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**PAKISTAN  
WATER AND POWER DEVELOPMENT AUTHORITY**

**KAREZ IRRIGATION IN  
BALUCHISTAN  
BENCH MARK STUDY**

*BY*

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**IRRIGATION SYSTEMS OUTSIDE THE INDUS BASIN  
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## **FOREWORD**

Karez Irrigation in vogue in Baluchistan is an age old method for extracting groundwater through gravity and has served the irrigation needs of the dispersed population of the area for centuries. According to available statistics, about 11% of the total irrigated area of the province is irrigated by karez. The system is operated and maintained in traditional manner and offers good opportunities for improving its performance and productivity. This report, probably a first attempt of its kind, presents data for 12 randomly selected karezes in four districts of Baluchistan viz; Ziarat, Pishin, Quetta and Kalat. The data covers engineering, agronomic and socio-economic aspects of karez irrigation. The survey has helped to draw definite conclusions about the existing performance of the system and to identify areas for future research. The study shall help in gaining understanding of working of the karezes and shall provide sound basis for bringing about improvement in their performance.

I would like to take this opportunity of recording my appreciation of the dedicated work put in the preparation of this valuable document by Mr. Muhammad Munir, Project Director and Mr. Muhammad Akram Kahlowan, Senior Engineer and other members of research team. I also wish to acknowledge the technical assistance provided by USAID through the Advisors from the University of Idaho, USA in the finalization of the report.

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## GLOSSARY

Doshakha	Twin branch of a tree combined at a single natural joint.
Mother-well	A well of karez, yielding water
Lamboor	Local name for karez tunnel.
Abu-Masar	Water Manager
Pir	A spiritual figure
Sahibzada	Son of a "Pir"
Shabana Roze	24 hours (Common in Pashtoon and Baluch Areas)
Vayal	12 hours or 1/2 of a Shabana Roze (Pashtoon Area)
Wagat	12 hours or 1/2 of a Shabana Roze (Baluch Area)
Saya	3 hours 1/8 of a Shabana Roze (Pashtoon Area)
Pass	3 hours 1/8 of a Shabana Roze (Baluch Area)
Shangar	45 Minutes or 1/32 of Shabana Roze (Pashtoon Area)
Dang	45 minutes or 1/32 of Shabana Roze (Baluch Area)
Gatta	22.5 minutes or 1/8 of a Saya (Pashtoon Area)
Nakhan	22.5 minutes or 1/8 of a Pass (Baluch Area)
Malik	Designation of a head of a tribe or sub-tribe in Pashtoon areas.

Sardar	Designation of head of tribe or sub-tribe in Baluch areas.
Chhatta	Spreading seed in the fields with hands (Broad casting)
Sardoar	The first turn of water among the karez share holders

## CHAPTER - 1

### INTRODUCTION

#### 1.01 BACKGROUND

"Irrigation System Management Research (ISMR) Project" identifies a number of research sub-projects, which also include "Irrigation Systems Outside the Indus Basin" Sub-Project for undertaking research on traditional modes of irrigation that exist outside the Indus Plains and include Barani, Sailaba, Karez and Well Irrigation systems. The objective of the sub-project are (1) :

1. Define and characterize patterns exhibited by the traditional forms of irrigation with respect to area, crops, physical, hydrologic and structural characteristics, indigenous management systems used and economic success of the various traditional systems.
2. Develop improved practices, structures and management patterns for these traditional systems.
3. Train personnel to conduct research on traditional irrigation systems outside the Indus Basin.
4. Determine the sustainability of traditional system irrigation levels, and of proposed levels of irrigation with maximum feasible development of all water sources.

Karez Irrigation system is the first which was taken up under the Sub-project for detailed study. This report compiles the bench mark information for the selected karezes. Effort has been made to analyse the system to the extent possible to identify the constraints and scope of its further improvement.

#### 1.02 STUDY AREA AND SAMPLE SIZE

To undertake the bench mark survey of karez irrigation in Baluchistan, the data on the extent of area irrigated by various existing irrigation systems in province was collected. It was observed that in Quetta Division about 40 percent of the irrigated area is supplied water through karezes against the provincial average of about 11% (Table 1.1).

- 
1. University of Idaho 1984 "Final Report on Irrigation Systems Management Research Design"

TABLE - 1.1

## AREA IRRIGATED BY DIFFERENT SOURCES

Sr. No.	Irrigation Source	Quetta Division	Sibi Division	Kalat Division	Makran Division	Baluchistan Province
1.	Total	91,350	340,490	63,820	15,360	511,020
2.	Canals	9,550	328,060		3,000	340,610
3.	Wells	6,600	2,280	3,650	6,000	18,530
4.	Tubewells	39,700	3,850	45,170	4,360	93,080
5.	Karezes, Springs	35,500	6,300	15,000	2,000	58,800
6.	(5) as Percent of (1)	39%	2%	24%	13%	11%

Source: Statistics Wing, Directorate of Agriculture Extension, Government of Baluchistan

The Makran area, which is also known for karez irrigation, was not selected for study as Baluchistan Area Development Project (BALAD) is executing a project there which also includes the improvement of karez irrigation system.

The Quetta Division was preferred because of the men and material resources available with the project. Selection of valleys in Quetta District reduced the logistics problems on one hand and offered diversified engineering, agro-economic and managerial parameters to make the study more comprehensive on the other hand.

A sample of 12 karezes in five valleys namely Punjpai, Kutchlak, Khanozai, Jungle Bundat and Mastung were selected for survey. These valleys are located in a radius of about 150 KM from Quetta and are easily accessible by metalled roads. The names and distribution of selected karezes are given in Table 1.2 and the location of the five valleys is marked on Plate 1-1

### **1.03 OBJECTIVES OF STUDY**

The overall objective of this study was to characterize Karez Irrigation Systems in Baluchistan. The following are the specific objectives of the study :

1. To review and summarize literature on karezes.
2. To undertake a survey of physical and structural characteristics of the karez system and determine its rehabilitation and improvement needs.
3. To study the existing agronomic practices such as cropping patterns, crop yields, farm income etc.
4. To collect data on karez organization and management including construction, maintenance and water distribution.
5. To identify the system constraints and suggest improvements for its better performance.

### **1.04 EARLIER STUDIES**

Previous work done and literature available on karez irrigation system was searched out by the help of University of Idaho Library Computerised Literature Search Service. As a result of this search a case study for Pakistan titled "Ecology of Karez Irrigation" by Rehman M. published in Geojournal 1981 and "Modern Interferences in Traditional Water Resources in Baluchistan", annual report of International Institute for Land Reclamation and Improvement were found of some

DETAILS OF KAREZES SELECTED FOR  
BENCH MARK SURVEY

Sr. No.	Name of Karez	Name of Valley	Name of Tehsil	Name of District
1.	Jalogir	Kutchlak	Quetta	Quetta
2.	Abdul Hakim	Punjpai	Punjpai	Quetta
3.	Khanozai	Khanozai	Khanozai	Pishin
4.	Balozai	Khanozai	Khanozai	Pishin
5.	Sahibzada	Khanozai	Khanozai	Pishin
6.	Shaib	Khanozai	Khanozai	Pishin
7.	Tor Daman	Khanozai	Khanozai	Pishin
8.	Jungle Bundat	Ahmadoon	Ziarat	Ziarat
9.	Ishkana	Mustung	Mustung	Kalat
10.	Mayana	Mustung	Mustung	Kalat
11.	Kalan	Mustung	Mustung	Kalat
12.	Kundki	Mustung	Mustung	Kalat



relevance to the study. The complete outcome of the computerized literature search service is summarised below.

**1) Najafabad Valley:**

Geographische Untersuchung einer Kanatlandschaft

Zagrosgebirge (Iran)/Martin Hartl.

Hartl. Martin.;

172 p.,

-Regensburger Geographische Schriften Heft 12 1979

**2) Iranian irrigation system: with special reference to Qanat and Kei.**

Okazaki, S.;

Ajia Keizai.21(6), June 1980. p.69-77.

Tokyo, Institute of Developing Economics.

**3) Modern interferences in traditional water resources in Baluchistan:**

Annual Report. International Institute for Land Reclamation and Improving/ILRI,

Oostenbaan. R.J.

Wageningen, Netherlands

1983- 23-34

Baluchistan, a province of Pakistan, is a mountainous region with little rainfall and no other major source of water. Nevertheless, the small amounts of rainfall, surface runoff, and groundwater are used to produce crops and to supply drinking water to humans and animals. Traditionally, (more or less) balanced water use system has evolved, but modern developments are tending to upset this balance by redistributing the water resources. The article discusses the water resources and traditional water-use systems of the region, before looking at modern developments and their

effects. In conclusion it has been noted that Islamic water laws attach no property rights to water resources; the laws attach rights only to the user of water as those who have constructed works to produce the water. Hence, the builders of a diversion weir or a Karez, and their heirs, have exclusive rights to the water produced by these works. But if a new dam is built upstream of their works, the same law applies to the builders of the dam. The fact that this dam reduces the downstream quantities of water, constitutes no legal problem. Modern water resources developments are allowed to interfere with existing traditional systems - often enriching the rich and impoverishing the poor. But careful hydrological investigations before and after the introduction of new water management can reveal its negative side effects. If these were followed by agreements on an equitable distribution of the benefit emanating from the new technology, or adequate indemnification for its victims, much could be accomplished in the cause of social justice.

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**4) Conservation at the local level; individual perceptions and group mechanisms:**

Martin, M. A.

In desertification and development dry land acology in social perspective edited by Spooner, B.; Mann, H.S.

London. UK; Academic Press Inc.

1982. 145-169

Land use and soil fertility are discussed in relation to ganat irrigation on the Tauran Plain, Iran.

**5) Ecology of Karez Irrigation: a case for Pakistan:**

Rahman, M.

Geojournal 1981. 5(1): 7-15

The karez (ganat) is a gently sloping underground tunnel which collects groundwater from alluvial fans and conducts it to the field or city. The oldest archaeological evidence of

such covered drains indicates that Moenjo Daro in the Indus Valley is one source of covered tunnel technology. Karez technology diffused into Pakistan from Afghanistan: most of the karezes are constructed along the Pakistan-Afghanistan border and most karez diggers came from Afghanistan. The easy availability and quick gains of tube-wells in contrast to trouble-prone karez systems (fluctuating water tables, siltation, roof collapse, and uncontrolled water supply), make karez irrigation unsuitable for modern planning. During a span of 20 years, the area irrigated by tubewells increased 338% while karez declined by 50% in the last 50 years. To modernize the karez system, concrete retention dams are used around source wells to raise the water table locally. However, their effectiveness has not yet been evaluated.

**6) Farm Water Management in Upland Areas of Baluchistan:**

Kemper, W D.; Mazher-ul-Haq; Saeed, A.

Engineering Research Center, Colorado State University Fort Collins, Colorado, USA.

1979, 88pp.

Research and Development Abstracts 8(i). 16.

This study describes and evaluates water management practices of farmers in Baluchistan, Pakistan. The study identifies specific farm water management activities which may be good investments for farmers and government. Water losses during delivery from source to field averages 24 percent in Baluchistan, which is about half as much loss as in the Punjab. Reduced delivery loss was caused by water courses being short and having operating water surface levels that are commonly lower than the surface of adjacent lands. The higher cost of water also causes most farmers to take better care of their water. The value of water also varies with the season, ranging from zero during January and February, when some farmers allow karez water to run to the rivers, to over Rs.1,000 per acre foot in the months of May through August when some of these same farmers are buying water from well owners. Surface and underground storage facilities are needed to save this water from seasons

when its value is low to seasons when its value is high. Over irrigation occurs in the average fields by almost 100 percent. In karez areas this is caused by lack of farmer control of the rate of delivery water. Substantial farmers inputs should be obtained on all improvements to assure their feeling of responsibility and to build their pride of ownership. Practical research with farmers is needed to gain information on frequency and intensity of runoff events, effective low cost designs for bunds and overflow structures, amounts of water that should be retained, and types of crops and cultural practices which will use that water most effectively. Appended to this study are: (1) a table of approximate costs of pumping water from dug wells; (2) estimates of evapotranspiration from watercourses and non-beneficial evapotranspiration from the hydrologic system; and (3) an essay on use of water on sailaba and barani lands.

**7) The geographical mobility of a rural Arab population: some implications of changing patterns:**

Birks, J.S.

Journal of Tropical Geography 1979.

Soc Abs, 1973

Population mobility is an outstanding feature of the human geography of Arabia, both as a traditional nomadic custom and as a result of the rapid oil-generated economic growth. This study determines patterns of mobility in a source area of migrants, the relatively traditional but rapidly evolving rural community of Khadl in the Sultanate of Oman. The village is on the slopes of the Hajar mountains, rising above the plains of the Um Samim. The population numbers 244, living in both mud and brick and temporary shelters. Agriculture is based upon the "ganat" system of irrigation. The date is the staple food, and field crops include alfalfa, wheat, onions and tomatoes. When Khadl was visited, almost 25% of the population were absent from home: all had been absent for seven days or more; permanent out-migrants were excluded. 82% of the absentees were males. This represents the movement of migrant labour to the more economically developed parts of the Arabian peninsula, most of the absentees working as unskilled labourers on a casual basis.

Almost 32% of the women had never left the immediate environs of the village, illustrating the social constraints on them, and most other women had only left the village to attend the hospital or to harvest dates in larger settlements. However, travel is increasing among women due to the widening of female role within Omani society.

## **CHAPTER 2**

### **KAREZ IRRIGATION SYSTEM AND ITS MANAGEMENT**

#### **2.01 HISTORY OF THE KAREZ SYSTEM:**

The karez irrigation system is one of the oldest gravity irrigation systems of Baluchistan. This has provided irrigation water to the small farmers for centuries. It is reported that some of the karezes were built in Baluchistan during the time of Mughals. This system remained in use in the area as a leading irrigation system until the introduction of modern tubewells. Even today the farmers are digging karezes in Makran and other parts of the province where they do not expect the electricity to be extended in the near future.

Karezes are known as Qanat in Persian or 'Foggara' in Arabic. They have been used successfully for 2000 years or more in Iran and for many centuries in Afghanistan, much of the Middle East and parts of Africa. Karezes are typically from 1 to 5 Km. but have been as much as 50 KM long. Some of the longest are in Iran near Isfahan. Many decades were sometimes needed to construct a long karez, but once completed they supply water at nominal cost for centuries. The surface appearance of a karez is distinctive, consisting of a row of low crater-like earth bunds consisting of excavated material surrounding each well opening. This is to prevent flash floods from pouring down the well and washing the sides away.

Efforts have been made in Iran to mechanize karez construction, but without great success, although in some cases karezes are combined with engine powered lift pumps in that the karez carries water more or less horizontally from under a nearby hill possessing a raised water table to a point on level ground above the local water table but below the surface, where a cistern is formed in the ground. A diesel pump is then positioned on a ledge above the cistern to lift the water to the surface.

In North Africa and the Middle East, karezes (sometimes called quanats or chain of wells) have been built to carry fresh groundwater from foot hills to central parts of broad plains where local groundwater is brackish. There is evidence that the karez irrigation system is also used in Xinjiang Province of China.

#### **2.02 KAREZ INCEPTION AND CONSTRUCTION**

##### **1. The Decision to Dig a Karez**

Initial habitation in Baluchistan, where no perennial rivers are available, must have first emerged around natural springs. Subsequent settlements, one would assume, sought locations where water could be made available without too

much effort, either through shallow pits in dry river beds of ephemeral streams or wells where the water table was relatively shallow. Gradually, rudimentary agriculture must have taken place around these settlements. Apart from exclusively rain fed, this agriculture appears to have been based on water harvesting techniques and the use of water from neighbouring ephemeral streams. This form of agriculture is uncertain and very hard hit in drought years. Depending upon the topography of the area, digging a karez has been a culturably time tested option for perennial irrigation in Baluchistan. Once this option is chosen, the process of site selection and resource mobilization starts.

## **2. Resource Mobilization**

All members of a lineage are entitled through custom to irrigate from the karez that is being dug. The share in the water is in direct proportion to the contribution made by the individual towards its construction. However, not all participate in the project. Some are outright pessimistic. Others oppose the idea just because of a general rivalry with the initiators. Some cannot afford to contribute towards the costs neither in cash nor in kind.

Once the eventual share holders are determined, one man is made responsible to manage the execution of the project. He will devise, through consensus, the mode and timeframe for the collection of each participants contribution. He will be charged to find a master and karez digger, ascertain his availability and negotiate appropriate terms and conditions. He will also make arrangements for the tools that are needed for the work and identify potential sources of labour, both within and outside the community.

## **3. Search for Water**

The presence of a particular species of grass or of water trickling are clear indications of its availability. However, in many situations such easy indications are not always present. In the arid environment of Baluchistan, water divining has developed as a fine art and water diviners are brought in from far away areas to help determine the location of exploitable aquifers. They use either a "Doshakha", which is two twigs off shooting from a stem in opposite directions in

the shape of a "V", or two strips of wire each bent into the shape of an "L".

When using the "Doshakha", the diviner grasps the ends of the two twigs, one in each hand in the position of an inverted "V" and with the stem pointing upwards he begins to slowly pace the area. Where ever the "Doshakha" swings downwards one can expect to find water.

When the wires are used, the smaller stem of the "L" is grasped in each hand. With arms stretched forward, as the diviner paces the area, the longer stems are held parallel to each other. Whereever the ends of these stems move inwards and touch each other, there is an indication of water.

#### **4. Karez Design**

The layout of a karez varies depending upon the topography and geology of an area and the location of its water source. Its length is a function of the following factors.

As a general rule karezes dug in the midst of broad valleys where the gradient is relatively minimal, will be long, anywhere from two to five miles. Where the gradient is steep, the length of a karez will generally be short, such as on karezes built to irrigate land closer to the hills of a valley or in valleys that are narrow.

The availability of ground water in the proximity of the commanded area is not as important as its availability at an elevation from which it can be drawn by gravity to surface above or at the point where land is to be irrigated. These potential water source points do not necessarily need to lie within the jurisdiction of the land of those intending to use it. Under Islamic law, water is a common resource and anybody who invests in the effort to exploit it has a right to its use. In the context of Baluchistan, karezes can start and run their entire length beneath someone else's land, as long as the water does not surface on it. However, an initial price has to be paid for each access well opening on some one else's land. This provision for a karez does not apply to a well. A well can only be dug on one's own land.

As a preliminary step, all the potential locations within an area from which water can be brought to surface at the desired level ("zero" point,) need to be identified. This "zero" point obviously has to be limited to the confines of the land owned by those cooperating to use the water. A well is then dug to the water table at the most appropriate location within the suspected source area. If the water table is lower than the desired "zero" point or land to be irrigated, then another one is dug at a higher elevation. However, some reliable technique is needed to determine whether the water table at these locations is higher than the desired zero point. Two techniques, depending upon the topography, are commonly used.

Where the slope is gradual and uniform, two wells are dug, say a 100 feet apart, at points A and B along that slope. The depth of the water table from the ground surface of both wells is then measured: say 90 ft. for A and 85 ft. for B. Through this exercise a 5.0 ft. drop in the elevation of the ground surface in a 100 ft. is established. This is based on the assumption that the water table at both A and B is at the same level. In all probability this assumption is correct given the mildness of the slope. On the basis of the drop in ground surface elevation between A and B an approximate gradient is assumed for the entire slope. This in the above example is 5:100. Given that the depth of the water table at point A is 90 ft. and that the slope declines 5 ft. in every 100 ft. then the water daylight point will be 10,000 ft. down the slope. If this does not fall within the desired range, then a location with a higher water table will be sought.

Where the slope is steep and erratic a well is dug at the apparently most appropriate point. Once the water table is reached, say at 50 ft., a peg is hammered at it's mouth. A rope is then tied to it and drawn down the slope where the next vertical shaft is to be dug, say at a 100 ft. here the rope is tied to the upper end of a pole which is then lifted till the rope is taut and at level with the peg end. The height between the raised rope and the ground surface at the point from which it is being lifted is measured. This height, say 10 ft. is the drop in surface elevation between the first and second well. Since steep slopes tend to be erratic, this gradient will be difficult to assume as uniform for the rest of the distance.

The above explained procedure is, therefore, used to individually establish the gradient between the next two wells and so on until the daylight point is located. If this point is not suitable and they want it to emerge further down then they will seek water at a higher elevation.

Another design factor is the distance between the vertical shafts or access wells. Besides being regulated by ventilation requirements, which can only be flouted at a risk to life, these also depend upon the structure of the soil through which it is being dug. Whether rightly or wrongly conceived, in unconsolidated soils these are closely interspaced, hoping to prevent the horizontal tunnel beneath from collapsing. In consolidated soils the distance between these shafts is increased.

#### **5. Method of Digging:**

The well and the water table level, which provided the "benchmark" for ascertaining the approximate daylight point also serve as reference points for both the depth and the alignment of the vertical access wells of a karez. As an initial step, pits for access wells are dug along the alignment established between the reference and daylight point.

The digging of the horizontal tunnel is generally visualized as a holistic process beginning from the reference point and going downwards to where it will daylight. However, the actual digging takes place in segments comprising two adjacent access wells and the section of the horizontal tunnel between them. These segments are then dug in succession beginning at the source well and ending at the daylight point. This eliminates the risk inherent in beginning at the lower end, of not connecting the alignment of the tunnel with that of the reference point. However, even this like most of what has been described depends upon the experience and preference of those constructing the karez.

Digging usually starts with two teams simultaneously working from both wells towards the center of the segment. This facilitates ventilation and allows the workers to be in easy reach of the access wells. This also helps in keeping the tunnel between the two wells in alignment. The determination of the correctness of the direction in which they are digging

can be confirmed by listening to the pounding of the other team. The segment between the source well and the first access well, however, is dug differently. In this case the digging starts from the lower well and proceeds towards the yielding well. To maintain the desired gradient a hand spirit level is used. Once the tunnel reaches near the yielding well care is taken to leave a portion undug so that the water does not start flowing. This wall is breached once the digging of the entire karez is complete.

The following equipment is generally used for digging:

- a) Windlass (Charkh).
- b) Carbide Lamp (Butti).
- c) Rope (Rassa), steel or nylon.
- d) Rubber Bucket (Dol).
- e) Pick (Gaintee) and Shovel (Bailcha).
- f) Field Tent (Tumboo).

The windlass is used to raise and lower workers into the access shafts from where they dig their way into the tunnel. Excavated material is collected in a bucket and pulled out with the help of a rope and the windlass. The carbide lamp provides light in the tunnel.

## **6. Establishing the Command Area**

Normally, the karez daylights at the anticipated point. However, very often it may even daylight elsewhere, though not too far from the anticipated point. In such a case the command area is adjusted accordingly. If portions of this adjusted command area belong to individuals who did not participate in the karez project, then custom demands them to exchange their land with those who participated.

## **2.03 Water Rights and Distribution**

Water rights on a karez are established at the inception, even before the quantity of water that will eventually be available can be determined. These rights are in direct proportion to the contribution that an individual or his household has made towards the digging process. Before determining the time that share holders can divert the flow of the karez for their use, the length of the cycle, in days, that the water will take before coming back to an individual is established. This cycle is known as "Daur" and is worked out on the basis of a "Shabana Roze", which literally means night and day, and keeps in mind the frequency of irrigation that standard crops require. In summer it is difficult for an orchard to survive without irrigation longer than 9 days. Since the irrigation requirement decreases in the winter, this cycle can then conveniently be increased. An 18 Shabana Roze Cycle is the usual practice on most karezes. The number of shabana roze that a karez has signifies the duration of its cycle of turns for the winter. In summer, the length of this cycle is reduced to ensure that water is delivered every 9th day,

Once the "Daur" of a karez is established, it is this cycle rather than the quantity of water that is divided amongst the share holders in proportion to their original contributions. These rights are inherited and in the process get fragmented into portions of the Shabana Roze unit. These are Pass, Dang, Saya, Sangar and Gata. Water rights are not linked with the ownership of land. These rights can be retained even if the land on the karez is sold. Conversely, water rights can also be sold without selling the land.

Water turns, or portions thereof, can also be sold. Such transactions are usually for a season.

## **2.04 MAINTENANCE AND REHABILITATION**

The main activity relating to karez maintenance is its cleaning. This is an annual feature which begins around February and continues well into the summer. The equipment needed for cleaning is the same as used for the initial digging. Cleaning takes place in segments and extends to the entire length of the karez. The mud and debris cleared during the process are dumped around the mouth of the access wells. They form a bund which prevents surface runoff from flowing into and eroding these wells. However, they also aggravate the cleaning problem by falling back into the tunnel beneath. In some places access wells have been capped with sticks, slates and turf to overcome this problem. The occasional access well threatened by erosion and susceptible to caving is held in place by constructing a wall made of piled stones around the circumference of the entire shaft. In places where the horizontal tunnel is prone to collapsing and sloughing, the tunnel is lined from the sides and the top with slabs. Special water resistant wood called "Obusht" is sometimes used instead of stone on the roof. This allows

the tunnel to collapse without ruining the structure of the Karez. There are times when the water table falls below its original level. In such cases the tunnel has to be deepened to enable the flow to resume. It is for such eventualities that the bottom of the tunnel is not lined.

To keep the water table at its required level advantage is taken of any opportunities available in the immediate environment. Such attempts include exploiting existing depressions for storing rain, or building bunds across near by ephemeral streams to check and store flood flows which ultimately helps in recharging the aquifer. Depending upon the resources available, efforts are also made to increase karez flows by deepening the contributing wells or by adding more such wells.

## **2.05 MANAGEMENT**

The management of a karez is carried out with the consensus of the community of share holders. The organization used varies with the socio-cultural environment. A manager is appointed on an annual salary payable in units of water and partially in cash. His duties include overseeing water distribution, supervising maintenance and repair works and collecting associated costs. The magnitude of the work, the costs involved and the level of contribution from share holders are collectively approved. The authority of this manager is restricted to implementing these decisions and does not include resolving water related differences amongst the share holders. In the northern highlands these managers are referred to as Jamadars. Here water related issues like all other disputes are normally resolved within the framework of the tribal institution of "Jirga". Depending upon the number of people or group involved a Jirga is composed by either a person or an entire committee whom contending parties mutually trust. Such persons have the reputation of impartiality and also possess the power and influence to enforce their decision in case one of the parties is hesitant to comply.

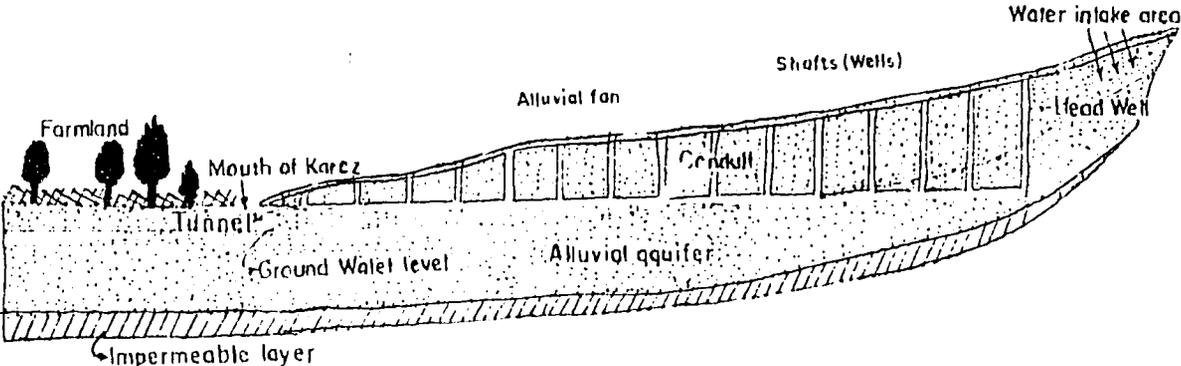
In Kalat area, water managers are called 'Raees'. Historically, a 'Raees' was a hereditary appointee of the Khan of Kalat and was given two Shabana Roze for looking after the affairs of the karez. The Khan of Kalat as the sovereign head had a share of water in all the karezes in his territory. Since he did not use the water, his share was distributed amongst the other shareholders. However, he appropriated what was due to him in the form of a share in the total produce of karez land proportionate to his share in the water. This "share" was collected by the office of the Mir-i-Aab, the Khan's emissary responsible for all karezes in an area. Share holders on these karezes took their water related disputes to this Mir. With the abolition of the State of Kalat, the Khan's water shares have been transferred to the government of Baluchistan. The government auctions its share to the highest bidder annually. The 'Raees' position continues but he is now the appointee of the share holders themselves who can change him. The share

holders have also developed the institution of a karez committee which manages the every day working of the 'Raees'. This committee takes all the decisions on the karez but has to get them ratified by the shareholders.

## **2.06 CASUALTIES IN KAREZES**

There is a concern among the planners, and donor agencies as the construction and maintenance of karezes is a difficult and risky job. Fatal accidents of workers, inhabitants and animals have been reported. During the Bench Mark Survey, data on this aspect was also collected. Out of 12 karezes, casualties on four karezes were reported. No such incidents took place during the cleaning and maintenance. A few cases of goats falling into the karez wells were also reported. The above reported casualties/incidents took place only once during the entire life of karezes which varies from 50 to 600 years.

CROSS - SECTION THROUGH A KAREZ



## **CHAPTER - 3**

### **GEOLOGY**

#### **3.01 GENERAL**

The report is the outcome of short reconnaissance trips to the three different locations selected to study the present karez system in these areas and is a part of overall proposal/recommendations to enhance the present yield of the karezes. Brief geological notes prepared during site visits were based on visual field observations. Help has been taken from already published literature regarding regional geology, landforms and drainage etc. As no geohydrological investigations were carried out during this phase of study of the project, use has been made of data reported in publication "Groundwater of the Pishin Lora Basin" issued under United Nations Development Programme in 1982. The three areas under study i.e. Punjpai, Kutchlak and Khanozai, all lie in the Pishin Lora Basin which is divided into ten sub-basins. Punjpai area is located in Southern Pishin sub-basin while Kutchlak and Khanozai lie in central and northern parts of Kutchlak sub-basin.

Local people have stated that the supply of groundwater from karezes has been on the decline generally resulting in the closure of several karezes especially in Punjpai area. This may be due to poor or non-maintenance of karezes, lowering of water table because of pumping through tubewells or low precipitation in the recharge areas. Annual recharge-discharge ratios for the year 1980 indicate that the two sub-basins were in a more or less balancing position. Discharge being slightly more than recharge in Pishin sub-basin but in Kutchlak sub-basin there was more recharge than discharge.

#### **3.02 GEOLOGICAL INVESTIGATIONS**

As already mentioned, no proper geological/ geohydrological investigations were carried out at any of the three sites under study. Due to non-availability of topographic maps and L-section, no geological mapping could be done except along one karez in Punjpai area (Abdul Hakim Karez) where a strip geological map and L-section have been prepared through reconnaissance. Lithological logging of in-place material in karez wells could not be done for lack of proper arrangements at the site. Description of material below about 15 ft. depth as given in the pit logs is not exact but just an approximation as logging was done from outside the wells. Similarly the soil samples were collected from the excavated material dumped around the karez pits. Fourteen Nos. of such samples were collected from Punjpai and Khanozai areas and analysed in the laboratory.

### 3.03 REGIONAL GEOLOGY

Rocks exposed in the region surrounding the three project areas are of sedimentary origin and range from Jurassic to Recent in age, in the following chronological order :

<u>Age</u>	<u>Unit</u>	<u>Composition</u>
Recent	Recent Deposits	Alluvium, coarse along the slopes, grading into fine material in centre of basins along main drainage lines. Mostly silt and gravels with clay and some sand.
Pleistocene	Sub-Recent Deposits	Older alluvium, more cohesive than younger Recent alluvium. Present West of Punjpai and South-West of Khanozai area.
Miocene	Shaigalu Sandstone	Widely spread in the West of Sandstone Punjpai and North of Khanozai area.
Oligocene	Murgha Faqirzai shale.	Mostly shale. Subordinate sandstone and shely sandstone found in Punjpai and Khanozai area.
Eocene	Nisai Group	Mainly limestone, marl and shale, exposed in a narrow strip North and North-West of Khanozai.
-do-	Nimargh Limestone	Exposed along a narrow strip in East of Punjpai area.
Late Cretaceous to Early Paleocene	Hindubagh Intrusions	Mostly serpentized ultra basic rocks (dunite, pyroxenite etc.) Dolerite, Gabbro and Diorite also present. Scattered outcrops South and South-East of Khanozai.
Early Cretaceous	Parh Group	Balemnites shale and Parh limestone, exposed South and South-East of Khanozai, associated with Hindubagh intrusions.

Jurassic	Chiltan Limestone	Dark colored limestone, minor black shale, exposed East of Kutchlak in NE-SW direction.
-do-	Shirinab Limestone	Interbedded limestone / shale, present East and South of Kutchlak.

### 3.04 SITE GEOLOGY

#### 1. Punjpai Area:

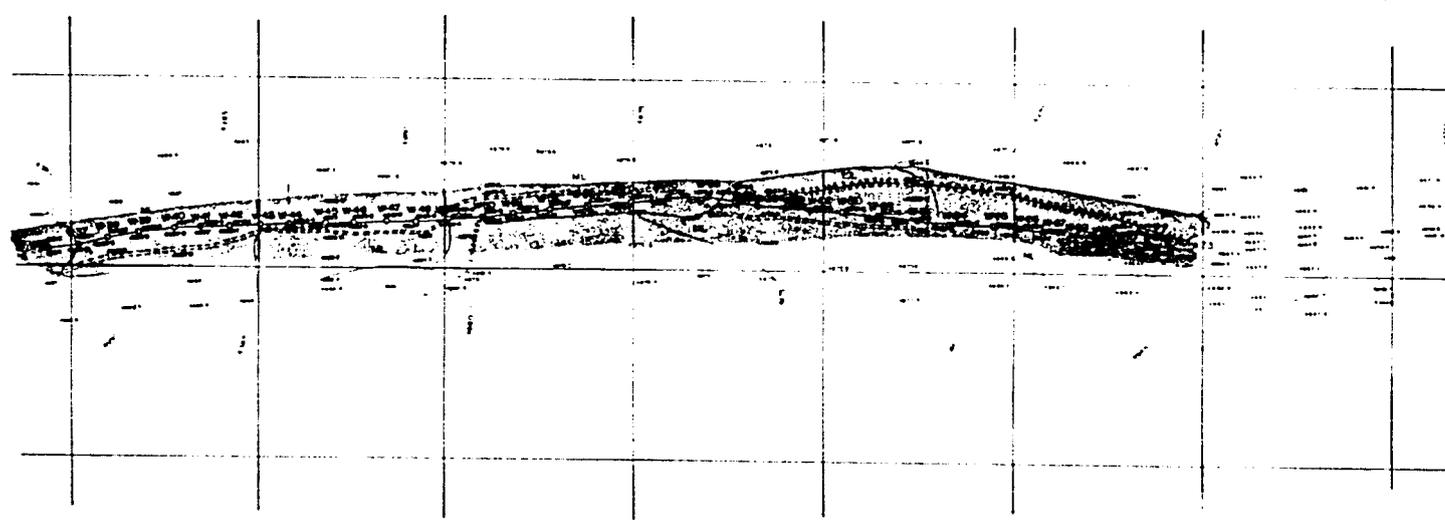
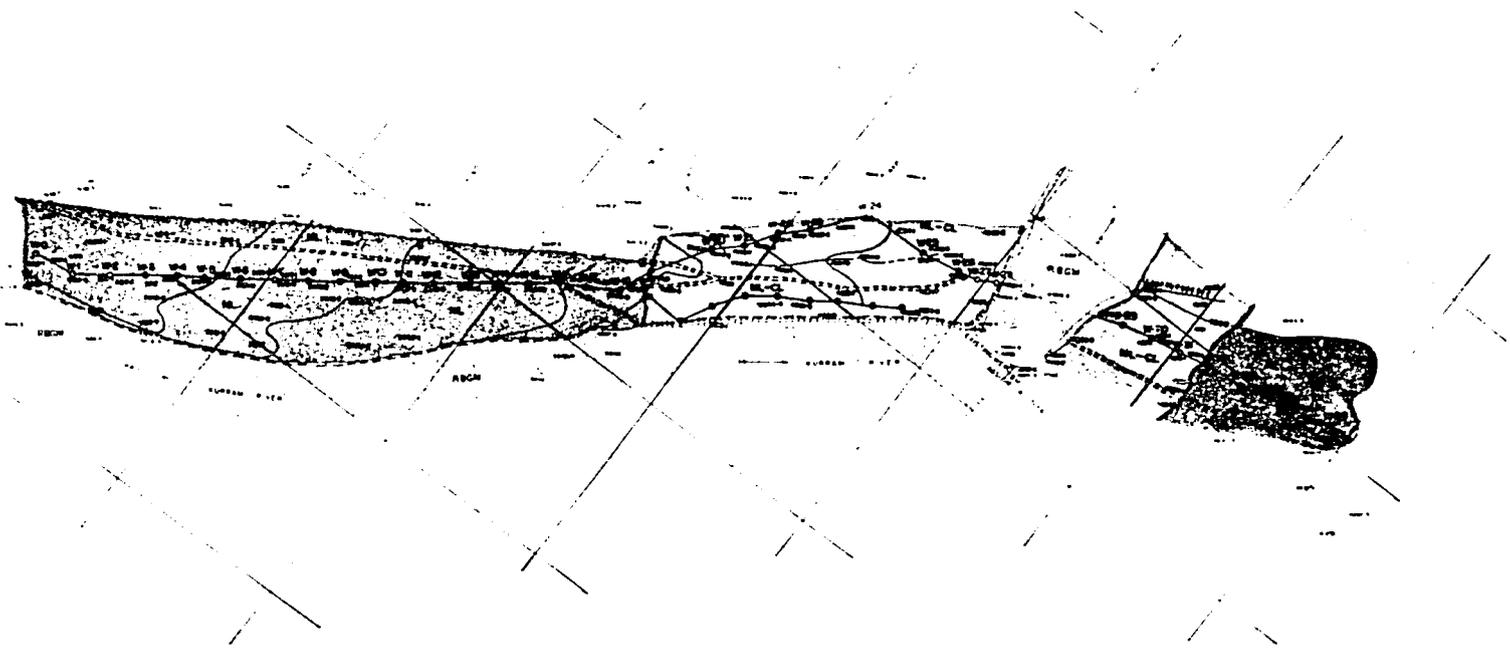
##### a) Abdul Hakim Karez

A geological map along the karez alignment was prepared on a scale 1" : 200 ft. with the help of topographic features and RDs (Drawing ISMR-001). The area is covered with overburdened material. Mostly gravel, boulder with fine to coarse sand, silt mixtures are deposited in the nallah bed of the Kurram Manda which flows along the karez alignment and crosses it at RD-3160. At the left bank of the river, most of the area along the karez alignment consists of greyish brown sandy silt. Sand is mostly fine grained. Few scattered rock fragments are present at places. The rest of the area between RD-1777 and 3160 and between RD-3833 and 4068 consists of light brown sandy clayey silt, with rounded to subrounded gravel at places.

A geological section of the karez has been prepared with the help of lithologic well logs and a geological map (Drawing ISMR-002). Most of the formation up to 40 ft. depth consists of silty sandy gravel. In well-60 (RD-7391), subsurface strata contains sandy silt. In well No.W-7 and W-13, deposits of sandy clayey silt and silty sand were found at the lower end of the wells, respectively.

##### b. Punjpai Karez:

The area along the karez consists of overburdened material comprised of sand, silt and gravel in varying proportions. Sand is fine to coarse, brownish grey, silt



**LEGEND**

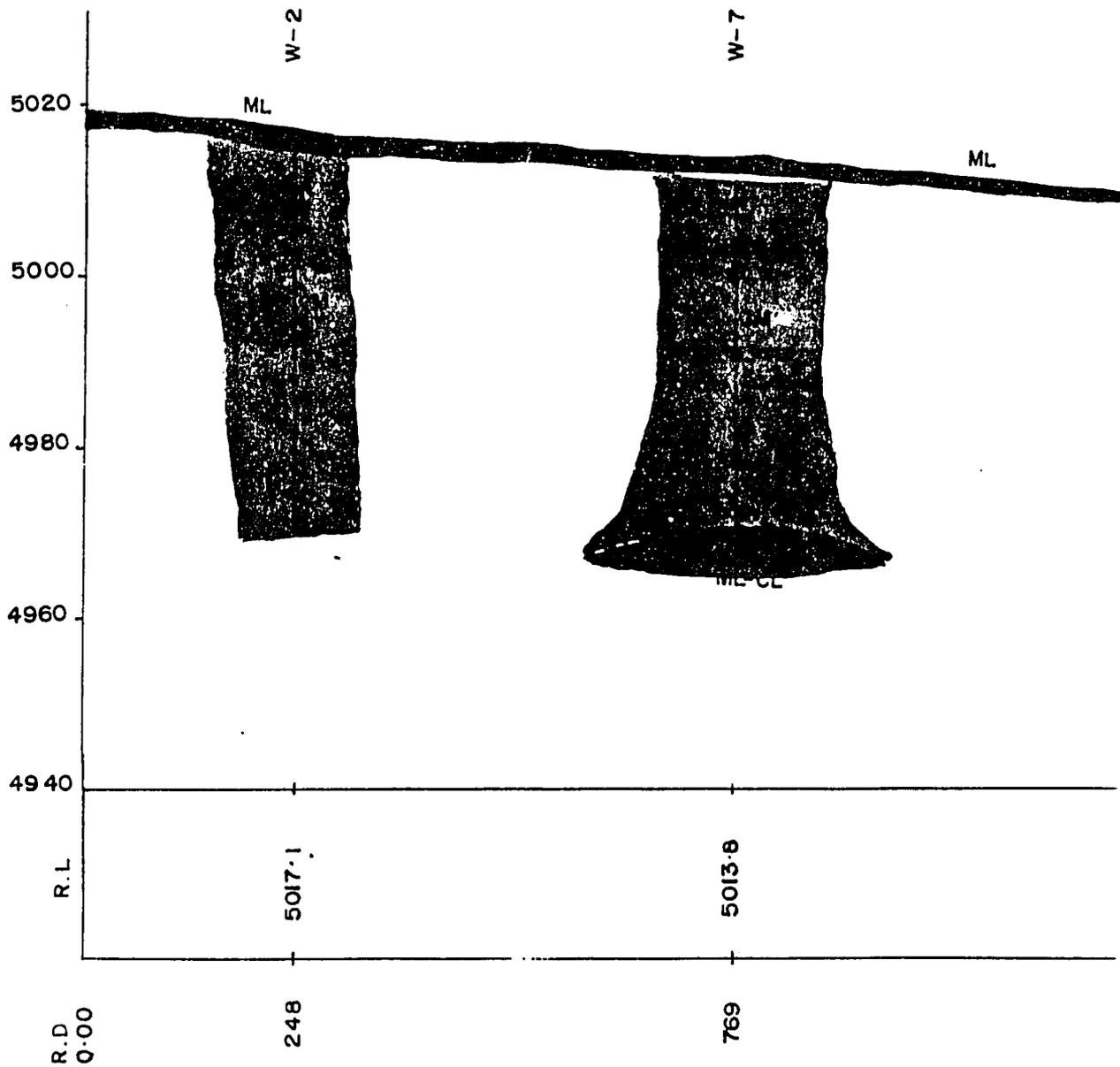
- ABCM (Handed Shaders and grid)
- M1 (Sandy Sil)  
Coarse Sandstone and silty sandstone  
with thin beds of shale
- M2 (Sandy Clay Sil)  
Fine sandstone and silty sandstone  
with thin beds of shale

SCALE



WATER RESOURCES DIVISION  
 GOVT. OF PUNJAB, INDIA  
**GEOLOGICAL MAP OF  
 ABDUL HAKEEM KAREZ (PANJ PAJ) AREA**  
 DRAWN BY: \_\_\_\_\_  
 CHECKED BY: \_\_\_\_\_  
 DATE: \_\_\_\_\_  
 SCALE: \_\_\_\_\_  
**DRG NO ISMR - 001**  
 WATER RESOURCES DIVISION, PUNJAB  
 PUNJAB, INDIA

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BEST AVAILABLE DOCUMENT

1383

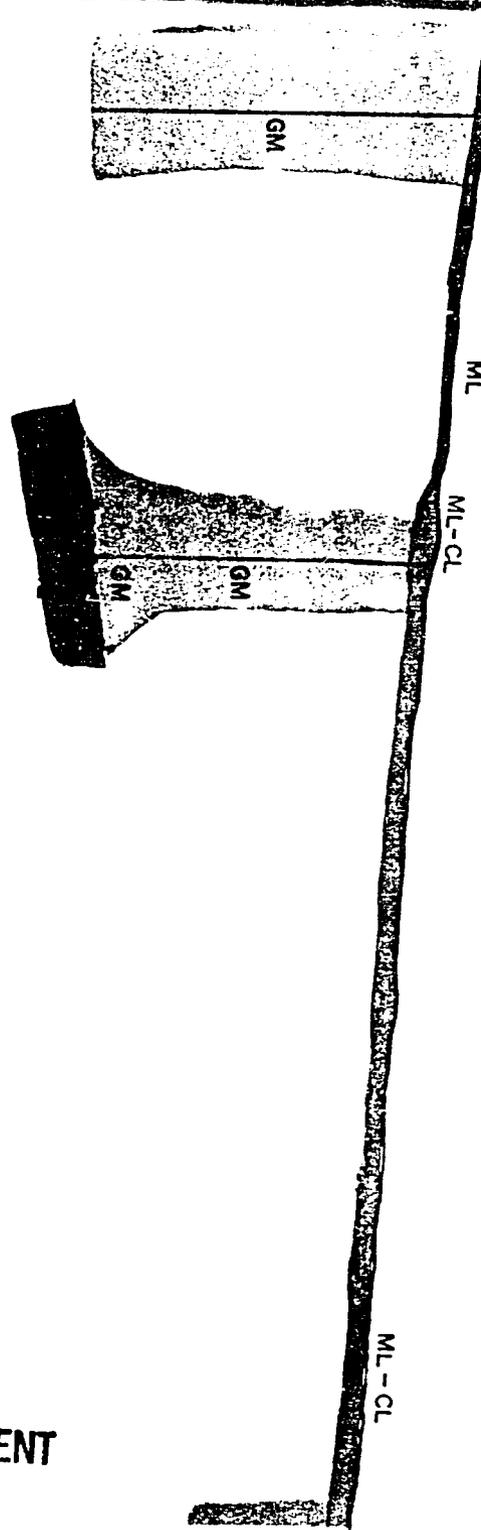
5008-2

W-13

1857

5003-8

W-18



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252

2895

4994.4

W-25



KURRAN RIVER

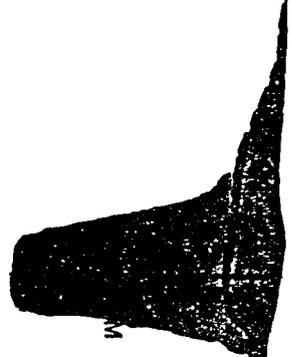
RBGM



3768

4991.1

W-31



ML

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4987-7

5912

4978-8



ML

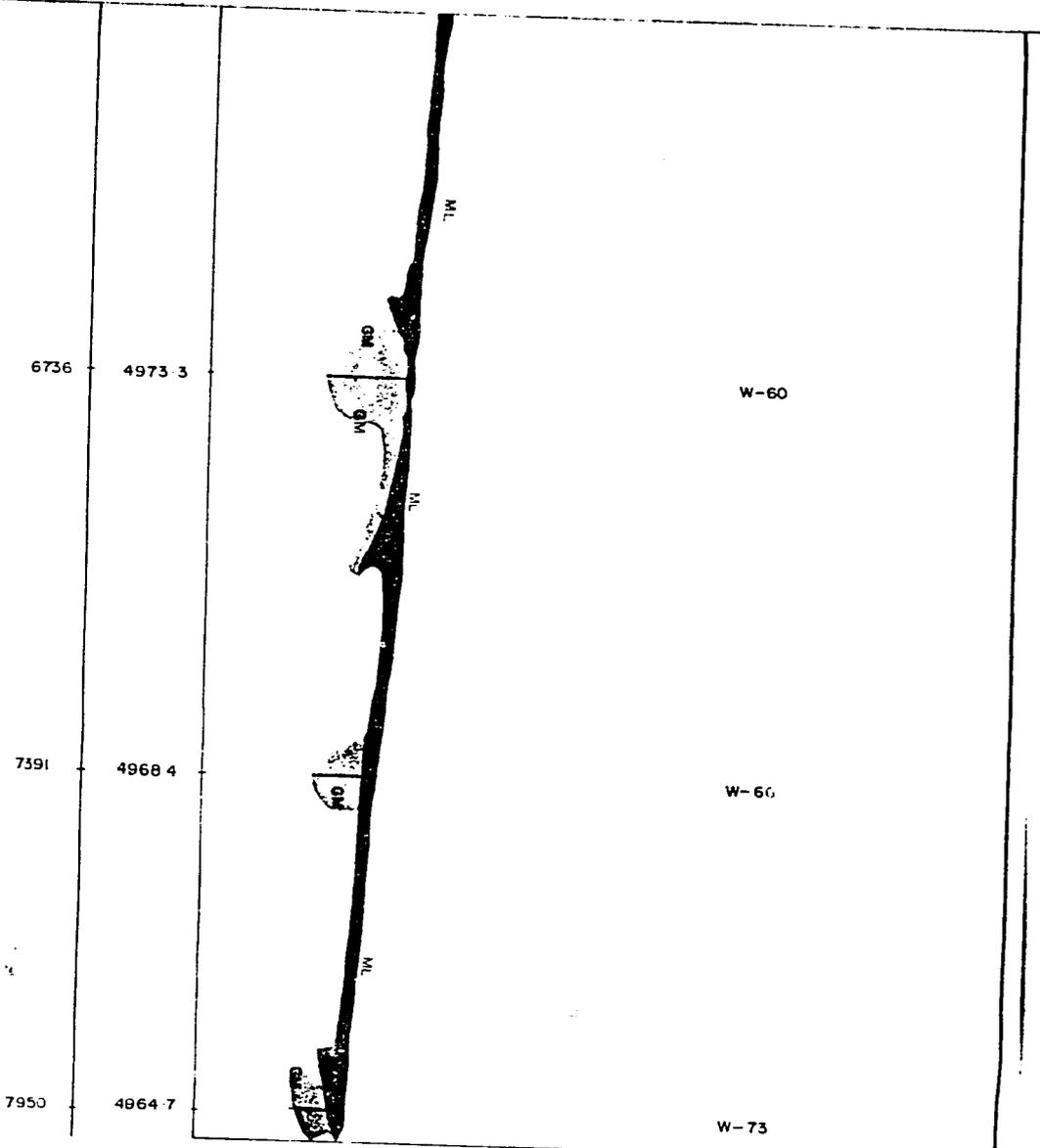
ML

ML

W-40

W-52

250



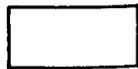
**NOTE**

The geology as shown on the L-section has been plotted through reconnaissance. The lithologic contacts marked on the section are approximate both at the surface and in the wells.

