

# **GIS METADATA FOR AN IRRIGATION SYSTEM**

## **VOLUME II: SELECTED WATERCOURSES WITHIN CHISHTIAN SUB - DIVISION**

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**October 1998**

**PAKISTAN NATIONAL PROGRAM**

**INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE**

**LAHORE**



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## FOREWORD

A numerous research studies had been carried out around the world, but, retrieving data from such studies by a third party is not always possible. More importantly, researchers in general do not make a concerted effort to make such a valuable resource available to other interested parties. Researchers at IMI Pakistan were not an exception to this until recently.

Mobin-ud-Din Ahmad, Samia Ali, Yann Chemin and Salman Asif have invested a considerable amount of time in producing this Metadata, on a compact disk (CD) and two volumes of these reports. Data presented in this CD relates to the Chistian Sub-division. It is described in the two volumes of reports. The first one provides sub-divisional level data, and the second one is a compilation of data from eight selected watercourses from the sub-division. The data were collected by a score of researchers associated with IIMI Pakistan, Punjab Irrigation and Power Department (PIPD), Soil Survey of Pakistan (SSP), Directorate of Land Reclamation (DLR), Water and Soil Investigation Division (WASID) WAPDA, SCARP Monitoring Organization (SMO) and Water Course Monitoring and Evaluation Directorate (WMED). Processing and compilation of data was carried by researchers at IIMI Pakistan, CEMAGREF France and WMED. By any possible measure, it reflects a genuine collaborative effort among National and International Agencies and the output is one that every one associated can be proud of.

The foreword will be incomplete, if Pierre Strosser's leadership and vision is not recognized. My commendations to Pierre and his team.

S. A. Prathapar  
Research Coordinator  
IIMI-Pakistan

## ACKNOWLEDGEMENTS

The authors wish to acknowledge Dr. Pierre Strosser to continuous supervision and valuable guidance to the GIS/RS activities in Chishtian sub-division.

Most of our recognition goes to the field staff of Hasilpur field station, for their constant and huge efforts to collect and to get in shape these data sets. Special thanks to Mr. Saeed ur Rehman for his work on the Warabandi data.

Authors wish to extend their thanks for the precious efforts and help of H  l  ne Debarnardi, Salman Ashraf, Ayesha Manzar, Gauhar Rehman, Asghar Hussain and SSP field staff for the development of the GIS database. Moreover, all collaborators from government agencies from where the secondary information has been obtained.

Authors appreciated the special editing care of Ms. Verenia Duke to bring this manuscript in the present form.

## 1 INTRODUCTION

This report describes *Metadata*<sup>1</sup> for different sets of information that have been collected in the Chishtian Sub-division to date, either by IIMI-Pakistan field staff or in collaboration with other organizations. Generally, *Metadata* is considered to be an extra and unnecessary task, but with long-term benefits. For example, if staff is substituted, new users could not exploit undocumented data, which may result to misleading conclusions.

This work is presented in two different volumes; the first pertains to *Metadata for the Chishtian Sub-division*, and the other, to *Metadata for Sample Watercourses*. Two main parts define its structures; an introductory explanation of the research's context, and the actual Metadata. These two volumes are complemented by one CDROM containing Metadata along with the GIS / digital database, available from the IIMI-Pakistan library.

### 1.1 Background

Research activities on the use of Geographical Information Systems (GIS) and Remote Sensing (RS) for irrigation management in the Chishtian Sub-division was initiated in 1995. With a gross command area of 75000 ha, it forms part of the Fordwah Eastern Sadiqia Irrigation System, which is confined by the Sutlej River in the northeast, the Indian border in the east, and the Cholistan Desert in the southeast (Figure 1).

These activities form part of the IIMI-Cemagref collaboration supported by the Government of France. In addition, these complement activities undertaken under other research programs and projects in the same area, such as *Managing Irrigation for Environmentally Sustainable Agriculture* funded by the Government of the Netherlands.

