for Water Users Federations on three distributaries in Province of Sindh. Paklslan. | Amin Sohani | Sep 1997 |
| R-35 | Assessing the Field Irrigation Performance and Alternative Management Oplions far Basin Surface Irrigation Systems through Hydrodynamic Modelling. | Ineke Margot Kalwij | 1997 |
| **R-36** | Socio-Economic Baseline Survey for Three Pilot Distributaries in Slndh Province, Pakistan. | Yameen Memon<br>Mehmood Ul Hassan<br>Don Jayatissa Bandaragoda | N w 1997 |
| R-37 | Sodo-Economic Basline Survey for a Pilot Project on Water Users Organizations in the Hakra 4-R Distributary Command Area, Punjab. | Muhammad Asghar Cheema<br>Zafar Iqbai Mirza<br>Mehmood Ui Hassan<br>Don Javatissa Bandaraaoda | Dec 1997 |
| R-38 | Baseline Survey for Farmers Organizations of Mirwal and Shahpur Small Dams, Punjab. Pakistan. | Muhammad Asghar Cheema<br>Don Jayatissa Bandaragoda | Dec 1997 |