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# LEGEND



## RBGM (Boulders And Gravel)

Rounded to subrounded, mostly of limestone with fine to coarse sand and silt, plastic fine at places.



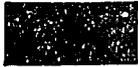
## ML-CL (Sandy Clayey Silt)

Light brown, slightly plastic, few rounded to subrounded gravel.



## ML (Sandy Silt)

Greyish brown silt with sand. Sand is mostly fine grained. Few scattered rock fragments, little or no clay.



## SM/ML (Silty Sand/Sandy Silt)

Fine to medium grained sand and silt almost in equal amounts, little or no clay, slightly moist, low dry strength.



## GM (Silty Sandy Gravel)

Generally subrounded to subangular poorly graded gravel with fine to coarse sand, varying amounts of silt, little or no clay, rare cobbles.

W-60

Karez Well

## SCALE

20

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W-73

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7950

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PAKISTAN	
WATER AND POWER DEVELOPMENT AUTHORITY	
ISMR PROJECT (OUT SIDE THE INDUS BASIN)	
<b>GEOLOGICAL SECTION OF ABDUL HAKEEM KAREZ(PANJ PAI AREA)</b>	
DRAWN. Mehboob Alam	SUBMITTED. Mehboob Alam (Jr. Geologist)
TRACED. <i>Ali</i>	RECOMMENDED. Mirza Alamgir (D.D Geology)
CHECKED. Mirza Alamgir	APPROVED. Muhammad Mumir (Project Director)
DATE LAHORE	<b>DRG. NO. ISMR-002</b>
WATER RESOURCES PLANNING & RESEARCH DIRECTORATE PLANNING AND INVESTIGATION ORGANIZATION LAHORE	

*052  
551*

is fine to dense with little or no clay while gravel is mostly subrounded to angular and fine to coarse.

Subsurface strata have a variable lithology. In most of the wells the upper section up to 10 ft. consists of silt, sand and gravel. Percentage of gravel decreases below 10 ft. depth and formation is comprised of silty sand/sandy silt.

## **2. Kutchlak Area**

### **a) Sahibzada Jalogir Karez:**

The area along the karez alignment mainly consists of sandy silt with some gravel at places. Deposit is brown, dry and loose to compact. Sand is mostly fine grained. Gravel is subrounded to subangular and is poorly graded. Silt is dense and contains little clay. The subsurface formation is mainly composed of sandy silt upto the logged depth.

### **b) Jalogir Karez:**

Most of the area along the alignment has a very simple geology and contains only sandy silt. Deposit is brown, dry, loose to compact and has low dry strength.

Subsurface strata up to logged depth (45 ft.) are composed of greyish brown, loose to compact sandy silt with little clay, low dry strength.

### **c) Khanozai Area:**

In this area five karezes have been reconnoitered. Surface geology along these karezes is variable. Major parts of these five areas are composed of overburdened material comprised of sand, silt and gravel in varying proportions with little or no clay. However, in Khanozai Karez the main constituent is gravel with mostly fine sand, silt and little clay. On the other hand in Sahibzada karez, the amount of clay increases comparatively. The surface and sub-surface lithology of Sahibzada karez has great variations.

The other 3 karezes, Balozai, Tor Doman and Sahib, have more or less similar lithology. The main components of alluvium are sand, silt and gravel. At some places only silty sand/sandy silt is present, while at other places silty gravelly sand or silty sandy gravel is present. The subsurface formational lithology is comparatively more variegated.

### **3.05 LANDFORMS AND DRAINAGE**

#### **1. Punjpal Area:**

Topography of alluvial deposits in the area is generally plain with gentle slopes as compared to the surrounding hills. Relief is generally low with highest elevation of 5577 ft. AMSL in the West while lowest elevation in the valley is 4877 ft. AMSL. Shora Rud, Abdi Khas and Kurram Manda with numerous small tributaries, are the main streams. With the exception of Shora Rud which has perennial flow along a part of its length (about 18 miles). Other streams flow during the rainy period. The drainage pattern and its texture is more or less similar in all the three project areas. The drainage pattern is dendritic to sub-parallel whereas the drainage texture is fine to medium.

#### **2. Kutchlak Area:**

Steep Tokatu hill which extends in NE-SW direction is the area of erosion. Deeply cut nallahs bring surface runoff during rains and deposit their load along the foothills, thus forming piedmont deposits, sloping towards the valley. The valley floor is characterized by uniform topography with low surface gradient. Highest elevation of 7380 ft. and lowest 5130 ft. AMSL is present in the area. Karak Lora is the main stream (with perennial flow length of about 12 miles) flowing in NW direction near the project area.

#### **3. Khanozai Area:**

Khanozai is a comparatively wide valley flanked by resistant NE-SW trending hills of low to moderate relief on South-Eastern side. On North-Western side hills are of low relief. Located between hills and the valley are piedmont deposits, comprising coarse pervious material. Surkhab nallah, forming

by the confluence of Murgha and Urak nallahs flows mostly in rainy season but it has perennial flow length of about 14 miles. Loghai nallah which is a major non-perennial stream closer to the project area, is a tributary of Surkhab Nallah. Ultimately all the streams drain into the Pishin Valley.

### **3.06 SURFACE WATER**

Rainfall and snowmelt are the principal sources of all the surface and groundwater. In the area maximum precipitation occurs during the period January to March. The average annual rainfall as recorded at Sumungli Climatological Station near Quetta during 1981-85 is 30.86 cm. All stations in Pishin Lora basin receive between 6 to 12 inches of rain annually on an average, the precipitation being greatest around Quetta.

Shora Rud, Karak Lora and Surkhab Nallah which are the major streams of the three project areas, are mostly ephemeral i.e. they flow only during heavy rains. However, some main streams have perennial flows along a part of their lengths. Compared with measured perennial flow, the peak flood flow rate may be many times larger but the flood waters do not stay long and are discharged within a period of few hours to two days. Average annual sub-basin surface water discharge from the Pishin sub-basin was 46,200 - 57,900 acre ft. in 1980. The volumes of surface water estimated to be extracted annually from the streams through irrigation schemes amounted to about 15,500 and 10,330 acre ft. from Pishin and Kutchlak sub-basins, respectively.

#### **Infiltration**

The most likely locations for infiltration in the sub-basins appear to be the gravel deposits of the fans and piedmont slopes, the nallah and river beds where they are underlain by permeable alluvium and in the flood channels of the plains. The alluvial fans are graveliferous and may be highly permeable while the central parts of the valley tend to be underlain by relatively impermeable fine-grained materials. Amounts of average annual surface water infiltration of the two sub-basins have been computed using data from 1960-80. In Pishin sub-basin average annual infiltration is about 140,000 acre ft. and in Kutchlak sub-basin it is about 24,900 acre ft.

### **3.07 EVAPOTRANSPIRATION AND EVAPORATION**

It has been assumed that evapotranspiration is effective to 25 ft. below ground level. Evapotranspiration from shallow water tables takes place in either sub-basins i.e. Pishin and Kutchlak, amounting to 133,145 and 6,428 acre ft. from the two sub-basins, respectively. The Pishin sub-basin loses about 47 percent of its surface and groundwater by evapotranspiration.

The evaporation process also is important in the two sub-basins. Evaporation in 1979 from perennial surface water bodies (river and reservoirs) was 43,640 and 1423 acre ft. from Pishin and Kutchlak sub-basins, respectively.

### **3.08 GROUNDWATER**

#### **1. Mode of Occurrence:**

##### **a) Occurrence:**

The available groundwater occurs mainly in intergranular openings, usually in unconfined aquifers. Recent to sub-recent deposits of sand and gravel are the principal areas of groundwater reservoir. In fact alluvial gravels and sand are the only important aquifers. The gravels underling the alluvial fans and piedmont slopes and in places extend as buried tongues below the fine grained alluvium of the valley floor. Some groundwater occurs in fractured and nodular limestones.

##### **b) Depth and Movement:**

The depth of groundwater in piedmont areas is shallow as compared to the valley bottom where coarser material (aquifer) is buried under thick cover of finer sediments. The depth of the groundwater surface from the ground surface is 25 ft. or less in Pishin sub-basin but in Kutchlak it is highly variable, ranging between 25 and over 200 ft. At one place in the central Kutchlak sub-basin, a deep lying aquifer is reported to be artesian, giving rise to water level 18 ft. above the ground surface. In the three project areas, groundwater levels were measured in the wells of alive karezes. In Punjpai, Kutchlak and Khanozai areas the groundwater levels from the ground surface varied

from 26 to 47 ft., 33 to over 120 ft., and 47 to over 130 ft., respectively.

Dominant groundwater drainage directions are from the mountain borders to the valley bottom. In Northern Kutchlak and upper Pishin sub-basins the drainage direction is from North-East to South-West. In the lower Pishin sub-basin where the study area of Punjpai is located, groundwater drainage may be from South to North.

c) Recharge:

Groundwater recharge is affected by the perennial flows and runoff passing along the river channels and over adjacent areas. This will be most rapid near the mountains on permeable alluvial gravels. Groundwater may also enter the plain from the buried limestone valley flanks. Stratigraphically the rocks which include groundwater of good quality in quantity are recent to sub-recent gravels and conglomerates, Miocene sandstone/conglomerates and Eocene to Jurassic limestones in all catchments.

d) Discharge:

In Pishin and Kutchlak sub-basins the surface water channel at the outlet discharges the groundwater over an impermeable barrier. In limestone discharge at surface takes place through springs but it is likely that elsewhere their discharging orifices are lying buried below the alluvium surface. However by far the greatest discharge sink from the groundwater body is evapotranspiration.

e) Extraction:

Extraction of groundwater is affected by open-wells, tubewells, springs and karezes. Average annual groundwater extraction from Pishin and Kutchlak sub-basins (from 1972 to 79) is about 54,500 and 37,500 acre ft., respectively. Karezes accounted for about 8 percent of the total groundwater extraction in the two sub-basins during the period 1972-79.

## 2. Recharge, Discharge and Water Balance:

### a) Recharge:

Internal precipitation is the main source of recharge. In Pishin sub-basin about 84 percent of average annual recharge of 194,600-198,000 acre ft. is due to effective precipitation. But in Kutchlak sub-basin effective precipitation causes about 34 percent of the average annual recharge of 84,700-102,200 acre ft. In Kutchlak imported groundwater and surface water flow (from adjacent sub-basin) contributed about 61 percent of the average annual recharge in 1980 (UNDP Report 1982).

### b) Discharge:

In the two sub-basins discharge occurs through karezes, dug-well, tube-wells, direct evaporation and transpiration from shallow water table areas and surface water outflow. In Pishin sub-basin out of average annual discharge of about 204,000-261,000 acre ft. groundwater and surface water extraction (55,000 and 15,500 acre ft. respectively) accounted for about 30 percent while evapotranspiration losses were about 47 percent. The rest was exported as surface water. In Kutchlak sub-basin, average annual discharge in 1980 amounted to 68,156-74,584 acre ft. of which 74 percent was internally consumed (as groundwater, surface water and evapotranspiration). The rest (26 percent) was discharged as exported surface water.

### c) Water balance:

The comparison of the recharge and discharge of the two sub-basins indicates that the recharge quantity exceeded the discharge in Kutchlak area. The recharge quantity lay between 1.24 and 1.37 of the discharge quantity. In Pishin sub-basin, discharge exceeded the recharge, the recharge quantity being 0.96 and 0.76 of the discharge quantity.

The above figures indicate that Kutchlak sub-basin is being discharged at a lesser rate than it is being recharged but Pishin sub-basin is discharged at a slightly faster rate than its recharging.

### **3.09 CONCLUSIONS/RECOMMENDATIONS**

Objective of the geological investigations was to identify the lithology of water bearing formations, their characteristics and availability of groundwater for development of karezes.

1. Lithological logging of the excavated material placed on the ground around the karez mother wells and mechanical analyses of the samples indicate that aquifers are mostly composed of gravel and sand with silt.
2. Topography of alluvial deposits is generally plain with gentle slopes as compared to the surrounding hills. Runoff is more in the hills as compared to alluvial deposits. As the source areas of karezes are mostly close to the hills and covered by loose material of sand, silt and gravel, most of the runoff from adjacent hills infiltrates through the gravelliferous alluvial fans more rapidly to join with the groundwater body.
3. In all catchments, rocks are mostly of sedimentary origin. These are Miocene sandstone/conglomerate and Eocene to Jurassic limestones. These rocks have joints/fractures and cavities which are also source for recharge of water to groundwater reservoir.
4. Climate of the areas is arid to semi-arid. Evapotranspiration losses are as high as 47 percent (Pishin Sub-Basin).
5. Due to less precipitation (Average Annual 30.88 cm. - 1981-85) surface water in the project areas is not perennial.
6. Maximum precipitation occurs during the period of January to March. These months are the main period of recharge. Snowmelt and water retained in joints/fractures of rocks may contribute to groundwater body for a longer period.
7. On the piedmont slopes, groundwater exists at shallow depth as compared to the valley bottom.

8. As indicated in UNDP report; hydraulic continuity is probably best near the mountains, from where most of the karezes begin. The average values of specific yields in Pishin and Kutchlak sub-basins are 11 percent and 17 percent, respectively. It reveals that generally these areas are promising for the development of karezes.
9. Infiltration rate is as high as 2.3 inches per hour on graveliferous formations. A large amount of groundwater passing through karez channels is expected to be reinfiltred into the ground through the gravelly material where it is present. Proper designing of subsurface channel at such places may increase the yield of karezes.
10. In Kutchlak sub-basin, groundwater recharge is at a higher rate than it is being discharged, but in Pishin sub-basin recharge is at slightly lesser rate than discharge.
11. Considering all aspects of the foregoing discussion it may be concluded that geology and geohydrology of the three project areas are comparatively favourable for the recovery and use of a larger portion of this water supply than it is now being used.

## CHAPTER - 4

### PRESENT AGRICULTURE OF STUDY AREAS

A comprehensive study was undertaken in the study areas to assess present agricultural practices and production levels. Data in respect of land tenure, size of holding, land utilization, cropping patterns and cropping intensities were collected from the secondary sources whereas information on cultural practices and farm inputs were gathered by interviewing the farmers. The details are as follows:

#### 4.01 Land Tenure and Size of Holding

##### 1. Land Tenure :

Land tenure refers to the possession of rights to the use of land. Different types of tenure arrangements exist in our agricultural economy today. These arrangements influence the efficiency with which the inputs are used and also affect the degree of uncertainty encountered in the operation of a farm. Common tenure classes found in our economy are: owners, owner-cum-tenants and tenants.

The survey revealed that in the study areas, farm business is carried out by the tenants who get 1/3 of the produce. The rental conditions suggest that the owner will be responsible for providing all the inputs except labour. Provision of labour for regular farm operations will be the responsibility of the tenant. Where the farm power, i.e. tractor, is provided by the owner. The rent is sometimes charged from the tenant according to the prevailing rates of tractor hiring. In some cases, the provision of tractor for farm preparation also becomes the responsibility of the owner, based on a mutual contract. But in this case the tenant will receive 1/4 of the produce instead of 1/3. This situation can be found in Mustung, Kutchlak and Khanozai areas in general and in Punjpai area in particular where presently no fruit crop is grown on the land irrigated by karez water.

In case of orchard crops, however, no tenants were reported by any of the respondents. The owners themselves establish and deal in the orchards. Majority of the farmers having orchards sell their crop to the contractors at flowering/fruiting stage. The contractor then becomes responsible for plant

protection activities, maintenance and harvesting of produce, etc; except the irrigation water. The provision of irrigation water remains the responsibility of the owner, also in the interest of his own orchards. The payment by the contractor is made in three instalments; first at the time of contract, second when the harvesting/marketing of the produce starts and the final when the harvesting is completed. Jungle Bandat Karez is a particular example in this case.

The above mentioned system is practised in the study areas as and when needed and is not admitted in the revenue records of the government agencies. As such, no data in respect of land tenure of the study areas was reportedly available.

## **2. Size of Holding:**

About half a century ago, 12.5 acres size of farm was considered as an optimum size of holding in canal irrigated areas. This size of farm is still considered appropriate by the policy makers in the country. The recent revolution in water development, seed improvement, application of fertilizers, adoption of plant protection techniques and mechanical devices have partially if not fully affected the validity of this concept. This traditional concept required second thought particularly in the orchard growing areas of Baluchistan where a farmer having only 2 acres of land with orchard earns more than Rs.160,000/- per year as much as farmer having 12.5 acres of other irrigated crops.

Data regarding size of holding in the study areas were collected from revenue records of the Government of Baluchistan. For Punjpai and Mustung areas karez-wise data were not available. For these areas, tehsil-wise data have been collected and discussed. However, for Khanozai, Kutchlak and Jungle Bundat areas, data in respect of studied karezes were available from the revenue records and are discussed as such.

### **a) Punjpai Area:**

The statistics on size of holding in this area showed that farmers having 1 -12 acres holding are dominant in this sub-tehsil of Quetta District by occupying 67

percent and 63 percent of the total area in Chachezai and Punjpai villages, respectively. On the other end is the class of farmers having larger than 100 acres. Their dominance was observed in Mouza Muhammad Khail where they occupy 38 percent of the total holdings compared with the 25 percent of the owners having 1 -12 acres of holding .In mouza chachezai and Punjpai, owners occupying more than 100 acres are 5 percent and 17 percent respectively. Data in respect of size of holding of Punjpai are furnished in Table 4.1.

b) Khanozai Area:

All the karezes under study in Khanozai come under Halqa Karezat, Khanozai with the exception of Karez Tor Daman which falls in Gulistan Sub-Tehsil of Pishin District. In case of Karez Khanozai, Balozai and Sahib, an identical trend regarding size of holding is observed that the majority of the farmers i.e. more than 90 percent fall in the group having 1-5 acres of holding. Farms having land holdings larger than 25 acres do not exist in any of the karezes under study with the exception of one owner at Karez Sahib Balozai. In case of Karez Sahibzada and Tor Daman, the figures regarding size of holding exhibit a mixed trend. Holding size of 1 -5 acres and 5-12 acres show an inverse relationship in case of these karezes. In case of Sahibzada, 56 percent of the holdings were in the 1 - 5 acres class as compared with 27 percent in case of Tor Doman. The same trend is also observed in case of 5-12 acres holding class. In this class, in case of Karez Sahibzada, there are 28 percent owners compared with the 53 percent of Tor Daman. The number of owners in 12-25 acres farm class is about the same in both the karezes i.e. 17 percent and 20 percent, respectively. The data are furnished in Table 4-2.

The main reason the above mentioned trends may be seen in the light of the fact that Khanozai and Balozai karezes are ancient with centuries old inherited rights and the others are newly built as compared with these karezes.

TABLE 4.1

## SIZE OF HOLDING PUNJPAI

Holding Size	Number of Owners	Percent
1 - 5 Acres	403	25.92
5 - 12 Acres	347	22.31
12 - 25 Acres	165	10.61
25 - 50 Acres	165	10.61
50 - 100 Acres	132	8.49
Above 100 Acres	343	22.06
Total	1555	100.00

Source: Revenue Department, Quetta District (Punjpai Sub-Tehsil)

TABLE 4.2

## SIZE OF HOLDING - KHANOZAI

Holding Size	Karez Khanozai		Karez Sahib Khanozai		Karez Balozai		Karez Sahib Balozai		Karez Sahibzada		Karez Tor Daman	
	Owners	Percent	Owners	Percent	Owners	Percent	Owners	Percent	Owners	Percent	Owners	Percent
1-5 Acres	140	95.90	60	95.20	145	93.50	70	90.90	20	55.50	4	26.70
5-12 Acres	5	3.40	3	4.80	8	5.20	4	5.20	10	27.08	8	53.30
12-25 Acres	1	0.70	-	-	2	1.30	2	2.60	6	16.70	3	20.00
25-50 Acres	-	-	-	-	-	-	1	1.30	-	-	-	-
50-100 Acres	-	-	-	-	-	-	-	-	-	-	-	-
Above 100 Acres	-	-	-	-	-	-	-	-	-	-	-	-
<b>Total</b>	<b>146</b>	<b>100.00</b>	<b>63</b>	<b>100.00</b>	<b>155</b>	<b>100.00</b>	<b>77</b>	<b>100.00</b>	<b>36</b>	<b>100.00</b>	<b>15</b>	<b>100.00</b>

Source: Revenue Department Pishin District (Karezat Khanozai Sub-Tehsil)

c) Kutchlak Area:

According to the revenue records of Mouza Karez Jalogir of Halqa Kutchlak, there are 29 owners at this karez. Owners having 1-12 acres holding dominate by occupying 62 percent of the total holdings. The other dominating class is that of the owners having 25-50 acres size of holding which owns 35 percent. Farms having 12-25 acres and above 100 acres do not exist in this area. There is only one owner in the 50-100 acres class constituting 3 percent of the total area. Table 4.3 furnishes details.

d) Mustang Area:

Data in respect of size of holding in various karezes of Mustang Valley was not available from the revenue records. However, aggregate figures from Mustang tehsil were found from the settlement records. These figures revealed the dominance of 1-12 acres farms with a share of 78 percent to the total holdings. Farmers having a holding of 50-100 acres and more than 100 acres have a negligible ratio of one percent and 0.6 percent, respectively. About 18% of the farms occupied area fell within 12-25 acres class whereas only 3 percent fell in 25-50 acres holding farm class. Details are given in Table 4.4.

e) Ziarat Area:

Data collected from the revenue records revealed that there is no owner in Jungle Bandat having a holding of more than 100 acres. There are only six owners ; one in 1-5 acres class, 2 each in 5-12 acres class and 12-25 acres class and one in 50-100 acres class. There exists no owner in 25-50 acres and more than 100 acres classes. The data are provided in Table 4.5.

#### **4.02 LAND UTILIZATION**

Land use statistics and patterns were recorded during the bench mark survey. The farm areas were classified into 'cultivated' and 'un-cultivated' area. The cultivated area was further studied with regard to 'area under crops' and 'current fallow'. The uncultivated area likewise was broken down into 'not

TABLE 4.3  
 SIZE OF HOLDING-KUCTHILAK  
 (KAREZ JALOGIR)

Holding Size	Owners	Percent
1-5 Acres	12	41.40
5-12 Acres	6	20.70
12-25 Acres	-	-
25-50 Acres	10	34.50
50-100 Acres	1	3.40
Above 100 Acres	-	-
TOTAL:	29	100.00

Source: Revenue Department, Quetta District (I talqa Kutchlak)

TABLE 4-4

## SIZE OF HOLDING - MUSTUNG

Holding Size	Owners	Percent
1 - 5 Acres	4539	32.47
5 - 12 Acres	6352	45.44
12 - 25 Acres	2462	17.61
25 - 50 Acres	396	2.83
50 - 100 Acres	149	1.07
Above 100 Acres	80	0.57
Total	13978	100.00

Source: Revenue Department, Kalat District (Mustung Tehsil)

TABLE 4.5

## SIZE OF HOLDING - JUNGLE BUNDAT

Holding Size	Owners	Percent
1 - 5 Acres	1	16.67
5 - 12 Acres	2	33.33
12 - 25 Acres	2	33.33
25 - 50 Acres	-	
50 - 100 Acres	1	16.67
Above 100 Acres	-	
Total	6	100.00

Source: Revenue Department, Ziarat District.

available for cultivation' and 'cultivable waste' for a thorough insight. Area-wise data are produced in Table 4.6.

Land utilization patterns of the selected karezes are discussed as under:

**1) Punjpal Area:**

Total area of Punjpal sub-tehsil is 290,604 acres. Uncultivated area amounts to 277,116 acres(95.4%) of the total area and the cultivated area is only 13,488 acres(4.6%), thereby showing this valley as a sparsely vegetated one. Out of cultivated, area under khushkaba cultivation is 8,522 acres(63%) followed by sailaba as 3572 acres(26%), well irrigated(chahi) as 906 acres(7%) and karez irrigated(abi) as 488 acres(4%). The reason for having the smallest portion of the cultivated area under karez irrigation is that out of ten karezes in the valley, only one karez, the karez Abdul Hakim is yielding water for irrigation and the rest nine have stopped functioning. However, two of these are supplying water but only for drinking and domestic uses.

Out of the karez irrigated area, 454 acres(93%) are fallow and the rest 34 acres are cropped. Area under crops under khushkaba, sailaba and well irrigation is 168 acres, 44 acres and 234 acres, respectively, (showing that, out of the available irrigation supply only well irrigation is the main utilization.)

**Karez Abdul Hakim**

As mentioned earlier, this is the only karez yielding water for irrigation purposes. The land use pattern of this karez shows that it has a total of 100 acres under its command out of which 66 acres are fallow and only 34 acres can be grown at any one time. There are no orchards on this karez and crops other than orchards are cultivated with the available supplies. Land use statistics of this Kerez are given in Table 4.7.

**2. Khanozai Area**

Out of five karezes studied in this area, four fall in the Halqa Karezat of Khanozai sub-tehsil and one in the Gulistan sub-tehsil.

TABLE 4.6

**LAND USE STATISTICS - STUDY AREAS  
1985-1986**

(Area in Acres)

Description	Punjpai		Khanozai		Kutchlak		Mustung		Ahmadoon (Zarat)	
	Area	%	Area	%	Area	%	Area	%	Area	%
1. Total Area	290604	100.00	251115	100.00	104843	100.00	337247	100.00	6061	100.00
2. Uncultivated Area	277116	95.40	149904	59.69	74546	71.10	142435	42.23	3135	51.72
i) Not Available	151710	52.20	98883	39.38	59009	56.28	117303	34.78	1724	28.44
ii) Culturable waste	125406	43.20	51021	20.32	15537	14.82	25132	7.45	1411	23.28
3. Cultivated Area	13488	4.64	101201	40.30	30297	28.90	194812	57.77	2926	48.28
i) Current Fallow	13008	4.48	78687	31.33	20688	19.73	154824	45.91	2304	38.01
ii) Area under crops	480	0.16	22514	8.97	9609	9.16	39988	11.86	622	10.26
4. Culturable Area [3+2(ii)]	138894	47.79	152222	60.62	45834	43.72	219944	65.22	4337	71.56

Source: Revenue Department, Government of Baluchistan.

TABLE 4.7

LAND USE PATTERN OF SELECTED KAREZES  
IN PUNJPAI AREA

(Acres)

Description	Karez Abdul Hakim
1. Command Area	100
2. Current Fallow	66
3. Cropped Area	34
a) Orchards	-
b) Other Crops	34

Source: Topographic Survey of the Karez by WAPDA.

A perusal of the land use statistics of the Khanozai sub-tehsil reveals that out of a total area of 251,115 acres, 60% (149,904 acres) are uncultivated and the rest 40% (101,201 acres) are cultivated. Area under current fallow comprises 78,687 acres (78% of the cultivated area) and only 22,514 acres (22%) are cropped. Khushkaba cultivation possesses the biggest portion of the cultivated area having 55,836 acres (55%) followed by karez irrigated as 38,099 acres (38%), well irrigated as 6,225 acres (5%) and a meagre of 1,041 acres (1%) under sailaba. Fallow area under chahi cultivation (well irrigation) is the minimum i.e. 15% of the cultivated area followed by abi (karez irrigation) where it is 70% and then khushkaba where fallow area comes to 88% of the cultivated area. Under sailaba, no crops are grown as 100% of the area is fallow.

#### The Studied Karezes

Among the studied karezes, the Khanozai karez has a commanded area of 389 acres of which 277 acres (71%) are current fallow and 112 acres (29%) are being cropped in season.

Out of a total area of 628 acres at Karez Balozai, 519 acres (83%) are fallow and the rest 109 acres (17%) are sown.

Sahib karez has its area in both the villages namely Khanozai and Balozai. In Khanozai, 140 acres are under its command whereas in Balozai, commanded area is 106 acres. The cropped area in the respective villages comes to 14% and 24% depicting the ratio of fallow area as 86% and 76%.

Sahibzada karez has 67 acres under its command. Out of these, 47 acres are fallow and 20 acres are being cropped.

Karez Tor Daman (falling in sub-tehsil Gulistan) has a commanded area of 146 acres, out of which 121 acres are fallow and only 25 acres are cropped in a season.

The land use patterns of the selected karezes have been given in Table 4.8. A perusal of the table reveals that all the karezes have a significant proportion of cropped area under orchards with the exception of Sahibzada karez which has no orchards; may be due to the reason that presently it is under

TABLE 4.8

**LAND USE PATTERN OF SELECTED KAREZES  
IN KHANOZAI AREA**

(Acres)

Description	Name of Karez					Tor Daman
	Khanozai	Balozai	Sahib		Sahib- zada	
			Khanozai	Balozai		
1. Command Area	389	628	140	106	62	146
2. Current Fallow	277	519	121	81	42	121
3. Cropped Area	112	109	19	25	20	25
a) Orchards	27	13	5	10	-	8
b) Other Crops	85	96	14	15	20	17

Source: Revenue Department, Government of Baluchistan, Pishin District

rehabilitation process and the available water is in-sufficient to cater for the needs of an orchard.

### **3. Kutchlak Area:**

Kutchlak is a Revenue Circle of Quetta tehsil. It spreads over an area of 10,4843 acres out of which 71% is uncultivated. Cultivated area amounts to 30,297 acres forming 29% of the total area. About 86% of the cultivated area is fallow and 32% (9,609 acres) is under crops. Within cropped area, well irrigated area dominates with 5+ % followed by khushkaba as 42% and abi as 4%.

#### **Karez Jalogir**

This is the only karez which is operating in Kutchlak area. The commanded area of this karez is 176 acres. However, presently only 25 acres are irrigated leaving rest of the area (151 acres) as fallow. Orchards occupy 51% of the cropped area and on the rest 49% (12 acres) wheat crop is cultivated. Table 4.9 exhibits the figures.

### **4. Mustung Area:**

Mustung is a tehsil headquarter of district Kalat. There are eight revenue circles in this tehsil. The selected karezes fall in Halqa Mustung town and Halqa Paringabad.

The total area of Mustung tehsil is 337,247 acres. The uncultivated area amounts to 142,435 acres thus leaving 58% of the area as cultivated. Out of this cultivated area, 77% is fallow and the rest 23% area is under crops. Orchards occupy one percent of the cropped area and the rest 99% is under other crops.

#### **The Studied Karezes:**

Four karezes were studied from this area. Two of these belonged to Mustung town committee area whereas the other two fall in Halqa Paringabad. The land use pattern of the karezes falling in Mustung Town i.e. Ishkana and Mayana were not available from the revenue records individually. So, the figures have been developed on the basis of information gathered from the Rais (Managers) of these karezes and from other farmers.

TABLE 4.9

**LAND USE PATTERN OF SELECTED KAREZES  
IN KUTCHLAK AREA**

(Acres)

Description	Karez Jalogir
1. Command Area	176
2. Current Fallow	151
3. Cropped Area	25
a) Orchards	13
b) Other Crops	12

Source : Revenue Department, Government of Baluchistan  
Quetta District.

Eventually, Karez Ishkana has a total command area of 1,030 acres out of which 544 acres (53%) are cropped and the remaining 486 acres (47%) are fallow. The major portion of the cropped area is occupied by the non-orchard crops (87%) and orchards possess only 13% of the cropped area.

Mayana Karez has a total land of 62 acres, out of which fallow land and the cropped area have almost an equal share i.e. 50% each. Out of 33 acres being cropped, no area is under orchards. The main cause of this trend is the ever decreasing supplies from this karez.

The karez from Paringabad have revealed a fair land use pattern. The Kalan Karez has a commanded area of 509 acres, with 400 (79%) acres under crops and 109 acres (21%) as fallow land. About 1/4 of the cropped area is under orchards.

At Kundki Karez, there are 200 acres under crops and only 53 acres are fallow, thus making the total area of this karez as 253 acres. This karez has a significant area under orchards, viz: 153 acres out of 200 acres or 77% of the total cropped area. Land use patterns of the studied karezes are shown in Table 4.10.

##### **5. Ziarat Area (Mouza Ahmadoon)**

Mouza Ahmadoon of tehsil and district Ziarat has a total area of 6,261 acres of which 3,135 (51.7%) are uncultivated and the rest 2,926 acres (48.3%) are cultivated. Of the uncultivated area, 1,411 acres are culturable waste and the culturable area is 4337 acres or 71.5% of the total area. Out of the cultivated area, area under crops has been reported to be 622 acres (21.3%) leaving 2304 acres as current fallow (78.8%).

From the cropped area, 520 acres are irrigated and 102 acres are under khushkaba cultivation. The main sources of irrigation in the area are "vayalas" (streams) or "iskhubas" (a depression made by hills around) where the water coming from the small streams stores.

TABLE - 4.10

**LAND USE PATTERN OF SELECTED KAREZES  
IN MUSTUNG AREA**

(Acres)

Description	Name of Karezes			
	Ishkana	Mayana	Kalan	Kundki
1.Command Area	1030	62	509	253
2.Current Fallow	486	29	109	53
3.Cropped Area	544	33	400	200
a) Orchards	69	-	106	153
b) Other Crops	475	33	214	47

Source: Revenue Department, Government of Baluchistan, Kalat District.

## Karez Jungle Bundat

Jungle Bundat is an estate of Ahmadoon revenue circle. The karez that is existing here was basically a spring that was converted into a karez by the owners later on. Total area under the command of this karez is 54 acres of which 43 acres (79%) are current fallow and the rest 21% is under crops. Orchards dominate by occupying 73% of the total cropped area (reference Table 4.11).

### 4.03 CROPPING PATTERNS

A brief discussion of existing cropping patterns, as observed on the fields during the bench mark survey and confirmed by the revenue records of the relevant areas, is presented in the following paragraphs.

Generally, two types of crops are grown by the farmers in the study areas. These are broadly speaking food crops and cash crops. A meagre portion of area is also occupied by the fodders. The area-wise situation in respect of cropping patterns is as under:

#### 1. Punjpai Area:

An examination of cropping pattern of the Abdul Hakim Karez reveals that 19 percent of the culturable area was under cash crops (onion 14 percent and cumin 5 percent), followed by food crops which occupied 12 percent of the culturable area. Alfalfa occupied 3 percent of the culturable area. No orchard crop is being grown at this karez. Besides the shortage of irrigation water, the main reason as stated by the owners is that this karez is adjacent to Pak-Afghan border and falls in the way of the "Powindas" who regularly come to Pakistan in winter and go back to Afghanistan in summer. These people travel alongwith their animals such as sheep and goats which graze the crops in the area. Due to the watch and ward problem, the owners of the karez have not grown orchards as yet.

#### 2. Khanozai Area:

A karez-wise perusal of the figures reveal that cash crops dominate in Khanozai and Balozai karezes, having 17 percent and 10 percent of the culturable area as against 6 percent and 8 percent for food crops of both the karezes, respectively. In case of Sahib Khanozai, Sahib Balozai,

LAND USE PATTERN OF SELECTED KAREZES  
IN ZIARAT AREA

(Acres)

Description	Karez Jungle Bundat
1. Command Area	54
2. Current Fallow	43
3. Cropped Area	11
a) Orchards	8
b) Other Crops	3

Source : Revenue Department, Government of Baluchistan Ziarat District.

Sahibzada and Tor Daman, cereal crops were more than the cash crops. The aggregate analysis of the figures in respect of cropping patterns of karezes under study in Khanozai area reflected the dominance of cash crops over food crops. Karez Khanozai is the only karez where fodder crops occupied about 5 percent of the culturable area.

### **3. Kutchlak Area**

In the Kutchlak area, the cropping pattern of Karez Jalogir consisted of only two crops i.e. wheat and orchards; wheat being the food crop and orchards the cash crop. Both the crops shared almost equally the culturable area, amounting to 7 percent each. Farmers reported cultivation of some other crops such as pulses and vegetables. These were inter-cropped and were mainly for home consumption.

### **4. Mustang Area:**

The analysis of the prevailing cropping patterns of the karez under study in Mustang Valley reveals that farmers tend to grow cash crops more as compared to food crops.

The study of individual karezes in respect of cropping patterns showed that wheat occupied 37 percent, 6 percent, 18 percent and zero percent of culturable area at Mayana, Ishkana, Kalan and Kundki karezes, respectively. The onion is the main vegetable crop followed by carrot, turnip and potato at the karezes under study. Onion is grown at all the above mentioned karezes and its respective share works out to be 11 percent, 28 percent, 29 percent and 7 percent of the culturable area, respectively. Carrots and turnips shared equally at Mayana karez having 2 percent of the culturable area each whereas at Ishkana karez, area of these crops was 2 percent and 3 percent of the culturable area, respectively.

Alfalfa is the only fodder crop being grown in the area and it occupies 2 percent, 5 percent, 10 percent and 12 percent of the culturable area at karezes Mayana, Ishkana, Kalan and Kundki, respectively. The Mayana karez has no orchards. At Ishkana karez, mulberry was the main orchard crop having 4 percent of culturable area followed by apples (2 percent) and apricots (one percent). At Kalan karez, grapes, apples and apricots occupied 3 percent, 13 percent and 5 percent of the

culturable area, respectively. The Khundki karez is the one where garden crops are dominant occupying 43 percent of culturable area for apples, 14 percent for apricots and 3 percent of mulberry.

#### 5. Ziarat Area:

A perusal of the figures in respect of cropping patterns of Karez Jungle Bandat reveals that orchards occupy the major portion of the area under crops. Of the total area, orchards occupy 15 percent followed by 4 percent of cereals and 2 percent for alfalfa. Data in respect of cropping patterns are provided in Tables 4.12 to 4.16 in respect of the studied karezes.

### 4.04 CROPPING INTENSITIES

Cropping intensity indicates the ratio in which the area under crops stands to the culturable area. This is based on the following formula:

$$\frac{\text{Cropped Area} \times 100}{\text{Culturable Area}}$$

In the true sense, cropping intensity here means irrigation intensity wherein the perennial crops like orchards and alfalfa are counted once in the season in which they are harvested. According to the bench mark survey, the cropping intensity varied from karez to karez mainly depending upon size of holding, location and quantity of irrigation water available from the karez. Karez-wise cropping intensities are shown in Table 4.17.

### 4.05 CULTURAL PRACTICES

#### 1. Land Preparation:

Use of animal power for land preparation is not reported by any of the respondents in the study areas. Generally seed beds are prepared with a tractor. Number of ploughings varied from crop to crop. However, the data revealed that on an average 2 ploughings are given to cereal crops, 3 to cash crops and 4 to garden crops.

TABLE 4-12

CROPPING PATTERN AND INTENSITIES - PUNJABI AREA  
KAREZ ABDUL HAKIM

CA = 100 Acres

Crops	Acreage (Acres)	Percent
Onion	14.00	14.00
Wheat	10.00	10.00
Barley	2.00	2.00
Cumin	5.00	5.00
Alfalfa	3.00	3.00
Total	34.00	34.00

Source: Field Survey.

\* Culturable Area

TABLE 4-13

## CROPPING PATTERNS AND INTENSITIES - KHANOZAI AREA

Crops	Khanozai		Balozai		Sahib Khanozai		Sahib Balozai		Sanjozada		Tor Daman	
	CA 369 Acres		CA 628 Acres		CA 140 Acres		CA 106 Acres		CA 97 Acres		CA 146 Acres	
	Acreage	Percent	Acreage	Percent	Acreage	Percent	Acreage	Percent	Acreage	Percent	Acreage	Percent
	(Acres)	(Acres)	(Acres)	(Acres)	(Acres)	(Acres)	(Acres)	(Acres)	(Acres)	(Acres)	(Acres)	(Acres)
Tobacco	35.81	9.46	48.15	7.57	1.00	0.11	1.00	0.94	5.63	3.40	3.80	2.60
Potato	3.35	1.00	-	-	-	-	0.50	0.47	4.55	3.79	0.50	0.34
Wheat	23.25	5.98	47.75	7.50	12.50	6.93	13.00	12.26	10.00	14.92	12.50	8.56
Barley	2.00	0.51	-	-	3.50	0.26	-	-	-	-	-	-
Fodder	13.57	3.47	-	-	-	-	-	-	-	-	-	-
Alfalfa	4.90	1.26	0.05	0.01	-	-	-	-	-	-	-	-
Apple	27.45	7.07	13.40	2.13	5.35	3.82	9.15	8.53	-	-	7.75	5.31
GRAND TOTAL	111.79	23.75	109.35	17.41	19.35	13.92	23.65	22.31	20.13	30.11	24.55	16.81

Source: Revenue Department, Pishin District, Government of Baluchistan  
\* Culturable Area

BEST AVAILABLE DOCUMENT

TABLE 4.14

CROPPING PATTERNS AND INTENSITIES -  
KUTCHLAK AREA - KAREZ JALOGIR

\* CA = 176

Crops	Acreage	Percent
Wheat	11.77	6.69
Apple	13.23	7.52
Total	25.00	14.21

Source: Field Survey.

\* Culturable Area

TABLE 4.15

## CROPPING PATTERNS AND INTENSITIES - MUSTUNG AREA

Crops	Mayana Karez		Ishkana Karez		Kalan Karez		Kundki Karez	
	CA 62 Acres		CA 1030 Acres		CA 509 Acres		CA 253 Acres	
	Acreage	Percent	Acreage	Percent	Acreage	Percent	Acreage	Percent
Wheat	23	37.10	60	5.83	94	18.47	-	-
Onion	7	11.29	300	29.13	150	29.47	17	6.72
Potato	-	-	10	0.97	-	-	-	-
Alfalfa	1	1.61	50	4.86	50	9.82	30	11.86
Carrot	1	1.61	20	1.94	-	-	-	-
Turnip	1	1.61	35	3.39	-	-	-	-
Grapes	-	-	-	-	14	2.75	-	-
Apples	-	-	19	1.84	65	12.77	110	43.48
Apricots	-	-	10	0.97	27	5.30	35	13.83
Mulberry	-	-	40	3.88	-	-	8	3.16
<b>Total</b>	<b>33</b>	<b>53.22</b>	<b>544</b>	<b>52.81</b>	<b>400</b>	<b>78.58</b>	<b>200</b>	<b>79.05</b>

Source: i) Field Survey  
ii) Revenue Department, Govt. of Baluchistan, Kalat District

\*CA = Culturable Area

TABLE 4-16

CROPPING PATTERNS AND INTENSITIES  
 ZIARAT AREA - JUNGLE BUNDAT

CA = 54 Acres

Crops	Acreage	Percent
Wheat	1.15	3.24
Barley	0.50	0.93
Apples	7.00	12.96
Pears	0.50	0.93
Plums	0.50	0.93
Alfalfa	1.00	1.85
<b>TOTAL</b>	<b>11.25</b>	<b>20.84</b>

- Source:
- 1) Revenue Department, Government of Baluchistan, Ziarat District.
  - 2) Field Survey.
  - \* Culturable Area

**BEST AVAILABLE DOCUMENT**

TABLE 4.17

## CROPPING INTENSITIES OF SELECTED KAREZES

Name of Karez	Culturable Area (Acres)	Cropped Area (Acres)	Cropping Intensity (%)
Abdul Hakim	100	34	34.00
Khanozai	389	112	28.80
Balozai	628	109	17.40
Sahib Khanozai	140	19	13.60
Sahib Balozai	106	25	23.60
Sahibzada	67	20	29.80
Tor Daman	146	25	17.10
Jalogir	176	25	14.20
Ishkana	1030	544	52.80
Mayana	62	33	53.20
Kalan	509	400	78.60
Kundki	253	200	79.00
Jungle Bundat	54	11	20.40

## **2. Sowing of Crops:**

Sowing in the study areas is done in traditional manner i.e. 'Chhatta' (the spreading of seed in the fields by hand). Sowing in lines was not reported by any of the farmers.

## **3. Harvesting and Threshing :**

The crops are harvested by manual labour and use of modern harvester or reapers has not been reported. Threshing of crops is carried out in two ways. One is tractor threshing and the other is animal threshing. Tractor threshing is confined only to cereal crops i.e. wheat and barley. The harvested crop is collected at one place called "Khalyan" (a piece of land prepared for crop threshing) and the tractor attached with indigenous thresher is driven on the "Khalyan". The tractor is driven until the grain is separated from the straw. Animal threshing is usually undertaken by the camels. The threshing of all other crops such as cumin etc. is generally done by camel driven indigenous thresher. All the crops are cleaned (grain and straw are separated) by manual labour and use of mechanical power is not reported by any of the respondents.

## **4. Irrigation**

Irrigation of crops under karez system is not practised in accordance with the crop water requirements. Rather, the turn of water for crop irrigation is fixed according to the inherited water rights schedule, being operated by the karez farmers. It varies from karez to karez. Generally they try to cultivate the same amount of land for which they may get water according to their share, depending upon climatic conditions.

### **4.06 FARM INPUTS**

This section deals with the bench mark records of farm inputs use. These generally comprised of farm power, manual labour, seed, fertilizer, plant protection, etc.

#### **1. Farm Power:**

The survey revealed that major source of farm power for land preparation in the areas under study was the tractor. None of

the respondents reported the use of other power sources for this purpose. The tractor ploughs an acre of land in one hour. From field ploughing to seed bed preparation, it costs 4 hours on an average for all crops. Other sources of farm power in the study areas are donkeys and camels which are used for minor farm operations and carrying the load.

## **2. Manual Labour:**

Manual labour is a prime source farm operations and is making use of the farm inputs. Farmers were asked about the use of manual labour for various farm operations such as land preparation, seeding, irrigation, plant protection, harvesting, threshing, picking of fruit, etc.

The survey revealed that in all the areas under study, there appeared no major variation regarding the use of manual labour for various tasks.

## **3. Seed:**

The present pattern of use of seed for various crops in the study area has been investigated. In some cases the seed applied is less than the recommended standards of the Agriculture Department and in other cases, it exceeds the recommended rates. As far as varieties are concerned, farmers generally tend to grow improved varieties.

## **4. Fertilizers:**

In the study areas, farmers were found using both farm yard manure and chemical fertilizers.

### **a) Farm- yard Manure:**

The use of farm yard manure is mainly restricted to garden and cash crops. It is applied to the orchard fields in every alternate year. The approximate quantity applied is 1.0 ton/acre.

### **b) Chemical Fertilizers:**

Farmers of the study areas are inclined towards the use of chemical fertilizers. Almost all the respondents told that they were using chemical fertilizers. However,

they were not aware of the right doses and were using the fertilizers because of the general consensus that these help increase the crop production.

## **5. Plant Protection.**

In Baluchistan, about 20 percent of cropped area has been treated during the last 4 years on an average. In the study areas, 10% of the farmers interviewed were using the insecticides/pesticides to protect their crops from the pests and disease attack. The major use was found on garden and vegetable crops. The farmers reported that due to the non availability of the sprayers, about 50 percent of the willing farmers fail to spray their crops. The major insecticides/pesticides used were Dimecran, Larsbeen and Benelate. The bench mark findings are given in Tables 4.18 to 4.21 for the study area and the recommended dozes of seed and fertilizers are provided in Table 4.22.

TABLE 4.18

USE OF INPUTS (BENCH MARK SURVEY FINDINGS)  
PUNJPAI AREA

Items	Unit	Crops				
		Alfalfa	Onion	Wheat	Barley	Cumin
Seed Rate	Kgs/Acre	8	5.5	28	25	24
Fertilizers:						
N	'n' Kgs/Acre	-	101	32	46	16
P	'n' Kgs/Acre	-	23	23	-	11
K	'n' Kgs/Acre	-	-	-	-	-
Farm Yard Manure	Truck loads/Acre	1	1	-	-	-
Plant Protection	Litres/Acre	-	-	-	-	-
Manual Labour	Mandays/Acre	25	42	18	15	9
Farm Power(Tractor)	Hours/Acre	2	3	2	2	2

TABLE 4:19

**USE OF INPUTS (BENCH MARK SURVEY FINDINGS)  
KHANOZAI AND KUTCHLAK AREAS**

Items	Unit	Crops						
		Tobacco	Potato	Alfalfa	Orchards (Apples)	Wheat	Barley	Fodders
1. Seed Rate	Kgs/Acre	0.02	394	7	90	30	29	30
2. Fertilizers:								
N	'n' Kgs/Acre	29	55	-	133	30	30	-
P	'n' Kgs/Acre	11	23	-	89	18	-	-
K	'n' Kgs/Acre	-	-	-	-	-	-	-
3. Farm Yard Manure	Truck loads/Acre	-	1	1	1	-	-	-
4. Plant Protection	Litres/Acre	-	-	-	-	-	-	-
5. Manual Labour	Mandays/Acre	28	30	23	70	15	12	15
6. Farm Power(Tractor)	Hours/Acre		3	3	2	4	2	2 2

USE OF INPUTS (BENCH MARK SURVEY FINDINGS)  
MUSTUNG AREA

Items	Unit	Crops									
		Wheat	Onion	Potato	Carrot	Turnip	Alfalfa	Apples	Apricot	Grapes	Mulbery
1. Seed Rate	Kgs/Acre	38	5	486	3	0.75	12	* 100	* 190	* 300	* 100
2. Fertilizers:											
N	'n' Kgs/Acre	32	110	73	55	55	32	240	55	55	-
P	'n' Kgs/Acre	23	92	138	23	23	23	120	23	23	-
K	'n' Kgs/Acre	-	-	-	-	-	-	-	-	-	-
3. Farm Yard Manure	Truck loads/ Acre	-	1	-	-	-	1	1	1	4	2
4. Plant Protection	Litres/Acre	-	1	-	-	-	-	2	-	2	-
5. Manual Labour	Mandays/Acre	18	40	34	28	23	20	95	79	80	20
6. Farm Power(Tractor)	Hours/Acre	2	3	3	3	3	2	4	4	4	4
	* Plants/Acre										

**USE OF INPUTS (BENCH MARK SURVEY FINDINGS)  
JUNGLE BUNDAT**

Items	Unit	Crops					
		Wheat	Barley	Alfalfa	Apples	Pears	Plums
1. Seed Rate	Kgs/Acre	35	30	8	* 100	* 110	* 110
2. Fertilizers:							
N	'n' Kgs/Acre	32	30	-	120	55	55
P	'n' Kgs/Acre	18	-	-	85	23	23
K	'n' Kgs/Acre	-	-	-	-	-	-
3. Farm Yard Manure	Truck loads/Acre	-	-	1	1	1	1
4. Plant Protection	Litres/Acre	-	-	-	3	1	1
5. Manual Labour	Mandays/Acre	18	14	25	80	75	78
6. Farm Power (Tractor)	Hours/Acre	2	2	2	4	4	4

TABLE 4.22

## RECOMMENDED SEED &amp; FERTILIZER LEVELS FOR VARIOUS CROPS

Crops	Unit	Seed	Fertilizer		
			N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
<u>KHARIF</u>					
Tobacco	Kg/Acre	0.02	36	36	30
Onion	Kg/Acre	6.00	60	30	25
Potato	Kg/Acre	448.00	100	50	-
<u>RABI</u>					
Wheat	Kg/Acre	37.00	60	30	-
Barley	Kg/Acre	37.00	40	-	-
Cumin	Kg/Acre	5.00	11	11	-
<u>PERENNIAL</u>					
Alfalfa	Kg/Acre	9.00	50	50	-
Apples	Kg/Plant	48-69 Plants	0.84	0.84	0.90
Apricot	Kg/Plant	48/69 p/acre	0.84	0.84	0.90
Grapes	Kg/Plant	435 p/acre	0.84	0.84	0.90
Plum	Kg/Plant	109-194 "	0.84	0.84	0.90
Peaches	Kg/Plant	109-194 "	0.84	0.84	0.90
Mulberry	Kg/Plant	27 - 35 "	0.84	0.63	0.90

Source: Agriculture Department, Baluchistan

## CHAPTER - 5

### PHYSICAL MEASUREMENTS

Detailed physical measurements of various components of karez irrigation systems have been undertaken. These include the measurements of various karez elements; i.e. water availability, conveyance losses, water quality data, agro-economic data, rainfall data and topographic surveys etc. The details of these measurements are narrated below.

#### 5.01 PHYSICAL MEASUREMENTS OF KAREZ COMPONENTS

Physical measurements of karez components included; number of yielding wells, number of access wells, dia and depth of wells, distance between the wells, flow depth in karez tunnel, length of karez tunnel, slope of karez tunnel, length of channel from daylight point to command area, size of water storage tank, geology of karezes etc. The measurements of these components of twelve karezes are summarized in Table 5-1. The analysis of data indicate that the farmers are convinced with the usefulness of capping of wells and majority of the wells on a karez are usually capped using the indigenous technology. As a result of this erosion of wells is not a serious problem. However, opening of these lids at the time of cleaning results in dropping of silt and debris in the karez tunnel. The average number of wells on a karez is 65 and distance between two wells is 115 feet. Average length of karez tunnel is 7351 ft. and length of open channel varies from 65 to 13200 ft.

#### 5.02 WATER AVAILABILITY

Gravity flow from karezes is available throughout the year. However, considerable variation in flow during a year has been reported by the farmers. To establish magnitude of fluctuation in flow, four karezes namely; Abdul Hakim, Tor Daman, Khanozai and Jungle Bundat were selected. Flow data of these karezes for one year is shown on Plates 5-1 to 5-4. Actual measurements were also recorded on karez discharge fluctuations of Mustang Sub-basin from 1976-79 by "United Nations Groundwater Studies in Selected Areas of Baluchistan" (Technical Report No.4 of Government of Baluchistan, Pishin Lora Basin). Their findings are in general, during the years 1976-79 the greatest discharges occurred between July and October and the least between December and February. The maximum level usually did not occur at the same time in different karezes. The average greatest discharge was about 125% of the average least discharge but individual karezes showed much greater variations. These were mostly marked on those karezes where the average annual discharge was below one cusec. At least one karez has appeared to be particularly responsive to annual rainfall fluctuations. During the period 1976 to 1979 most karezes showed an overall increase in yield,

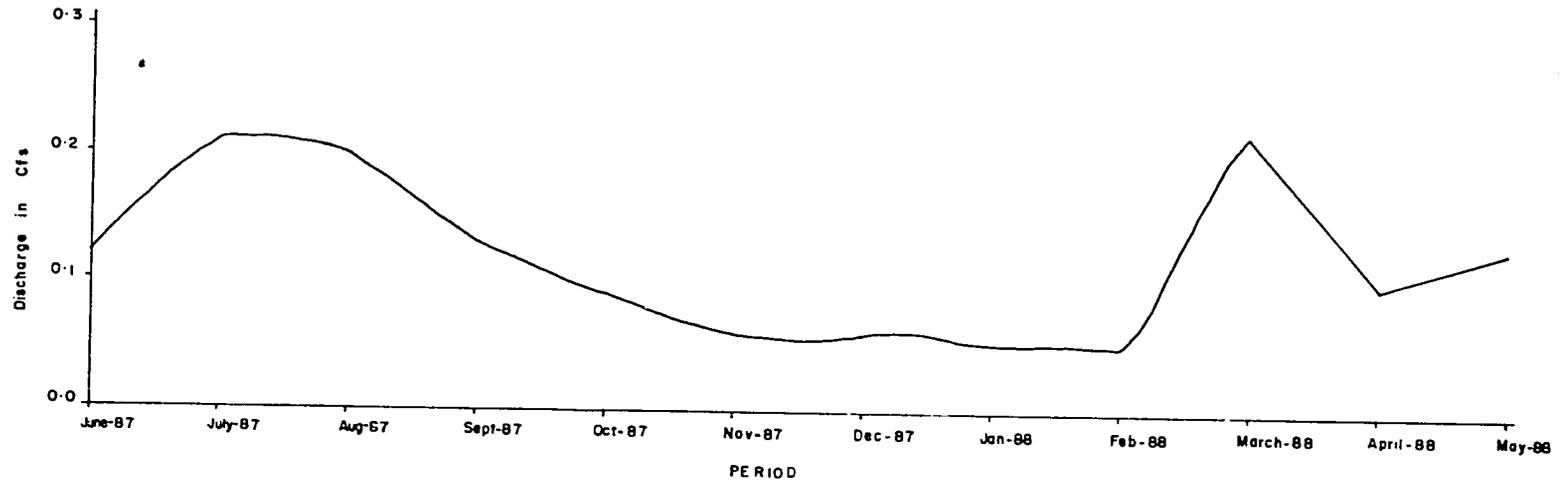
TABLE 5.1

## SUMMARY OF PHYSICAL MEASUREMENTS

Sr. No.	Detail of Measurements	Unit	NAME OF KAREZES											AVERAGE	
			Abdul Hakim	Jarogir	Khano-zai	Balo-zai	Sahib	Sahib-Zada	Tor-Daman	Jungle Bandat	Ish-kana	Mayana	Kalan		Kundki
1.	Age of Karez	Years	50	150	300	300	250	25	55	60	500	600	600	600	292
2.	Total No. of Access Wells	Nos.	74	44	138	40	45	117	50	15	74	17	78	95	65
3.	Av. Distance Between Wells	Ft.	103	78.5	105.2	104.6	94.6	125.8	119.7	125	122.4	164.9	111.5	124.4	115
4.	Av. Dia./Dimension of Wells	Ft.	2.11x3.97	11.79	2.75	2.4x3.6	3.25	4.65	3x4.3	-	5.15x3.46	11.2	-	-	-3.16x3.89/6.73
5.	Average Depth of Wells	Ft.	24.4	33.5	83.2	30.5	33.4	0.65	37.4	-	134.7	109.3	96	122.5	64
6.	Length of Karez Tunnel	Ft.	7992	3454	14512	4184	4256	14716	5986	1975	9060	2204	8596	10576	7351
7.	Length of Open Channel	Ft.	1700	13200	1372	7920	850	1600	233	-	65	5280	1690	10243	4080
8.	Karez Discharge	Cfs	0.2	0.3	0.9	0.5	0.5	0.1	0.35	0.02	0.3	0.11	0.35	0.35	0.37
9.	Conveyance Losses	Percent	40-00	39-25	60-00	62-00	63-00	50-00	71-00	72-43	64-56	54-55	38-71	85-00	60-00
10.	Frequency of Karez Cleaning	year	1	1	1	1	1	1	1	1	1	1	1	1	1
11.	Size of Water Tank	Ft.	189x132x4	-	-	-	-	-	92x101x4	80x60x5	48x24x4	-	-	-	102x84x4
12.	Topographic Survey	-	Yes	No.	Yes	No.	No	No	No	Yes	No	No.	No.	No.	-
13.	Geological Measurements	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No.	No.	No.	-
14.	Command Area	Acres	100	176	389	616	246	57	146	54	1030	62	509	253	305
15.	Cropped Area	Acres	34	25	112	110	43	20	25	11	544	33	400	200	130

NOTE : In Jungle Bundat water is collected in the reservoir just near the mouth of karez. So there is no channel between karez and reservoir and conveyance losses were calculated in the channel between reservoir and field.

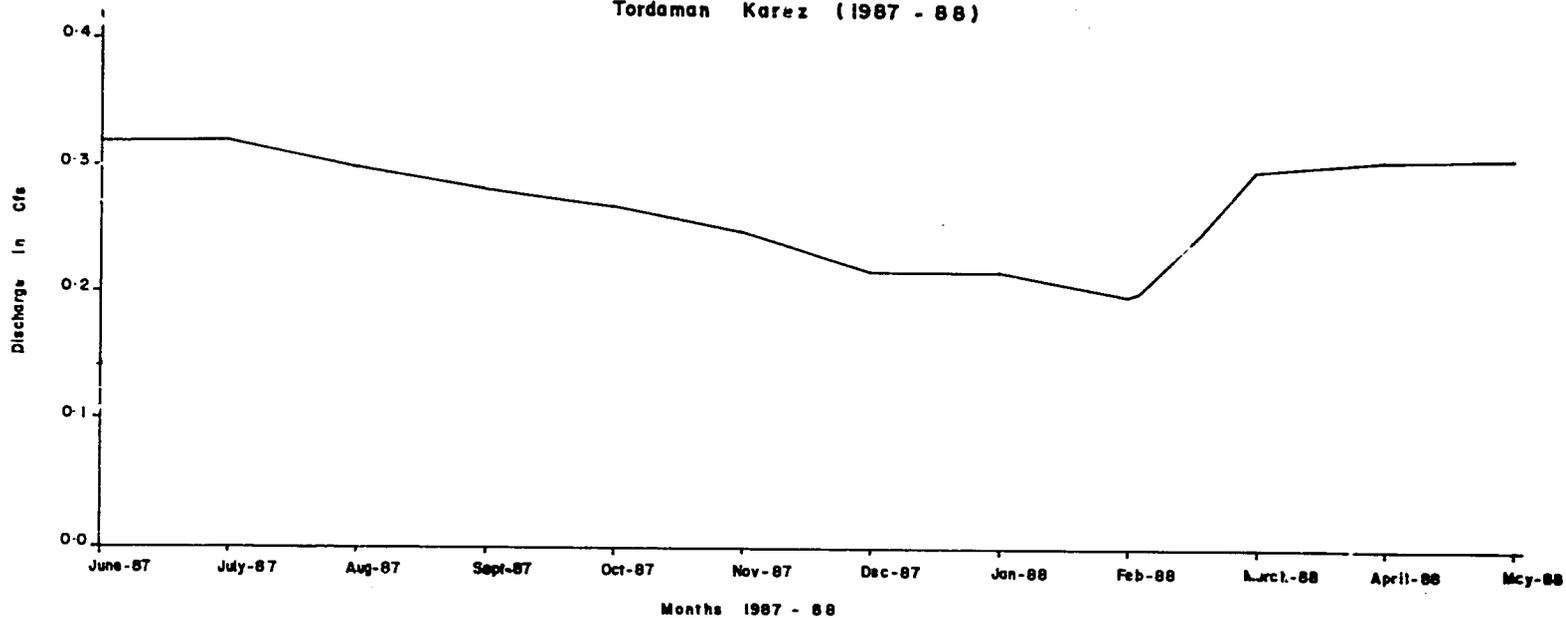
Variation in Discharge of  
Abdul Hakum Karez (1987-88)



5-3

72

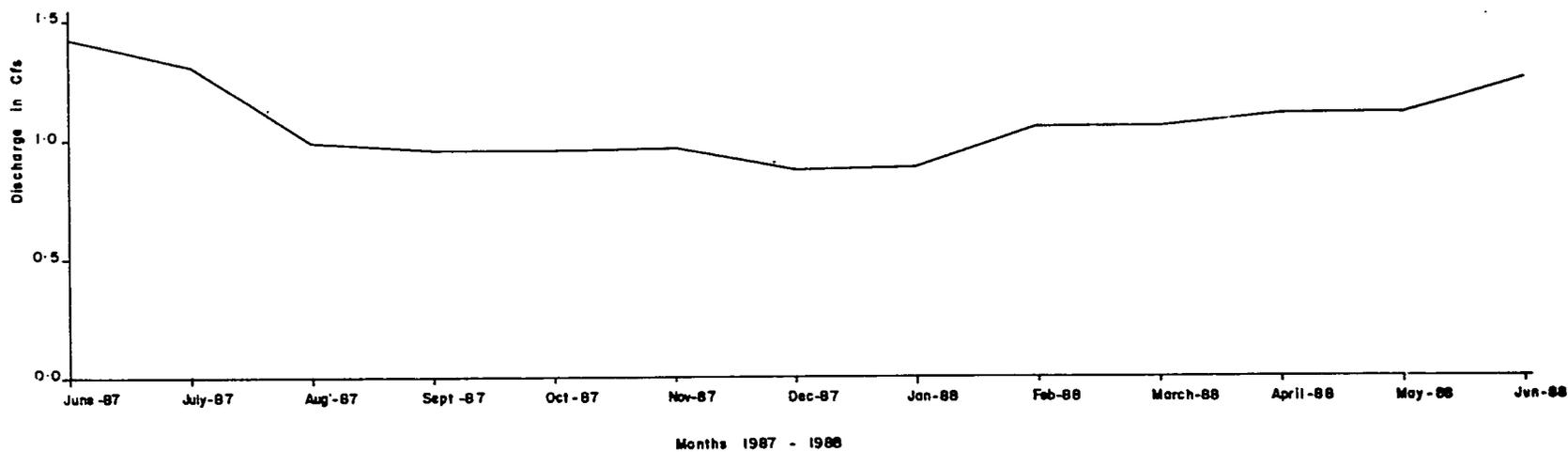
Variation in Discharge of  
Tordaman Karez (1987 - 88)



5-4

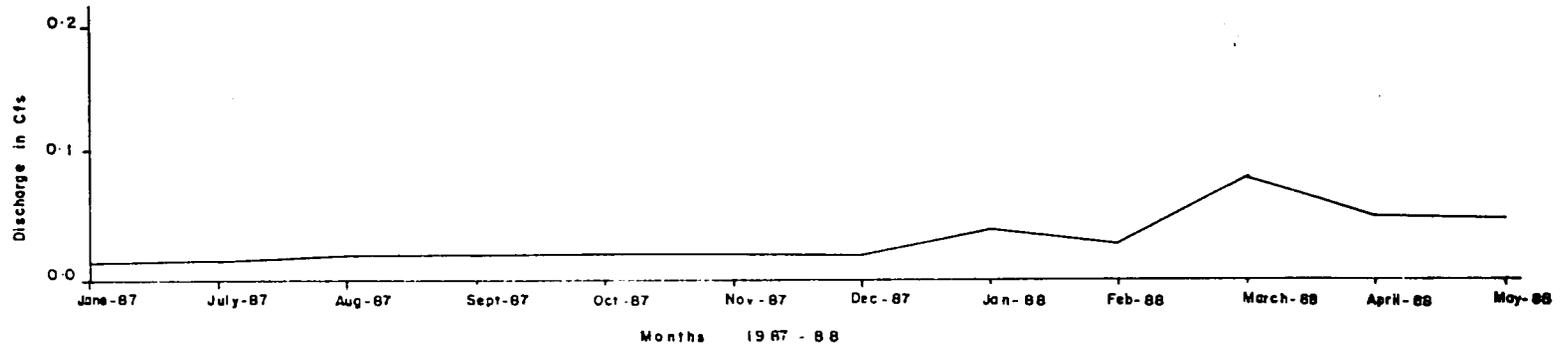
Variation in Discharge of  
Khanozai Karez (1987-88)

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Variation in Discharge of  
Jungle Bund at Karez (87-88)



5-6

75

commonly doubling in amount. Some karezes maintained an essentially constant yield and others showed a decline. That is, there was some evidence of a wide spread increase in karez discharge. Table 5.2 summarizes the information available from the karezs of Mustung area. The variation in flow is shown on Plates 5-5 to 5-7.

Flow measurements from a spring located in Quetta valley are available, the hydraulics of which is similar to that of a karez. The variation in the flow of a spring during the year 1984-85 was in the range of 2.45 cfs to 2.01 cfs. Fluctuation in water availability is a function of the dry and wet spells. However, data for this type of situation are not available.

Discharge measurements of selected karezes for the benchmark study were measured using the cut-throat flumes. These data are summarised in Table 5-3.

### **5.03 WATER LOSS MEASUREMENTS**

#### **1. Conveyance Losses :**

Water loss measurements were undertaken in the main channels of karezes conveying water from the mouth of karez to the command area. Conveyance loss measurements were also conducted in the main water courses of the command area of 12 karezes selected for the benchmark study. These data are presented in Table 5.4. Using a direct reading pygmy current meter, the karez flow in the tunnel of Abdul Hakim Karez was measured at four locations on 22nd March 1988. Three were at access well numbers 6, 30 and 34, respectively. The other location was in the lined channel just downstream from the karez outlet. Results of these measurements are given in Table 5.5. Cut-throat flumes were used for measuring the discharge. Inflow - outflow method was used for determining the conveyance losses. Conveyance loss measurements undertaken by Planning (South) WAPDA in Kutchlak area of Quetta valley during 1982-83 are given in Table 5.6. Similar measurements were conducted by the pilot project cell of BMIADP in Chashma Achozai area of Quetta valley. Those measurements are summarised in Table 5.7.

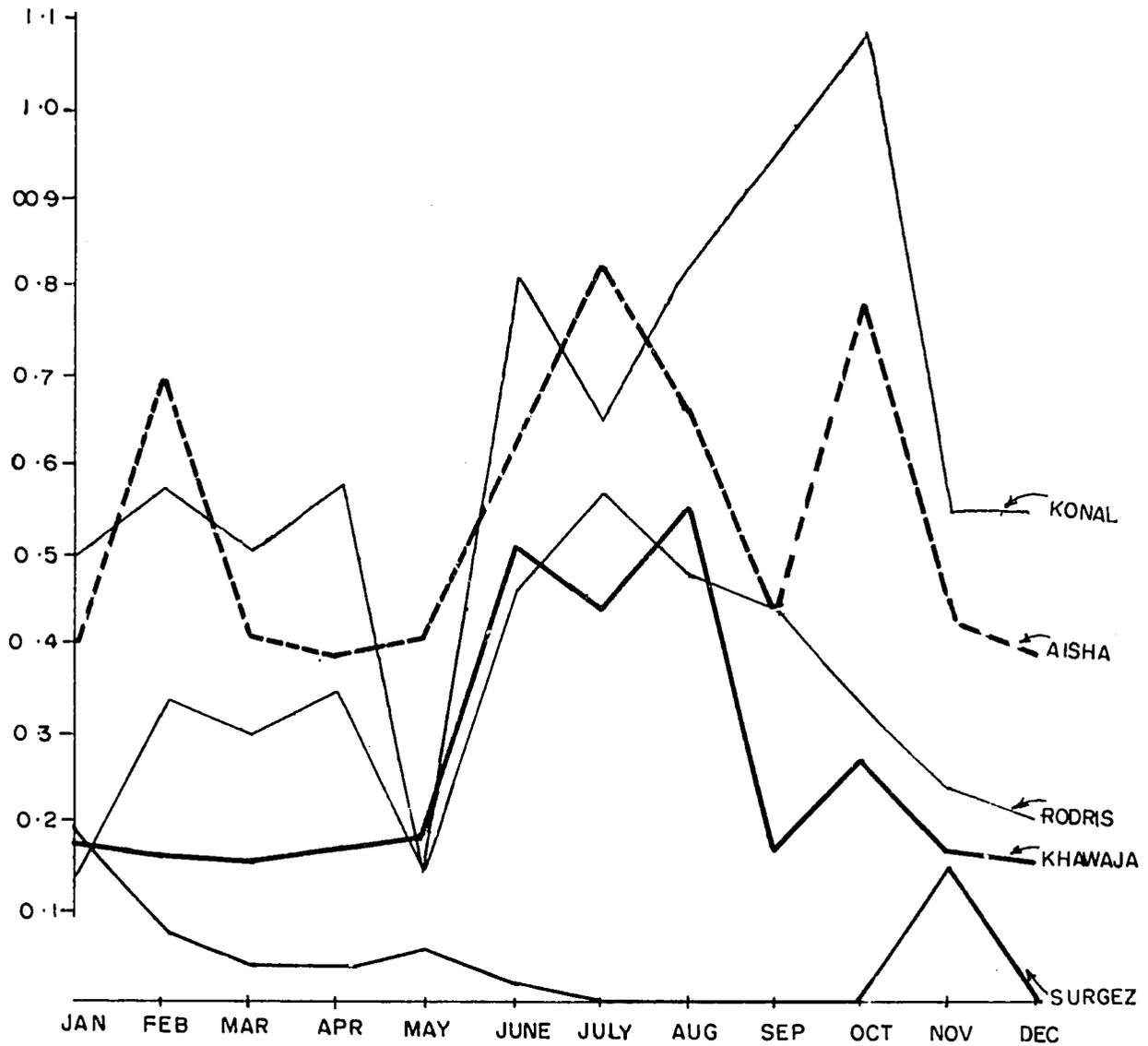
TABLE 5.2

**KAREZ DISCHARGE FLUCTUATION WITH TIME  
MUSTUNG SUB BASIN, 1976-1979**

KAREZ	MONTHS											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
SURGEZ	0.19	0.08	0.04	0.04	0.06	0.02	dry	dry	dry	dry	0.15	dry
KONAI	0.50	0.58	0.51	0.58	0.13	0.81	0.65	0.82	0.95	1.08	0.55	0.55
KALAN	1.68	1.45	1.92	1.68	1.79	1.66	0.94	1.42	1.79	1.45	1.73	1.61
KUNDKI	2.05	2.33	2.48	2.41	2.52	2.46	2.28	2.30	2.10	2.60	2.44	2.10
AISHA	0.39	0.70	0.41	0.39	0.41	0.63	0.82	0.66	0.43	0.78	0.43	0.39
RODRIS	0.14	0.34	0.30	0.35	0.15	0.46	0.57	0.48	0.44	0.33	0.24	0.21
KHAWAJA	0.18	0.17	0.16	0.17	0.18	0.51	0.44	0.55	0.17	0.27	0.17	0.16
DAND	0.37	0.59	0.92	0.52	0.35	0.83	0.93	1.79	0.58	0.82	0.93	0.84
SHEKHAN	0.58	0.46	0.53	0.45	0.58	0.54	0.92	0.80	1.02	1.00	0.46	0.23
MIANA	0.56	0.65	0.86	0.71	0.49	0.63	0.64	0.65	0.73	0.58	0.35	-
ISHKANA	1.55	1.42	1.75	2.06	1.87	1.74	1.57	1.40	1.59	1.70	1.42	1.69
KHAWASAM	0.17	0.14	0.15	0.14	0.13	0.14	0.09	0.30	0.46	0.42	0.11	0.19
BH.SHAFI	0.24	0.22	0.18	0.18	0.14	0.09	0.10	0.26	0.10	0.21	0.18	0.25
TINDLAN	1.30	1.20	1.21	1.25	1.22	1.11	1.80	1.04	1.10	1.50	1.58	1.11
KARAK	0.99	0.93	1.00	1.09	1.02	1.13	0.91	1.42	1.40	1.33	1.14	1.19
G.PAREZ	0.94	0.82	0.81	1.07	0.76	0.79	0.94	0.99	1.03	0.99	0.69	0.74
CHUTTA	0.55	0.63	0.50	0.51	0.50	0.49	0.69	0.85	0.46	0.83	0.47	0.52
TOTAL	12.38	12.71	14.28	13.60	12.30	14.04	14.29	15.73	14.35	15.89	13.04	11.78
AVERAGE	0.73	0.75	0.84	0.80	0.72	0.83	0.84	0.93	0.84	0.93	0.77	0.69

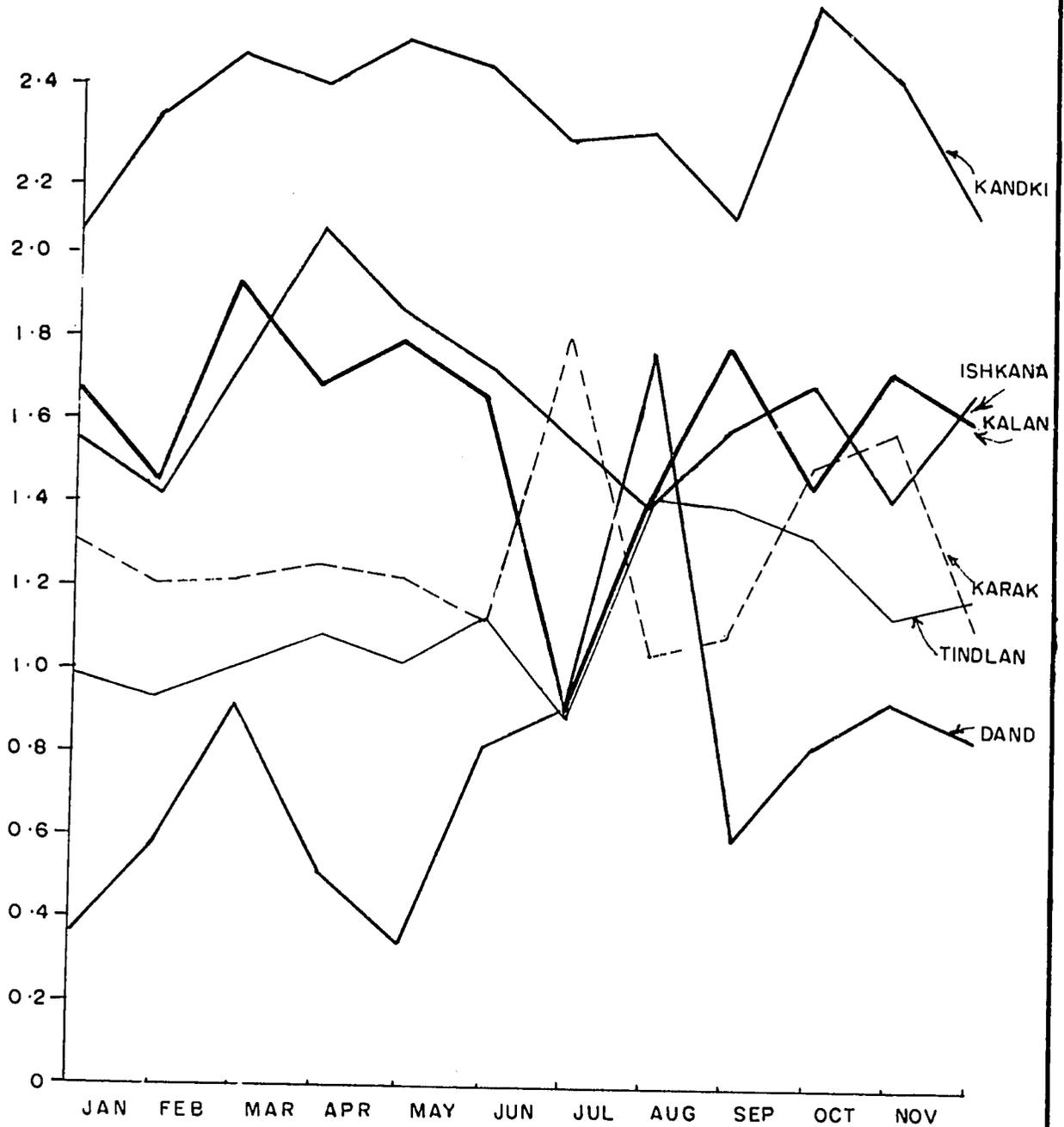
SOURCE: UNITED NATIONS GROUND WATER STUDIES IN SELECTED AREAS OF BALUCHISTAN,  
TECHNICAL REPORT NO.4 GOVERNMENT OF BALUCHISTAN, PISHIN LORA BASIN.

KARAZ DISCHARGE FLUCTUATION WITH  
TIME MASTUNG SUB BASIN 1976 -1979



KAREZ DISCHARGE FLUCTUATIONS WITH  
TIME MASTUNG SUB BASIN 1976 - 1979

Plate 5.6



KAZEZ DISCHARGE FLUCTUATIONS WITH  
 TIME MASTUNG SUB BASIN 1976 - 1979

Plate 5.7

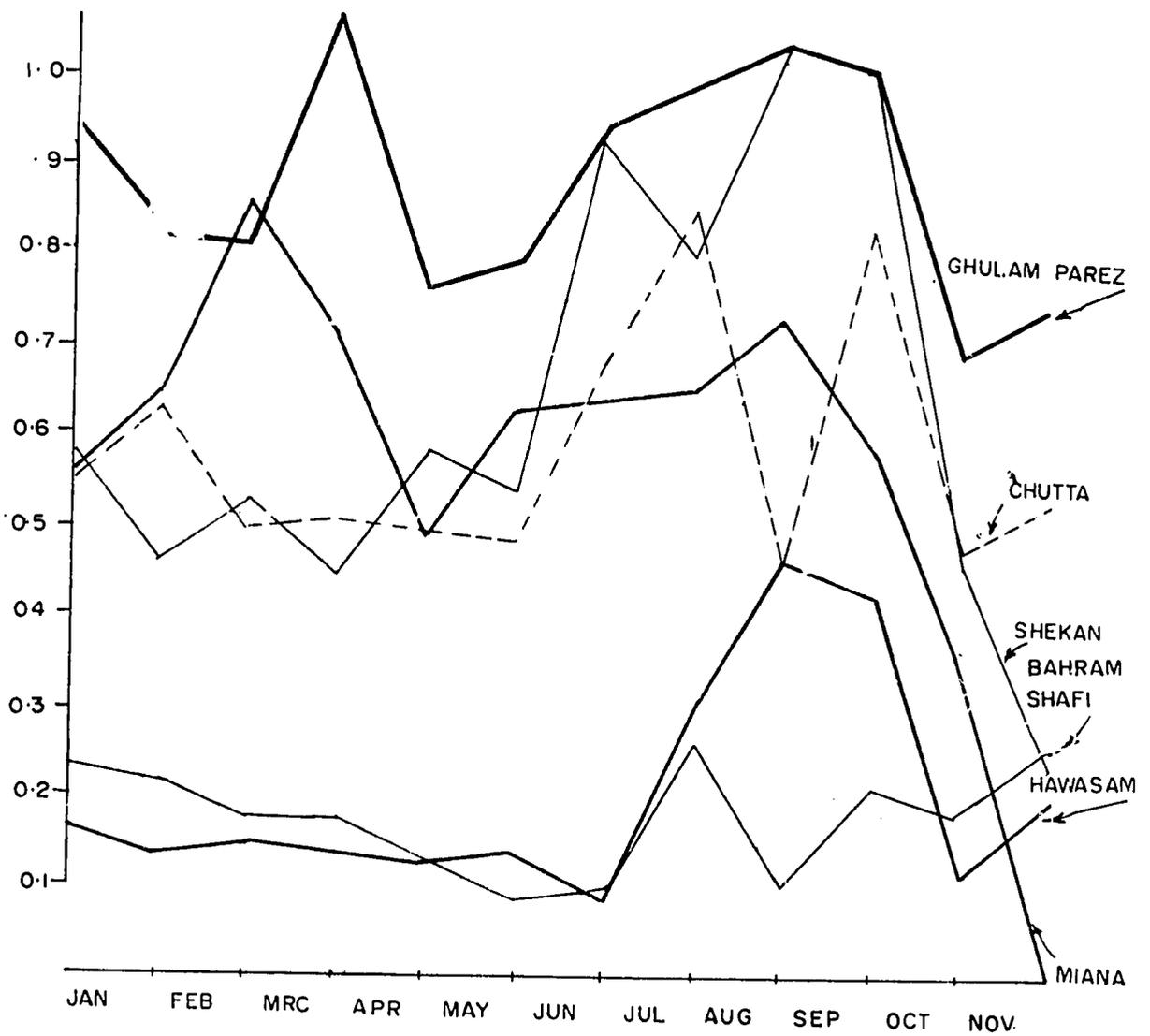


TABLE 5.3

## KAREZ DISCHARGE MEASUREMENTS

Sr. No.	Name of Karez	Date of Measurement	Discharge (Cfs.)
1.	Abdul Hakim	May 1987	0.20
2.	Jalogir	May 1987	0.30
3.	Khanozai	May 1987	0.90
4.	Balozai	May 1987	0.50
5.	Sahib	May 1987	0.50
6.	Sahibzada	May 1987	0.10
7.	Tor Daman	May 1987	0.35
8.	Jungle Bundat	May 1987	0.02
9.	Ishkana	May 1987	0.80
10.	Mayana	May 1987	0.11
11.	Kalan	May 1987	0.35
12.	Kundki	May 1987	0.35

TABLE 5.4

## LOSS MEASUREMENTS ON KAREZES

Sr. No.	NAME OF KAREZ	DATE OF MEASUR.	Q1(CFS)	Q2(CFS)	DIS.BET. Q1 & Q2 IN FT.	LOSS IN CFS PER 1000 FT.	PERCENT-AGE LOSS	REMARKS
1.	ABDUL HAI	8/87	0.21	0.08	1050.00	0.12	61.90	
2.	GALOGIR	"	0.27	0.11	1010.00	0.16	59.25	
3.	JUNGLE BUNDAT(R)	"	0.37	0.13	544.00	0.44	64.86	
4.	JUNGLE BUNDAT(L)	"	0.70	0.14	400.00	1.40	80.00	
5.	ISHKANA	"	0.79	0.28	1470.00	0.35	64.56	
6.	PISHKRAM	"	0.16	0.04	1640.00	0.07	75.00	
7.	SAHIB	"	0.43	0.16	1230.00	0.22	63.00	
8.	BALOZAI	"	0.53	0.20	1100.00	0.30	62.00	
9.	TORDAMAN	"	0.34	0.10	1250.00	0.19	71.00	
10.	SAHABZADA	"	0.08	0.04	1300.00	0.03	50.00	
11.	KHANOZAI	"	0.55	0.22	1000.00	0.33	60.00	
12.	KALAN	"	0.31	0.19	1000.00	0.12	38.71	
13.	KUNDIKI	"	0.34	0.05	1133.00	0.26	85.00	
14.	MAYANA	"	0.11	0.05	1245.00	0.05	54.55	
15.	ABDUL HAKIM	"	0.20	0.12	1660.00	0.05	40.00	

NOTE : In Jungle Bundat there are two outlets from the reservoir on right and left side.

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TABLE 5.5

**LOSS MEASUREMENT IN KAREZ TUNNEL  
(KAREZ ABDUL HAKIM)**

Location	Average Width (ft)	Average Depth (ft)	Area (Sq.ft)	Average Vel. (fps)	Distance (ft.)	Discharge (cfs)
Well-6	1.50	0.50	0.75	1.70	0.00	1.28
Well-30	1.75	1.00	1.75	0.80	2636	1.40
Well-34	12.33	0.17	0.22	1.20	3506	0.27
Channel	1.04	0.25	0.26	1.00	7800	0.26

## LOSSES IN EARTHEN WATERCOURSES OF KUTCHLAK AREA

SR. NO.	NAME OF WATERCOURSE	VILLAGE	LENGTH (FT)	Q1 (CFS)	Q2 (CFS)	LOSS CFS/ 1000 F	ED %
1.	HAJI ABDUL ALAM	KILLI MITERZAI	1100	0.50	0.38	0.11	76.00
2.	MALIK WAHAB	KILLI MALANGI	2000	0.54	0.35	0.10	65.00
3.	ABDUL GHANI KAKAR	KILLI DIRAN	2000	0.33	0.21	0.06	64.00
4.	SULTAN MOHAMMAD	KILLI BATHAZAI	1500	0.68	0.50	0.12	74.00
5.	HAJI NOOR SHAH	KILLI NAWABAD	1500	0.72	0.50	0.15	69.00
6.	NIAZ MOHAMMAD TARE	KILLI BATT AZAI	2000	0.54	0.35	0.10	65.00
7.	HAJI MOHAMMAD AKBA	KILLI SYDABAD	1000	0.30	0.22	0.08	73.00
8.	HAJI WALI MOHAMMAD		2000	0.25	0.14	0.05	64.00
9.	HAJI MOHAMMAD HASH		2200	0.27	0.16	0.05	59.00
AVERAGE						0.15	67.67

SOURCE: UNPUBLISHED DATA OF WAPDA

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TABLE 5.7

**CONVEYANCE LOSSES IN EARTHEN WATERCOURSES  
(CHASHMA ACHOZAI)**

Sr. No.	Q1 Cfs.	Q2 Cfs.	Distance Between Q1 & Q2 (Feet)	Loss Cfs/ 1000 ft.	Percent Loss/ 1000 Ft.	Ed%
1.	1.88	1.34	1679	0.32	17.11	71
2.	1.83	0.86	1612	0.60	32.88	47
3.	1.82	1.35	1300	0.36	19.86	74
4.	1.46	0.80	1720	0.38	26.28	55
5.	0.32	0.24	1800	0.04	13.88	75
AVERAGE				0.43	22.00	64

Source: Chashma Achozai Conjunctive Water Use Scheme BMIADP, Quetta.

Dr. W. D. Kemper took very extensive conveyance loss measurements in earthen watercourses served by karez, tubewells and springs while preparing a report titled Water Management In High Lands of Baluchistan. Measurements conducted by him are given in Table 5.8.

## 2. Application Losses:

Application loss measurements in the command area of selected karezes could not be undertaken. However, the application efficiency measurements conducted by BMIADP at Chasma Achozai are given in Table 5.9 which give general magnitude of application losses in the area. These efficiencies are of similar order to efficiencies reported in Punjab and Sind.

### 5.04 WATER QUALITY

Water samples from the selected karezes were collected for water quality analysis. A total of 10 samples, one from each karez of three areas namely; Punjpai, Kutchluk and Khanozai were collected. These samples were sent to Water Analysis Laboratory of Hydrogeology Directorate of WAPDA, Quetta. The analysis has shown that the quality of water is good except for the water from the Abdul Hakim Karez. TDS, SAR and RSC of all the water samples is within the permissible limits and water is fit for domestic and agricultural use. The results for the Abdul Hakim Karez indicate that careful water management will be necessary for irrigation with this water. More frequent irrigation of crops may be needed because the water contains higher level of salinity and sodium. The results of water analysis are given in Table 5.10 and the irrigation water quality standards proposed by different organizations are given in Table 5-11.

### 5.05 RAINFALL DATA:

Out of the five study areas only Jungle Bundat area has a Climatological station. Nine years rainfall data (1975-1984) from two meteorological stations namely; Killi Kotwall and Sumungli nearest to our other study areas have been collected. These data have daily rainfall records, average monthly rainfall data, annual amounts of rainfall and temperature. These data are attached as Annexure 5-1.

Table 5.8

## WATER SUPPLY RATES AND WATERCOURSE LOSS RATES

Study No.	Location	Source of Water	Supply Source (Cusecs)	Rate Field (Cusecs)	Channel Length (Feet)	Water Loss		Ed %
						(Cusecs)	Rate %/1000	
1.	Quetta-Sariab	Dugwell of Niaz Mohammad	0.50	0.34	10,000	0.16	3.2	68
2.	Kutchlak	Dugwell of Abdul Baqi & adjacent sources	1.37	1.08	3,500	0.29	6.0	79
3.	Kutchlak	Karez Kona Nasir	0.68	0.63	6,000	0.05	1.2	93
4.	Pishin Kutchlak	Dugwell of Haji Mohammad Hassan	0.36	0.35	320	0.01	8.7	97
5.	Pishin Lake	Dugwell of Haji Abdul Razzak	0.33	0.23	4,450	0.10	6.7	70
6.	Pishin Lake	Dugwell of Haji Mohammad Shah	0.51	0.44	Leaking Pond	0.07		86
7.	Bala Neganda-Near Pishin	Dugwell owned by B.N. Villagers	0.70	0.62	4,730	0.08	2.4	89
8.	Jehangir Village near Kila Saifullah.	Dugwell of Mr. Ramzan	0.46	0.29	1,900	0.17	20.0	63
9.	Loralai	Karez Ureagde	5.00	5.00	short	-	-	-
10.	Loralai	Rodeleem	-	1.78	-	-	-	-
11.	Loralai	Karez Matwakhk	1.34	1.07	7,750	0.27	2.6	80
12.	Sinjawai	Karez Passard	0.91	0.59	7,922	0.32	4.4	65

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13.	Sinjawai	Karez Chilize Mirajikh	2.29	1.55	7,400	0.74	4.4	68
14.	Sinjawai	Rehman Karez (Adjacent to No.13)	1 to 6	3*	4,000*	0.70*	4.0*	50
15.	Zandra in Ziarat Division	Karez Zandra	3.1	1.2	10,000	2.00**	F/A	39
16.	Ahmadoon Village	North of Jungal Bundat -Ahmadoon Springs	1.95	1.84	8,270	0.11	0.7	94
17.	Giddar	Extensiuon Farm. Dugwells and pucca holdign tanks	0.64	0.53	2,000	0.11	8.6	83
18.	Wad	Tubwell of Mir Sher Jan Mengal	0.62	-	-	-	13.4+	-
19.	Wad	Tubwell of Rasool Bakhsh Mengal	0.43	0.2-0.42	1,000	-	-	-
20.	Wad	Tubwell of Haji Gholam Nabi Mengal	0.65	-	-	-	-	-
21.	Wad	Tubwell of Mr. Dost Mohammad Lango	0.73	-	-	-	-	-
22.	Turbat	Karez Suragi	0.76	0.68	775	0.08	13.2	89
23.	Turbat	Karez Marri	1.25	0.41	2,730	0.84	24.6	33
24.	Mastung	Karez Kunger	0.76 <sup>o</sup>	0.61	1,050	0.15	19.2	80
25.	Mastung	Karez Ishkana	1.20	1.17	1,200	0.03	2.1	97
Average:							8.1	

\* Estimated average

\*\* This large loss was primarily due to a major breach in the pucca channel.

+ This determination was made using the ponding and recession method.

o This flow was below a holding pond, next to the pucca road and the following 1050 feet was the test section.

Source: Farm Water Management in Upland of Baluchistan by Dr. W.D. Kemper.

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TABLE 5.9

**APPLICATION EFFICIENCY MEASUREMENTS  
(CHASHMA ACHOZAI AREA)**

Sr. No.	Crop	Area of field (m <sup>3</sup> )	Soil Moisture deficiency at the time of Irrigation (mm)	Water Applied by farmer (mm)	Over Irrigation (%)	Under Irrigation (%)	Application Efficiency (%)
1.	Tomato	758.31	89.33	98.96	9.73	-	98.27
2.	Tomato	250.70	79.12	124.71	36.56	-	63.44
3.	Wheat	732.55	137.16	77.77	-	43.30	* 56.70
4.	Wheat	864.25	94.24	68.77	-	27.03	* 72.97
5.	Pumpkin	111.42	175.56	34.82	-	80.17	* 19.83
6.	Pumpkin	733.50	23.26	25.31	8.81	-	91.90
7.	Bringal	538.25	77.91	140.90	80.85	-	55.29
8.	Bringal	365.00	97.00	208.58	115.03	-	46.50
9.	Okra	386.44	51.33	91.88	79.00	-	55.87
10.	Chillies	606.13	66.75	50.43	-	24.45	75.55*
<b>Average:-</b>							<b>67.21**</b>

\* % of soil moisture deficit. Actual efficiency of application is 100%.

Since there was no deep percussion.

\*\* Average of irrigations which refilled the profile.

Source: Chashma Achozai Conjunctive Wateruse Scheme BMIADP, Quetta.

SUMMARY OF WATER ANALYSES

TABLE 5.10

SAMPLES ANALYSED BY  
HYDROGEOLOGY DIRECTORATE, WAPDA, QUETTA

Sr. No.	Lab. No.	Date Sampled	Source	Symbol	Milliequivalents Per Litre									D.S. (by Evap) ppm	Ecx10 <sup>6</sup> at 25°C	pH	Res Na <sub>2</sub> CO <sub>3</sub> me/l	SAR	
					Ca	Mg	Na	Total Cations	CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub> Anions	NO <sub>3</sub>						Total
1.	155	Not Mentioned	Khano-Zai Karez	B-1	2.33	5.02	3.95	11.30	0.31	3.56	1.64	5.50	0.29	11.30	765	1100	8.3	-	2.1
2.	156	"	"	B-2	1.99	5.73	3.95	11.67	-	4.49	1.83	5.13	0.22	11.67	799	1100	8.0	-	2.0
3.	157	"	"	B-3	1.41	5.84	3.73	10.98	0.62	4.03	1.28	4.78	0.27	10.98	741	1030	8.4	-	2.0
4.	158	"	"	B-4	0.97	4.42	2.26	7.65	-	5.42	1.09	0.92	0.22	7.65	542	760	8.1	-	1.3
5.	159	"	Kucth-lak Karez	B-5	2.52	6.78	3.95	13.25	-	7.13	3.47	2.41	0.24	13.25	912	1300	8.0	-	1.8
6.	160	"	"	B-6	2.42	8.08	4.34	14.84	-	9.76	2.74	2.20	0.14	14.84	947	1410	8.1	-	1.9
7.	161	"	Punj-pai Karez	-	1.36	3.75	22.08	27.19	1.86	7.28	10.79	7.17	0.09	27.19	1813	2800	8.4	4.03	13.8
8.	162	"	Abdul Hakim Karez	-	1.75	3.46	18.43	23.64	0.62	4.65	9.15	9.08	0.14	23.64	1572	2430	8.3	0.06	11.4
9.	86	142.86	"		1.06	3.95	23.48	28.49	0.57	8.64	10.97	8.20	0.11	28.49	1943	2900	8.5	4.2	15.0

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TABLE 5.11 (a)

**IRRIGATION WATER QUALITY STANDARDS  
PROPOSED BY DIFFERENT ORGANIZATIONS**

**I. WAPDA Consultants:**

Water Class	TDS	SAR	RSC (me/l)	Boron (ppm)
Good	1000	10	2.5	1
Marginal	1000 - 2000	10-17	2.5-5.0	1-2
Hazardous	>2000	>17	>5.0	>2

**II. Mona Reclamation Project, WAPDA**

Good	1000	7	2.5	1
Marginal	1000 -	7-12	2.5-5.0	1-2
Hazardous	>2000	>12	>5	>2

**III. Harza Engineering Co.**

Good	Upto 1200	Less Than 7.5
Marginal	1200 -2500	7.5-10.0
Hazardous	>2500	>10

**IV. Land Reclamation Directorate**

Water Class	$E_c \times 10^6 / \text{Cm}$ at 25°C	SAR	Rsc (me/l)
Low	750	Upto 5.0	Upto 1.25
Medium	750-1500	5.0-7.5	1.25 to 2.50
High	1500-2000	7.5-10.0	2.50 to 4.00

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TABLE 5.11(b)

## V. United States Department of Agriculture Handbook-60

Sodium (Alkali) Hazard	C l a s s		SAR(Approx. Range)	EC x 10 <sup>6</sup> /Cm at 25°C
	Sali- nity	Class		
Low	Low	S <sub>1</sub> C <sub>1</sub>	8 - 10	100 - 250
Low	Medium	S <sub>1</sub> C <sub>2</sub>	6 - 8	250 - 750
Low	High	S <sub>1</sub> C <sub>3</sub>	4 - 6	750 - 2250
Low	Very High	S <sub>1</sub> C <sub>4</sub>	2 - 4	2250
Medium	Low	S <sub>2</sub> C <sub>1</sub>	15 - 18	100 - 250
Medium	Medium	S <sub>2</sub> C <sub>2</sub>	12 - 15	250 - 750
Medium	High	S <sub>2</sub> C <sub>3</sub>	9 - 12	750 - 2250
Medium	Very High	S <sub>2</sub> C <sub>4</sub>	6 - 9	2250
High	Low	S <sub>3</sub> C <sub>1</sub>	22 - 26	100 - 250
High	Medium	S <sub>3</sub> C <sub>2</sub>	18 - 22	250 - 750
High	High	S <sub>3</sub> C <sub>3</sub>	14 - 18	750 - 2250
High	Very High	S <sub>3</sub> C <sub>4</sub>	11 - 14	2250

## **5.06 AGRO-ECONOMIC DATA:**

Agro-economic data of selected karez systems have been collected with regard to existing land use statistics, cropping patterns, cropping intensities, production levels, use of farm inputs, area irrigated and prices of inputs and outputs. The source of these data is Provincial Revenue Records and the farmers. These data are discussed and analyzed in detail in Chapters 4 and 6.

## **5.07 TOPOGRAPHIC SURVEY:**

Topographic survey of Abdul Hakim Karez, Khanozai Kkarez and Jungle Bundat Karez was undertaken in connection with the study of existing features of karez irrigation system. This survey includes the strip survey of the area along the axis of karez wells, profiles of karez tunnel and topographic survey of command area. The profiles of karez tunnels show that the karez diggers tend to maintain gentle, uniform slopes in the tunnel. The area commanded by the karez systems is fairly level and farmers have divided the cultivated area into small bunded units to facilitate the irrigation. There are many long and short watercourses conveying the water to different parts of command area. These meandering water courses are poorly constructed and maintained. The topographic survey maps are attached as Annex. 5-2. to 5.7.

## **5.08 WATER RIGHTS**

The data on water rights of all the karez systems selected for benchmark survey have been collected. The source of these data are the Provincial Revenue Records. The details of data include the number of shareholders, share of water in terms of time etc. These data are summarized and given in Annexure 5.8.

## CHAPTER -6

### ECONOMICS OF KAREZ IRRIGATION SYSTEM

#### 6.01 INTRODUCTION

Economic analysis of the Karez Irrigation System has been carried out with a view to establish the present levels of incomes of the farmers, they are deriving by practising karez irrigated agriculture. Analysis for individual karezes has been carried out. The values have been summed up to have an aggregate look on System's economic performance. The analysis emphasizes mainly on determining the bench mark levels of crop yield, farm costs and net agricultural benefits against the capital investment and recurring costs. For evaluation purposes, benefit cost ratio technique has been used. This technique renders all the projects as profitable where the BCR is greater than unity.

#### 6.02 METHODOLOGY

The economic analysis is based on the following methods and assumptions:

1. Farmgate prices for the year 1986-87 have been used in the analysis.
2. For Karezes falling in the same valley, a uniform level of per acre crop yields and farm costs has been assumed. Thus crop yields and farm costs have been developed for Punjpai, Khanozai & Kutchlak, Mustung and Jungle Bundat areas.
3. The wages used for various farm operations in the analysis are discussed as under:

a) Tractor

Tractor is used mainly for land preparation purposes. The rate of hiring tractor for one hour has been found ranging from Rs.60.00 to Rs.65.00. This includes the provision of driver by the owner of the tractor.

b) Manual Labour

Manual labour is applied to carryout sowing, watering, inculture, harvesting and threshing of crops. As far as the interculture of crops is concerned, a labour is paid Rs.30.00 to Rs.35.00 per day ( a day is comprised of 8

working hours as stated by the farmers). But as far as harvesting and threshing of wheat and barley is concerned, the labourers are paid in two ways. The first way is to make payments in kind and the other relates to cash payments.

In the first payment method, a labourer is asked to pick as much harvested crop from the heap as he can with the help of his open arms. This becomes his reward for that day's work. But in this case, the condition is that a labourer must harvest such quantity that after he has taken his wage, an amount must remain with the farmer more than or at least equal to the share of the labourer. In other payment method, payments are made according to the prevailing wage rates, and farmers generally tend to adopt this method in case of all other crops except for food crops.

4. Labour (whether family or hired) has been rewarded on existing wage rates.
5. Produce as a whole has been treated in the analysis and home consumed produce has been neglected.
6. Orchard produce is assumed to be marketed by the farmer himself.
7. For all karezes falling in the same valley, a uniform level of per acre crop yields and farm inputs has been assumed.

### **6.03 CROP YIELD & PRODUCTION**

Per acre crop yield is an important factor which indicates the efficiency and quality of farming business. Yield per acre is influenced by a number of factors such as quality of soils, cultural practices, quantity of inputs and their timely use, and above all the availability of irrigation water. Crop yields as obtained by the farmers were recorded during the bench mark survey and are given in Table 6.1. It may be mentioned that no major variation in respect of per acre crop yields was found in the study areas.

Crop production is obtained by multiplying the per acre yield with acreage of respective crop. Crop production in the study areas is furnished in Table 6.2.

Table 6.1

## CROP YIELDS

(Kgs/Acre)

Crops	Punjpai Area	Khanozai & Kutchlak Areas	Mustung Area	Ziarat Area
Wheat	448	475	495	525
Barley	374	395	-	350
Cumin	187	-	-	-
Alfalfa	11974	9000	6730	6500
Fodders	-	7000	-	-
Onion	7403	-	6356	-
Potato	-	4397	3272	-
Tobacco	-	775	-	-
Carrot	-	-	4543	-
Turnip	-	-	5608	-
Apples	-	5608	5500	11000
Apricots	-	-	6000	-
Grapes	-	-	4100	-
Pears	-	-	-	5000
Plums	-	-	-	6600
Mulbery	-	-	3200	-

## CROP PRODUCTION

Table 6.2

(000 Kgs)

CROPS	Name of Karezes											
	Abdul Hakim	Khano-zai	Balozai	Sahib	Sahib-zada	Tor Daman	Jalogir	Ishkana	Mayana	Kalan	Kundki	Jungle Bundat
Wheat	5.46	11.04	22.68	12.59	4.75	5.94	5.59	25.24	11.38	46.53	-	0.53
Barley	0.91	0.79	-	0.20	-	-	-	-	-	-	-	0.18
Cumin	0.82	-	-	-	-	-	-	-	-	-	-	-
Alfalfa	46.70	44.10	0.45	-	-	-	-	302.85	6.73	336.50	201.90	3.25
Fodders	-	94.50	-	-	-	-	-	-	-	-	-	-
Onion	119.04	-	-	-	-	-	-	635.60	44.49	953.40	108.05	-
Potato	-	17.06	-	1.10	20.01	2.20	-	32.72	-	-	-	-
Tobacco	-	28.53	37.32	1.55	4.35	2.94	-	-	-	-	-	-
Carrot	-	-	-	-	-	-	-	90.86	4.54	-	-	-
Turnip	-	-	-	-	-	-	-	162.63	5.61	-	-	-
Apples	-	153.94	75.15	81.32	-	43.46	74.19	104.50	-	357.50	605.00	77.00
Apricots	-	-	-	-	-	-	-	60.00	-	162.00	210.00	-
Grapes	-	-	-	-	-	-	-	-	-	57.40	-	-
Pears	-	-	-	-	-	-	-	-	-	-	-	2.50
Plums	-	-	-	-	-	-	-	-	-	-	-	3.30
Mulberry	-	-	-	-	-	-	-	99.20	-	-	25.60	-

#### 6.04 MARKETING OF PRODUCE

The bench mark survey of the karezes revealed that farmers tend to go to Quetta market for the disposal of their agricultural produce. Similarly they bring the requisite farm inputs from Quetta. Data were obtained through interviews to determine the extent of marketing costs of various agricultural commodities. On the project basis, the following ratios emerged. These ratios include the expenditure incurred by the farmers to bring their produce to Quetta on loading, unloading, transportation, octroi, payment to commission agent and other petty payments.

<u>Agri.Commodity(Outputs)</u>	<u>Marketing Margin</u>
Tobacco	25%
Potato	33%
Onion	20%
Cumin	11%
Vegetables	20%
Orchards	30%
Cereals	16%
Fodders	10%
<u>Inputs</u>	
Fertilizers	7%
F.Y.M.	14%
Insecticides/pesticides	2%

#### 6.05 PRICES OF AGRICULTURAL COMMODITIES AND FARM INPUTS

The survey was conducted to collect data in respect of prices of agricultural commodities received by the farmers. Sometimes, a farmer was unable to report any reasonable figure while some were reluctant to provide any information on this aspect. In this situation reliance had to be made on the secondary sources. Consequently, the price data were collected from the Economics & Marketing Directorate, Agri. Department, Government of Baluchistan, Quetta and from the office of Market Committee, Quetta. These data

were reviewed and processed in the light of available information from the farmers.

The farmers income has been computed on the basis of farmgate prices. To arrive at the farmgate prices, marketing margins, given earlier, have been deducted from the whole-sale market prices. Farmgate prices used in the calculations of income values are exhibited in Table 6.3.

#### **6.06 FARM INCOMES:**

The estimation of farm incomes helps in determining the levels of efficiency of farm business with particular reference to some inputs in point. Karez water is that very input in this study. All the benefits emerging as a result of using karez water and costs being incurred to keep the karez water running will be taken into consideration.

#### **6.07 GROSS VALUE OF PRODUCTION**

Gross value of production(GVP) is estimated by multiplying the per acre crop yields (Ref. Table 6.1) with the acreage (Ref. Table 4.12-4.16) of respective crops. It provides an estimation of income in which all the expenditure incurred on raising of crops are included.

#### **6.08 FARM COSTS**

The farm costs are comprised of two main items, i.e. fixed and variable. Fixed costs are those costs which a farmer has to bear whether or not he cultivates some crop. These expenses are incurred on purchase/repairs of farm implements, hand tools, etc. In the present analysis, these were adopted from the feasibility reports of various irrigation schemes, prepared by this Directorate for Baluchistan.

Variable costs represent those costs/items which are subject to change with any change in the volume of farming business. These include the expenditure incurred on seed, fertilizers, farm yard manure, plant protection, farm power, manual labour and other petty items. Per acre and total farm costs are exhibited as in Tables 6.4 and 6.5, respectively for the study areas.

#### **6.09 NET VALUE OF PRODUCTION**

Net value of production (NVP) is arrived at by subtracting the farm costs from the GVP. It represents the net income which a farmer receives after meeting all expenditures incurred by him on raising the crops. Karez-wise and aggregate GVPs, farm costs and NVPs are provided in Table No.6.6. Annexure 6-1 provides details of derivation of farm incomes.

Table 6.3

## FARM GATE PRICES

Crops/Items	Market Price (Rs/Ton)	Crop Prices		Seed Prices	
		Marketing Margins (Rs/Ton)	Farmgate Price (Rs/Ton)	Per Ton (Rs.)	Per Kg. (Rs.)
<b>GENERAL CROPS</b>					
Tobacco	13000	2600	10400	13520	13.52
Wheat	3840	538	3302	3632	3.63
Barley	3800	532	3268	3595	3.59
Cumin	36000	3600	32400	35640	35.64
<b>VEGETABLE CROPS</b>					
Potato	3600	612	2988	3510	3.51
Onion	5000	850	1450	70000	70.00
Turnip	2915	495	2420	80000	80.00
Carrot	2973	505	2468	90000	90.00
<b>ORCHARDS</b>					
Apples	1280	2944	9856	-	15/Plant
Apricots	8000	1840	6160	-	12/Plant
Grapes	10000	2300	7700	-	2/Stick
Pears	5200	1196	4004	-	12/Plant
Plums	4800	1104	3696	-	12/Plant
Mulberry	8000	1840	6160	-	10/Plant
<b>FODDER CROPS</b>					
Alfalfa & other Fodders	1200	120	1080	33480	33.48
<b>INPUTS</b>					
Nitrogeneous, Fertilizers (Urea)	128/Bag	10/Bag	138/Bag		6/N.Kg
Phosphatic Fertilizers (DAP)	133/Bag	10/Bag	143/Bag		3.87/N.Kg
Farm Yard Manure	1500/T.load	250/T.load	1750/T.load		
Insecticides/ Pesticides	350/Litre	5/Ltr.	352/Ltr.		

PER ACRE FARM COSTS - PUNJPAI AREA

Items	Unit	Crops					
		Alfalfa	Onion	Wheat	Barley	Cumin	
Seed	Quantity	Kgs	8.00	5.50	28.00	25.00	24.00
	Unit Rate	Rs/Kg	33.48	70.00	3.63	3.50	35.64
	Cost	Rs/Acre	267.84	385.00	98.00	87.50	855.36
Fertilizers	Nitrogeneous	Kgs	-	101.00	32.00	46.00	16.00
	Unit Rate	Rs/Kg	-	6.00	6.00	6.00	6.00
	Cost 'N'	Rs/Acre	-	606.00	192.00	276.00	96.00
	Phosphorous	Kgs	-	23.00	23.00	-	11.00
	Unit Rate	Rs/Kg	-	3.87	3.87	-	3.87
	Cost 'P'	Rs/Acre	-	89.01	89.01	-	42.57
	Potashic	Kgs	-	-	-	-	-
	Unit Rate	Rs/Kg	-	-	-	-	-
	Cost 'K'	Rs/Acre	-	-	-	-	-
	Total 'N,P,K'	Rs/Acre	-	695.01	281.01	276.00	138.57
Farm Yard Manure	Quantity	Truck load	1.00	1.00	-	-	-
	Unit Rate	Rs/Load	1,750.00	1,750.00	-	-	-
	Cost	Rs/Acre	1,750.00	1,750.00	-	-	-
Plant- Protection	Quantity	Litres	-	-	-	-	-
	Unit Rate	Rs/Ltr	-	-	-	-	-
	Cost	Rs/Acre	-	-	-	-	-
Farm power	Tractor Hours	No.	2.00	3.00	2.00	2.00	2.00
	Unit Rate	Rs/Hr	60.00	60.00	60.00	60.00	60.00
	Cost	Rs/Acre	120.00	180.00	120.00	120.00	120.00
Manual Labour	Mandays	No.	25.00	42.00	18.00	15.00	9.00
	Unit Rate	Rs/Day	35.00	35.00	35.00	35.00	35.00
	Cost	Rs/Acre	875.00	1,470.00	630.00	525.00	315.00
Fixed Costs		Rs/Acre	248.00	168.00	150.00	125.00	125.00
Total Costs		Rs/Acre	3,260.00	4,648.01	1,279.01	1,133.50	1,553.93
Misc. Costs	@ 2 Percent of Total Costs	Rs/Acre	65.22	92.96	25.58	22.67	31.08
Grand Total		Rs/Acre	3,326.06	4,740.97	1,304.59	1,156.17	1,585.01

PER ACRE FARM COSTS - KHANOZAI AND KUTCHLAK AREAS

Table 6.4  
Page 2 of 5

Items	Unit	Crops							
		Tobacco	Potato	Alfalfa	Apples	Wheat	Barley	Fodder	
Seed	Quantity	Kgs	0.02	394.00	7.00	90.00	30.00	29.00	30.00
	Unit Rate	Rs/Acre	13.52	3.51	33.48	15.00	3.63	3.50	1.19
	Cost	Rs/Acre	0.27	1382.94	234.36	1350.00	108.90	101.50	35.00
Fertilizers	Nitrogeaneous	Kgs	29.00	55.00	-	133.00	30.00	30.00	-
	Unit Rate	Rs/Kg	6.00	6.00	-	6.00	6.00	6.00	-
	Cost 'N'	Rs/Acre	174.00	330.00	-	798.00	180.00	180.00	-
	Phosphorous	Kgs	11.00	23.00	-	89.00	18.00	-	-
	Unit Rate	Rs/Kg	3.87	3.87	-	3.87	3.87	-	-
	Cost 'P'	Rs/Acre	42.57	89.01	-	344.43	69.66	-	-
	Potashic	Kgs	-	-	-	-	-	-	-
	Unit Rate	Rs/Kg	-	-	-	-	-	-	-
	Cost 'K'	Rs/Acre	-	-	-	-	-	-	-
	TOTAL 'N' P, K'	Rs/Acre	-	216.57	419.01	-	1142.43	249.66	180.00
Farm Yard Manure	Quantity	Truck Load	-	-	1.00	1.00	1.00	-	-
	Unit Rate	Rs/Load	-	1750.00	1750.00	1750.00	-	-	-
	Cost	Rs/Acre	-	1750.00	1750.00	1750.00	-	-	-
Plant Protection	Quantity	Litres	-	-	-	-	-	-	-
	Unit Rate	Rs/Ltr	-	-	-	-	-	-	-
	Cost	Rs/Acre	-	-	-	-	-	-	-
Farm Power	Tractor Hours	No.	3.00	3.00	2.00	4.00	2.00	2.00	2.00
	Unit Rate	Rs/Hr	60.00	60.00	60.00	60.00	60.00	60.00	60.00
	Cost	Rs/Acre	180.00	180.00	120.00	240.00	120.00	120.00	120.00
Manual Labour	Mandays	No.	28.00	30.00	23.00	70.00	15.00	12.00	15.00
	Unit Rate	Rs/Day	35.00	35.00	35.00	35.00	35.00	35.00	35.00
	Cost	Rs/Acre	980.00	1050.00	805.00	2450.00	525.00	420.00	525.00
Fixed Costs		Rs/Acre	125.00	125.00	248.00	248.00	150.00	125.00	100.00
Total Costs		Rs/Acre	1501.84	4906.25	3157.36	7180.43	1153.55	946.50	780.70
Misc. Costs	@ 2 Percent of Total Costs	Rs/Acre	-	30.04	98.12	63.15	143.61	23.07	18.93
Grand Total		Rs/Acre	1531.88	5004.37	3220.51	7324.04	1176.63	965.43	796.31

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PER ACRE FARM COSTS - MUSTUNG AREA

Items	Unit	Crops						
		Wheat	Onion	Potato	Carrot	Turnip	Alfalfa	
Seed	Quantity	Kgs	38.00	5.00	486.00	3.00	0.75	12.00
	Unit Rate	Rs/Kg	3.63	70.00	3.51	90.00	80.00	33.48
	Cost	Rs/Acre	137.94	350.00	1705.86	270.00	60.00	401.76
Fertilizer	Nitrogeneous	Kgs	32.00	110.00	73.00	55.00	55.00	32.00
	Unit Rate	Rs/kg	6.00	6.00	6.00	6.00	6.00	6.00
	Cost 'N'	Rs/Acre	192.00	660.00	438.00	330.00	330.00	192.00
	Phosphorous	Kgs	23.00	92.00	138.00	23.00	23.00	23.00
	Unit Rate	Rs/Kg	3.87	3.87	3.87	3.87	3.87	3.87
	Cost 'P'	Rs/Acre	89.01	356.04	534.06	89.01	89.01	89.01
	Potasshic	Kgs	-	-	-	-	-	-
	Unit Rate	Rs/Kg	-	-	-	-	-	-
	Cost 'K'	Rs/Acre	-	-	-	-	-	-
	Total 'N,P,K'	Rs/Acre	281.01	1016.04	972.06	419.01	419.01	281.01
Farm Yard Manure	Quantity	Truck Load	-	1.00	--	-	-	1.00
	Unit/Rate	Rs/Load	-	1750.00	-	-	-	1750.00
	Cost	Rs/Acre	-	1750.00	-	-	-	1750.00
Plant Protec- tion	Quantity	Litres	-	1.00	-	-	-	-
	Unit Rate	Rs/Ltr	-	352.00	-	-	-	-
	Cost	Rs/Acre	-	352.00	-	-	-	-
Farm Power	Tractor hrs.	Nos.	2.00	3.00	3.00	3.00	3.00	2.00
	Unit Rate	Rs/Hr	60.00	60.00	60.00	60.00	60.00	60.00
	Cost	Rs/Acre	120.00	180.00	180.00	180.00	180.00	120.00
Manual Labour	Mandays	No.	18.00	40.00	34.00	28.00	23.00	20.00
	Unit Rate	Rs/Day	35.00	35.00	35.00	35.00	35.00	35.00
	Cost	Rs/Acre	630.00	1400.00	1190.00	980.00	805.00	700.00
Fixed Costs		Rs/Acre	150.00	168.00	125.00	125.00	125.00	248.00
Total Costs		Rs/Acre	1318.95	3816.94	4172.90	1974.01	1589.01	3500.77
Misc. Costs	@ 2 percent of Total Costs	Rs/Acre	26.38	76.32	83.46	39.48	31.72	70.02
<b>Grand Total</b>		<b>Rs/Acre</b>	<b>1345.33</b>	<b>3892.36</b>	<b>4256.36</b>	<b>2013.49</b>	<b>1620.73</b>	<b>3570.79</b>

PER ACRE FARM COSTS - MUSTUNG AREA

Items	Units	Crops				
		Apples	Apricots	Grapes	Mulbery	
Seed	Quantity	Nos	100.00	190.00	300.00	100.00
	Unit Rate	Rs/Plant	15.00	12.00	2.00	10.00
	Cost	Rs/Acre	1500.00	2280.00	600.00	1000.00
Fertilizers	Nitrogeaneous	Kgs	240.00	55.00	55.00	-
	Unit Rate	Rs/Kgs	6.00	6.00	6.00	-
	Cost 'N'	Rs/Acre	1440.00	330.00	330.00	-
	Phosphorous	Kgs	120.00	23.00	23.00	-
	Unit Rate	Rs/Kg	3.87	3.87	3.87	-
	Cost 'P'	Rs/Acre	464.40	89.01	89.01	-
	Potasshic	Kgs	-	-	-	-
	Unit Rate	Rs/Kg	-	-	-	-
	Cost 'K'	Rs/Acre	-	-	-	-
	Total 'N,P,K'	Rs/Acre	1904.40	419.01	419.01	-
Farm Yard Manure	Quantity	Truck Load	1.00	1.00	4.00	2.00
	Unit Rate	Rs/Load	1750.00	1750.00	1750.00	1750.00
	Cost	Rs/Acre	1750.00	1750.00	7000.00	3500.00
Plant Protection	Quantity	Litres	2.00	-	2.00	-
	Unit Rate	Rs/Litre	352.00	-	352.00	-
	Cost	Rs/Acre	704.00	-	704.00	-
Farm Power	Tractor Hrs.	No.	4.00	4.00	4.00	4.00
	Unit Rate	Rs/Hr.	60.00	60.00	60.00	60.00
	Cost	Rs/Acre	240.00	240.00	240.00	240.00
Manual Labour	Mandays	No.	95.00	79.00	80.00	20.00
	Unit Rate	Rs/Day	35.00	35.00	35.00	35.00
	Cost	Rs/Acre	3325.00	2765.00	2800.00	700.00
Fixed Costs		Rs/Acre	248.00	248.00	248.00	248.00
Total Costs		Rs/Acre	9671.40	7702.01	12011.01	4988.00
Misc. Costs	@ 2 percent of total costs	Rs/Acre	193.43	154.04	240.22	99.76
Grand Total		Rs/Acre	9864.83	7856.05	12251.23	5787.76

PER ACRE FARM COSTS - JUNGLE BUNDAT

Items		Unit	Crops					
			Wheat	Barley	Alfalfa	Apples	Pears	Pi
Seed	Quantity	Kgs	35	30	8	100	110	110
	Unit Rate	Rs/Kg	3.63	3.50	33.48	15	12	12
	Cost	Rs/Acre	127.05	105	267.84	1500	1320	1320
Fertilizers	Nitrogeeous	Kgs	32	30	-	120	55	55
	Unit	Rs/Kg	6.00	6.00	-	6.00	6.00	6.00
	Cost 'N'	Rs/Acre	192	180	-	720.00	330.00	330.00
	Phosphorous	Kgs	18	-	-	85	23	23
	Unit Rate	Rs/Kg	3.87	-	-	3.87	3.87	3.87
	Cost 'P'	Rs/Acre	69.66	-	-	328.95	89.01	89.01
	Potashic	Kgs	-	-	-	-	-	-
	Unit Rate	Rs/Kg	-	-	-	-	-	-
	Cost 'K'	Rs/Acre	-	-	-	-	-	-
	Total 'N,P,K'	Rs/Acre	261.66	180	-	1048.95	419.01	419.01
Farm Yard	Quantity	Truck Loads	-	-	1	1	1	1
	Unit Rate	Rs/Load	-	-	1750	1750	1750	1750
	Cost	Rs/Acre	-	-	1750	1750	1750	1750
Plant protection	Quantity	Litres	-	-	-	3	1	1
	Unit Rate	Rs/Ltr.	-	-	-	352	352	352
	Cost	Rs/Acre	-	-	-	1056	352	352
Farm Power	Tractor/Hrs	No.	2	2	2	4	4	4
	Unit Rate	Rs/Hr.	60	60	60	60	60	60
	Cost	Rs/Acre	120	120	120	240	240	240
Manual Labour	Man days	No.	18	14	25	80	75	78
	Unit Rate	Rs/Day	35	35	35	35	35	35
	Cost	Rs/Acre	630	490	875	2800	2625	2730
Fixed Costs		Rs/Acre	150	125	248	248	248	248
Total Costs		Rs/Acre	1288.71	1020	3260.84	8642.95	6954.01	7059.01
Misc. Costs	@ 2% of Total cost	Rs/Acre	25.77	20.4	65.22	172.86	139.08	141.18
Grand Total		Rs/Acre	1314.48	1040.4	3226.06	8815.81	7093.09	7200.19

BEST AVAILABLE DOCUMENT

TOTAL FARM COSTS - PUNJPAI AREA KAREZES  
(KAREZ ABDUL HAKIM)

Crops	Per Acre Cost	Acreage	Total Costs
Alfalfa	3,326.00	3.90	12,971.63
Onion	4,740.97	16.08	76,234.80
Wheat	1,304.59	12.19	15,902.95
Barley	1,156.17	2.44	2,821.05
Cumin	1,585.01	4.39	6,958.19
TOTAL		39.00	1,14,888.62

Note: Costs figures in rupees.

TOTAL FARM COSTS - KHANOZAI AREA KAREZES

Crops	Per Acre Costs	Khanozai		Baiozai		Sanib Khanozai		Sanib Baiozai		Sanibzada		Tordaman	
		Acr- eage	Total Costs	Acr- eage	Total Costs	Acr- eage	Total Costs	Acr- eage	Total Costs	Acr- eage	Total Costs	Acr- eage	Total Costs
Tobacco	1531.88	36.81	56383.50	48.16	73775.34	1.00	1531.88	1.00	1531.88	5.83	8624.48	3.80	5821.14
Potato	5004.37	3.86	19416.95	-	-	-	-	0.25	1251.09	4.55	22769.88	0.50	2502.18
Alfalfa	3220.51	4.90	15760.50	0.05	161.03	-	-	-	-	-	-	-	-
Apples	7324.04	27.45	201044.89	13.40	96142.13	5.35	39183.61	9.15	37014.98	-	-	7.75	56761.31
Wheat	1176.63	23.25	27356.65	47.75	56184.08	12.50	14707.57	14.00	16472.82	10.00	11766.30	12.50	14707.37
Barley	965.43	2.00	1930.86	-	-	0.50	462.71	-	-	-	-	-	-
Forage	796.31	13.50	10750.18	-	-	-	-	-	-	-	-	-	-
Total	-	111.79	332668.53	109.36	223262.53	19.35	55306.07	24.40	36270.77	20.18	-3160.66	24.55	79792.50

Note: Costs figures in rupees.

BEST AVAILABLE DOCUMENT

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TOTAL FARM COSTS-KUTCHLAK AREA KAREZES  
(KAREZ JALOGIR)

Crops	Costs Per Acre	Acreage	Total Costs
Wheat	1,176.63	11.76	13,837.17
Garden Apple	7,324.04	13.23	96,897.05
Total		24.99	110,734.22

Note: Costs figures in rupees.

**TOTAL FARM COSTS - MUSTUNG AREA KAREZES**

Crops	Per Acre Costs	Mayana Karez		Ishkana Karez		Kalan Karez		Kundki Karez	
		Acre-age	Total Costs	Acre-age	Total Costs	Acre-age	Total Costs	Acre-age	Total Costs
Wheat	1345.33	23	30,942.59	51	68,611.83	94	126,461.02	-	-
Onion	3892.36	7	27,246.52	100	389,236.00	150	583,854.00	17	66,170.12
Potato	4256.36	-	-	10	42,563.60	-	-	-	-
Carrot	2013.49	1	2,013.49	20	40,269.80	-	-	-	-
Turnip	1620.73	1	1,620.73	29	47,001.17	-	-	-	-
Alfalfa	3570.79	1	3,570.79	45	160,685.55	50	178,539.50	30	107,123.70
Apples	9864.83	-	-	19	187,431.77	65	641,213.95	110	1085,131.30
Apricots	7856.05	-	-	10	78,560.50	27	212,113.35	35	274,961.75
Grapes	12251.23	-	-	-	-	14	171,517.22	-	-
Mulbery	5787.76	-	-	31	179,420.57	-	-	8	46,302.08
	-	33	65,394.12	315	1193,780.70	400	1913,699.04	200	1579,688.95

Note: Costs figures in rupees.

TOTAL FARM COSTS - ZIARAT AREA KAREZES  
(KAREZ JUNGLE BUNDAT)

CROPS	Per Acre Costs	Acreage	Total Costs
Wheat	1314.48	1.25	1643.10
Barley	1040.40	0.50	520.20
Alfalfa	3326.06	0.50	1663.03
Apples	8815.81	67.00	1710.67
Pears	7093.09	0.50	3546.55
Plums	7200.19	0.50	3600.10
TOTAL	-	10.25	72683.65

Note: Costs figures in rupees.

Table 6.6

**GROSS VALUE OF REDUCTION, FARM COSTS  
AND NET VALUE OF PRODUCTION**

Sr. No.	Name of karez	G. V. P.	Farm Costs	N.V.P
1.	Abdul Hakim	592.03	114.88	477.15
2.	Khanozal	2054.26	332.67	1721.59
3.	Balozai	1204.43	228.26	976.17
4.	Sahib	863.42	142.17	721.25
5.	Sahibzada	120.85	43.16	77.69
6.	Tor Daman	485.27	79.79	405.48
7.	Jalogir	749.96	110.74	639.22
8.	Ishkana	5774.96	1193.77	4581.19
9.	Mayana	254.24	65.39	188.85
10.	Kalan	9438.43	1913.70	7524.73
11.	Kundki	8083.05	1579.60	6503.36
12.	Jungle Bundat	787.28	72.68	714.60
<b>TOTAL</b>		<b>30408.18</b>	<b>5876.90</b>	<b>24531.28</b>

## 6.10 COSTS OF KAREZ SYSTEM

The basic required information to calculate the costs of a karez is its physical measurements of the various components. The actual field measurements as collected by the Project personnel are used for the present analysis.

### 1. Capital Costs

Detailed discussions were held with the people who were directly involved in the construction, rehabilitation or cleaning works of the karezes to collect the costs of the system. On the basis of these discussions the following results were derived to form the basis of calculating the capital cost of the project.

#### PER UNIT COSTS

##### a) Tunnel & Well Construction

- Length of tunnel dug/day(ft.)	3
- Depth of well dug/day(ft.)	6
- Labour employed (persons)	
Skilled	2
Unskilled	3
- Wage Rate (Rs./Day)	
Skilled	80.00
Unskilled	50.00
Total costs of construction(Rs)	310.00
- Cost of construction/ft. of tunnel (Rs.)	105.00
- Cost of construction/ft. of well (Rs.)	55.00

b) Open Channel Construction

- Length dug/day (ft.)	6
- Labour employed (person)	3 (Unskilled)
- Wage rate (Rs./day)	50.00
Total Cost(Rs.)	150.00
Cost/ft. (earthen)	Rs. 25.00
Cost/ft. (concrete)	Rs. 50.00

On the basis of above mentioned per unit rates, total costs of each karez have been determined by multiplying the length of tunnel, wells and open channel with the respective per unit cost. During the survey, it was observed that almost each karez has a water tank and some have concrete built tanks. A lump sum provision for this item was also shown in the capital costs calculation i.e. Rs.4000.00 and Rs.25,000.00 for earthen and concrete built tanks, respectively. Capital cost of each individual karez and the total sample are given in Table 6.7.

**2. Cleaning Costs**

Maintenance of karez is the major activity carried out by the share holders. It is necessary to keep the karez running, otherwise the tunnel of karez may get choked due to lack of proper cleaning. The following per unit costs of cleaning the karez were determined on the basis of discussions held with the persons who were directly involved in this work.

a) Tunnel Cleaning

- Average length between the two wells (ft.)	80
- Labourers required to clean one well and the tunnel between the two wells.	5 (2 Skilled and 3 unskilled)
- Days required	3
- Total man days	15 (6 skilled, 9 unskilled)

Table 6.7

## CAPITAL COSTS OF KAREZES

(000 Rs)

Name of Karez	Component Costs				Total Costs
	Tunnel	Wells	Open Channel	Water Tank	
Abdul Hakim	839.05	99.33	42.50	4.00	984.88
Khanozai	1523.76	631.84	46.80	4.00	2206.40
Balozai	439.32	67.21	198.00	4.00	708.53
Sahib	446.88	141.62	38.97	4.00	631.47
Sahibzada	1545.18	418.27	40.00	4.00	2007.45
Tor Daman	628.53	102.85	11.65	25.00	768.03
Jalogir	361.62	86.38	330.00	4.00	784.00
Ishkana	951.30	548.13	3.25	25.00	1527.68
Mayana	294.42	102.19	132.00	4.00	532.61
Kalan	913.08	707.52	47.25	4.00	1671.85
Kundki	1110.48	572.66	256.07	4.00	1943.21
Jungle Bundat	196.87	66.00	65.00	25.00	352.87
<b>TOTAL</b>	<b>9250.49</b>	<b>3546.00</b>	<b>1211.49</b>	<b>111.00</b>	<b>14118.98</b>

-	<b>Wage Rates:</b>	
	Skilled (Rs./day)	80
	Unskilled(Rs./day)	50
-	Cost of cleaning 80 ft. of karez length (Rs.)	930
-	Per ft. cost of cleaning of wells portion	11.63
b)	<u>Open Channel Cleaning</u>	
-	Length of channel(ft.)	5280
-	Labourers employed (including pond cleaning, Nos.)	10 (unskilled)
-	Days required	60
-	Total man days	600
-	Wage Rate (Rs./day)	50
-	Total cost of cleaning 5280 ft. of open channel(Rs.)	30,000
-	Cost of cleaning one ft. of open channel(Rs)	5.68

Based on these per unit costs, the cleaning costs of individual karez and the total sample are given in Table 6.8.

### 3. Annual Costs

The useful life of a karez, as revealed by the karez owners is that period during which, generally, no major rehabilitation works are to be undertaken to keep the water running. This period is determined to be about 30 years by the farmers on the basis of their experience. The capital cost has been annualized over the karez's useful life at 12% rate of interest.

### 4. Recurring Costs

The annualized costs were added to the karez cleaning costs to arrive at the recurring costs of the karez. Table No.6.9 furnishes details of these costs.

Table 6.8

## CLEANING COSTS OF KAREZES

(000 Rs)

Name of Karez	Component Costs		Total Costs
	Wells Portion	Open Channel (including Tank)	
Abdul Hakim	92.93	9.66	102.59
Khanozai	168.77	10.63	179.40
Balozai	48.66	44.99	93.65
Sahib	49.50	8.85	58.35
Sahibzada	171.15	9.09	180.24
Tor Daman	69.62	1.32	70.94
Jalogir	40.05	74.98	115.03
Ishkana	105.37	0.37	105.74
Mayana	32.61	29.99	62.60
Kalan	101.13	10.73	111.86
Kundki	123.00	58.18	181.18
Jungle Bundat	21.81	7.38	29.29
<b>TOTAL</b>	<b>1024.00</b>	<b>266.17</b>	<b>1290.17</b>

Table 6.9

## RECURRING COSTS

(000 Rs)

Name of Karez	Annual Costs @ 12%	Cleaning and Maintenance costs	Recurring Costs
Abdul Hakim	122.27	102.53	224.86
Khanozai	273.91	179.40	453.31
Balozai	87.96	93.65	181.61
Sahib	78.39	58.35	136.74
Sahibzada	249.21	180.24	429.45
Tor Daman	95.35	70.94	166.29
Jalogir	97.33	115.03	212.36
Ishkana	189.65	105.74	295.39
Mayana	66.12	62.60	128.72
Kalan	207.55	111.86	319.41
Kundki	241.24	181.18	422.42
Jungle Bundat	43.81	29.29	73.10
<b>TOTAL</b>	<b>1752.79</b>	<b>1290.87</b>	<b>3043.66</b>

## **6.11 BENEFITS AND COSTS OF WATER PER UNIT**

The bench mark values in respect of benefits and costs per acre ft. of karez water are discussed hereunder :

### **1. Benefits**

Benefits per acre ft. of water have been arrived at by dividing the net income obtained (as a result of use of this water for irrigation purposes) by the quantity of water supplied by the karezes. Total benefits of the sample karezes work out to be Rs.24531.28 thousand. Total water availability per annum from the sample karezes stood at 2646 acre ft. and the resultant figure of benefits per acre ft. of water worked out as Rs.9271/-.

### **2. Costs**

Total recurring costs of the karezes under study amounted to Rs.3043.66 thousand. By dividing this figure to the annual availability of water of 2646 acre ft., the cost per acre ft. of water comes to Rs.1150/-.

## **6.12 BENEFIT COST RATIO**

BCR is an analysis technique which establishes the feasibility/viability of a project/system. If a project is rendered as viable, its BCR must be equal to or more than unity. The BCR for the project (Karez Irrigation System - sample karezes) calculates as 8:1 which shows that the karez irrigated agriculture is highly remunerable. If the steps are undertaken on the basis of results of research being undertaken to improve the efficiency of the system, the BCR may show further improvements, thus guaranteeing a better future of the economy of individual farmer , and of the country. Karezwise and aggregate analysis is shown in Table 6.10.

## **6.13 INCOME OF THE BENEFICIARIES**

It is of vital importance to have an idea of the income of the various beneficiary units of the system. For this purpose, four units, viz. population, number of house-holds, area irrigated and culturable area of the whole sample have been taken into consideration. The results of the analysis are as under :

Table 6.10

## PER UNIT BENEFITS, COSTS AND BENEFIT COST RATIO

Name of Karez	Annual Discharge (AF)	Benefits		Costs		B.C.R.
		Total (000 Rs.)	Per Acre foot Rs.	Total (000 Rs)	Per Acre foot (Rs.)	
Abdul Hakim	122.86	477.15	3883.69	224.86	1830.21	2.12:1
Khanozai	487.48	1721.59	3531.61	453.31	929.90	3.80:1
Balozai	288.48	976.17	3383.84	181.61	629.54	5.37:1
Sahib	231.00	721.25	3122.29	136.74	591.95	5.28:1
Sahibzada	44.00	77.69	1765.68	429.45	9760.23	0.18:1
Tor Daman	185.13	405.48	2190.24	166.29	898.23	2.44:1
Jalogir	143.00	639.22	4470.07	212.36	1485.03	3.01:1
Ishkana	565.75	4581.19	8097.55	295.39	522.12	15.50:1
Mayana	97.50	188.85	1936.92	128.72	1320.21	1.47:1
Kalan	224.04	7524.73	33586.55	319.41	1425.68	23.57:1
Kundki	245.72	6503.36	26466.55	422.42	1719.11	15.40:1
Jungle Bundat	11.00	714.60	64964.64	73.10	6645.45	9.78:1
<b>TOTAL</b>	<b>2645.96</b>	<b>24531.28</b>	<b>9271.22</b>	<b>3043.66</b>	<b>1150.30</b>	<b>8.06:1</b>

-	Total benefits(000 Rs)	24531.28
-	Total population(persons)	14841
-	Income/person (Rs.)	1652.00
-	Total Number of House-hold(No)	1238
-	Income/house-hold (Rs.)	19815.00
-	Total Area Irrigated (Acres)	1561
-	Income/Acre irrigated (Rs.)	15715.00
	Total Culturable Area (Acres)	4569
	Income/Acre of Culturable Area (Rs.)	5369.00

## CHAPTER - 7

### CONCLUSIONS AND RESEARCH NEEDS

Based on the data/information collected during the bench-mark study, following conclusions were reached and a list of the problems requiring research was prepared.

#### 7.01 CONCLUSIONS

1. Water loss in the open channels conveying water from the karez daylight point to the command area is in the range of 24 % to 64 % per 1000 ft. length of channel and on an average it comes to 36%.
2. Length of karez varies from 2804 ft. to 14716 ft. with an average length of 3835 ft.
3. Number of access wells on a karez range from 15 to 138 and on average 34 wells.
4. The depth of access wells ranges from 24 ft. to 134 ft. and averaged 31 ft.
5. Number of yielding wells usually range between 1 to 5 on a karez.
6. Karez owners tend to cap the wells and maintain the cross-section of the karez tunnel using conventional techniques.
7. Annual cleaning and maintenance costs vary from new to old karezes.
8. Average annual cleaning cost ranges from Rs. 80,000 to Rs.150,000.
9. Fluctuation in ground water table and consequently in discharge is a major problem faced by the karez owners.
10. Managerial practices vary from Pathan inhabited areas to Baluch inhabited areas.
11. Traditional cropping patterns are being followed.

## 7.02 PROBLEMS NEEDING RESEARCH

Research on following problems related to karez irrigation is recommended.

1. Materials, types and methods for lining karez tunnels and feasibility of tunnel lining need to be investigated.
2. Techniques for increasing the discharge of a karez by increasing the groundwater recharge should be developed.
3. A digital model of the groundwater system around a karez needs to be developed so that certain techniques may be studied with the model before performing the more costly field research.
4. Long term monitoring of discharge of selected karezes for developing the pattern of groundwater fluctuations and monitoring of water quality to assist in irrigation management decisions are recommended.
5. Setting up of meteorological stations for collecting the hydrometrological data of selected karezes would be beneficial to correlate the effect of rain on karez discharge.
6. Practical methods need to be developed for measuring the losses in the karez tunnels.
7. Experimental capping of karez wells to determine its effect on cleaning frequency is recommended.
8. Hand-boring in the yielding wells to determine its effect on karez discharge where the hydraulics permits, need to be undertaken.
9. Studies are needed to determine as to why high value/cash crops are not grown with karez water.
10. Use of modern irrigation systems such as sprinkler and drip systems should be investigated for improved water application on the fields.
11. Development of survey techniques for location of new karezes utilizing modern geophysical exploration methods such as resistivity and seismic surveys should be studied.

12. Abandonment of karezes should be studied to determine the reasons for discontinuing the use.
13. Investigate the feasibility of closing the karez to prevent discharge at times when the water is not needed.
14. Studies should be conducted to determine if surface storage of water can provide a more dependable supply than can be obtained by recharging groundwater feeding the karez.
15. In area where electrical power is available, full study is needed on the substitution of tubewell for karezes including physical, socio-economic and cultural factors.

**LIST OF OFFICIALS CONTACTED FOR IDENTIFYING THE RESEARCH  
NEEDS**

- I - Mr. Abduul Raziq Khan, Secretary, Irrigation & Power Department, Government of Baluchistan, Quetta.
- Mr. Sardar M. Sharif Khan, Secretary, Planning & Development Department, Baluchistan Office of Development Authority, Quetta.
- Mr. Zulfiqar Ali Khan, Director General, Department of Agriculture, Government of Baluchistan, Quetta.
- Mr. Mumtaz Ali Khan, Principal, Agricultural College of Baluchistan, Baleli.
- Mr. M. Raza, Deputy Secretary Technical, Irrigation and Power Department, Governemnt of Baluchistan, Quetta.
- Mr. M. Arshad, Deputy Director, Project Planning, Department of Agriculture, Government of Baluchistan, Quetta.
- II.- Mr. Badur-ud-Din, General Manager, Planning Division, WAPDA, Lahore.
- Mr. Riaz Nazir Tarer, Chief Engineer, Planning and Investigation, WAPDA, Lahore.
- Mr. Muhammad Munir, Project Director, Planning Directorate(South), Planning & Investigation Organization, WAPDA, Lahore.
- Mr. Nazar Hussain, Project Director, Hydrogeology, WAPDA, Quetta.
- Mr. Akbar Hussain Mirza, Director of Hydrology, WAPDA, Quetta.
- III.- Mr. Jim Scott, ODA, Quetta.
- Mr. Riazur Rehman, Geologist, BALAD, Turbat.
- Mr. David Birch, Design Engineer, BMIADP, Quetta.
- Mr. John Beeny, Agronomist, BMIADP, Quetta.

- Mr. Dyno Keatinge, Germ Plasma Specialist, ICARDA, Arid Zone Research Institute, Quetta.
- Mr. M. Ahmad Goheer, Secretary, Pakistan Council on Research in Water Resources, Islamabad.
- Mr. Joe Young, Territorial Officer, UNHCR, Quetta.
- Mr. Steve Kovak, USAID OFWM, Karachi.
- Mr. John Bannigan, USAID-ISM, Karachi.
- Mr. Robert Mathia, Assistant Project Development Officer, USAID, Islamabad.
- Dr. G. L. Corey, Chief of Party, ISiR, USAID, Lahore.
- Mr. John Anania, Project Officer, ISMR, USAID, Islamabad

**SUMMARY OF RESEARCH NEEDS**

**1) Karez Irrigation System:**

- a) Rehabilitation of Karezes:
  - Putting curbs around access wells and capping them to prevent erosion.
  - Cleaning methods and techniques.
- b) Karez Improvements:
  - Lining or piping of karez tunnels.
  - Piping of the infiltration area.
  - Water table or infiltration manipulation to improve the water supply to the karez.
- c) Conveyance Channel Below the Karez Outlet:
  - Lining or piping.
- d) Infiltration Galleries As New Sources.
- e) Deepening of Source Wells

**2. Sailaba Irrigation System:**

- a) Design of Diversion Structures:
  - Hydraulic design for various flows.
  - Silt control or rejection.
- b) Diversion Channels :
  - Silt handling problems.
  - Cleaning techniques.
  - Structures for diverting to banded fields.

- c) Bund Construction:
  - Construction techniques.
  - Compaction
- d) Field Layout and Organization for Best Water Handling.
- e) Khushkaba:
  - Sizing of contributing area.
  - Crop selection.
  - Machinery for Planting.
- f) Conjunctive Water Use:
  - Use of well water.

### **3. Aquifer Recharge :**

- a) On the Watershed:
  - Improved cover
  - Terracing:
    - i) Mechanical
    - ii) Plants
- b) From Nallah:
  - Water Spreading Techniques:
    - i) Zig-zag bunds.
    - ii) Low Gabions.

### **4. Flood Abatement:**

- a) Delay Action Dams
- b) Water-shed Improvement

## **5. Hydrology**

- a) Collection of existing Data.
- b) Computerization of Existing Data.
- c) Analysis of Existing Data for Rainfall and Runoff Amount and Intensity Probabilities.
- d) Evaluation, Improvement and Expansion of Present Meteorological Networks.

## **6. Water Requirements of Crops:**

- a) ET of Various Crops Under Pakistan Conditions:
  - Crops
  - Appropriate calculation methods.

## **7. Small Irrigation System Study Rehabilitation:**

- a) Physical Layout of Best Water Management:
  - Closed pipe distribution system.
  - Sprinkler
  - Drip-Trickle
  - Open lined distribution system.
- b) Institutional Changes:
  - Smaller flow rates - longer hours needed.
  - Cropping patterns.
- c) Low Cost Channel Linings:
  - Precast, fiberglass, reinforced.
- d) Re-organization.

## **8. Establishment of Irrigation Research Centre:**

Experimental outlines for the following research studies were developed.

- a) Karez Rehabilitation and Improvement.
- b) Farm Organization and Water Management for Sailaba Irrigation Systems.
- c) The Physical and Institutional Aspects of Rehabilitation of Small Irrigation Projects.
- d) Flood Abatement and Utilization of Flood Water for Groundwater Recharge

HYDROGEOLOGY PROJRCT WAPDA QUETTA  
MECHANICAL ANALYSIS

Well No. \_\_\_\_\_ Type \_\_\_\_\_

LOCATION Kariyz Abdul Hakim Lab No. 11SAMPLE NO. 1 DEPTH(FEET) \_\_\_\_\_

FIELD DESCR PTION OF THE SAMPLE \_\_\_\_\_

WT OF SAMPLE ANALYSED 100 GM ROTAR SHAKING TIME 15 MINUTES.

TYLERS TYPE	STANDARD SIZE(m.m)	SIEVES MESH	PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE PASSED
Pebbles	4.0	4	-	-	-
Granules	2.0	9	0.0	0.0	-
V.Coarse Sand	1.0	16	0.7	0.7	-
Coarse Sand	0.5	32	0.6	1.3	-
Medium	0.25	60	1.2	2.5	-
Sand	0.177	80	1.0	3.5	-
Fine	0.149	100	1.2	4.7	-
Sand	0.125	150	3.4	8.1	-
V.Fine	0.074	200	11.6	19.7	-
Sand	0.053	270	12.2	31.9	-
Silt&Clay	0.05	Below 270	68.1	100.0	-

Some values Derived from the cumulative curve.

P90 (M.M)	Q3(P75) (M.M)	P60 (M.M)	MD(P50) (M.M)	Q1(P25) (M.M)	P10 (M.M)
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SUMMARY

No.	Parameter	Name	Abbreviation Formula	Value
1.	Sorting	Quartile Deviation(QDe)	$(Q3-Q1)/2$	
		Coeff: of Sorting	$So(Q3/Q1)$	
		Log. So	$Log(Q3/Q1)$	
		Uniformity Coeff:- (Uc)	$P60/P10$	
2.	Symmetry	Skewness Sk	$Q1.Q2/Md2$	
		Log Sk	$Log(Q1.Q3/Md2)$	
3.	Peckedness	Kurtosis(K)	$(Q3-Q1)/2(P90-P10)$	

HYDROGEOLOGY PROJRCT WAPDA QUETTA  
MECHANICAL ANALYSIS

Well No. \_\_\_\_\_ Type \_\_\_\_\_

LOCATION Karez Abdul Hakim Lab No. 18SAMPLE NO 2 DEPTH(FEET) 1-2'

FIELD DESCRIPTION OF THE SAMPLE \_\_\_\_\_

WT OF SAMPLE ANALYSED 100 GM ROTAR SHAKING TIME 15 MINUTES.

TYLERS TYPE	STANDARD SIZE(m.m)	SIEVES MESH	PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE PASSED
Pebbles	4.0	4	-	-	-
Granules	2.0	9	0.0	0.0	-
V.Coarse Sand	1.0	16	0.9	0.9	-
Coarse Sand	0.5	32	0.9	1.8	-
Medium	0.25	60	2.2	4.0	-
Sand	0.177	80	1.3	5.3	-
Fine	0.149	100	1.9	7.2	-
Sand	0.125	150	4.4	11.6	-
V.Fine	0.074	200	10.5	22.1	-
Sand	0.053	270	9.3	31.4	-
Silt&Clay	0.05	Below 270	68.6	100.0	-

Some values Derived from the cumulative curve.

P90 (M.M)	Q3(P75) (M.M)	P60 (M.M)	MD(P50) (M.M)	Q1(P25) (M.M)	P10 (M.M)
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SUMMARY

No.	Parameter	Name	Abbreviation Formula	Value
1.	Sorting	Quartile Deviation(QDe)	$(Q3-Q1)/2$	
		Coeff: of Sorting	$So(Q3/Q1)$	
		Log. So	$Log(Q3/Q1)$	
		Uniformity Coeff:- (Uc)	$P60/P10$	
2.	Symmetry	Skewness Sk	$Q1.Q2/Md2$	
		Log Sk	$Log(Q1.Q3/Md2)$	
3.	Peckedness	Kurtosis(K)	$(Q3-Q1)/2(P90-P10)$	

**HYDROGEOLOGY PROJRCT WAPDA QUETTA**  
**MECHANICAL ANALYSIS**

Well No. \_\_\_\_\_ Type \_\_\_\_\_  
 LOCATION Karez Abdul Hakim Lab No. 19  
 SAMPLE NO. 3 DEPTH(FEET) 2-3'  
 FIELD DESCRIPTION OF THE SAMPLE \_\_\_\_\_  
 WT OF SAMPLE ANALYSED 100 GM ROTAR SHAKING TIME 15 MINUTES.

TYLERS TYPE	STANDARD SIZE(m.m)	SIEVES MESH	PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE PASSED
Pebbles	4.0	4	-	-	-
Granules	2.0	9	0.0	0.0	-
V.Coarse Sand	1.0	16	9.0	9.0	-
Coarse Sand	0.5	32	7.6	16.6	-
Medium Sand	0.25	60	6.3	22.9	-
Sand	0.177	80	2.6	25.5	-
Fine Sand	0.149	100	2.7	28.2	-
Sand	0.125	150	5.3	33.5	-
V.Fine Sand	0.074	200	13.5	47.0	-
Sand	0.053	270	10.0	57.0	-
Silt&Clay	0.05	Below 270	43.0	100.0	-

Some values Derived from the cumulative curve.

P90 (M.M)	Q3(P75) (M.M)	P60 (M.M)	MD(P50) (M.M)	Q1(P25) (M.M)	P10 (M.M)

**SUMMARY**

No.	Parameter	Name	Abbreviation Formula	Value
1.	Sorting	Quartile Deviation(QDe)	$(Q3-Q1)/2$	
		Coeff: of Sorting	$So(Q3/Q1)$	
		Log. So	$Log(Q3/Q1)$	
		Uniformity Coeff:- (Uc)	$P60/P10$	
2.	Symmetry	Skewness Sk	$Q1.Q2/Md2$	
		Log Sk	$Log(Q1.Q3/Md2)$	
3.	Peckedness	Kurtosis(K)	$(Q3-Q1)/2(P 90-P 10)$	

HYDROGEOLOGY PROJRCT WAPDA QUETTA  
MECHANICAL ANALYSIS

Well No. \_\_\_\_\_ Type \_\_\_\_\_  
 LOCATION Karez Abdul Hakim Lab No. 20  
 SAMPLE NO 4 DEPTH(FEET) 3-4'  
 FIELD DESCRIPTION OF THE SAMPLE \_\_\_\_\_  
 WT OF SAMPLE ANALYSED 100 GM ROTAR SHAKING TIME 15 MINUTES.

TYLERS TYPE	STANDARD SIZE(m.m)	SIEVES MESH	PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE PASSED
Pebbles	4.0	4	-	-	-
Granules	2.0	9	0.0	0.0	-
V.Coarse Sand	1.0	16	7.4	7.4	-
Coarse Sand	0.5	32	7.6	15.0	-
Medium Sand	0.25	60	7.5	22.5	-
Sand	0.177	80	3.6	26.1	-
Fine Sand	0.149	100	3.3	29.4	-
Sand	0.125	150	6.2	35.6	-
V.Fine Sand	0.074	200	14.3	49.9	-
Sand	0.053	270	10.9	60.8	-
Silt&Clay	0.05	Below 270	39.2	100.0	-

Some values Derived from the cumulative curve.

P90 (M.M)	Q3(P75) (M.M)	P60 (M.M)	MD(P50) (M.M)	Q1(P25) (M.M)	P10 (M.M)
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SUMMARY

No.	Parameter	Name	Abbreviation Formula	Value
1.	Scrting	Quartile Deviation(QD <sub>e</sub> )	$(Q3-Q1)/2$	
		Coeff: of Sorting	$So(Q3/Q1)$	
		Log. So	$Log(Q3/Q1)$	
		Uniformity Coeff:- (U <sub>c</sub> )	$P60/P10$	
2.	Symmetry	Skewness Sk	$Q1.Q2/Md2$	
		Log Sk	$Log(Q1.Q3/Md2)$	
3.	Peckedness	Kurtosis(K)	$(Q3-Q1)^2/(P90-P10)$	

HYDROGEOLOGY PROJRCT WAPDA QUETTA  
MECHANICAL ANALYSIS

Well No. \_\_\_\_\_ Type \_\_\_\_\_

LOCATION Karez Abdul Hakim Lab No. 21

SAMPLE NO 5 DEPTH(FEET) 0-1'

FIELD DESCRIPTION OF THE SAMPLE \_\_\_\_\_

WT OF SAMPLE ANALYSED 100 GM ROTAR SHAKING TIME 15 MINUTES.

TYLERS TYPE	STANDARD SIZE(m.m)	SIEVES MESH	PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE PASSED
Pebbles	4.0	4	-	-	-
Granules	2.0	9	0.0	0.0	-
V.Coarse Sand	1.0	16	0.2	0.2	-
Coarse Sand	0.5	32	0.6	0.8	-
Medium	0.25	60	1.6	2.4	-
Sand	0.177	80	1.4	3.8	-
Fine	0.149	100	2.0	5.8	-
Sand	0.125	150	4.3	10.1	-
V.Fine	0.074	200	13.5	23.6	-
Sand	0.053	270	13.6	37.2	-
Silt&Clay	0.05	Below 270	62.8	100.0	-

Some values Derived from the cumulative curve.

P90 (M.M)	Q3(P75) (M.M)	P60 (M.M)	MD(P50) (M.M)	Q1(P25) (M.M)	P10 (M.M)
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SUMMARY

No.	Parameter	Name	Abbreviation Formula	Value
1.	Sorting	Quartile Deviation(QDe)	$(Q3-Q1)/2$	
		Coeff. of Sorting	$So(Q3/Q1)$	
		Log. So	$Log(Q3/Q1)$	
		Uniformity Coeff:- (Uc)	$P60/P10$	
2.	Symmetry	Skewness Sk	$Q1.Q2/Md2$	
		Log Sk	$Log(Q1.Q3/Md2)$	
3.	Peckedness	Kurtosis(K)	$(Q3-Q1)/2(P 90-P 10)$	

HYDROGEOLOGY PROJRCT WAPDA QUETTA  
MECHANICAL ANALYSIS

Well No. \_\_\_\_\_ Type \_\_\_\_\_

LOCATION Karez Abdul Hakim Lab No. 22SAMPLE NO 6 DEPTH(FEET) 1-2'

FIELD DESCRIPTION OF THE SAMPLE \_\_\_\_\_

WT OF SAMPLE ANALYSED 100 GM ROTAR SHAKING TIME 15 MINUTES.

TYLERS TYPE	STANDARD SIZE(m.m)	SIEVES MESH	PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE PASSED
Pebbles	4.0	4	-	-	-
Granules	2.0	9	0.0	0.0	-
V.Coarse Sand	1.0	16	5.0	5.0	-
Coarse Sand	0.5	32	6.3	11.3	-
Medium	0.25	60	4.3	15.6	-
Sand	0.177	80	1.6	17.2	-
Fine	0.149	100	1.7	18.9	-
Sand	0.125	150	3.6	22.5	-
V.Fine	0.074	200	9.8	32.3	-
Sand	0.053	270	9.9	42.2	-
Silt&Clay	0.05	Below 270	57.8	100.0	-

Some values Derived from the cumulative curve.

P90 (M.M)	Q3(P75) (M.M)	P60 (M.M)	MD(P50) (M.M)	Q1(P25) (M.M)	P10 (M.M)
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SUMMARY

No.	Parameter	Name	Abbreviation Formula	Value
1.	Sorting	Quartile Deviation(QDe)	$(Q3-Q1)/2$	
		Coeff: of Sorting	$So(Q3/Q1)$	
		Log. So	$Log(Q3/Q1)$	
		Uniformity Coeff:- (Uc)	$P60/P10$	
2.	Symmetry	Skewness Sk	$Q1.Q2/Md2$	
		Log Sk	$Log(Q1.Q3/Md2)$	
3.	Peckedness	Kurtosis(K)	$(Q3-Q1)/2(P90-P10)$	

HYDROGEOLOGY PROJRCT WAPDA QUETTA  
MECHANICAL ANALYSIS

Well No. \_\_\_\_\_ Type \_\_\_\_\_  
LOCATION Karez Abdul Hakim Lab No. 26  
SAMPLE NO 7 DEPTH(FEET) 2-3'

FIELD DESCRIPTION OF THE SAMPLE \_\_\_\_\_  
WT OF SAMPLE ANALYSED 100 GM ROTAR SHAKING TIME 15 MINUTES.

TYLERS TYPE	STANDARD SIZE(m.m)	SIEVES MESH	PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE RETAI'ED	CUMULATIVE PERCENTAGE PASSED
Pebbles	4.0	4	-	-	-
Granules	2.0	9	0.0	0.0	-
V.Coarse Sand	1.0	16	10.2	10.2	-
Coarse Sand	0.5	32	10.9	21.1	-
Medium	0.25	60	9.8	30.9	-
Sand	0.177	80	3.6	34.5	-
Fine	0.149	.00	3.3	37.8	-
Sand	0.125	150	6.0	43.8	-
V.Fine	0.074	200	13.3	57.1	-
Sand	0.053	270	8.9	66.0	-
Silt&Clay	0.05	Below 270	34.0	100.0	-

Some values Derived from the cumulative curve.

P90 (M.M)	03(P75) (M.M)	P60 (M.M)	MD(P50) (M.M)	Q1(P25) (M.M)	P10 (M.M)

SUMMARY

No	Parameter	Name	Abbreviation Formula	Value
1.	Sorting	Quartile Deviation(QDe)	$(Q3-Q1)/2$	
		Coeff: of Sorting	$So(Q3/Q1)$	
		Log. So	$Log(Q3/Q1)$	
		Uniformity Coeff:- (Uc)	$P60/P10$	
2.	Symmetry	Skewness Sk	$Q1.Q2/Md2$	
		Log Sk	$Log(Q1.Q3/Md2)$	
3.	Peckedness	Kurtosis(K)	$(Q3-Q1)/2(P90-P10)$	

HYDROGEOLOGY PROJRCT WAPDA QUETTA  
MECHANICAL ANALYSIS

Well No. \_\_\_\_\_ Type \_\_\_\_\_

LOCATION Karez Abdul Hakim Lab No. 21SAMPLE NO 8 DEPTH(FEET) 3-4'

FIELD DESCRIPTION OF THE SAMPLE \_\_\_\_\_

WT OF SAMPLE ANALYSED 100 GM ROTAR SHAKING TIME 15 MINUTES.

TYLERS TYPE	STANDARD SIZE(m.m)	SIEVES MESH	PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE PASSED
Pebbles	4.0	4	-	-	-
Granules	2.0	9	0.0	0.0	-
V.Coarse Sand	1.0	16	4.1	4.1	-
Coarse Sand	0.5	32	2.5	6.6	-
Medium	0.25	60	2.4	9.0	-
Sand	0.177	80	1.4	10.4	-
Fine	0.149	100	1.6	12.0	-
Sand	0.125	150	4.1	16.1	-
V.Fine	0.074	200	10.3	26.4	-
Sand	0.053	270	8.7	35.9	-
Silt&Clay	0.05	Below 270	64.9	100.0	-

Some values Derived from the cumulative curve.

P90 (M.M)	Q3(P75) (M.M)	P60 (M.M)	MD(P50) (M.M)	Q1(P25) (M.M)	P10 (M.M)
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SUMMARY

No.	Parameter	Name	Abbreviation Formula	Value
1.	Sorting	Quartile Deviation(QDe)	$(Q3-Q1)/2$	
		Coeff: of Sorting	$So(Q3/Q1)$	
		Log. So	$Log(Q3/Q1)$	
		Uniformity Coeff:- (Uc)	$P60/P10$	
2.	Symmetry	Skewness Sk	$Q1.Q2/Md2$	
		Log Sk	$Log(Q1.Q3/Md2)$	
3.	Peckedness	Kurtosis(K)	$(Q3-Q1)/2(P90-P10)$	

HYDROGEOLOGY PROJRCT WAPDA QUETTA  
MECHANICAL ANALYSIS

Well No. \_\_\_\_\_ Type \_\_\_\_\_  
 LOCATION Karez Abdul Hakim Lab No. 28  
 SAMPLE NO. 9 DEPTH(FEET) 0-1'  
 FIELD DESCRIPTION OF THE SAMPLE \_\_\_\_\_  
 WT OF SAMPLE ANALYSED 100 GM ROTAR SHAKING TIME 15 MINUTES.

TYLERS TYPE	STANDARD SIZE(m.m)	SIEVES MESH	PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE PASSED
Pebbles	4.0	4	-	-	-
Granules	2.0	9	0.0	0.0	-
V.Coarse Sand	1.0	16	4.1	4.1	-
Coarse Sand	0.5	32	4.2	8.3	-
Medium	0.25	60	3.9	12.2	-
Sand	0.177	80	1.7	13.9	-
Fine	0.149	100	2.0	15.9	-
Sand	0.125	150	4.2	20.1	-
V.Fine	0.074	200	11.5	31.6	-
Sand	0.053	270	10.0	41.6	-
Silt&Clay	0.05	Below 270	58.4	100.0	-

Some values Derived from the cumulative curve.

P90 (M.M)	Q3(P75) (M.M)	P60 (M.M)	MD(P50) (M.M)	Q1(P25) (M.M)	P10 (M.M)
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SUMMARY

No.	Parameter	Name	Abbreviation Formula	Value
1.	Sorting	Quartile Deviation(QDe)	(Q3-Q1)/2	
		Coeff: of Sorting	So(Q3/Q1)	
		Log. So	Log(Q3/Q1)	
		Uniformity Coeff:- (Uc)	P60/P10	
2.	Symmetry	Skewness Sk	Q1.Q2/Md2	
		Log Sk	Log(Q1.Q3/Md2)	
3.	Peckedness	Kurtosis(K)	(Q3-Q1)/2(P 90-P 10)	

HYDROGEOLOGY PROJECT WAPDA, QUETTA

Test hole/Tube-well No. \_\_\_\_\_ Project Area. \_\_\_\_\_

Sr. No.	Lab No.	Depth	Wt of total sample after grinding	Wt of sampel retained by sieve of mesh	(2.00 m.m.)	% wt retained by sieve of mesh										Sp. Gravity	Porosity	Mosture Hydran equivallic		Remark
						16 (100 m.m.)	32 (0.50 m.m)	60 (0.25 m.m.)	80 (0.177 m.m.)	100 (0.149 m.m.)	150 (0.125 m.m.)	200 (0.074 m.m.)	270 (0.053 m.m.)	%We passed through mesh 270	lent.			conductivity		
						7	8	9	10	11	12	13	14	15					16	
1	17	0-1	100 gm	0.00	0.00	0.7	0.6	1.2	1.0	1.2	3.4	11.6	12.2	68.1	-	-	-	-	-	
2	18	022	-	0.00	0.00	0.9	0.9	2.2	1.3	1.9	4.4	10.5	9.3	68.6	-	-	-	-	-	
3	19	2-3	-	0.00	0.00	9.0	7.6	6.3	2.6	2.7	5.3	13.5	10.0	43.0	-	-	-	-	-	
4	20	3-4	-	0.00	0.00	7.4	7.6	7.5	3.6	3.3	6.2	14.3	10.9	39.2	-	-	-	-	-	
5	21	0-1	-	0.00	0.00	0.2	0.6	1.6	1.4	2.0	4.3	13.5	13.6	62.8	-	-	-	-	-	
6	22	1-2	-	0.00	0.00	5.0	6.3	4.3	1.6	1.7	3.6	9.8	9.9	57.8	-	-	-	-	-	
7	26	2-3	-	0.00	0.00	10.2	10.9	9.8	3.6	3.3	6.0	13.3	8.9	34.0	-	-	-	-	-	
8	27	3-4	-	0.00	0.00	4.1	2.5	2.4	1.4	1.6	4.1	10.3	8.7	64.9	-	-	-	-	-	
9	28	0-1	-	0.00	0.00	4.1	4.2	3.9	1.7	2.0	4.2	11.5	10.0	58.4	-	-	-	-	-	

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WATER AND POWER DEVELOPMENT AUTHORITY

AREA/DISTRICT/TEHSIL/PROJECT

Karez Abdul Hakim

HYDROGEOLOGY PROJECT, WAPDA, QUETTA  
SOIL ANALYSIS (CHEMICAL)

1. AGENCY  
2. ANALYSED BY

S.No.	Lab No.				Depth	Texture Field Appraisal	Saturation Percentage (S.P)	P H of Saturation Paste	(ECe) Electrical Conductivity at 25 °C as E <sub>c</sub> x 10	SOLUBLE CATIONS Meq/Litre				SOLUBLE ANIONS Meq/Litre				(SAR) Sodium Adsorption Ratio	Exchangeable Sodium (R <sub>ex</sub> ) (meq/100 gm)	Cation Exchange Capacity (meq/100 gms)	Exchangeable Sodium % age	Calcium Content % age	Organic Matter % age	Gypsum	REMARKS			
		Photo No.	Village /Site	Bore No. Pit No.						Ca + Mg	Na	K	Co <sub>3</sub>	Hco <sub>3</sub>	Cl	So <sub>4</sub>												
1.	17			P-1	0-1'		32	8.0	2.2	2.28	21.01			10.08	5.49	7.72	2.1	7.80										
2.	18			"	1-2'		36	8.0	5.61	3.42	52.58			7.92	23.55	24.53	40	4.50										
3.	19			"	2-3'		37	8.0	6.0	10.26	49.72			7.92	21.98	30.08	22											
4.	20			"	3-4'		35	8.1	3.96	6.27	34.87			9.36	21.19	10.59	20	3.09										
5.	21			P-2	0-1'		32	8.1	9.9	9.69	90.86			12.96	34.54	53.05	41	3.27										
6.	22			"	1-3'		30	8.4	5.72	3.42	55.00			10.80	21.98	25.64	42	7.38										
7.	23			P-2	3-4'		35	7.9	9.35	11.97	82.72			7.20	43.17	44.32	34	-										
8.	24			P-3	0-1'		30	8.2	4.95	3.42	46.42			7.92	11.38	30.54	36	4.50										
9.	25			"	1-2'		35	8.2	6.6	6.84	63.14			8.64	14.52	46.82	34	1.80										
10.	26			"	2-3'		34	7.6	12.1	18.81	107.44			5.76	62.80	57.69	35											
11.	27			"	3-4'		30	8.3	3.74	2.28	36.30			10.08	11.77	16.73	34	7.80										
12.	28			P-4	0-1'		34	8.3	5.06	5.70	44.88			7.92	14.52	28.14	26	2.22										
13.	29			"	1-2'		30	8.4	2.1	2.28	20.13			9.00	5.88	7.53	19	6.72										
14.	30			"	2-3'		37	7.8	4.84	8.55	38.17			5.76	14.13	26.83	18											
15.	31			"	3-4'		31	7.8	10.78	15.96	90.86			5.76	30.61	7.45	32											

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## MONTHLY PRECIPITATION AT SAMUNGLI

Years	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1978	2.68	2.29	0.72	0.62	0.00	0.00	4.80	0.04	0.00	0.00	0.91	0.30	12.36
1979	2.79	3.55	4.37	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.72	13.73
1980	2.75	2.55	2.16	0.11	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.14	7.91
1981	4.40	3.47	2.50	0.21	0.46	0.00	0.08	0.00	0.00	0.00	0.00	1.38	12.50
1983	2.40	2.40	2.68	5.83	1.14	0.00	0.87	0.00	0.00	0.00	0.00	0.00	15.32
AVG.	3.00	2.85	2.49	1.41	0.32	0.04	1.15	0.01	0.00	0.00	0.18	0.91	12.36

MONTHLY PRECIPITATION AT KILLI KOTWAL

Years	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1971	0.24	0.80	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	1.98
1972	2.35	0.49	2.48	1.54	0.75	0.88	1.16	0.00	0.00	0.00	0.27	0.28	10.20
1973	1.64	0.72	0.18	0.21	0.00	0.00	1.54	0.00	0.00	0.00	0.00	0.00	4.29
1974	-	-	-	0.49	0.00	0.00	0.00	0.00	0.04	0.00	0.00	1.92	-
1975	2.75	1.72	1.37	0.64	0.00	0.00	0.09	2.66	0.00	0.00	0.00	0.43	9.66
1979	1.03	2.45	3.22	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.90	8.75
1980	2.50	1.33	2.32	0.00	0.00	1.59	0.00	0.00	0.00	0.55	0.31	1.08	9.68
AVG.	1.75	1.25	1.67	0.43	0.11	0.35	0.40	0.38	0.00	0.08	0.08	0.87	7.43

### MONTHLY EVAPORATION AT BUNDAT JUNGLE

Years	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1970	2.57	3.39	5.29	10.28	13.35	14.92	15.10	12.62	10.27	8.89	5.68	3.33	105.78
1971	2.57	3.62	7.43	10.65	15.11	16.72	15.44	14.29	11.31	9.03	-	-	106.17
1973	-	2.18	4.39	9.34	13.80	14.51	13.60	14.63	11.17	9.13	7.21	3.12	103.47
1975	4.32	3.23	3.65	6.16	11.07	15.41	15.80	11.86	10.95	7.90	5.37	4.66	100.38
1979	-	0.95	3.69	9.01	11.32	13.94	16.08	14.69	12.50	12.68	11.45	9.11	115.81
1980	6.38	3.87	4.63	7.18	9.77	10.70	13.19	12.64	16.18	12.30	9.15	7.38	113.37
AVG	3.95	3.53	4.85	8.77	12.40	14.43	14.87	13.46	12.06	10.00	7.77	5.52	107.43

(-) indicates no record.

**BEST AVAILABLE DOCUMENT**

### MONTHLY PRECIPITATION AT BUNDAT JUNGLE

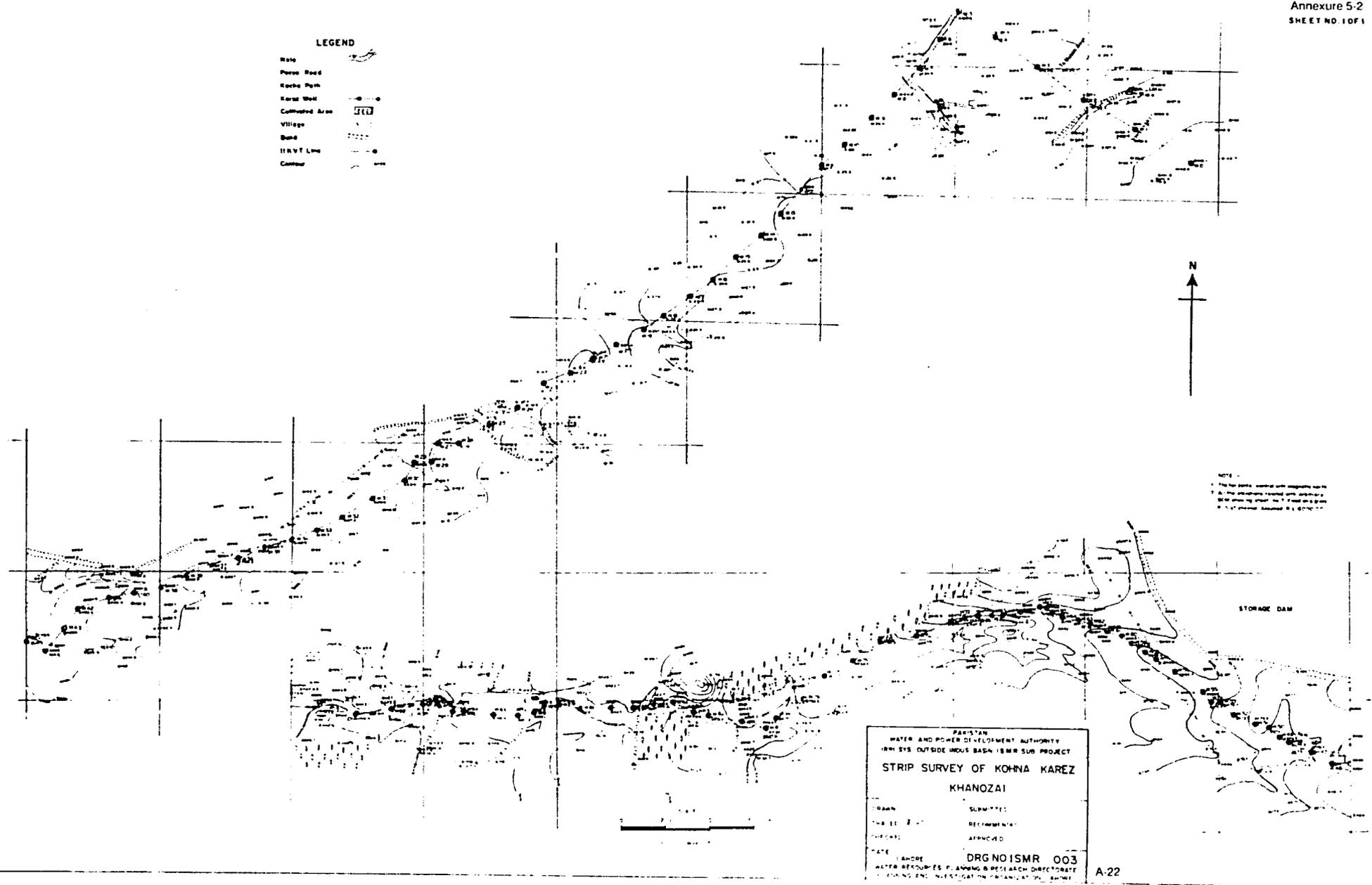
Years	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1965	1.10	1.76	1.10	3.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	8.71
1966	0.00	0.30	1.30	1.55	0.00	0.30	1.90	0.45	0.55	0.67	0.00	0.00	7.02
1967	0.20	4.55	3.71	2.53	0.00	0.00	0.40	0.49	0.00	0.00	0.50	1.60	13.98
1968	2.78	3.78	0.90	0.00	0.85	0.00	0.10	0.00	0.00	0.00	0.00	1.64	10.05
1969	1.37	1.20	0.90	1.08	1.23	0.01	1.09	0.00	0.00	0.00	0.30	0.11	7.29
1970	1.91	1.49	4.28	0.28	0.28	0.00	0.65	0.82	0.00	0.00	0.00	0.39	10.10
1971	0.52	1.24	0.69	0.08	0.00	0.07	0.21	0.00	0.00	0.00	-	-	-
1973	2.78	1.63	1.58	0.32	0.00	0.00	2.30	0.00	0.00	0.00	0.15	1.48	10.24
1974	2.43	3.20	0.20	0.69	0.20	0.00	0.00	0.00	0.00	0.00	0.00	2.51	9.23
1975	2.27	2.19	2.58	0.87	0.15	0.00	0.00	3.10	0.00	0.00	0.00	0.25	11.41
1979	0.92	1.42	4.63	0.33	0.08	0.00	0.00	0.00	0.00	0.08	0.18	1.66	9.30
1980	2.69	1.83	3.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	8.51
1983	0.97	1.97	0.31	1.50	0.43	0.00	1.00	3.93	0.30	0.00	0.00	0.89	11.30
1984	1.41	0.56	1.29	0.31	0.00	0.00	0.98	1.62	0.00	0.00	0.05	0.57	6.79
1985	0.60	0.00	2.13	0.15	0.15	0.00	0.75	0.00	0.00	0.00	0.00	0.99	4.77
1986	0.60	1.22	2.88	0.00	0.00	0.00	1.08	2.55	0.00	0.00	0.56	0.00	8.89
<b>Total</b>	<b>1.41</b>	<b>1.77</b>	<b>2.03</b>	<b>0.85</b>	<b>0.21</b>	<b>0.02</b>	<b>0.65</b>	<b>0.81</b>	<b>0.05</b>	<b>0.05</b>	<b>0.11</b>	<b>0.87</b>	<b>8.60</b>

(-) indicates no record.

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**LEGEND**

- Water
- Power Road
- Karez Path
- Karez Well
- Cultivated Area
- Village
- Dam
- IRVT Line
- Contour



NOTE -  
1. The map scale is 1:50,000  
2. All the dimensions shown on the map are in meters unless otherwise specified.

PAKISTAN  
WATER AND POWER DEVELOPMENT AUTHORITY  
IRVT SYS. OUTSIDE INDUS BASIN ISMR SUB PROJECT  
**STRIP SURVEY OF KOHNA KAREZ**  
**KHANOZAI**

DATE: 1980  
DRAWN BY: [illegible]  
CHECKED BY: [illegible]  
APPROVED BY: [illegible]

DATE: 1980  
DRAWN BY: [illegible]  
CHECKED BY: [illegible]  
APPROVED BY: [illegible]

DRG NO ISMR 003  
WATER RESOURCES PLANNING & RESEARCH DIRECTORATE  
ISMR HEADQUARTERS, ISMAILIYAH, KARACHI

A-22

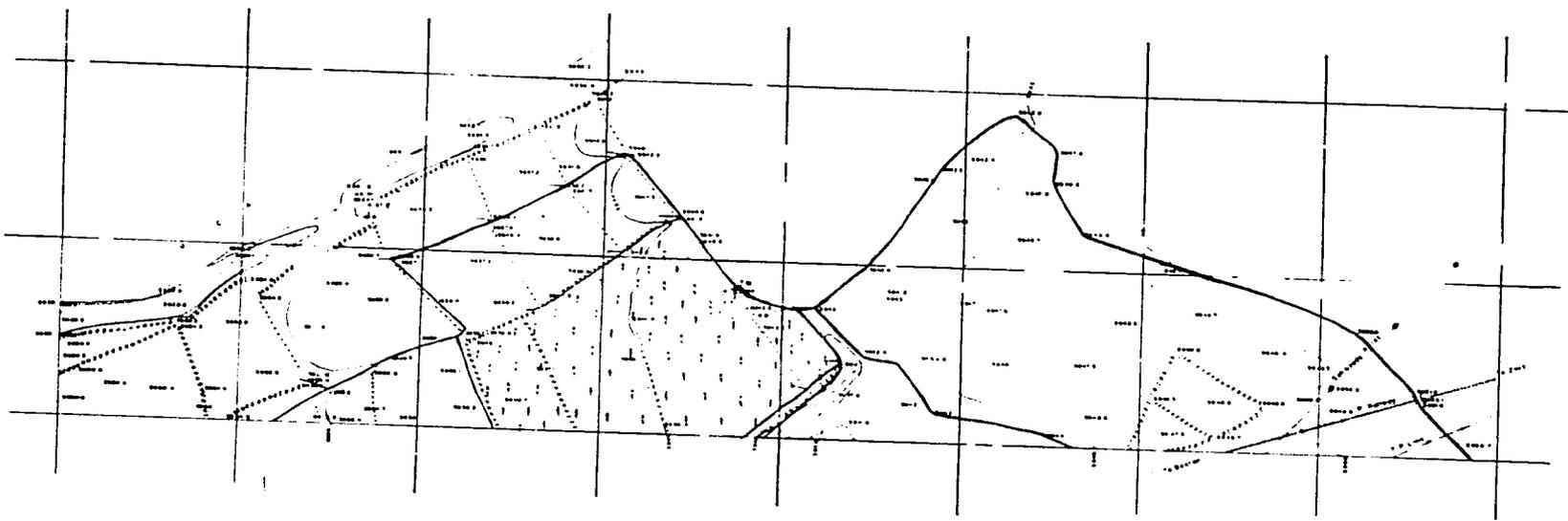
**BEST AVAILABLE DOCUMENT**

145



LEGEND

- Bar
- Bar W/C
- Bar W/C
- T. W.
- Roadway Line
- Telephone Line
- Cultivated Area
- Contour
- Elevation
- Well
- Village



Index To Sheet



NOTE  
The map is for reference only and should not be used for any other purpose without the permission of the Director General, W.P.D. of the Government of Punjab.

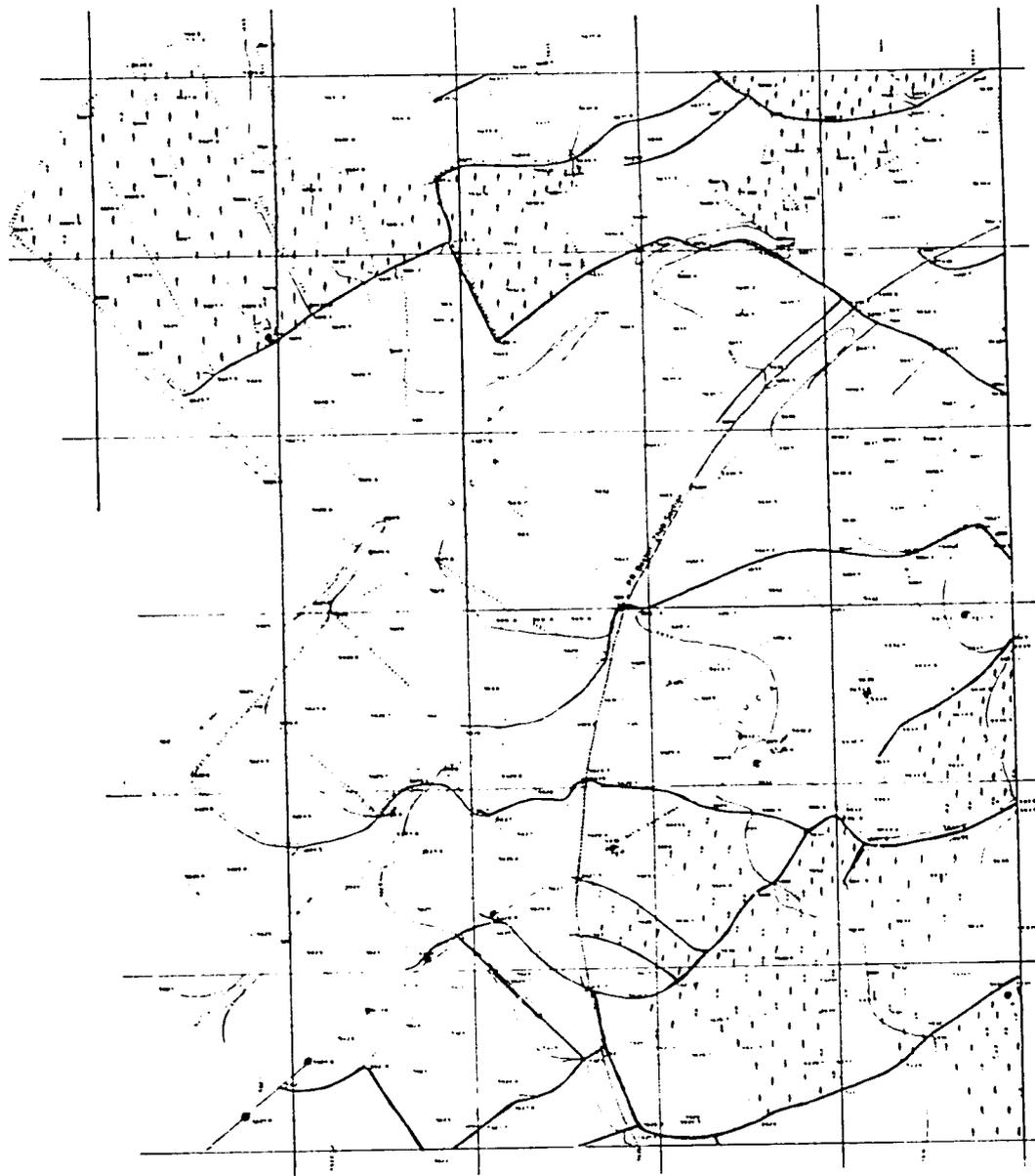


PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY	
WRI STS OUTSIDE INDUS BASIN ISMR SUB PROJECT	
TOPOGRAPHIC SURVEY OF COMMAND AREA KOHNA KAREZ KHANOZAI	
DRAWN	SUBMITTED
TRACED	RECOMMENDED
CHECKED	APPROVED
DATE	DRG NO ISMR 004
WATER RESOURCES PLANNING & RESEARCH DIRECTORATE PLANNING AND INVESTIGATION ORGANIZATION, LAHORE	

A-23

BEST AVAILABLE DOCUMENT

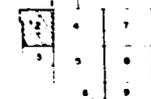
146



LEGEND

- Main W/L
- Branch W/L
- Canal
- Cultivated Area
- Village
- Well
- Well
- T. Well
- Railway Line
- Karez Well
- T.P. Line
- Katcha Road

Index to Sheet

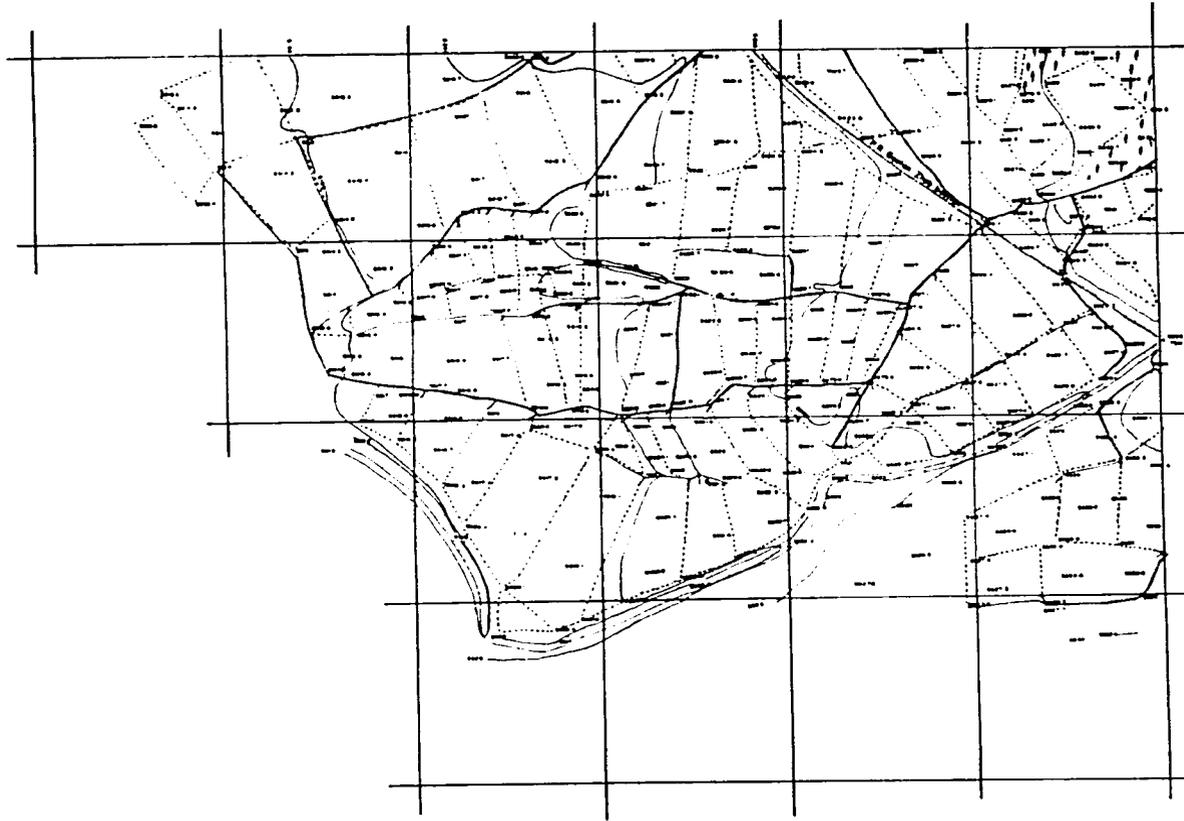


PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY IBRIN SYS. OUTSIDE INDUS BASIN - SBR SUB PROJECT TOPOGRAPHIC SURVEY OF COMMAND AREA KOHNA KAREZ KHANOZAI	
DRAWN TRACED CHECKED DATE	SUBMITTED RECOMMENDED APPROVED DRG NO ISMR 005 WATER RESOURCES PLANNING & RESEARCH DIRECTORATE PLANNING AND INVESTIGATION ORGANIZATION, LAHORE

A-24

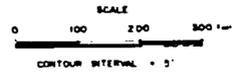
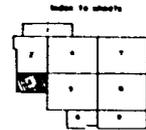
BEST AVAILABLE DOCUMENT

149



LEGEND

- Plot
- Main W/L
- Branch W/L
- Railway Line
- Road
- Contour



Note: 1. The contour lines are drawn from the 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100.

PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY WIND BYE OUTSIDE INDUS BASIN ILMR SUB PROJECT	
TOPOGRAPHIC SURVEY OF COMMAND AREA KOHNA KAREZ KHANOZI	
DRAWN TRACED CHECKED	SUBMITTED RECOMMENDED APPROVED
DATE LAHORE	DRG NO ISMR 006 WATER RESEARCH PLANNING & RESEARCH DIRECTORATE PLANNING AND RESEARCH ORGANIZATION, LAHORE

A-25

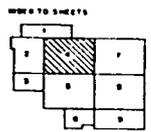
BEST AVAILABLE DOCUMENT

8/7/71



LEGEND

- Dund
- Main W/C
- Branch W/C
- Karez Path
- Karez Well
- Railway Line
- Telephone Line
- Cultivated Area
- Canal
- Channel
- Town Well
- Village



NOTE:  
1. The boundaries shown with dashed lines are for  
2. All the boundaries shown with solid lines  
3.000 showing sheet no. 7. Plot 1000 of area  
8/16 of original ground 1:1, 5000:100



PAKISTAN  
WATER AND POWER DEVELOPMENT AUTHORITY  
SWM BYS OUTSIDE INDUS BASIN ISMR SUB PROJECT

**TOPOGRAPHIC SURVEY OF CAMMAND AREA  
KOHNA KAREZ KHANQAZI**

DRAWN	SUBMITTED
TRACED	RECOMMENDED
CHECKED	APPROVED
DATE: LAHORE	DRG. NO. 15MR 007

WATER RESOURCES PLANNING & RESEARCH DIRECTORATE  
PLANNING AND INVESTIGATION ORGANIZATION, LAHORE

A-26

BEST AVAILABLE DOCUMENT

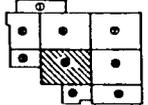
149



LEGEND

- Main W/C
- Branch W/C
- Canal
- Kanals Poles
- Village
- Road
- H.V.T. Line
- Railway Line
- Coloured Area
- T. Well

INDEX TO SHEETS



- NOTE -  
1. The boundaries shown are approximate.  
2. All the dimensions are in feet.  
3. The drawing sheet is 7' 7" x 11' 6" in size.  
4. The scale is 1" = 1000'.

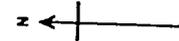
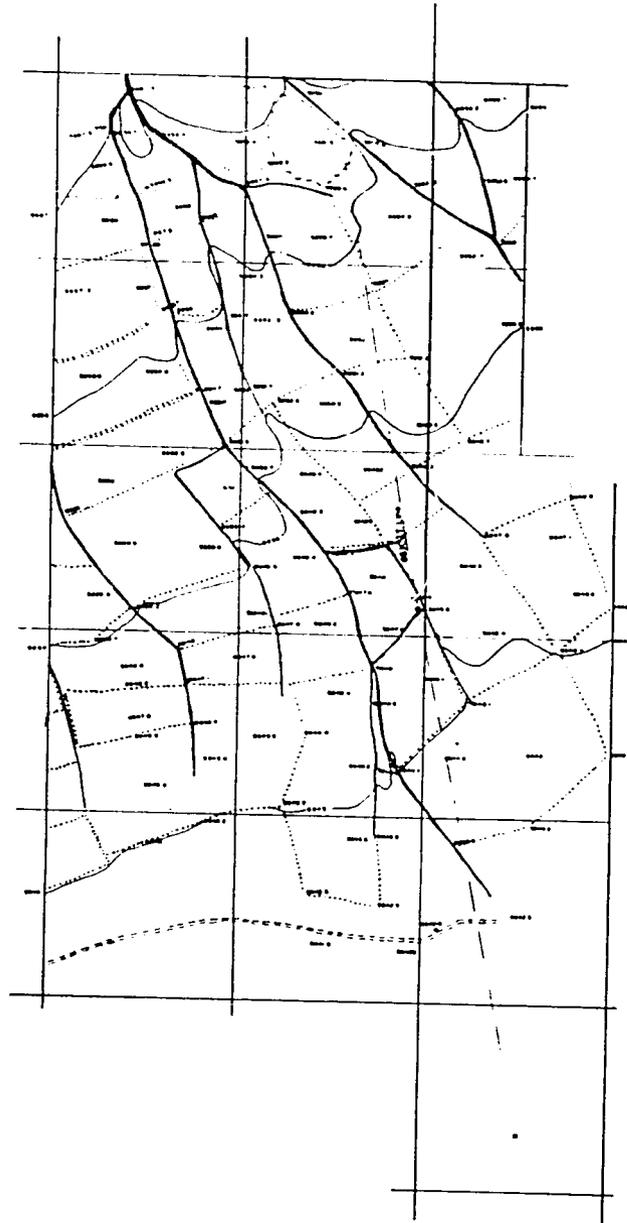


PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY IRRIGATION DIVISION TOPOGRAPHIC SURVEY OF COMMAND AREA KOHNA KAREZ KHANZOAI	
DRAWN TRACED CHECKED DATE	SUBMITTED RECOMMENDED APPROVED DRG. NO. ISMR 008 WATER RESOURCES PLANNING & RESEARCH DIRECTORATE PLANNING AND INVESTIGATION ORGANIZATION, LAHORE

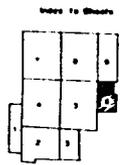
A-27

BEST AVAILABLE DOCUMENT

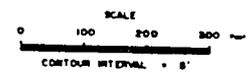
152



Main W/c	
Branch W/c	
Canal	
Dam	
GRAVELLY	
Water Pits	
Elevation	



Note: 1. The horizontal control points are shown  
2. All the elevations are based on MSL  
3. The contour interval is 5' and the scale is 1" = 1000'

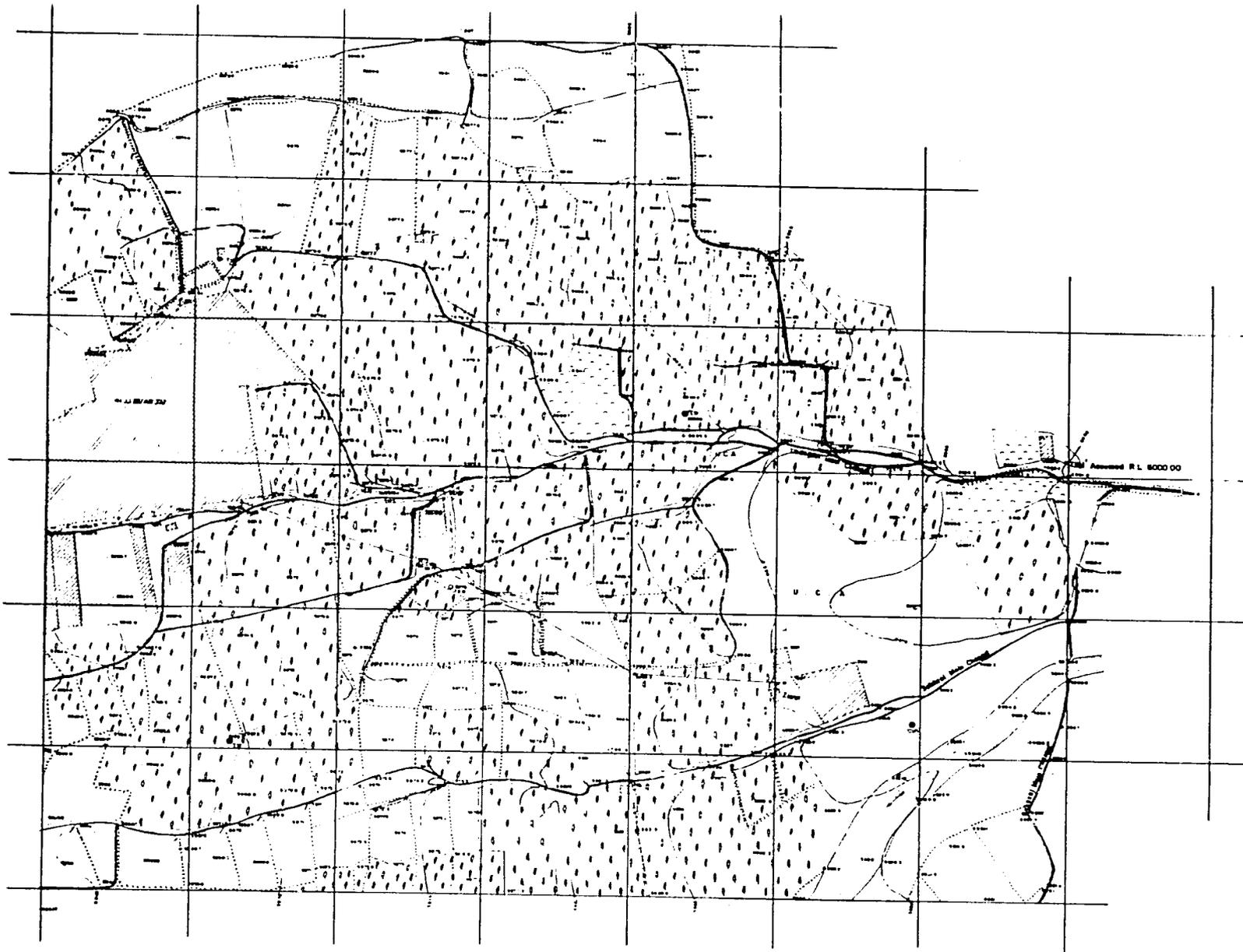


PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY WRS SYS. OUTSIDE INDUS BASIN LEHR SAN PROJECT	
TOPOGRAPHIC SURVEY OF COMMAND AREA KOHNA KAREZ KHANOZAI	
DRAWN TRACED CHECKED	SUBMITTED RECOMMENDED APPROVED
DATE LAHORE	DRG. NO. ISMR 009 WATER RESOURCES PLANNING & RESEARCH DIRECTORATE PLANNING AND INVESTIGATION ORGANIZATION, LAHORE

A-28

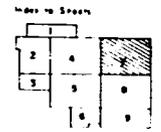
BEST AVAILABLE DOCUMENT

15.1

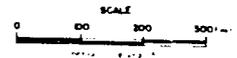


**LEGEND**

- Bank W/c
- Stream W/c
- Contour
- Contoured Area
- Village
- Well
- Road
- Well
- T. Well
- T.M. Assumed
- K.Y.T. Line



**NOTE**  
 1. The horizontal datum used is Indian Mean Time (I.M.T.)  
 2. All the elevations are given in meters above sea level (M.S.L.)  
 3. The contour interval is 1:1000 ft. or 300 m.

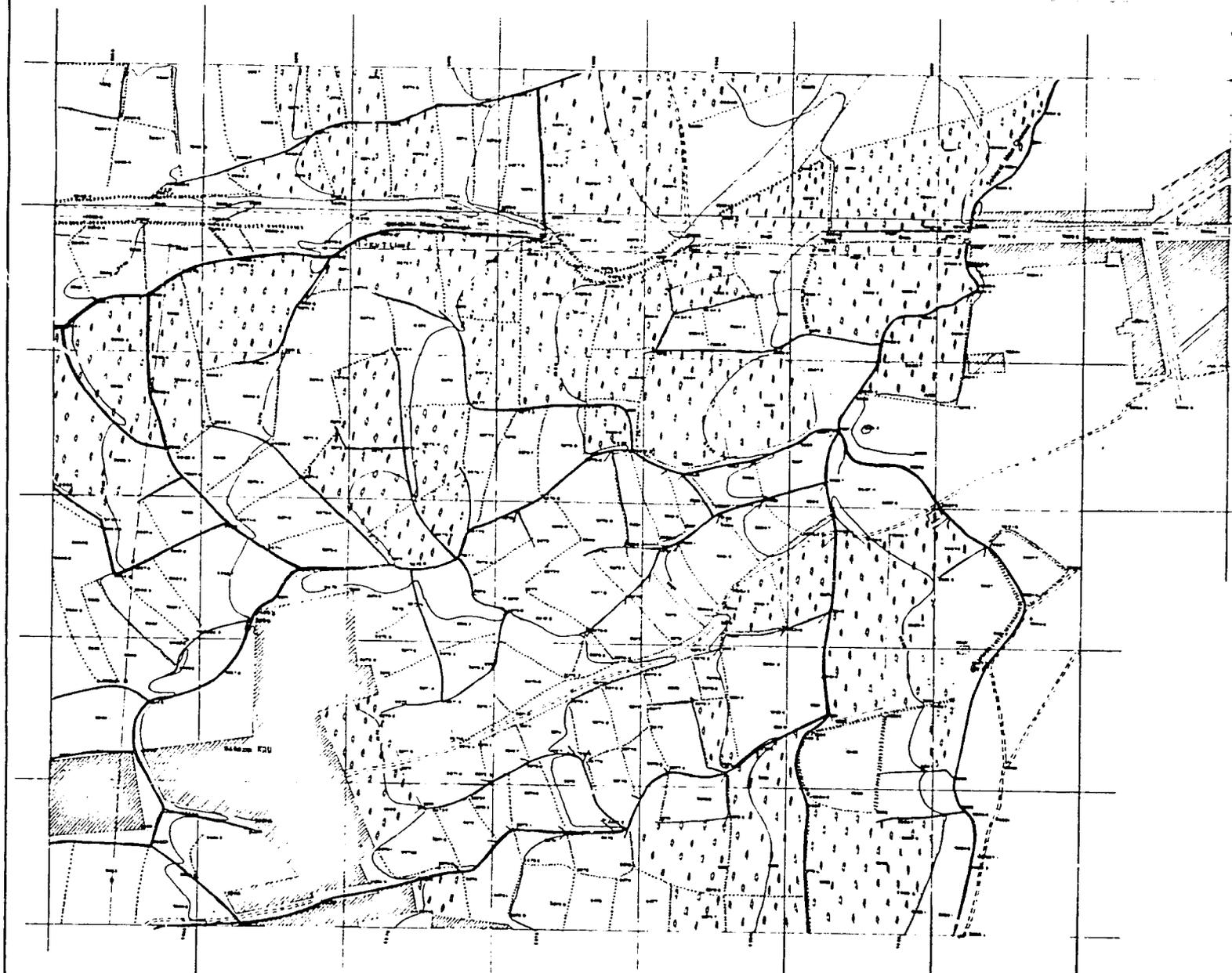


PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY W.P.D.A. OUTSIDE INDUS BASIN I.S.M.R. SUB PROJECT	
<b>TOPOGRAPHIC SURVEY OF COMMAND AREA</b> KOHNA KAREZ KHANOZAI	
DRAWN TRACED - CHECKED	SUBMITTED RECOMMENDED APPROVED
DATE LAHORE	DRG/NOISM/R OIO WATER RESOURCES PLANNING & RESEARCH DIRECTORATE, PLANNING AND INVESTIGATION ORGANIZATION, LAHORE

A-29

BEST AVAILABLE DOCUMENT

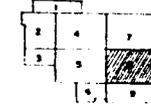
152



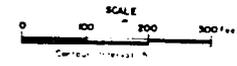
LEGEND

- Drawn W/L
- Drain W/L
- Contour
- Cultivated Area
- Village
- Ridge Path
- R.V.T. Line
- Bank

Index to Sheets



NOTE:  
1. The boundary shown with irregular lines  
2. All the numbers are in feet and are not  
3. The map is drawn to a scale of 1 inch = 200 feet  
4. The map is drawn to a scale of 1 inch = 200 feet

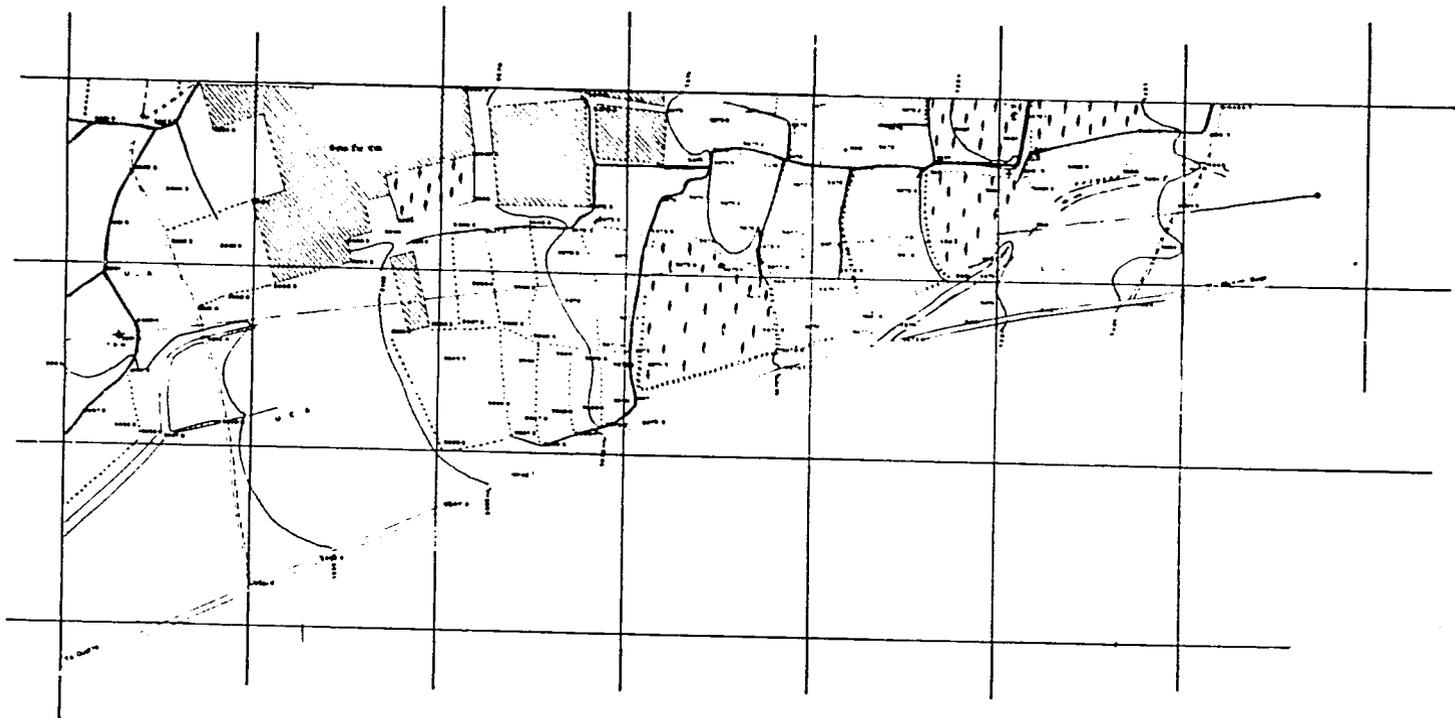


PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY 599 575 OUTSIDE INDUS BASIN I.S.C.R. SUB PROJECT TOPOGRAPHIC SURVEY OF COMMAND AREA KOHNA KAREZ KHANOZAI	
DRAWN TRACED CHECKED DATE	SUBMITTED RECOMMENDED APPROVED LAHORE DRG. NO. ISMR 011 WATER RESOURCES PLANNING & RESEARCH DIRECTORATE, PLANNING AND INVESTIGATION ORGANIZATION, LAHORE

A-30

BEST AVAILABLE DOCUMENT

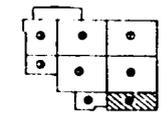
153



**LEGEND**

- Dam
- Main W/C
- Branch W/C
- Force Road
- Korcha Path
- T. Well
- SECRET Line
- Cultivated Area
- Contour
- Elevation
- Rate
- Vegete

**Index To Sheet**



- NOTE**
1. The borders for each of cells, depicted here.
  2. All the contours, plotted after the survey.
- Scale: 1:50,000  
Contour Interval: 5

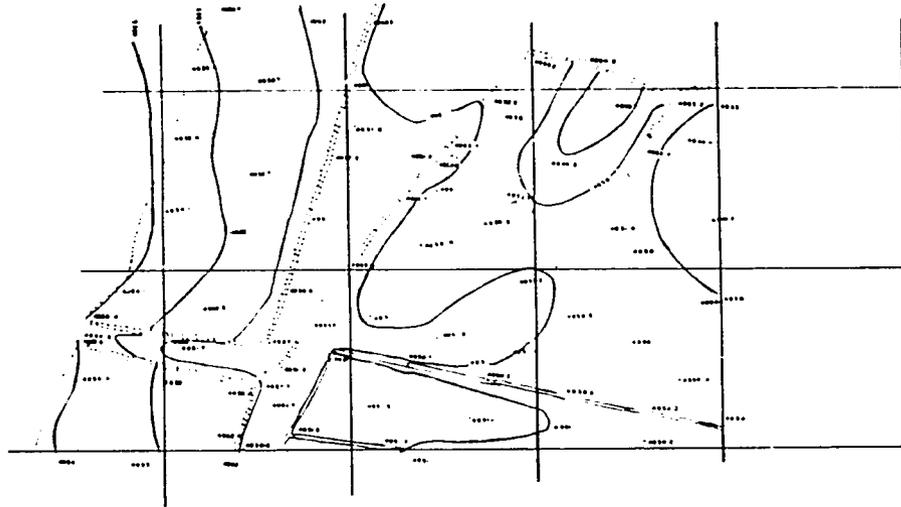


PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY WORKS OUTSIDE INDUS BASIN I & II SUB PROJECT	
<b>TOPOGRAPHIC SURVEY OF COMMAND AREA</b> KOHNA KAREZ KHANJOZI	
DRAWN TRACED <i>[Signature]</i> CHECKED <i>[Signature]</i>	SUBMITTED RECOMMENDED APPROVED
DATE LAHORE	DRG. NO. ISMR 012
WATER RESOURCES PLANNING & RESEARCH DIRECTORATE PLANNING & INVESTIGATION ORGANIZATION, LAHORE	

A-31

BEST AVAILABLE DOCUMENT

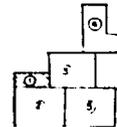
154



LEGEND

- Band
- Contour
- Elevation
- Drainage Way

INDEX TO SHEET



SCALE



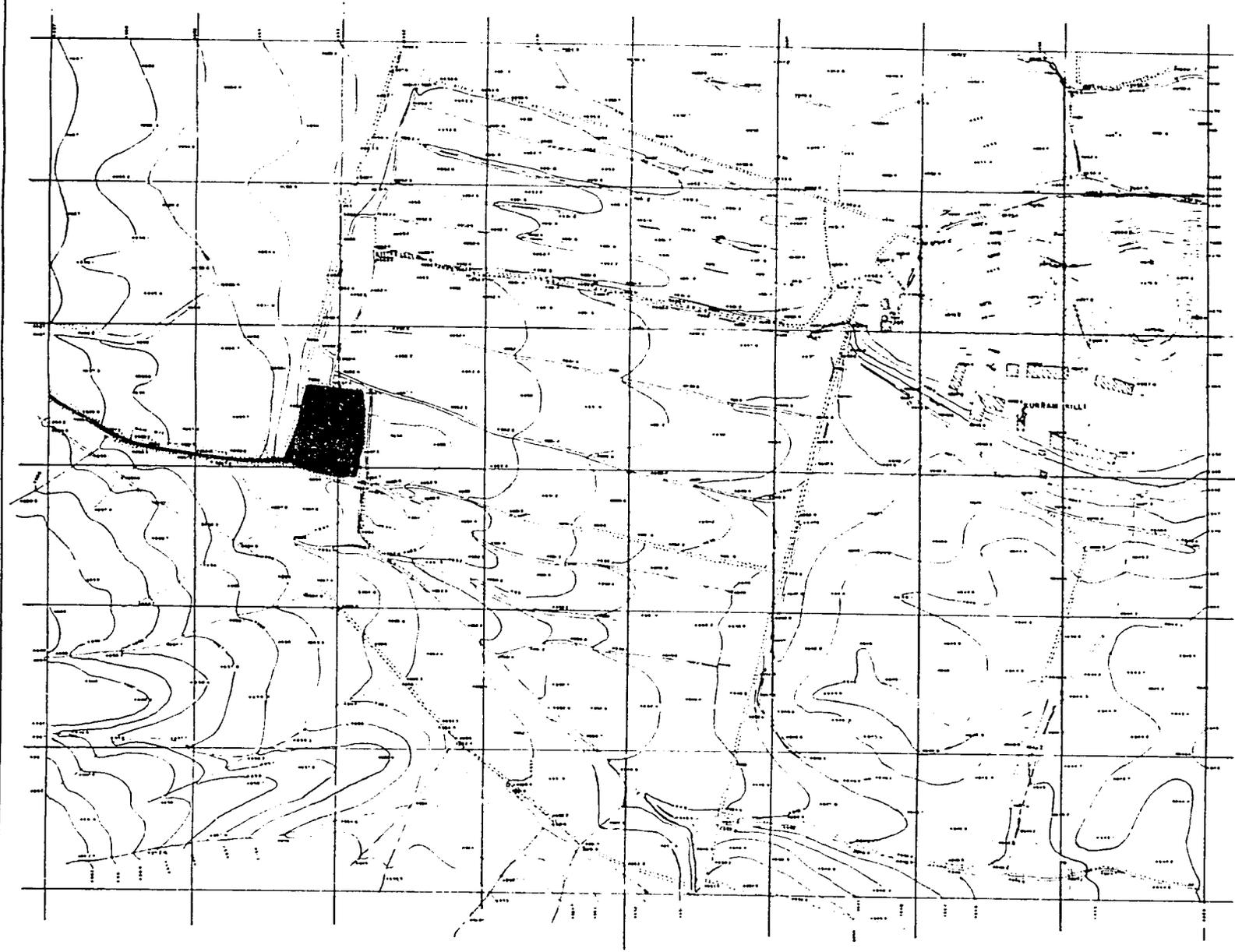
CONTOUR INTERVAL 5

PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY	
WATER RESOURCES PLANNING & RESEARCH DIRECTORATE PLANNING AND INVESTIGATION ORGANIZATION, LAHORE	
TOPOGRAPHIC SURVEY OF ABDUL HAKIM KAREZ	
DRAWN	SUBMITTED
TRACED	RECOMMENDED
CHECKED	APPROVED
DATED LAHORE DRG NO ISMR-013	
WATER RESOURCES PLANNING & RESEARCH DIRECTORATE PLANNING AND INVESTIGATION ORGANIZATION, LAHORE	

A-32

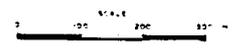
BEST AVAILABLE DOCUMENT

15/1



LEGEND

- Major Rd
- Minor Rd
- Water Tank
- Water Poles
- Well
- Karez
- Contour

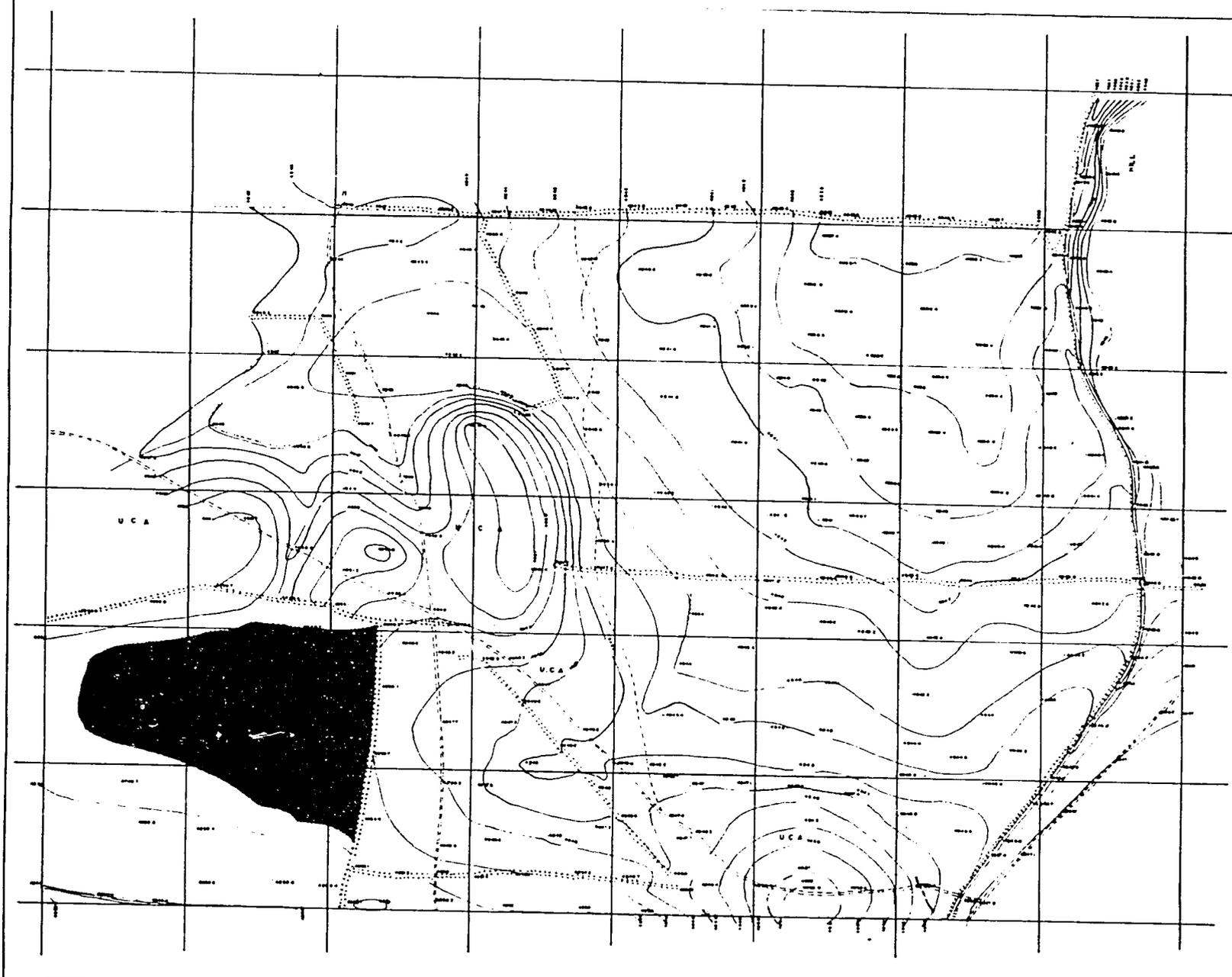


PERIETAN WATER AND POWER DEVELOPMENT AUTHORITY 800 SRS OUTSIDE HOUG BASHI ISMR SUB PROJECT	
TOPOGRAPHIC SURVEY OF COMMAND AREA ABDUL HAKIM KAREZ	
DRAWN TRACED CHECKED DATE	SUBMITTED RECOMMENDED APPROVED DRG NO ISMR-014
LAHORE WATER RESOURCES PLANNING & RESEARCH DIRECTORATE PLANNING AND INVESTIGATION ORGANIZATION, LAHORE	

A-33

BEST AVAILABLE DOCUMENT

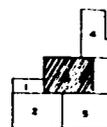
156



LEGEND

Water Run   
 Road   
 Canal

HOW TO SHEET



SCALE  
0 100 200 300 Feet

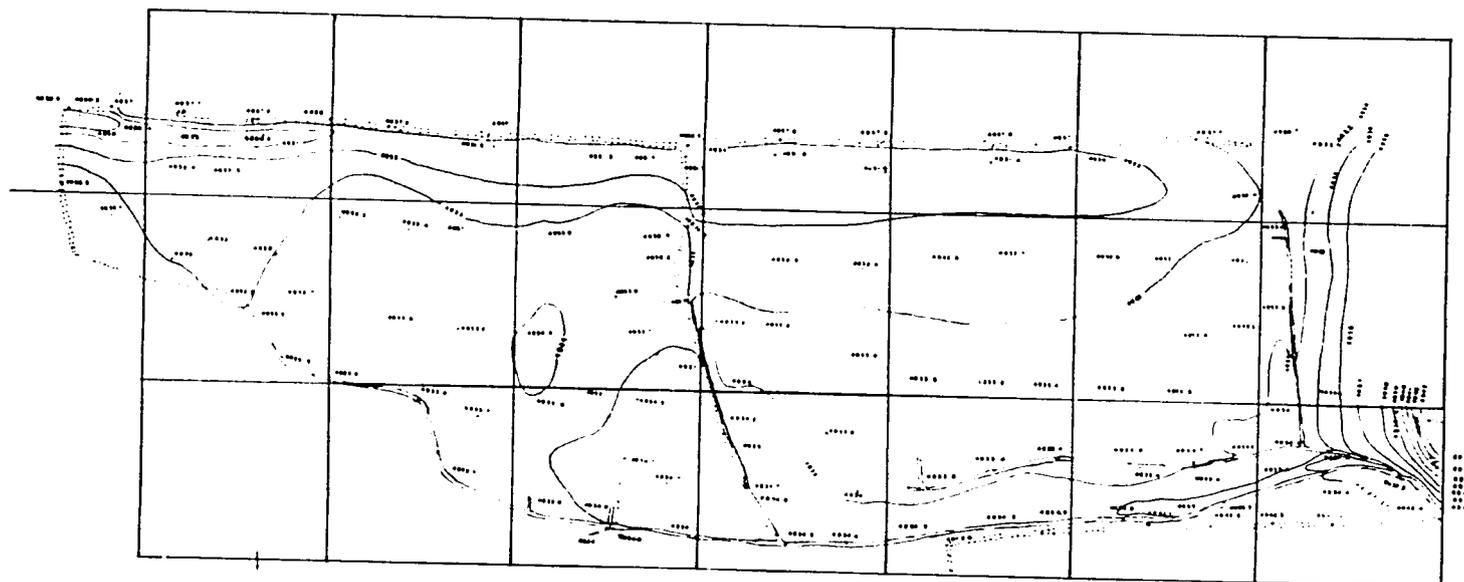
CONTOUR INTERVAL = 1'

PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY	
MR. F.Y. DUTKIN (M.P.) BASHI (S.M.A.) P.W.D. PROJECT	
TOPOGRAPHIC SURVEY OF COMMAND AREA ABDUL HAKIM KAREZ	
DRAWN	SUBMITTED
TRACED	RECOMMENDED
CHECKED	APPROVED
DATE	DRG NO. ISMR-015
LAHORE WATER RESOURCES PLANNING & RESEARCH DIRECTORATE, PLANNING AND INVESTIGATION ORGANIZATION, LAHORE	

A-34

BEST AVAILABLE DOCUMENT

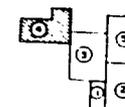
159



LEGEND

- Spot      -
- Contour      -
- Elevation      -
- Drainage Way      -

INDEX TO SHEET



SCALE



CONTOUR INTERVAL 10'

A-35

PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY WPD SYSTEMS OUTSIDE INDUS BASIN / ISRA SUB PROJECT	
TOPOGRAPHIC SURVEY OF ABDUL HAKIM KAREZ	
DRAWN	SUBMITTED
TRACED	RECOMMENDED
CHECKED	APPROVED
DATED	LAHORE, DRG NO ISMR-016
WATER RESOURCES PLANNING & RESEARCH DIRECTORATE PLANNING AND INVESTIGATION ORGANIZATION, LAHORE	

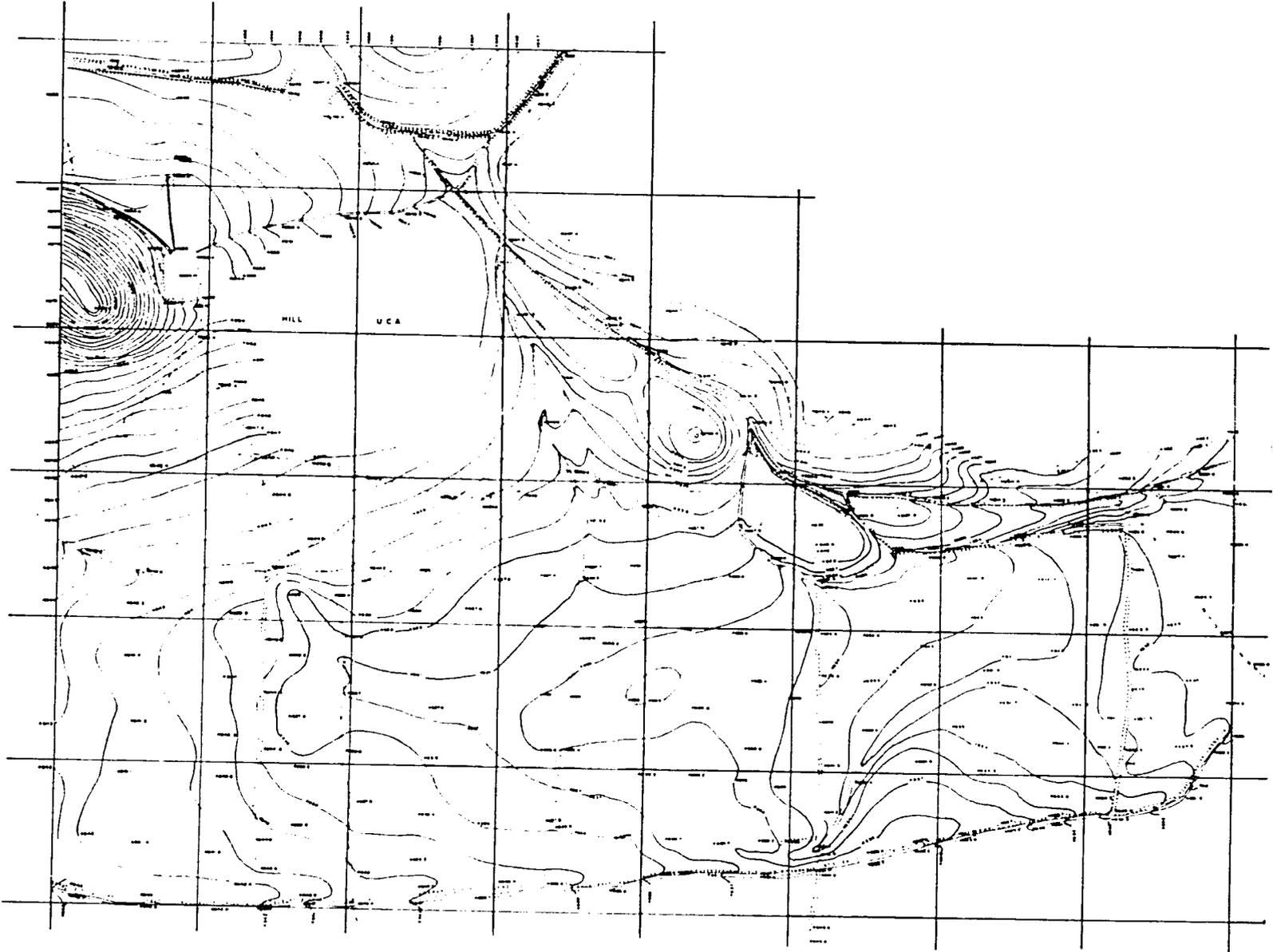
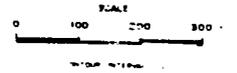
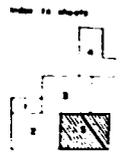
BEST AVAILABLE DOCUMENT

1578



LEGEND

- Spot
- Spot 10
- Contour
- Contour
- Contour
- Contour

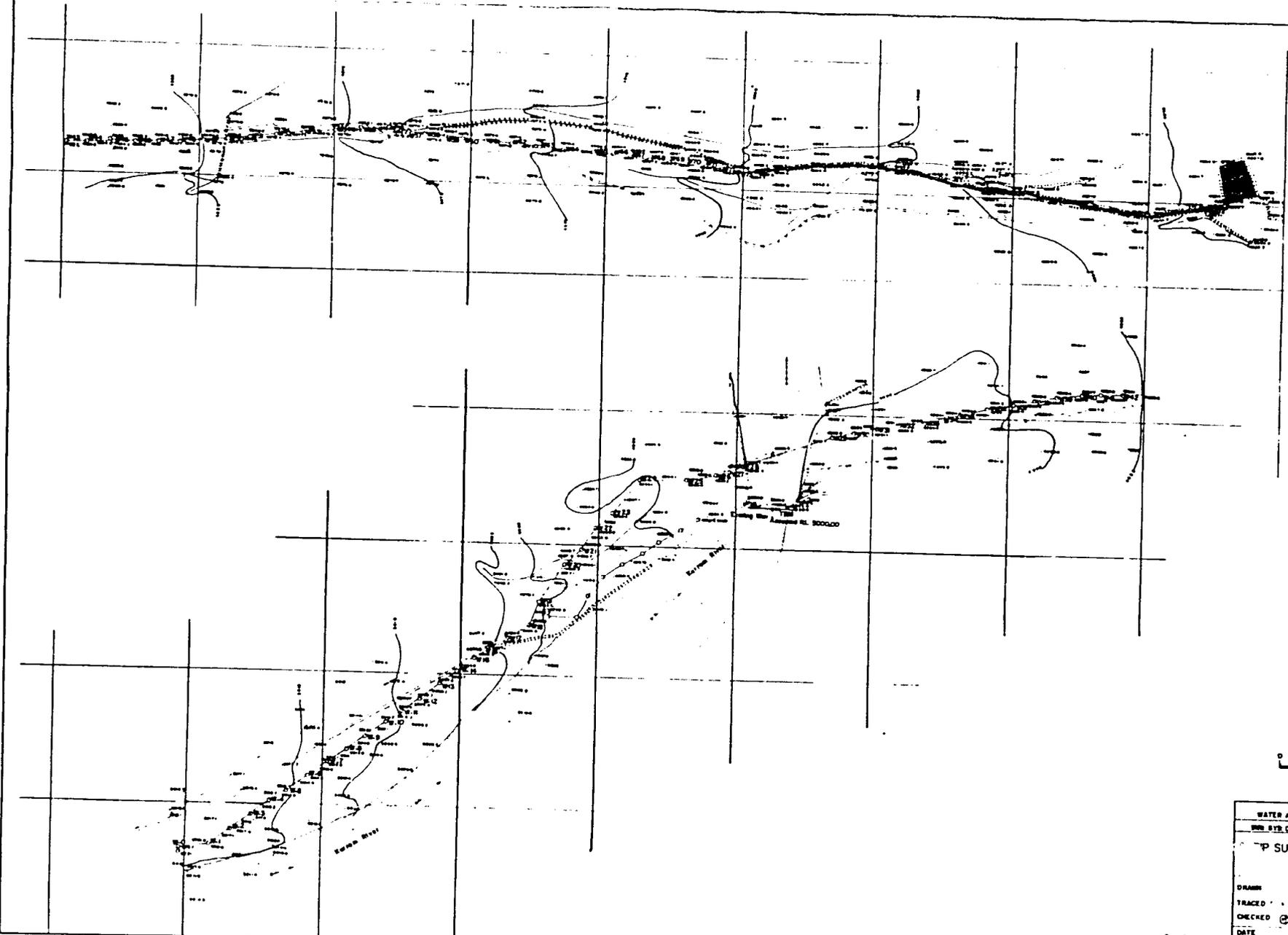


PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY WAPDA WAPDA'S OUTSIDE INDUS BASIN IRRIGATION PROJECT	
TOPOGRAPHIC SURVEY OF COMMAND AREA ABDUL HAKIM KAREZ (KURRAM)	
DRAWN TRACED CHECKED DATE	SUBMITTED RECOMMENDED APPROVED DRG NO ISMR-017
WATER RESOURCES PLANNING & RESEARCH DIRECTORATE PLANNING AND INVESTIGATION ORGANIZATION, LAHORE	

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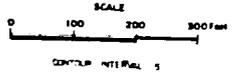
BEST AVAILABLE DOCUMENT

1574



LEGEND

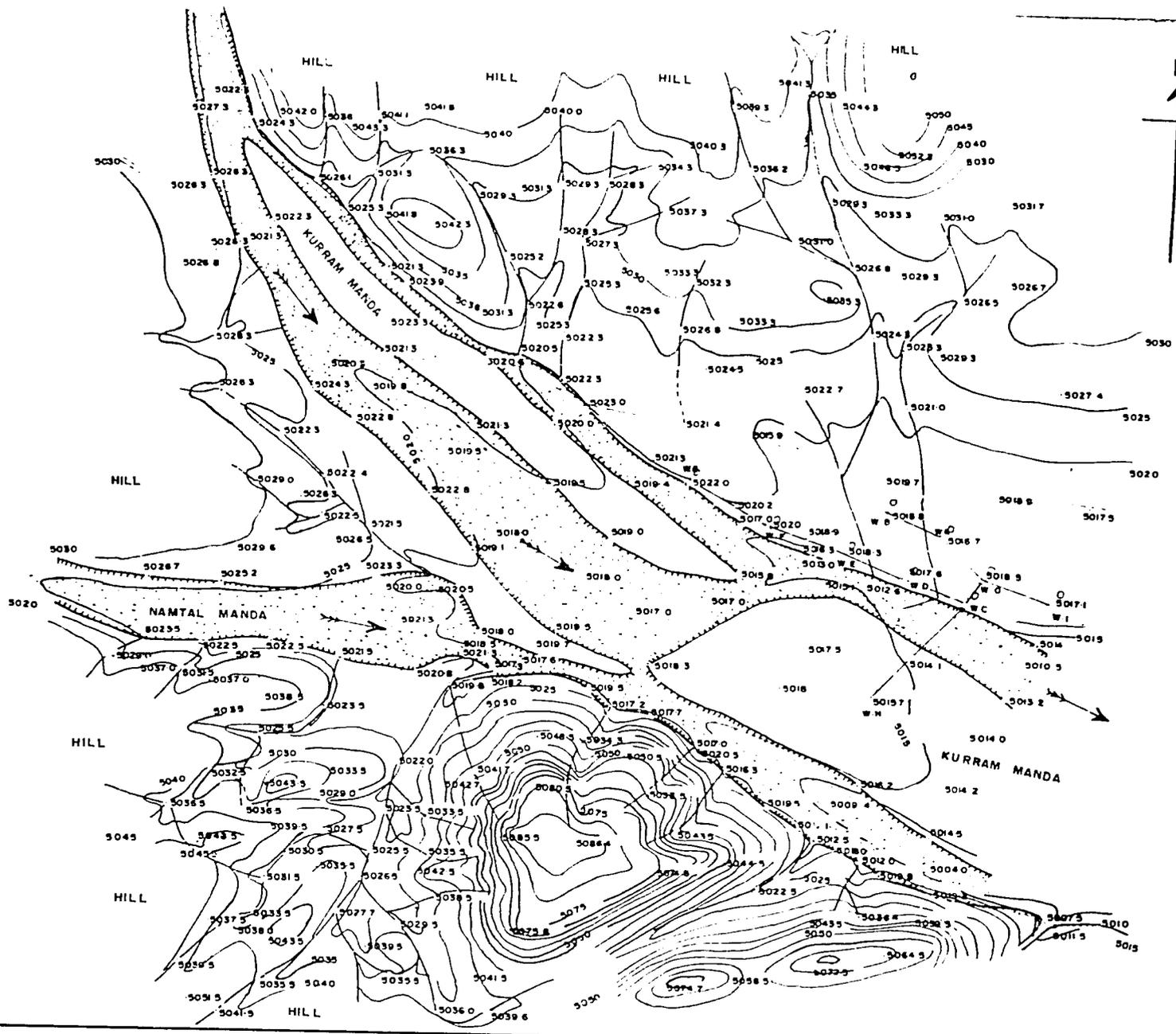
- Water Pond
- Well
- Canal
- Karez Well
- TBM Alignment
- Shed
- W. Tank



PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY WAPDA SURVEY OF ABDUL HAKIM KAREZ	
DRAWN TRACED CHECKED	SUBMITTED RECOMMENDED APPROVED
DATE LAHORE	DRG NO ISMR-018 WATER RESOURCES PLANNING & RESEARCH DIRECTORATE, PLANNING AND INVESTIGATION ORGANIZATION, WAPDA

A-37

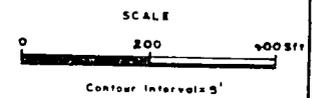
160



**LEGEND**

- Nala
- Kacha Path
- Karez Well
- Contour

**NOTE -**  
 ALL ELEVATIONS ARE RELATED TO ARBITRARY BENCH MARK FIXED ON A REGULATOR OF CANAL HEADWORKS OF EXISTING WAIR SITE  
 ASSUMED R. L. OF BENCH MARK, 5000.00  
 (i) = HORIZONTAL CONTROLLED WITH MAGNETIC NORTH

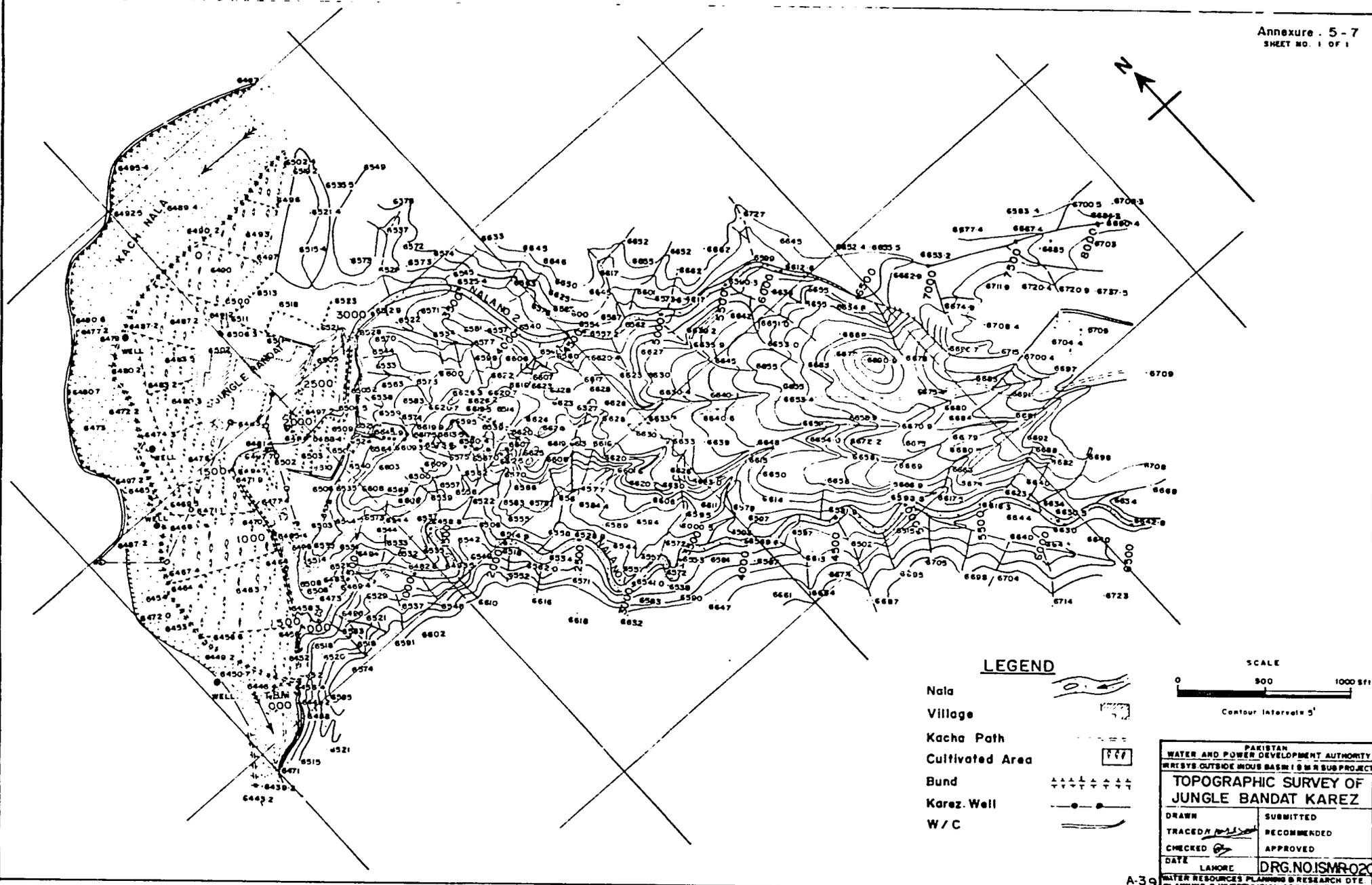


PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY IRRAWADDY BASIN SUB PROJECT	
<b>TOPOGRAPHIC SURVEY OF ABDUL HAKIM KAREZ UP STREAM OF WELL NO. 0</b>	
DRAWN	SUBMITTED
TRACED <i>11/11/51</i>	RECOMMENDED
CHECKED <i>11/11/51</i>	APPROVED
DATE LAHORE	DRG. NO. ISMR-019
WATER RESOURCES PLANNING & RESEARCH O.T.E. PLANNING & INVESTIGATION ORGANIZATION, LMR	

A-38

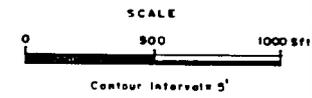
BEST AVAILABLE DOCUMENT

1161



**LEGEND**

- Nala
- Village
- Kacha Path
- Cultivated Area
- Bund
- Karez Well
- W/C



PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY MINISTRY OUTSIDE INDUS BASIN I & II SUB PROJECT	
<b>TOPOGRAPHIC SURVEY OF                  JUNGLE BANDAT KAREZ</b>	
DRAWN	SUBMITTED
TRACED	RECOMMENDED
CHECKED	APPROVED
DATE	LAHORE
DRG. NO. ISMR-020	

A-39

WATER RESOURCES PLANNING & RESEARCH DTE  
PLANNING & INVESTIGATION ORGANIZATION, LHR

BEST AVAILABLE DOCUMENT

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LIST OF SHARE HOLDERS  
ABDUL HAKIM KAREZ

Sr. No.	Name of Share Holder	Water Share
1.	Ali Khan, Tauz Khan and Allah Noor	2Shabana Roze
2.	Haji Muhammad Hasan	1 "
3.	Muhammad Anwar, Tareen Khan and Shirin Khan	2 "
4.	Muhammad Ismail, Haji Roze-ud-din, Zareen Khan, Ibrahim and Qasim	3 "
5.	Muhammad Hashim, Haji Muhammad Ayub Muhammad Yousaf, Ghulam Mohi-ud-din	3 "
6.	Mehar Ali, Sher Ali and Shah Wali	1 "
	Total:	<u>12</u> "

## LIST OF SHARE HOLDERS

## KHANOZAI KAREZ

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Saya	Shangar
1.	Abdul Aziz Sabzli S/O Majloon	-	1	2
2.	Muhammad Khan, Ahmad Jan S/O Muhammad Noor	-	1	-
3.	Abdul Sammad S/O Ali Gul	-	-	3
4.	Muhammad Hassan S/O Naik Muhammad	-	-	1
5.	Hali S/O Yousaf	-	-	1
6.	Sattar S/O Yousaf	-	-	1
7.	Sadu Gul S/O Yousaf	-	-	1
8.	Jano S/O Hanif	-	-	2.5
9.	Muhammad Sadiq, Abdul Razaq, Abdul Malik S/O Sultan Muhammad	-	1	2
10.	Abdul Halim, Abdul Rahim S/O Muhammad Gul	-	1	-
11.	Meer Asad S/O Badu Khan	-	1	-
12.	Abdul Halim S/O Manu	-	-	1.5
13.	Zain-ud-Din S/O Kuno	-	-	1
14.	Noor Muhammad S/O Faiz Muhammad	-	-	2.5
15.	Abdul Karim, Gul Barani S/O Mali	-	1	-
16.	Muhammad Gul, Sultan Muhammad Noor Muhammad S/O Muhammad Jan	-	1	-
17.	Wali Muhammad, Muhammad Jan Abdul Razaq S/O Abdul Khliq	-	1	-
18.	Mauluce Arab khan S/O Ghulam Ikhtiar	-	1	-
19.	Dour Muhammad, Faqir Muhammad, Mauladad, Haqdar S/O Gul Ikhtiar	-	1	1
20.	Moulue Muhammad Qasim, Abdul Wahid, Abdul Ahmad S/O Muhammad Jan	-	1	2

**LIST OF SHARE HOLDERS  
KHANOZAI KAREZ**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Saya	Shangar
21.	Haji Abdullah Jan S/O Haroon	-	-	3.5
22.	Abdul Hamid S/O Abdullah Jan	-	-	2
23.	Abboo Jan S/O Haroon	-	-	2.5
24.	Khudai Rohm S/O Sattar	-	-	3
25.	Wazir Muhammad S/O Musa	-	3	-
26.	Muhammad Shafi S/O Abdul Rahim	-	1	-
27.	Sher Muhammad, Dost Muhammad S/O Qayyum	-	1	1
28.	Abdul Rehman, Juma Khan, Abdul Rahim, Muhammad Zameer S/O Sher Khan	-	1	2.5
29.	Malik Abdul Aziz, Abdul Qadir S/O Kuttle	-	-	2
30.	Karim S/O Kuttle	-	-	2
31.	Naik Muhammad S/O Bhaloo	-	1	-
32.	Muhammad Sharif S/O Anayat Muhammad	-	1	-
33.	Faiz-ul-Haq S/O Latif	-	1	1.5
34.	Majiud S/O Mir Alam	-	-	1.5
35.	Saffan S/O Khushdil	-	-	2
36.	Saffar S/O Khushdil	-	-	2
37.	Mali, Baz Muhammad Niaz Muhammad S/O Sattar	-	1	2
38.	Ikhwandad, Muhammad Isa S/O Abdullah Jan	-	-	2
39.	Abdul Rehman, Muhammad Khan, Abdul Rahim, Muhammad Khair S/O Sher Khan	-	3	2
40.	Nazar S/O Babdad	-	1	-
41.	Sayyad S/O Safar	-	-	2
42.	Halim S/O Jamal	-	1	-

**LIST OF SHARE HOLDERS  
KHANOZAI KAREZ**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Saya	Shangar
43.	Ghaffar S/O Mir Alam	-	3	-
44.	Salho S/O Mehmood Gul1	-	1	-
45.	Zarif, Muhammad, Khan S/O Turdam Khan	-	1	-
46.	Agha Muhammad, Faqir Muhammad Khan Muhammad S/O Safar	-	1	-
47.	Abdul Razaq, Abduul Faiz S/O Iqbal	-	2	-
48.	Mali Muhammad Saddique S/O Ghaibi	-	2	-
49.	Abdul Hakim S/O Zameen	-	2	-
50.	Saleh Muhammad, Juma Khan S/O Alaf	-	2	-
51.	Abdul Wahid, Maulvi Abdul Khaliq, Muhammad Jan S/O Ali Jan	-	2	-
52.	Hassan S/O Ismail	-	1	3
53.	Abdul Salam S/O Yaqub	-	1	3
54.	Dalasa S/O Musa	-	3	-
55.	Dost Muhammad S/O Saleh Muhammad	-	1	2
56.	Dost Muhammad S/O Saleh Muhammad	-	1	2
57.	Muhammad Rafique S/O Zaman	-	2	-
58.	Din Muhammad, Nazar Muhammad S/O Abdullah Khan	-	1	-
59.	Mali Muhammad Saddique S/O Ghaibi	-	1	1
60.	Bardil S/O Nathu	-	1	-
61.	Isa Jan, Mosa Khan, Abdul Halim S/O Chiand	-	1	2
62.	Abdul Kakim S/O Muddat	-	1	-
63.	Wall Muhammad, Saleh Muhammad S/O Wahab	-	1	-
64.	Abdul Aziz	-	1	-

**LIST OF SHARE HOLDERS  
KHANOZAI KAREZ**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Saya	Shangar
65.	Taj Muhammad S/O Rehman	-	1	-
66.	Dost Muhammad S/O Ghaffar	-	-	4
67.	Sher Muhammad S/O Gul Muhammad	-	-	2
68.	Meer Ali, Muhammad Ali S/O Gondal	-	-	2
69.	Noor Din S/O Jabbar	-	-	2
70.	Ali Gul S/O Ghafoor	-	0.66	3
71.	Abdul Karim S/O Abdul Rahim	-	1	1.33
72.	Muhammad Qasim, Muhammad Isa S/O Lal Muhammad	-	-	2
73.	Abdul Razzaq, Allah Yar, Sardar S/O Mushai	-	2	-
74.	Shah Jehan S/O Balal	-	1	-
75.	Rashid S/O Bilal	-	1	-
76.	Abdul Sammad, Abdullah S/O Abdul Hayee	-	2	1
77.	Sher Muhammad S/O Din	-	1	3
78.	Sahibdad S/O Arbab	-	-	2
79.	Bungle S/O Arbab	-	-	2
80.	Faiz Muhammad, Noor Muhammad S/O Muhammad Shafiq	-	1	-
81.	Agha Muhammad S/O Noor Muhammad	-	2	-
82.	Haji Ghamandad S/O Joti	-	1	-
83.	Muhammad Ali S/O Muhammad	-	1	-
84.	Yar Muhammad, Noor Muhammad S/O Ghulam	-	1	2
85.	Bahauddin-Khairi, Jalal-ud-Din S/O Khan	-	1	1
86.	Lal Muhammad S/O Khudai Rehm	-	1	1

LIST OF SHARE HOLDERS  
KHANZOAI KAREZ

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Saya	Shangar
87.	Akhanozada, Abdul Ali S/O Abdul Khaliq	-	1	1
88.	Abdullah, Faiz-Ullah S/O Muhammad Gul	-	2	3
89.	Saleh Muhammad S/O Meer	-	1	1
90.	Muhammad Iarif, Abdullan, Muhammad Sharif S/O Arsla	-	1	1

Source: Revenue Department, Government of Baluchistan,  
Pishin District.

**LIST OF SHARE HOLDERS  
BALOZAI KAREZ**

Sr. No.	Name of Share Holder	Water Share	
		Gata	Saya
1.	Ghulam S/O Khudai Rehm	-	1
2.	Mulla sahib, Jan S/O Rehmat	4	1
3.	Ghulam Haider S/O Mangta	1	1
4.	Umer Jan S/O Khudai Rehm	4	1
5.	Abdul Hakim, Niaz S/O Khaliqdad	4	-
6.	Taj Muhammad S/O Abdul Haq	-	2
7.	Abdul Wahab, Abdul Mannaf S/O Ghafoor	2	2
8.	Muhammad Noor, Muhammad S/O Pirdad	5	-
9.	Ghulzar S/O Mushkal	5	-
10.	Dost Muhammad, Agha Muhammad Saleh S/O Naib Muhammad	4	-
11.	Taj Muhammad S/O Salam	-	1
12.	Khudai Rehm. Khudadad S/O Mali Bakhtiar	-	1
13.	Noor Muhammad S/O Moasoom	-	2
14.	Malik Abdul Rehman, Abdul Rahim, Abdul Shakoor S/O Agha Muhammad	-	4
15.	Pir Muhammad S/O Hamza	7	-
16.	Dost Muhammad, Agha Muhammad S/O Naib Muhammad	5	-
17.	Fateh Muhammad, Saeed Bungle S/O Abdul Hamid	4	-
18.	Ghulzar S/O Mushkal	4	1
19.	Qadir S/O Ayub	4	-
20.	Noor-ud-Din, Muee-ud-Din, Ghulam Muhy-ud-Din S/O Rahim Baksh	-	2
21.	Ghulam Rasool S/O Rawat	6.5	-
22.	Muhammad Faiz S/O Ali Jan	5.5	-

**LIST OF SHARE HOLDERS  
BALOZAI KAREZ**

Sr. No.	Name of Share Holder	Water Share	
		Gata	Saya
23.	Jalal S/O Qaim	5	-
24.	Sikandar S/O Mullah Mian	5	-
25.	Nawaid S/O Mullah Akbar	3	-
26.	Saeed Ahmad S/O Muhammad Hussain	1	-
27.	Faiz-ul-Haq, Noor-ul-Haq S/O Muhammad Saddiq	6	-
28.	Anwar, Mairani S/O Khaliq-Ullah	1	4
29.	Faiz-ul-Haq, Noor-ul-Haq	7	-
30.	Sher Ali S/O Anayat	5	-
31.	Ghafoor S/O Sammad, Naib Muhammad Bakht	3	-
32.	Abdul Jalil S/O Salam	6	-
33.	Abdul Sammad	2	1
34.	Abdul Wahid S/O Halim	-	2
35.	Mullah Wazir Muhammad, Faqir Muhammad S/O Wali	-	2
36.	Habib-Ullah S/O Akhtar	5	-
37.	Ahmad-Ullah S/O Islam	6	-
38.	Abdul Baqi, Abdul Ali, Jan Muhammad	5	-
39.	Fateh Muhammad, Saeed Mangle S/O Abdul Hamid	5	-
40.	Taj Muhammad S/O Salam	1.5	-
41.	Khudai Rehm S/O Khudai Dad	1.5	1
42.	Muhammad Shafi, Muhammad Qasim S/O Usman, Faiz Muhammad S/O Bostan		7

**LIST OF SHARE HOLDERS  
BALOZAI KAREZ**

Sr. No.	Name of Share Holder	Water Share	
		Gata	Saya
43.	Abdul Hakim S/O Sharif	5	-
44.	Sayed Muhammad, Khan Muhammad S/o Suleman	3	-
45.	Abdul Aziz S/o Ali Jan	3	2
46.	Muhammad Yar S/o Rooh-Ullah	-	2
47.	Lal Muhmmad, Wali Muhammad S/o Muhammad Khan	-	2
48.	Abdul Samad, Fateh Muhammad S/o Gul Muhammad	7	-
49.	Muhammad Yar S/o Rooh-Ullah	-	1
50.	Pir Muhmmad, Heera Jan, Manu Baz Muhammad S/O Mohammadu	4	-
51.	Syeed-Ullah S/O Mir Alam	4	1
52.	Raz Muhammad S/O Salhu	-	1
53.	Ghulam Rasool S/O Islam	2	-
54.	Ghulam Dastagir S/O Hadayat	3	-
55.	Abdul Wahab, Majeed S/O Bashira	-	1
56.	Haroon S/O Usman, Taj Muhammad S/O Umer	4	2
57.	Ghulam Dastagir S/O Hadayat	-	2
58.	Nazar Muhammad	2	1
59.	Habib-Ullah S/O Hakim	5	-
60.	Muhammad Yaqub, Muhammad Ishaq, Muhammad Ayub, Abdul Shakoor S/O Muhammad Rafiq	4	-
61.	Akbar, Ghaffar. Soorat Khan S/O Saif-ud-Din	5	-
62.	Abdullah Jan S/O Qaim Khan	1	1
63.	Mullah Delawar S/O Wairs	7	-

LIST OF SHARE HOLDERS  
BALOZAI KAREZ

Annexure 5-8

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Sr. No.	Name of Share Holder	Water Share	
		Gata	Saya
64.	Sayed Muhammad ,Khan Muhammad S/O Suleman	5	-
65.	Abdul Wadood, Mullah Wazir Muhammad, Muhammad Ghaffar S/O Alla-ud-Din	1	5
66.	Haroon S/O Usman, Taj Muhammad S/O Umer	7	2
67.	Abdul Sattar, Abdul Wasay S/O Khudai Rehm	4	3
68.	Muhammad S/O Halim	4	-
69.	Rahim S/O Sada	-	1
70.	Muhammad Hassan, Abdullah Jan Sahib Jan S/O Yahya	-	3
71.	Qadoos Gazi, Mullah Abdul Wahid S/O Muhayuddin	4	4
72.	Qayyum S/O Halim	4	-
73.	Rehmdil S/O Rahim	-	3
74.	Muhammad Shafi, Muhammad Qasim S/O Usman, Faiz Muhammad S/O Bostan	-	1
75.	Kamal S/O Yaqub	2	1
76.	Muhammad Ibrahim, Karim S/O Mehdi	7	-
77.	Qadir S/O Noor Din	3	-
78.	Yar Muhammad, Abdul Sammad S/O Salhoo	5.5	-
79.	Abdul Hamid, Saeed Ahmad S/O Aziz-Ullah	2	-
80.	Abdul Manan S/O Niaz Muhammad	4.5	-
81.	Mullah Daud, Mursal, Baqidad, Karim Dad S/O Shah Muhammad	-	2
82.	Nazar Muhammad, Abdul Aziz S/O Niaz Muhammad	-	2
83.	Abdul Wahid, Neemat, Dost Muhammad S/O Din Muhammad	1.5	1
84.	Arabi S/O Ghafoor	4.5	-
85.	Mullah Abdul Razaq S/O Bahawal	2	-

**LIST OF SHARE HOLDERS  
BALOZAI KAREZ**

Sr. No.	Name of Share Holder	Water Share	
		Gata	Saya
86.	Alamnaz S/O Zakariya	5	-
87.	Saleh Muhammad S/O Naqi-ud-Din	4	1
88.	Humai S/O Aulia	-	1
89.	Abdul Wahab S/O Aulia	7	-
90.	Nadir S/O Rahimdad	1	1
91.	Salam, Hamid-Ullah S/O Qaim	4	-
92.	Mullah Sultan Muhammad S/O Karam	4	-
93.	Mastoor, Samandar, Bakht Muhammad, Naik Muhammad	4	4
94.	Saraj Din S/O Salhoo	-	1
95.	Amir Muhammad, Baz Gul Khudadad	6	-
96.	Muhammad Faiz, Faiz Muhammad S/O Sher Dil	2	-
97.	Abaidullah S/O Rehmdil	7	-
98.	Nadir S/O Rahimdad	5	-
99.	Agha Muhammad S/O Naseer	0.5	-
100	Agha Muhammad S/O Naseer	0.5	-
101	Sahib Khan S/O Saifuddin	5.5	-
102	Abdul Haq, Abdul Wadood S/O Rosy	-	2
103	Abdullah S/O Rahim	2	1
104	Abdul Ghafar, Abdul Sattar S/O Zarain	4	1
105	Masoom S/O Musa	2	1

Source: Revenue Department, Govt. Of Baluchistan,  
Pishin District.

**LIST OF SHARE HOLDERS  
SAHIB KAREZ (KHANOZAI)**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Saya	Shangar
<b><u>DADAKZAI</u></b>				
1.	Haji Abdul Karim & Haji Ibrahim	2	2	2
2.	Haji Noor Muhammad	-	10	6
3.	Noorullah Khan & Hafizullah	-	8	7
4.	Haji Faqir Muhammad	-	4	1
5.	Haji Abdul Quddus	-	1	-
6.	Abdul Zair	-	1	-
7.	Abdul Hamid	-	1	-
8.	Haji Abdul Wadood	-	1	1
9.	Jalad Khan & Alamgir	-	3	-
10.	Musa	-	1	-
11.	Noor Muhammad S/O Yar Muhammad	-	4	-
12.	Haji Mehar Ali	-	1	2
13.	Baha-ud-Din	-	-	6.5
14.	Nazir Ahmad	-	5	0.5
15.	Badar Din	-	5	-
16.	Sher Shah	-	-	7
17.	Sharif-Ullah	-	-	1
18.	Sher Muhammad	-	-	2
19.	Abdul Rahim	-	2	2
20.	Aziz-Ullan Rehman	-	2	1
21.	Haji Abdul Karim	-	1	-

**LIST OF SHARE HOLDERS  
SAHIB KAREZ (KHANOZAI)**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Saya	Shangar
22.	Bismillah	-	-	2
23.	Haji Abdul Abad S/O Rehmat-Ullah	-	1	-
24.	Mehmood Azam	-	2	-
25.	Nisar Ahmad	-	2	2
26.	Abdul Qadir & Adbul Sammad	-	2	1
<b><u>SAHEHZAIT IBRAHIMZAI</u></b>				
27.	Muhammad Qasim	-	7	2
28.	Amir Muhammad	-	7	2
29.	Muhammad Fazal & Mirza Khan	-	1	-
30.	Haji Abdul Ghafoor	-	6	-
31.	Sher Muhammad	-	1	-
32.	Haji Abdul Rahim	1	1	1
33.	Hamid-Ullah	-	1	2
34.	Dad Muhammad	-	4	-
35.	Sher Muhammad & Agha Muhammad	-	6	-
36.	Taj Muhammad	-	3	-
37.	Haji Lal Muhammad	-	2	-
38.	Gul Muhammad	-	4	2

**LIST OF SHARE HOLDERS**  
**SAHIB KAREZ (BALOZAI)**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Saya	Shangar
<u>ALADADZAI</u>				
1.	Baz Muhammad & Sher Muhammad	1	2	-
2.	Mueen-ul Haq	-	6	1
3.	Dad Muhammad S/O Faiz Muhammad	2	-	2
4.	Malik Abdul Shakoor	2	-	3
5.	Ahmad Jan	-	2	4
6.	Abdullah S/O Ghulam	-	1	2
7.	Mullah Abdul Karim Dad	-	1	2
8.	Anayat-Ullah	-	2	-
<u>UMARZAI</u>				
9.	Syed-Ullah S/O Muhammad Hussain	-	4	1
10.	Mullah Abdul Hayee	-	2	-
11.	Abdul Hakim Jamal Dar	-	1	-
12.	Abdul Aziz	-	-	3
13.	Sufi Abdul Wadood	-	2	3
14.	Abdul Hakim	-	-	2.5
15.	Faiz-ul-Haq	-	1	2
16.	Abdul Aziz	-	-	3
17.	Meera Jee	-	-	2
18.	Muhammad Umar	-	2	3
19.	Muhammad Umar	-	-	2
20.	Muhammad Umar	-	-	0.5
21.	Rehmat-Ullah	-	-	2
22.	Sarif-Ullah	-	2	2

Source: Revenue Department, Government of Baluchistan,  
Pishin District.

**LIST OF SHARE HOLDERS**  
**SAHIBZADA KAREZ**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Saya	Shangar
1.	Ameer Hamza S/O Malik Muhammad Akbar	1	4	-
2.	Malik Saleh Muhammad S/O Jamal	4	-	-
3.	Shah Jan S/O Balal	4	-	-
4.	Akhwandzada Abdullah Ali S/O Abdul Khaliq	4	-	-
5.	Abdul Haq, Abdul Salam S/O Meer Ahamd	-	4	-
6.	Abdul Ghani S/O Aarsaladed	-	4	-
7.	Ameer Muhammad S/O Ghazfar	-	4	-
8.	Mir Ali Muhammad Ali S/O Gondal	1	-	-
9.	Sikandar S/O Pista Khan	1	4	-
10.	Taamal S/O Ali	1	-	-
11.	Sahib Jan, Abdullah Jan S/O Jamal	-	4	-
12.	Abdul Rehman, Juma Khan, Abdul Rahim, Muhammad Khair	3	-	-

Source: Revenue Department, Govt. of Baluchistan,  
Pishin District.

LIST OF SHARE HOLDERS  
TOR DAMAN KAREZ

Sr. No.	Name of Share Holder	Water Share
1.	Haji Abdul Aleem and 4 brothers	11Shabana Roze
2.	Haji Abdul Rahim and 5 brothers	9 " "
3.	All Muhammad and 2 brothers	4 " "

Total share holders = 14

Source: Owner's Interviews.

LIST OF SHARE HOLDERS

KAREZ JALOGI

Sr. No.	Name of Share Holder	Water Share
1.	Malik Ashraf and 3 brothers	8Shabana Roze
2.	Malik Abdul Rehman and 6 brothers	7
	Total share holders =	11

Source: Owner's Interview

## LIST OF SHARE HOLDERS

## KUNDKI KAREZ

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Saya	Shangar
1.	Abdul Rahman S/O Madad Khan	11	1	0
2.	Faiz Muhammad S/O Dar Muhammad	0	3	0
3.	Pir Muhammad S/O Dar Muhammad	0	1	0
4.	Aziz Muhammad S/O Dar Muhammad Halima D/O Pir Muhammad	2	0	0
5.	Abdul Aziz S/O Dur Muhammad	6	2	0
6.	Habibullah S/O Qadir Bux	3-1/2	0	0
7.	Mohd Akbar S/O Mohd Hassan	11	0	0
8.	Mohd Usman S/O Khan Mohd	1-1/2	0	0
9.	Shamman S/O Sher Khan	6	0	0
10.	Ghulam Nabi S/O Araz Mohd	2	0	0
11.	Sariya Khatoon, Noorunisa D/O Araz Mohd	2	0	0
12.	Bakhtawar D/O Alam Khan	6	0	0
13.	Noor Mohd, Niaz Mohd S/O Nimatullah	2	0	0
14.	Abdul Qayyum, Abdullah S/O Abdul Wahab	3	1	0
15.	Dar Mohd S/O Murad Khan	0	1	0
16.	Ata Mohd S/O Mohd Siddique	3	3	0
17.	Ahamd Khan S/O Nawab Khan	4	0	0
18.	Abdul Haq, Khudadad S/O Dad Khan	9	5	0
19.	Faqir Mohd S/O Zamir Jan	9	0	0
20.	Lal Mohd, Noor Ahamd S/O Amir Khan	2	2	0
21.	Jorak S/O Gul Muhammad	2	2	2
22.	Shakar S/O Muhammad Khan	0	0	2
23.	Muhammad Khan, Muhammad Rehim S/O Muhammad Murad	0	0	2
24.	Nimatullah, Rehmtullah S/O Shakker	0	0	3
25.	Abdullah, Muhammad Khair S/O Zaman Khan	0	0	10

## LIST OF SHARE HOLDERS

## KUNDKI KAREZ

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
26	Sahib Khatoon D/O Zaman Khan	0	0	5
27.	Muhammad Yousaf, Muhammad Yaqub S/O Abdul Gaffar	0	2	5
28.	Muhammad Akbar S/O Ghulam Nabi	0	2	0
29.				
30	Khair Bux S/O Khuda Bux	0	0	2
31.	Muhammad Bux S/O Madad Khan	0	0	8
32.	Lal Muhammad S/O Madad Khan	0	0	2
33.	Abdul Wahid S/O Muhammad Yar	0	0	2
34.	Rabia D/O Taj Muhammad	0	0	3
35.	Dur Muhammad S/O Sher Muhammad	0	0	2
36.	Khair Muhammad S/O Sher Muhammad	0	0	9
37.	Saleh Muhammad S/O Sher Muhammad	0	0	2
38.	Rehmat Khatoon D/O Alam Khan	0	0	1-1/2
39.	Muhammad Hassan S/O Lal Muhammad	0	1	6
40.	Sahib Khatoon D/O Faqir Muhammad	0	1	0
41.	Muhammad Ali, Muhammad Usman S/O Yar Muhammad	0	1	1
42.	Hajra S/O Juma Khan	0	1	0
43.	Sher Ali S/O Ahmad	0	0	10
44.	Khuda Bux S/O Ahmad Ali	0	2	0
45.	Shakar Khan, Muhammad Azam S/O Juma Khan	0	0	10
46.	Dur Muhammad S/O Shakar Khan	0	0	2
47.	Niaz Muhammad S/O Khuda Dad	0	2	8
48.	Janat S/O Adam Khan	0	0	3
49.	Imam Dad S/O Jahani Shah	0	0	10
50.	Muhammad Anwar S/O Dur Muhammad	0	0	6
51.	Khuda Bux S/O Afzal	0	0	9

## LIST OF SHARE HOLDERS

## KUNDKI KAREZ

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
52.	Ghulam Jan S/O Badal Khan	0	0	4
53.	Haji Khan, Amir Khan, Shakar khatoon S/O Badal Khan	0	3	10
54.	Muhammad Ghias S/O Muhammad Din	0	0	4
55.	Abdul Khaliq S/O Ali Muhammad	0	0	10
56.	Taj Muhammad S/O Ali Jan	0	0	2
57.	Faiz Muhammad S/O Rahim Bux	0	0	5/1/2
58.	Abdullah, Abdul Hakim S/O Nabi Bux	0	1	1/2
59.	Gul Jan D/O Ali Muhammad	0	0	2
60.	Abdul Razaq S/O Faiz Muhammad	0	3	4/1/2
61.	Abdul Karim S/O Abdul Qadir	0	1	3
62.	Manzoor.Ahamd S/O Sahib Dad	0	4	9
63.	Abdul Baqi S/O Abdul Azeem	0	2	1
64.	Khan Muhammad S/O Shahdad	0	0	1
65.	Abdul Majid, Abdul Karim, Abdul Haq S/O Gul Muhammad	0	0	6
66.	Muhammad Khan S/O Saadat	0	0	2
67.	Peroz Khan, Rasool Bux, Muhammad Bux, Mlook Khan, Mehraliah S/O Rahim Bux	0	0	6
68.	Dil Bux S/O Wali Muhammad	0	0	6
69.	Muhammad Wafa. Muhammad Azam, Sultan Muhammad S/O Muhammad Bux	0	0	6
70.	Buddah S/O Sabzel Khan	0	0	6
71.	Muhammad Akbar S/O Ahmad Khan	0	0	2
72.	Yar Ali S/O Afzal	0	0	1/1/2
73.	Naseer Ahmad S/O Afzal	0	0	8
74.	Hazar Khan S/O Afzal	0	0	2
75.	Juma S/O Muhammad Munsh	0	0	2
76.	Ghulam Qadir S/O Babu	0	0	2

LIST OF SHARE HOLDERS  
KUNDKI KAREZ

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
77.	Pir Bux S/O Allah Ditt	0	3	11/1/2
78.	Muhammad Jan S/O Behram Khan	0	1	6
79.	Muhammad Akbar S/O Behram Khan	0	0	6
80.	Muhammad Aslam S/O Begram Khan	0	0	9
81.	Zar Bibi D/O Gul Muhammad	0	0	1
82.	Ghulam Haider S/O Jamal Khan	0	0	1
83.	Faiz Muhammad S/O Sadiq	0	0	2/1/4
84.	Nazir Khan S/O Afzal	0	0	3/4
85.	Abal Khan S/O Karim Bux	0	0	4
86.	Jattha Khan S/O Kahore	0	0	11
87.	Shah mehr S/O Suhrab	0	0	5
88.	Mehmood, Adam S/O Lal Muhammad	0	0	5
89.	Pasand Khan S/O Amir	0	1	1
90.	Alambardar S/O Rahim Bux	0	0	3
91.	Allah Ditta /S/O Baligh Khan	0	1	0
92.	Hakim S/O Ballgh Khan	0	0	2/1/2
93.	AbdulQadir S/O Mehr Muhammad	0	0	3
94.	Mehrdin S/O Sher Muhammad	0	0	4
95.	Ahmad S/O Shadi Khan	0	0	6/1/2
96.	Muhammad Ayub S/O Lal Muhammad	0	1	0
97.	Abdul Nabi S/O Acta Muhammad	0	0	4
98.	Abdul Rehman S/O Khuda Bux, Dadu Khan S/O Haroon, Ali Muhammad S/O Mhrad Ali	0	0	6
99.	Abdul Rahim, Soona Khan, MuhammadYaqub, Muhammad Usman, Faiz Muhammad S/O Sher Khan	0	0	10
100	Muhammad Karim, Sahib Bad, Araz Muhammad S/O Mall Muhammad	0	0	4

LIST OF SHARE HOLDERS  
KUNDKI KAREZ

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
101	Muhammad Hassan S/O Soona Khan	0	0	3
102	Muhammad Fahim, Muhammad Hassain S/O Mohd Bux	0	0	4
103	Nehal Khan S/O Abdul Ghani	0	0	3
104	Qadir Bux, Muhammad Khair S/O Khaliqdad	0	1	0
105	Eid Muhammad S/O Suhrab	0	0	4
106	Muhammad Rahim S/O Gul Muhammad	0	0	3
107	Shah Muhammad S/O Noor Muhammad	0	0	2
108	Muhammad Karim S/O Nawab	0	2	4
109	Fazal S/O Iesa Khan	0	1	0
110	Dur Khan S/O Musa Khan	0	1	0
111	Allah Bux S/O Qadir Bux, Qadir Bux S/O Imam Bux, Muhammad Jan S/O Murad Bux, Muhammad Hassan S/O Mahim Bux	0	0	6
112	Murad Bux S/O Nabi Bux, Dad Muhammad S/O Khair Muhammad	0	1	0
113	Jahangir S/O Madad Khan	0	1	10
114	Imam Bux Hizak Khan S/O Shakkar	0	1	1/2
115	Khuda Bux, Isa Khan S/O Shakkar	0	0	6
116	Ahmad Khan S/O Behram Khan	0	0	2
117	Muhammad Sharif S/O Dur Muhammad	0	0	6
118	Abdul Rehman S/O Jamshaid	0	0	3
119	Muhammad Umar S/O Pir Muhammad	0	0	11
120	Muhammad Bux, Muhammad Umer S/O Hazoor Bux	0	0	5
121	Muhammad Yousaf S/O ahmad Khan	0	0	4
122	Dara Khan S/O Ahmad Khan	0	2	0
123	Sher Muhammad S/O Shah Muhammad, Shah Muhammad Afa Muhammad S/O Sher Muhammad	0	1	0
124	Pir Bux S/O Allah Ditta	0	0	2

## LIST OF SHARE HOLDERS

## KUNDKI KAREZ

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
125	Muhammad Sadique S/O Allah Yar Khan	1	1	5
126	Muhammad Anwar, Muhammad Arif S/O Allah Yar Khan	1	2	3/1/2
127	Azad Khan S/O Sharbat Khan	0	0	6
128	Sherdil Khan S/O Ali Dost	0	0	9
129	Sharbat S/O Haibit	0	0	4
130	Muhammad Rahim S/O Gul Muhammad	0	0	6
131	Abdul Razan S/O Noor Muhammad	0	0	3
132	Abdul Aziz S/O Muhammad Khan	0	2	0
133	Amir, Sher Khan S/O Khuda Bux	0	0	7
134	Abdul Qadir, Abdul Majid, Abdul Khaliq S/O Abdul Khair	0	0	5
135	Bahar Shah S/O Muhammad Shah	0	0	5
136	Agha Shah S/O Muhammad Shah	0	0	1
137	Abdul Rehman Shah S/O Muhammad Shah	0	5	10
138	Ghulam Haider Shah S/O Rustam Shah	0	1	7
139	Muhammad, Umer Shah, Muhammad.Akbar Shah S/O Muhammad Shah	0	0	9
140	Malook Shah S/O Haji Shah	0	3	0
141	Shawal Das, Patel Das S/O Dalip Das	0	0	6
142	Shalamat Wakf	0	1	0
143	Shalamat Wakf, Masjid Sharif	0	0	6
144	Govt. West Pakistan	0	2	6

Source: Revenue Department, Govt. of Baluchistan,  
Kalat Distt:

**LIST OF SHARE HOLDERS  
ISHKANA KAREZ**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
1.	Surrab Khan, Muhammad Khan S/O Taj Muhammad	0	2	0
2.	Akhtar Muhammad S/O Noor Muhammad	0	0	2
3.	Muhammad Hayat, Abdul Hamid, Abdul Hayat S/O Abdul Wahid	0	0	2
4.	Mula S/O Muhammad	0	0	2
5.	Abaldurehman S/O Hamim Khan	0	1	2
6.	Muhammad Hanif, Muhammad Anwar S/O Alambardar	0	1	2
7.	Abaldurehman S/O Nasir Khan	0	1	0
8.	Hazoor Bux, Mubarak Khan S/O Murad Bux	0	0	2
9.	Sharaf Khatoon D/o Khatanm Khan	0	0	2
10.	Ghulam Nabi S/O Khatanm Khan	0	0	2
11.	Ghulam Rasool, Ghulam Mustafa, Ghulam Sarwar S/O Hussain Bux	0	0	2
12.	Khan Muhammad S/O Mir Muhammad	0	0	2
13.	Dalil Khan S/O Khatam Khan	0	1	2
14.	Ghulam Muhammad, Atta Muhammad S/O Gehwar Jan	0	0	2
15.	Abaldurehman S/O Khatam Khan	0	1	0
16.	Habib Khan S/O Khatam Khan	0	0	2
17.	Hamim Khan S/O Abdul Fateb	0	0	2
18.	Dost Muhammad, Janda Khan S/O Mir	0	1	0
19.	Abdul Hamid, Abdul Majid S/O Munir Muhammad	0	0	2
20.	Muhammad Hayat, Abdul Majid, Abdul Hayat S/O Abdul Wahid	0	0	2
21.	Abdul Majid S/O Muhammad Shafi	0	3	0
22.	Muhammad Hanif, Muhammad Anwar S/O Alambardar	0	1	0
23.	Niaz Ullah, Anyat Ullah S/O Hir Ullah	0	1	0
24.	Bahawal Khan, Muhammad Yar S/O Khuda Bux	0	0	2
25.	Shafi Muhammad S/O Faiz Muhammad	0	0	2

**LIST OF SHARE HOLDERS  
ISHKANA KAREZ**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Dang
26.	Imam Bux S/O Munir Bux	0	2	0
27.	Munir Muhammad S/O Abdul Jan	0	1	2
28.	Muhammad Rahim, Muhammad Amin S/O Shabbaz Khan	0	1	2
29.	Ghulam Rasool, Ghulam Mustafa, Ghulam Sarwar S/O Hussain Bux	0	1	0
30.	Pehlwan S/O Dar Muhammad	0	1	0
31.	Khuda Bux S/O Noor Muhammad	0	1	2
32.	Muhammad Hanif, Muhammad Anwar S/O Alambardar	0	1	2
33.	Abdul Majid S/O Muhammad Shafi	0	1	0
34.	Muhammad Amir, Qaisar Khan S/O Hizri Khan	0	1	0
35.	Abdul Rehman S/O Nasir Khan	0	1	0
36.	Abdul Haq S/O Haji Khan	0	0	2
37.	Ghaus Bux, Muhammad Hayat S/O Shafi Muhammad	0	0	2
38.	Aurang Shah S/O Nehal Shah	0	0	2
39.	Abdul Rehman S/O Fateh Khan	0	0	2
40.	Bahadar Khan, Muhammad Yar S/O Khuda Bux	0	0	2
41.	Abdul Sammad, Abdul Karim S/O Khaliq Dad	0	1	0
42.	Ghaus Bux, Muhammad Hayat S/O Shafi Muhammad	0	1	0
43.	Hamim Khan S/O Abdul Fateh	0	0	2
44.	Munir Muhammad S/O Sabzal Khan	0	0	2
45.	Muhammad Rahim, Muhammad Amin S/O Shahbaz Khan	0	2	0
46.	Suhrab Khan, Muhammad Khan S/O Taj Muhammad	0	2	0
47.	Abdul Qaddus S/O Muhammad Shafi	0	2	0
48.	Munir Bux S/O Muhammad Amin	0	0	2
49.	Abdul Hakim, Khan, Abdul Wahid S/O Noorul Haq	0	0	2
50.	Shakar Khan, Ahmad Bux S/O Ali Muhammad	0	0	2
51.	Abaidullah S/O Khawashi	0	1	0
52.	Mula Bux S/O Muhammad	0	1	2

**LIST OF SHARE HOLDERS  
ISHKANA KAREZ**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Dang
53.	Nasir Ahmad Khan S/O Sabzal Khan	0	2	0
54.	Manzoor Ali Khan Anwar Ali, Ahmad Ali Shah S/O Muhammad Ali shah	0	2	0
55.	Abdul Hakim, Abdul Wahid S/O Noor -ul-Haq	0	2	0
56.	Sharaf khatoon W/o Khatan Khan	0	1	0
57.	Ghulam Nabi S/O Khatan Khan	0	1	0
58.	Abdul Hamid, Abdul Hajid S/O Munir Muhammad	0	3	10
59.	Nunir Muhammad S/O Sabzal Khan	0	0	2
60.	Muhammad Rahim, Muhammad Amin S/O Shabbaz Khan	0	0	2
61.	Shafi Muhammad, S/O Faiz Muhammad	0	2	0
62.	Ghaus Bux, Muhammad Hayat S/O Shafi Muhammad	0	1	0
63.	Abdul Razaq, Abdul Rahim, Muhammad Akbar, Abdul Qayyum, Muhammad Afzal S/O Juma Khan	0	1	0
64.	Muhammad Wafa, Muhammad Pana, Muhammad Shafa, Muhammad Salah, Muhammad Baza S/O Faqir Muhammad	0	1	0
65.	Juma Khan S/O Muhammad Ismail	0	1	0
66.	Abdul Haq S/O Haji Khan	0	1	0
67.	Khadim Hussain S/O Ghulam Jaffar	0	1	0
68.	Ghulam Rasool, Ghulam Mustafa, Ghulam Sarwar S/O Hussain Bux, (i) Yaqub S/O Sahib Dad Yaqub S/O Muhammad Jan, Lal Shah S/O Badr Shah	0	1	0
68/1	Ghulam Nabi Shah, Sharif Shah, Mehrab shah S/O Anayat Shah	0	3	0
69.	Sultan Ahrnad Khan, Sher Khan, Nasir Khan S/O Wadera Noor Muhammad	0	2	2
70.	Ghulam Qadir S/O Sabzael	0	0	2
71.	Hamid Ultlah S/O Allah Yar	2	1	0
72.	Perol Khan S/O Arif Khan	0	0	2
73.	Fateh Muhammad S/O Arif Khan	0	1	0
74.	Baland Khan S/O Arif Khan	0	1	2
75.	Ghulam Jan S/O Gehwar Jan	0	1	2

**LIST OF SHARE HOLDERS  
ISHKANA KAREZ**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Dang
76.	Ghulam Haider, Abdul Rahim S/O Sabar Khan	0	0	2
77.	Rahim Shah S/O Mehboob Shah	0	3	0
78.	Lal Shah S/O Badal Shah	0	1	0
79.	Ghulam Shah S/O Dar	0	2	0
80.	Mula Dad S/O Khan Muhammad	0	0	2
81.	Mawa Khan S/O Masti Khan	0	0	2
82.	Salim Shah S/O Rehmat Shah	0	1	0
83.	Abdul Karim S/O Adam Khan	0	0	2
84.	Abdul Karim S/O Adam Khan	0	0	2
85.	Abdul Wahid S/O Abdullah	0	1	0
86.	Fateh Muhammad S/O Arif Khan	0	1	0
87.	Perol Khan S/O Arif Khan	0	1	0
88.	Baland Khan S/O Arif Khan	0	1	0
89.	Ghulam Jan, Ata Muhammad S/O Gehwar Jan	0	2	0
90.	Sedal, Pehlwan S/O Zehdin	0	0	2
91.	Abdul Rehman S/O Moran	0	0	2
92.	Abdul Sammad S/O Sadiq Khan	0	3	0
93.	Rehmat, Abdul Karim, Pir Muhammad S/O Nunir Muhammad	0	1	0
94.	Shakar Khan S/O Ali Muhammad	0	1	0
95.	Ghulam Nabi Shah, Sharif Shah, Nehrab Shah S/O Anayat shah	0	1	0
96.	Kalmi Jan S/O Isa Khan	0	1	0
97.	Ghulam Jan, Ghulam Rasool S/O Hussain Bux	0	0	2
98.	Akhtar Muhammad S/O Noor Muhammad	0	0	2
99.	Abdul Majid, Abdul Hamid S/O Munir Muhammad	0	0	2
100	Noor-ud-din, Ghulam Haider, Ghulam Qadir Habib Ullah S/O Ahmad Khan	0	2	2

LIST OF SHARE HOLDERS  
ISHKANA KAREZ

Annexure 5-8

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Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Dang
101	Aziz Ullah S/O Mano	0	1	0
102	Bahadar Khan S/O Dar Muhammad	0	2	0
103	Allah Yar S/O Munir Muhammad	0	4	0
104	Muhammad Hanif, Muhammad Anwar S/O Alambardar	0	2	0
105	Abdul Majid, Abdul Hamid S/O Munir Muhammad	0	4	0
106	Abdul Hakim, Abdul Wahid S/O Noor-ul-Haq	0	5	0
107	Abdul Ghafoor, Abdul Karim (1/2 share) Abdul Aziz (1/2 share) S/O Muhammad Yaqub	0	1	0
108	Abdullah S/O Khawaski	0	1	0
109	Rahim Shah S/O mehboob shah	0	0	2
110	Khuda Bux S/O Noor Muhammad	0	0	2
111	Bakhtiar S/O Fateh Muhammad	0	2	0
112	Abdul Rehman S/O Khatan Khan	0	1	0
113	Habib Ullah S/O Khatan Khan	0	1	0
114	Ali Muhammad S/O Aziz Ullah	0	2	0
115	Muhammad Hassan, Muhammad Huassain, Abdul Karim S/O Rasool Bux	0	1	0
116	Ghulam Nabi S/O Khatan Khan	0	1	0
117	Suhrab Khan, Muhammad Khan S/O Taj Muhammad	0	2	0
118	Qaisar Khan S/O Misry Khan	0	2	0
119	Muhammad Wafa, Muhammad Pans, Muhammad Shafa Muhammad Salah, Muhammad Raza S/O Faqir Muhammad	0	2	0
120	Ganj Bibi, Khair Bibi, Khair-un-Nisa, Meerunisa D/o Muhammad Khan	0	0	2
121	Hamid Ullah S/O Allah Yar	0	0	2
122	Ghulam Nabi S/O Khatan Khan	0	0	3
123	Ghulam Rasool, Ghulam Mustafa, Ghulam Sarwar S/O Hussain Bux	0	0	1
124	Abdul Majid, Abdul Hamid S/O Munir Muhammad	0	2	0
125	Abdul Razaq, Abdul Rahim, Muhammad Akbar Abdul Qayyum, Muhammad Afzal S/O Juma khan	0	0	2

LIST OF SHARE HOLDERS  
ISHKANA KAREZ

Annexure 5-8

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Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Dang
126	Muhammad Hayat, Abdul Hamid, Abdul Hayat S/O Abdul Wahid	0	0	2
127	Ghaus Bux, Muhammad Hayat S/O Shafi Muhammad	0	1	0
128	Mula Bux S/O Muhammad	0	1	3
129	Muhammad Hayat, Abdul Hamid, Abdul Hayat S/O Abdul Wahid	0	1	0
130	Khair Bux, Munir Bux S/O Muhammad Amin	0	0	2
131	Bengal, Jangan, Rosy S/O Pandi	0	0	3
132	Abdul Hamid S/O Muhammad Shafi	0	4	2
133	Abdul Qayyum S/O Mirza Muhammad Shafi	0	0	2
134	Munir Muhammad S/O Abdul Jan	0	0	3
135	Muhammad Rahim, Muhammad Amin S/O Shabaz Khan	0	0	3
136	Amim Khan S/O Abdul Fateh	0	1	2
137	Bahadar Khan S/O Dar	0	2	0
138	Muhammad Hanif, Muhammad Anwar S/O Alambarder	0	2	0
139	Shafi Muhammad S/O Faiz Muhammad	0	1	0
140	Khan Muhammad (Half) Karan Naz, Aisha D/o Ata Muhammad	0	1	0
141	Mewa Khan S/O Masti Khan	0	0	2
142	Mula Dad S/O Khan Muhammad	0	0	2
143	Abdul Majid S/O Munir Muhammad	0	0	2
144	Abdul Hakim, Abdul Wahid S/O Noor-ul-Haq	0	0	2
145	Juma Khan S/O Muhammad Ismail	0	1	2
146	Muhammad Wafa, Muhammad Pana, Muhammad Shafa Muhammad Baza S/O Faqir Muhammad	0	1	2
147	Ghulam Khan, Atta Muhammad S/O Gehwar Jan	0	1	0
148	Ganj Bibi, Khair Bibi, Khair-un-Nisa Mehrunisa D/o Muhammad Khan	0	1	0
149	Abdul Haq S/O Haji Khan	0	1	2
150	Ghulam Nabi Shah, Sharif, Mehrab Shah S/O Anayat Shah	0	1	2

**LIST OF SHARE HOLDERS  
ISHKANA KAREZ**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Dang
151	Sultan Ahmad, Sher Khan, Waris S/O Wadera Noor Muhammad	0	2	2
152	Allah Bux	0	0	2
153	Ghulam Rasool, Ghulam Mustafa, Ghulam Sarwar S/O Hussain Bux	0	0	2
154	Mehr Jan S/O Sahibdar	0	0	2
155	Perol Khan S/O Arif Khan	0	1	2
156	Mewa Khan S/O Masti Khan	0	1	0
157	Bengal, Jangan, Rasy S/O Pandi	0	1	0
158	Salim Shah S/O Rehmat Shah	0	0	2
159	Rahim Shah S/O Mehboob Shah	0	2	0
160	Juma Khan S/O Muhammad Ismail	0	1	0
161	Lal Shah S/O Badil Shah	0	1	0
162	Khadam Hussain S/O Ghulam Jaffer	0	1	0
163	Abaid-ur-Rehman S/O Jamal Khan	0	0	2
164	Khuda Bux S/O Noor Muhammad	0	0	2
165	Muhammad Aslam S/O Haji Muhammad Ashraf	0	0	2
166	Dost Muhammad, Ghanda Khan S/O Mir	0	0	1
167	Nabi Dad S/O Allah Yar	0	0	1
168	Abdul Wahid S/O Abdullah	0	1	0
169	Khuda Bux S/O Mir Khan	0	2	2
170	Allah Bux, Muhammad Anwar, Qadir Bux, Mian Khan, Abdul Khaliq S/O Muhammad Akbar	0	2	2
171	Ghulam Shah S/O Dad	0	2	0
172	Bahadar Khan S/O Dar Muhammad	0	1	0
173	Abdul Karim S/O Adil Khan	0	0	2
174	Perol Khan S/O Arif Khan	0	1	0
175	Abdul Karim S/O Azam Khan	0	0	2

**LIST OF SHARE HOLDERS  
ISHKANA KAREZ**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Dang
176	Fateh Muhammad S/O Arif Khan	0	1	0
177	Baland Khan S/O Arif Khan	0	1	0
178	Ghulam Jan, Atta Muhammad S/O Gehwar Jan	0	1	0
179	Ganj Bibi, Khair Bibi, Khair-un-Nisa, Mehr-un-Nisa D/o Muhammad Khan	0	1	0
180	Khair Bux S/O Muhammad Amin	0	0	2
181	Ghulam Nabi Shah, Sharif Shah, Mehrab Shah S/O Anayat Shah	0	1	2
182	Ghulam Nabi Shah, Sharif Shah, Mehrab Shah S/O Anayat Shah Bahahdar Shah S/O Dar Muhammad Muhammad Hanif, Muhammad Anwar S/O Alambardar Muz Dad S/O Khan Muhammad, Gaji S/O Pir Muhammad	0	1	0

Source: Revenue Department, Govt. of Baluchistan, Kalat District.

LIST OF SHARE HOLDERS  
ISHKANA KAREZ

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Dang
1.	Nasir Ahamd, Sher dil Khan, Manzoor Ahmad Khan, Zahoor Ahmad Khan S/O Mehr Dil Khan	1	0	0
2.	Provincial Govt. of Baluchistan	2	1	0
3.	Muhammad Khan S/O Ismail	0	1	1
4.	Mirza Khan, Sikandar Khan, Muhammad Ashraf S/O Gul Muhammad	0	1	1
5.	Aurang Shah S/O Mehal Shah	0	0	2
6.	Heer Muhammad S/O Noor Ahmad	0	0	2
7.	Maroof S/O Heer Muhammad	0	0	1/1/2
7.1	Muhammad Zaman S/O Meer Muhammad	0	0	1/1/2
8.	Provincial Govt. of Baluchistan	0	1	0
9.	Abdul Qayyum, Abdullah. Muhammad Hayat S/O Doran Khan	0	0	2
10.	Mirza Khan, Sikandar Khan, Muhammad Asiraf S/O Gul Muhammad	0	0	1
11.	Abdul Sammad S/O Saadat Khan	0	2	0
12.	Muhammad Waras S/O Shafi Muhammad	0	1	2
13.	Mirza Khan, Sikandar Khan, Muhammad Ashraf S/O Gul Muhammad	0	0	2
14.	Abdul Nabi S/O Tobak Khan	0	1	0
15.	Pasand Khan S/O Geedar Khan	0	1	0
16.	Ghulam Haider Shah S/O Rustam Shah	0	2	0
17.	Aurang Shah S/O Nchal Shah	0	2	0
18.	Abdul Sammad S/O Saadat Khan	0	2	0
19.	Machhar Jan S/O Shehdad	0	2	0
20.	Ghulam Haider Shah S/O Rustam Shah	0	2	0
21.	Juma Khan, Adam Khan, Baluch Khan S/O Zardar	0	1	1
22.	Abdul Nabi	0	0	1
23.	Abdul Wahab S/O Umer Khan	0	0	2
24.	Suleman Jan S/O Agha Abdul Karim	2	0	0

**LIST OF SHARE HOLDERS  
MAYANA KAREZ**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Dang
53.	Muhammad Khan S/O Haider Khan	0	6	2
54.	Hussain Bux S/O Dar Muhammad	0	0	2
55.	Aurang Shah S/O Nehal Shah	0	0	2
56.	Muhammad Umer, Muhammad Afzal, Muhammad Azam S/O Qadir Bux	0	0	2
57.	Mirza Khan, Sikandar Khan, Muhammad Ashraf S/O Gul Muhammad	0	4	0
58.	Muhammad Wafa, Muhammad Shah, Muhammad Shafa, Muhammad Salah, Muhammad Baqa S/O Faqir Muhammad	0	4	0
59.	Suleman Jan S/O Agha Abdul Karim	1	5	4
60.	Ahmad Shah S/O Bashir Ahmad Shah	0	3	0
61.	Khair Muhammad S/O Sher Dil	0	2	0
62.	Abdul Baqi, Muhammad Zaman S/O Abdul Samad	0	2	0
63.	Abdul Aziz S/O Shajran	0	1	0
64.	Muhammad Wafa, Muhammad Shah, Muhammad Shafa, Muhammad Suhah, Muhammad Baqa S/O Faqir Muhammad	0	1	0
65.	Abdul Sammad S/O Saadat Khan	0	2	0
66.	Abdullah, Muhammad Zaman S/O Abdul Sammad	1	0	0
67.	Heer Muhammad S/O Noor Ahmad	0	2	0
68.	Sher Dil Khan S/O Rehm Dil Khan	0	2	0
69.	Abdul Baqi, Muhammad Zaman S/O Abdul Sammad	0	2	0
70.	Shah Muhammad S/O Pehlwan	0	2	0
71.	Abdul Sammad S/O Saadat Khan	0	0	3
72.	Abdullah, Abdul Qadir, Abdul Wahid S/O Khair Bux	0	2	0
73.	Zar Bakhat Widow(1/8 Share) Izat Khatoon (7/8 Share) D/o Rasool Bux	0	0	3
74.	Khair Muhammad S/O Sher Dil	0	1	1

**LIST OF SHARE HOLDERS  
ISHKANA KAREZ**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Dang
75.	Khair Muhammad S/O Sher Dil	0	1	3
76.	Heer Muhammad S/O Noor Ahmad	0	0	1
77.	Pasand Khan S/O Sanwal Khan	0	0	2
78.	Abdul Baqi, Muhammad Zaman S/O Abdul Sammad	0	1	0
79.	Hamim Khan S/O Abdul Fateh	0	1	0
80.	Abdul Sammad S/O Saadat Khan	0	1	0
81.	Abdullah, Abdul Qadir, Abdul Wahid S/O Khair Bux	0	1	2
82.	Mechher Khan S/O Shehdad	0	1	2
83.	Ahmad Shah S/O Bashir Ahmad	0	2	0
84.	Wali Muhammad, Khan Muhammad S/O Wazir Khan	0	4	0
85.	Nehal Khan S/O Hayat Khan	0	1	0
86.	Pasand Khan S/O Ganwar Khan	0	0	2
87.	Machher Khan S/O Shehdad	0	0	2
88.	Ghulam Haider Shah S/O Rustam Shah	0	2	0

Source: Revenue Department, Govt. of Baluchistan Kalat District.

**LIST OF SHARE HOLDERS  
KAREZ KALAN**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
1.	Dad Khuda S/O Gharib Jan	0	2	3
2.	Ali Muhammad S/O Khair Muhammad	0	0	4
3.	Qadir Bux S/O Ali Muhammad	0	0	5
4.	Govt. of West Pakistan	0	3	0
5.	Juma Khan S/O Yar Khan	0	1	3
6.	Yar Muhammad S/O Juma Khan	0	1	3
7.	Imam Bux S/O Khujak	0	1	4
8.	Jamal S/O Mitha	0	0	3/1/2
9.	Rehm Bibi D/o Nabi Bux	0	0	2/1/2
10.	Ali Gul S/O Khair Bux	0	0	2
11.	Mula S/O Haji Ahmad	0	0	2
12.	Khuda Bux, Sher Muhammad, Faiz Muhammad S/O Sher Dil	0	1	0
13.	Muhammad Akbar, Ali Muhammad S/O Suhrab Khan	0	0	4
14.	Yaqub S/O Abdullah	0	0	9
15.	Shuman, Muhammad, Abdul Ghani S/O Sher Khan	0	1	0
16.	Muhammad Bux S/O Ali Muhammad	0	0	6
17.	Abdul Hamid, Abdul Ghafoor, Habit Khan, Abdul Sattar, Kafan S/O Jalal Khan	0	0	7/1/2
18.	Ali Ghul S/O Khair Ghul	0	2	0
19.	Faiz Muhammad, Ghulam Muhammad	0	0	4
20.	Khuda Bux S/O Qalandar, Ghulam Nabi Ghulam Hussain S/O Khair Bux	0	0	2
21.	Muhammad Umer, Muhammad Hassan, Muhammad Akabr, Ghulam Meer S/O Ahmad Khan	0	0	6
22.	Sultan Muhammad S/O Shahbaz Khan	0	0	1/1/2
23.	Muhammad Akram S/O Talkhu	0	2	3/1/2
24.	Abdul Hamid S/O Habib Khan	0	1	0
25.	Juma Khan S/O Shadi Khan	0	2	3/1/2

**LIST OF SHARE HOLDERS  
KAREZ KALAN**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
26.	Khair Bux S/O Khuda Bux	0	1	0
27.	Muhammad Anayat, Hassan Khan S/O Muhammad Hassan, Muhammad Azam, Haider S/O Muhammad Afzal	0	0	1/1/2
28.	Khaliq Dad S/O Allah Dad	0	0	1/1/2
29.	Ali Jan S/O Khair Bux	0	0	2
30.	Ali Gul S/O Khair Bux	0	0	2
31.	Faiz Muhammad S/O Waj Muhammad	0	0	2
32.	Abdul Wahab, Abdul Hamid S/O Khair Muhammad	0	0	4/1/2
33.	Muhammad Ibrahim S/O Raza Muhammad	0	0	2
34.	Saghu Mull S/O Nabba Mull	0	0	2
35.	Govt. of West Pakistan	0	5	0
36.	Muhammad Umer S/O Fazal Ullah	0	1	0
37.	Faiz Muhammad S/O Dabar Muhammad Khan	0	2	0
38.	Lal Muhammad S/O Rasool Bux	0	0	6
39.	Muhammad Hanif S/O Ali	0	0	4
40.	Amir Khan S/O Janus Khan	0	0	6
41.	Muhammad Bux S/O Saeed Khan	0	0	10
42.	Abdul Rahim, Safer Khan, Muhammad Yaqub Muhammad Usman, Khair Muhammad S/O Mashir Jan	0	0	4
43.	Mehr Dil S/O Sher Muhammad	0	0	6
44.	Abdul Rehman S/O Muhammad Shah	0	0	8
45.	Abdul Baqi S/O Muhammad Azam	0	0	2
46.	Faiz Muhammad S/O Ghulam Muhammad	0	0	2
47.	Khuda Bux, Abdul Rehman S/O Abdul Rasool	0	0	4
47.	Bibi Zulakha(daughter) 7 share Murad Khatoon (Wife) 3 share Abdul Karim S/O Abdul Rahim (14 share)	0	1	2
48.	Khair Bux S/O Khuda Bux	0	0	6
49.	Abdul Aziz S/O Khair Muhammad	0	0	6
50.	Faiz Muhammad S/O Waj Muhammad	0	1	6

**LIST OF SHARE HOLDERS  
KAREZ KALAN**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
51.	Haro Din S/O Khair Muhammad	0	1	1
52.	Saghu Mull S/O Nabba Mull	0	0	9
53.	Govt. of West Pakistan	0	3	0
53.	Sher Muhammad S/O Muhammad Karim	0	1	0
54.	Khuda Bux, Muhammad Waris S/O Muhammad Murad	0	1	0
55.	Muhammad Hayat S/O Noor Muhammad	0	1	0
56.	Pir Bux S/O Imam Bux	0	0	3
57.	Banu D/o Dar Muhammad	0	0	9
58.	Zainab W/o Dad Muhammad	0	0	3
59.	Hayat Khan S/O Aliu Jan, Dar Muhammad S/O Hayat	0	1	11
60.	Dad Khuda S/O Lal Muhammad	0	0	4
61.	Ali Muhammad S/O Ghulam Haider	0	0	1
62.	Ali Muhammad S/O Ghulam Haider	0	0	1
63.	mir Hassan, Muhammad Azam S/O Muhammad Amin (2/3 share) Muhammad Amin, Muhammad Azam S/O Eidu(1/3 share)	0	0	4
64.	Muhammad Akbar S/O Pukar Khan	0	0	4/1/2
65.	Abdul Ghani S/O Shah nawaz Khan	0	0	1
66.	Abdul Rahim S/O Mashir Jan	0	0	6
67.	Juma Khan S/O Yar Muhammad	0	0	8
68.	Shakar S/O Bangon	0	0	3
69.	Mehtab (widow 3 share) Fatima D/o Gehwar Shah	0	0	1
70.	Abdul Ghafar Khan S/O Murad Khan	0	1	0
71.	Shumman, Muhammad, Abdul Ghani S/O Sher Khan	0	0	6
72.	Khuda Bux S/O Habib Khan	0	0	4
73.	Pir Muhammad S/O Ahmad Khan	0	0	4/1/2
74.	Murad Ali, Qadir Bux, Fraz Muhammad Mehr Ali S/O Qutab Khan	0	0	6
75.	Muhammad Umer, Saleh Muhammad Malang, Muhammad Ayub S/O Khaliq Khan	0	0	1/1/2

**LIST OF SHARE HOLDERS  
KAREZ KALAN**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
76.	Muhammad Anayat, Hassan Khan S/O Muhammad Hassan, Muhammad Azam, Ghulam Hakder S/O Muhammad Afzal	0	0	7
77.	Faiz Muhammad S/O Dabar Khan	0	0	1
78.	Abdul Rasool, Abdul Ghafoor S/O Taj Khan	0	1	0
79.	Ghulam Rasool S/O Khan Muhammad	0	0	5
80.	Ghulam Hakder, Ali Muhammad S/O Sher Mohd,	0	0	2
81.	Khuda Bux S/O Qalandar, Ghulam Nabi,	0	0	3/1/2
82.	Ghulam Jan S/O Mehr Muhammad, Muhammad Hassan, Ali Khan S/O Ali Murad	0	0	3/1/2
83.	Khuda Bux S/O Qalandar, Ghulam Nabi, Ghulam Hassan S/O Khair Bux	0	0	2/1/2
84.	Inam Khan, Wali Muhammad S/O Fazal Khan	0	0	1-1/2
85.	Pir Muhammad S/O Dar Muhammad	0	0	3
86.	Bibi Halima D/o Pir Muhammad	0	0	3
87.	Adam Khan S/O Ali Jan	0	0	3
88.	Ali Jan S/O Khair Bux	0	1	9
89.	Madad Khan, Hassan S/O Abdul Rahim	0	0	3
90.	Khaliqdad, Shamboo S/O Sanad Khan	0	0	3/1/2
91.	Mehr Dil S/O Sher Muhammad	0	1	9/1/2
92.	Shabeen S/O Jamal	0	0	6
93.	Saleh Muhammad, Kamal Shah S/O Fateh Shah	0	0	3
94.	Dad Khuda S/O Gharib Jan	0	1	8
95.	Abaidullah S/O Madad Khan	0	0	8
96.	Sher Muhammad S/O Muhammad	0	0	5/1/2
97.	Shafi Muhammad, Eidl Muhammad S/O Khushi Muhammad	0	0	6
98.	Faiz Muhammad S/O Khan Muhammad	0	0	3
99.	Abdul Ghani S/O Shaib Khan	0	0	3
100	Ghulam Jan S/O Mehr Muhammad, Muhammad Hassan, Ali Khan S/O Ali Murad	0	0	3

**LIST OF SHARE HOLDERS  
KAREZ KALAN**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
101	Qadir Bux S/O Ali Muhammad	0	0	5
102	Ghulam Haider, Ali Muhammad S/O Sher Mohd.	0	0	2-1/2
103	Ali Gul S/O Khair Bux	0	0	2
104	Yar Muhammad S/O Madal Khan	0	0	4/1/2
105	Khaliq Dad S/O Allah Dad	0	0	2
106	Faiz Muhammad S/O Khan Muhammad	0	0	2/1/2
107	Muhammad Khan S/O Rashid Khan	0	3	0
108	Ali Jan S/O Khair Bux	0	0	1
109	Muhammad Ibrahim, Wahid Bux S/O Sain Dad	0	0	5
110	Qaisar Khan S/O Anayat Khan	0	0	5
111	Feroz Bakhat W/o Saghir Khan	0	0	2
112	Janat D/o Qaisar Khan	0	0	2
113	Bakhat D/o Qaisar Khan	0	0	2
114	Fazal Khan, Gul Muhammad, Dar Muhammad S/O Zarak Khan	0	0	3
115	Naz Bibii D/o Taj Muhammad	0	0	2
116	Saghir khan S/O Khair Bux	0	0	5
117	Juma Khan S/O Khaliq Dad	0	0	8/1/2
118	Khaliq Dad S/O Allah Dad	0	0	10/1/2
119	Muhammad Khair S/O Ali Jan	0	0	1/1/2
120	Muhammad Murad, Muhammad Karim S/O Aziz Khan	0	0	3/1/2
121	Yar Muhammad S/O Badal Khan	0	0	6
122	Khuda Bux S/O Qadir Bux	0	0	3
123	Faiz Muhammad, S/O Rahim Bux (Half) Mitha, Hakim S/O Nabi Bux	0	0	1/1/2
124	Faiz Muhammad S/O Rahim Bux (Half) Mitha, Hakim S/O Nabi Bux	0	0	1/1/2
125	Muhammad Gul (Ninor) S/O Gul Muhammad	0	0	1/1/2

**LIST OF SHARE HOLDERS  
KAREZ KALAN**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
126	Ali Jan S/O Khair Bux	0	0	3
127	Faiz Muhammad S/O Khan Muhammad	0	1	7/1/2
128	Haji Khan, Amir Khan S/O Badil Jan Shakar Khan D/o Badil Jan	0	1	7
129	Khuda Bux S/O Afzal	0	0	5
130	Ghulam Jan S/O Badal Jan	0	0	3-1/2
131	Ghulam Qadir S/O Abu Baker	0	0	6
132	Imam Bux S/O Khujak	0	1	6
133	Khuda Bux, Sher Muhammad, Faiz Muhammad S/O Sher Dil	0	0	1-1/2
134	Juma Khan S/O Yar Khan	0	0	10
135	Ali Jan S/O Khair Bux	0	0	4
136	Ali Jan S/.o Khair Bux	0	0	1
137	Rao Din S/O Imam Bux	0	0	3
138	Pir Muhammad, Noor Muhammad S/O Fazal	0	0	1
139	Malik Muhammad S/O Imam Bux	0	2	3-1/2
140	Pir Bux S/O Imam Bux	0	1	3
141	Abaidullah S/O Madad Khan	0	0	4
142	Aziz Ullah S/O Mebrullah	0	0	4-3/4
143	Khuda Bux S/O Afzal	0	0	3-3/4
144	Habib Ullah S/O Qadir Bux	0	1	0
145	Ali Muhammad S/O Ghulam Haider	0	0	1
146	Abdul Rahim, Safar Khan, Muhammad Yaqub, Muhammad Usman, Khair Muhammad S/O Mashir Jan	0	0	4
147	Khuda Dad, Juma Khan S/O Dar Muhammad	0	0	8
148	Abdul Ghafar S/O Abdul Qayyum Abaidullah S/O Abdul Wahab	0	1	6
149	Abdul Rehman S/O Muddat	0	0	6
150	Govt. of West Pakistan	0	0	2

**LIST OF SHARE HOLDERS  
KAREZ KALAN**

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
151	Khuda Bux, Abdul Rehman S/O Abdul Rasool	0	0	11/1/2
152	Muhammad Umer S/O Fazal Ullah	0	0	6
153	Govt of West Pakistan	0	0	2
154	Ali Gul S/O Khair Bux	0	0	6/1/2
155	Para Din S/O Khair Muhammad	0	0	8
156	Fazal Muhammad S/O Noor Muhammad	0	0	4
157	Faiz Muhammad S/O Dabar Muhammad Khan	0	0	3/1/2
158	Aziz Ahmad S/O Dar Muhammad	0	2	8/1/2
159	Pir Muhammad S/O Dar Muhammad	0	3	0
160	Muhammad Azam S/O Barkhurdar	0	2	0
161	Dar Muhammad S/O Sher Muhammad	0	1	0
162	Muhammad Murad, Muhammad Karim S/O Aziz Khan	0	0	6/1/2
163	Abdul Wahab, Abdul Hamid S/O Khair Muhammad	0	1	0
164	Ali Jan S/O Khair Bux	0	0	2
165	Ghulam Jan S/O Mehr Muhammad, Muhammad Hassan, Ali Khan S/O Ali Murad	0	0	8/1/2
166	Abdul Rehman S/O Allah Yar Khan	0	0	4
167	Yar Muhammad S/O Badal Khan	0	0	1
168	Khair Bux S/O Mubarak	0	0	2
169	Bahawal Khan S/O Khuda Bux	0	2	0
170	Abdul Aziz S/O Khair Muhammad, Faiz Muhammad S/O Khair Muhammad	0	1	0
171	Allah Yar, Yousaf Khan S/O Juma (1/4 share) Zabab S/O Zaman Khan (share 1/5)	0	0	9
172	Ali Gul S/O Khair Bux	0	0	3
173	Juma Khan S/O Yar Muhammad	0	0	6/1/2
174	Fateh Khatoon S/O Muhammad Sharif	0	0	4
175	Mehr Dil S/O Sher Muhammad	0	1	1/1/2

LIST OF SHARE HOLDERS  
KAREZ KALAN

Sr. No.	Name of Share Holder	Water Share		
		Shabana Roze	Pass	Nakhan
176	Khuda Dad, Juma Khan S/O Dar Muhammad	0	1	2-1/2
177	Khuda Bux S/O Habit Khan	0	1	0
178	Faiz Muhammad S/O Dabar Muhammad Khan	0	0	4
179	Khair Bibi D/o Dar Muhammad	0	0	5-1/4
180	Hayat Khatoon S/O Dar Muhammad	0	0	1-1/2
181	Gul Bibi D/O Dar Muhammad	0	0	1-1/4
182	Allah Bux S/O Khair Muhammad	0	0	4-1/2
183	Rann D/o Dar Muhammad	0	1	0
184	Muhammad Usman, Muhammad Hassan S/O Muhammad Bux	0	0	2
185	Muhammad Karim S/O Muhammad Rahim	0	0	2
186	Madad Khan, Hassan S/O Abdul Rahim	0	0	2
187	Ghulam Haider, Ali Muhammad S/O Sher Muhammad	0	0	6
188	Abdul Rahim, Safer Khan, Muhammad Yaqub, Muhammad Usman, Khair Muhammad S/O Mashir Jan	0	0	5
189	Faiz Muhammad S/O Dabar Muhammad Khan	0	2	8
190	Pir Muhammad S/O Dar Muhammad	0	0	10
191	Abdul Wahab, Abdul Hamid S/O Khair Muhammad	0	0	3
192	Qaisar Khan S/O Khair Muhammad	0	0	3
193	Abdul Rehman S/O Muhammad Shah	0	1	0
194	Usman Shah S/O Mula Bux	0	1	0
195	Ali Muhammad S/O Khair Muhammad	0	1	0
196	Habib Ullah S/O Qadir Bux	0	0	6
197	Fateh Muhammad S/O Muhammad Khan	0	0	7
198	Niaz Muhammad S/O Muhammad Yousaf	0	0	9
199	Khair Bux S/O Khuda Bux	0	0	3
200	Muhammad Umer S/O Fazal Ullah	0	0	9
201	Abdul Baqi S/O Muhammad Azam	0	0	2
202	Fara Din S/O Khair Muhammad	0	2	0

Source: Revenue Department, Government of Baluchistan, Kalat District.

G.V.P, FARM COSTS AND N.V.P.(PUNJPAI AREA)

KAREZ ABDUL HAKIM

Crops	Acreage	Yield (Kg/Acre)	Produc- tion (000 Kgs)	Price (Rs/Kgs)	G.V.P. (000-Rs)	Farm Costs (000-Rs)	N.V.P. (000-Rs)
Alfalfa	3.90	119.74	46.70	1.08	50.44	12.97	37.47
Onion	16.08	740.30	119.04	4.15	494.02	76.23	417.79
Wheat	12.19	740.30	119.04	4.15	494.02	76.23	417.79
Barley	2.44	374.00	0.91	3.27	2.98	2.82	0.16
Cumin	4.39	187.00	0.82	32.40	26.57	6.96	19.61
<b>TOTAL</b>	<b>39.00</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>592.03</b>	<b>114.88</b>	<b>477.15</b>

G.V.P. FARM COSTS & N.V.P. (KHANOZAI AREA)

KAREZ KHANOZAI

Crops	Acreage	Yield (Kg/Acre)	Production (000 Kgs)	Price (Rs/Kgs)	G.V.P. (000-Rs)	Farm Costs (000-Rs)	N.V.P. (000-Rs)
Tobacco	36.81	775	28.53	10.40	296.71	56.39	240.32
Potato	3.88	4397	17.06	2.99	51.01	19.42	31.59
Alfalfa	4.90	9000	44.10	1.08	47.63	15.78	31.85
Apples	27.45	5608	153.94	9.86	1517.84	201.04	1316.80
Wheat	23.25	475	11.04	3.30	36.43	27.36	9.07
Barley	2.00	395	0.79	3.27	2.58	1.93	0.65
Fodders	13.50	7000	94.50	1.08	102.06	10.75	91.31
TOTAL:	111.79	-	-	-	2054.26	332.67	1721.59

G.V.P., FARM COSTS AND N.V.P. - (KHANOZAI AREA)

KAREZ BALOZAI

Crops	Acreage	Yield (Kg/Acre)	Production (000 Kgs)	Price (Rs/Kgs)	G.V.P. (000-Rs)	Farm Costs (000-Rs)	N.V.P. (000-Rs)
Tobacco	48.16	775	37.32	10.40	388.13	73.78	314.35
Alfalfa	0.05	9000	0.45	1.08	0.49	0.16	0.33
Apples	13.40	5608	75.15	9.86	740.97	98.14	642.83
Wheat	47.75	475	22.68	3.30	74.84	56.18	18.66
TOTAL:	109.36	—	—	—	1204.43	228.26	976.17

G.V.P., FARM COSTS AND N.V.P. - (KHANOZAI AREA)

KAREZ SAHIB

Crops	Acreage	Yield (Kg/Acre)	Production (000 Kgs)	Price (Rs/Kgs)	G.V.P. (000-Rs)	Farm Costs (000-Rs)	N.V.P. (000-Rs)
Tobacco	2.00	775	1.55	10.40	16.12	3.06	13.06
Apples	14.50	5608	81.32	9.86	801.81	706.20	695.61
Wheat	26.50	475	12.59	3.30	41.55	31.18	10.37
Barley	0.50	395	0.20	3.27	0.65	0.48	0.17
Potato	0.25	4397	1.10	2.99	3.29	1.25	2.04
TOTAL	43.75	-	-	-	863.42	142.17	721.25

G.V.P., FARM COSTS AND N.V.P. - (KHANOZAI AREA)

KAREZ SAHIBZADA

Crops	Acreage	Yield (Kg/Acre)	Production (000 Kgs)	Price (Rs/Kgs)	G.V.P. (000-Rs)	Farm Costs (000-Rs)	N.V.P. (000-Rs)
Tobacco	5.63	775	4.36	10.40	45.34	8.62	30.72
Potato	4.55	4397	20.01	2.99	59.83	22.77	37.06
Wheat	10.00	475	4.75	3.30	15.68	11.77	3.91
TOTAL	20.18	-	-	-	120.85	43.16	77.69

G.V.P., FARM COSTS AND N.V.P. - (KHANOZAI AREA)

KAREZ TOR DAMAN

Crops	Acreage	Yield (Kg/Acre)	Production (000 Kgs)	Price (Rs/Kgs)	G.V.P. (000-Rs)	Farm Costs (000-Rs)	N.V.P. (000-Rs)
Tobacco	3.80	775	2.94	10.40	30.58	5.82	24.76
Potato	0.50	4397	2.20	2.99	6.58	2.50	4.08
Apples	7.75	56.08	43.46	9.86	428.51	56.76	371.75
Wheat	12.50	475	5.94	3.30	19.60	14.71	4.89
TOTAL:	24.55	-	-	-	485.27	79.79	405.48

G.V.P., FARM COSTS AND N.V.P. - (KUTCHLAK AREA)

KAREZ JALOGIR

Crops	Acreage	Yield (Kg/Acre)	Production (000 Kgs)	Price (Rs/Kgs)	G.V.P. (000-Rs)	Farm Costs (000-Rs)	N.V.P. (000-Rs)
Wheat	11.76	475	5.59	3.30	18.45	13.84	4.61
Apple	13.23	5608	74.19	9.86	731.51	96.90	634.61
<b>TOTAL:</b>	<b>24.99</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>749.96</b>	<b>110.74</b>	<b>639.22</b>

G.V.P., FARM COSTS AND N.V.P. - (MUSTUNG AREA)

KAREZ ISHKANA

Crops	Acreage	Yield (Kg/Acre)	Production (000 Kgs)	Price (Rs/Kgs)	G.V.P. (000-Rs)	Farm Costs (000-Rs)	N.V.P. (000-Rs)
Wheat	51	495	25.24	3.30	83.29	68.61	14.68
Onion	100	6356	635.60	4.15	2637.74	389.24	2248.50
Potato	10	3272	32.72	2.99	97.83	42.56	55.27
Carrot	20	4543	90.86	2.47	224.42	40.27	184.15
Turnip	29	5608	162.63	2.42	393.56	47.00	346.56
Alfalfa	45	6730	302.85	1.08	327.08	160.68	166.40
Apples	19	5500	104.50	9.86	1030.37	187.43	842.94
Apricot	10	6000	60.00	6.16	369.60	78.56	291.04
Mulbery	31	3200	99.20	6.16	611.07	179.42	431.65
<b>TOTAL</b>	<b>315</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>5774.96</b>	<b>1193.77</b>	<b>4581.19</b>

G.V.P., FARM COSTS AND N.V.P. - (MUSTUNG AREA)

KAREZ MAYANA

Crops	Acreage	Yield (Kg/Acre)	Production (000 Kgs)	Price (Rs/Kgs)	G.V.P. (000-Rs)	Farm Costs (000-Rs)	N.V.P. (000-Rs)
Wheat	23	495	11.38	3.30	37.55	30.94	6.61
Onion	7	6356	44.49	4.15	184.63	27.25	157.30
Alfalfa	1	6730	6.73	1.08	7.27	3.57	3.70
Carrot	1	4543	4.54	2.47	11.21	2.01	9.20
Turnip	1	5608	5.61	2.42	13.58	1.62	11.96
TOTAL	33	-	-	-	254.24	65.39	188.85

G.V.P., FARM COSTS AND N.V.P. - (MUSTUNG AREA)

KAREZ KALAN!

Crops	Acreage	Yield (Kg/Acre)	Production (000 Kgs)	Price (Rs/Kgs)	G.V.P. (000-Rs)	Farm Costs (000-Rs)	N.V.P. (000-Rs)
Wheat	94	495	46.53	3.30	153.55	126.46	27.05
Onion	150	6356	953.40	4.15	3956.61	583.86	3372.75
Alfalfa	50	6730	336.50	1.08	363.42	178.54	184.88
Apples	65	5500	357.50	9.86	3524.95	641.21	2883.74
Apricot	27	6000	162.00	6.16	997.92	212.11	785.81
Grapes	14	4100	57.40	7.70	441.98	171.52	270.48
TOTAL	400	-	-	-	9438.43	1913.70	7524.73

G.V.P., FARM COSTS AND N.V.P. - (MUSTUNG AREA)

KAREZ KUNDKI

Crops	Acreage	Yield (Kg/Acre)	Production (000 Kgs)	Price (Rs/Kgs)	G.V.P. (000-Rs)	Farm Costs (000-Rs)	N.V.P. (000-Rs)
Onion	17	6356	108.05	4.15	448.41	66.17	382.24
Alfalfa	30	6730	201.90	1.08	218.05	107.13	110.92
Apples	110	5500	605.00	9.86	5965.30	1085.13	4880.17
Apricot	35	6000	210.00	6.16	1293.60	274.96	1018.64
Mulberry	8	3200	25.60	6.16	157.698	46.30	11.39
TOTAL	200	-	-	--	8083.05	1579.69	6503.36

G.V.P., FARM COSTS AND N.V.P. - (ZIARAT AREA)

KAREZ JUNGLE BUNDAT

Crops	Acreage	Yield (Kg/Acre)	Production (000 Kgs)	Price (Rs/Kgs)	G.V.P. (000-Rs)	Farm Costs (000-Rs)	N.V.P. (000-Rs)
Wheat	1.25	425	0.53	3.30	1.75	1.64	0.11
Barley	0.50	350	0.18	3.27	0.59	0.52	0.07
Alfalfa	0.50	6500	3.25	1.08	3.51	1.66	1.85
Apples	7.00	11000	77.00	9.86	759.22	61.71	697.51
Pears	0.50	5000	2.50	4.00	10.00	3.55	6.45
Plums	0.50	6600	3.30	3.70	12.21	3.60	8.61
<b>TOTAL</b>	10.25	-	-	-	787.28	72.68	714.60