#### 1.1.1 Research Activities

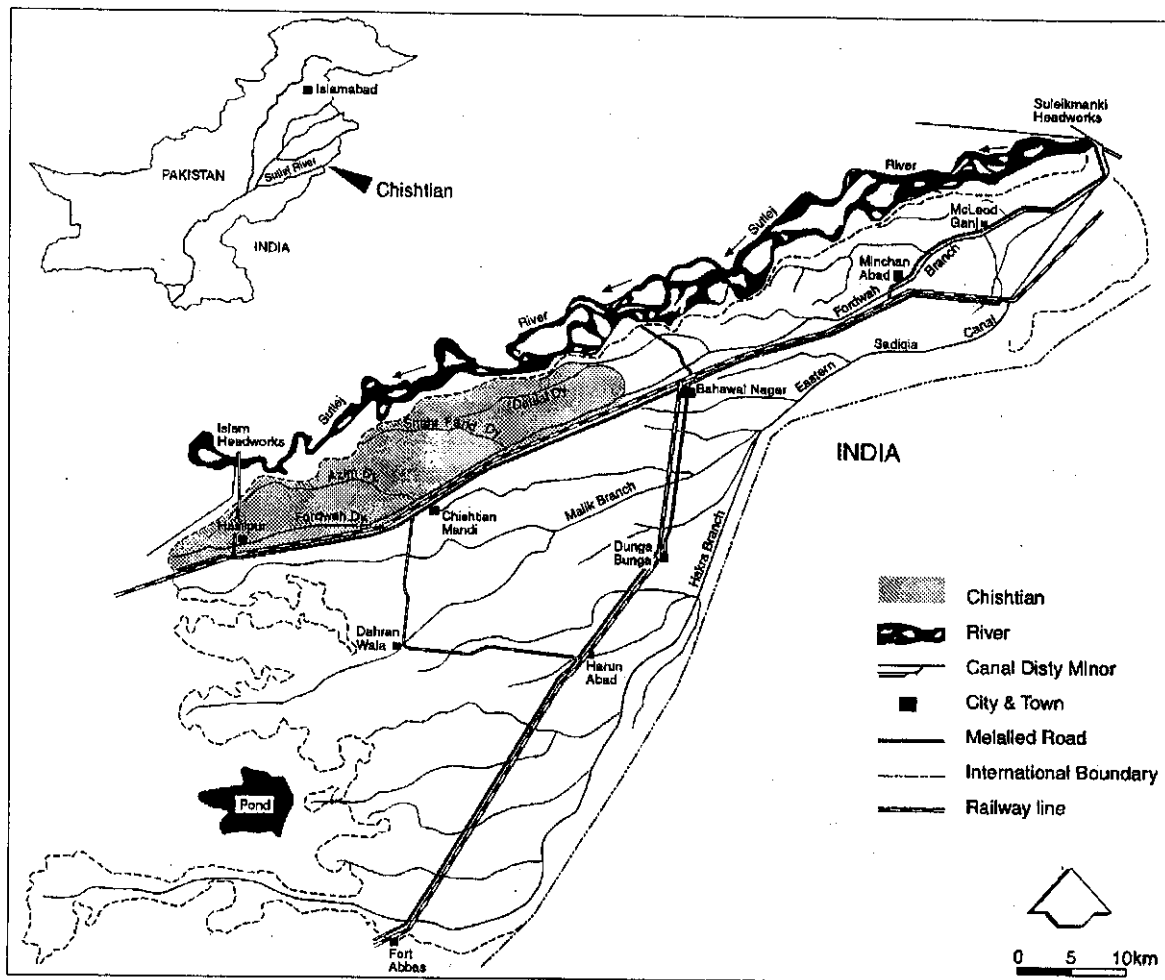
Research activities are organized around 4 different components, i.e.:

- Using GIS for spatial analysis of water supply performance;
- GIS and satellite imagery for the integrated approach;
- Satellite imagery for crop identification; and
- Satellite imagery and salinity monitoring.

These four components are described in further detail below.

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<sup>1</sup> Generally speaking, *Metadata* refers the "data about data", describing the content, quality, condition, and other characteristics of data.



**Figure 1. Layout of Chishtian Sub-division, Punjab.**

*1.1.2 Using GIS for Spatial Analysis of Water Supply Performance*

The main objective of this research component is the analysis of irrigation system performance within the watercourse command area. The different variables integrated into the analysis include irrigation water supply (canal and tubewell), soil and salinity parameters, and agricultural production indicators (cropping patterns, yields, and gross margins). A sample of 8 watercourses along the Azim and Fordwah Distributaries has been selected for the analysis.

Allocation and distribution of canal water is analyzed at the plot, farm and landowner levels. Tubewell water supplies are then added to canal water supplies and compared to crop water requirements. Water stress and potential problems with the use of poor quality irrigation water are then spatially analyzed using GIS. Factors expected to influence water stress, crop production and salinity are included in the analysis. These factors include farm level characteristics (tubewell ownership, farm size, tenure status), physical factors (soil type), and spatial variables (such as distance from the head of the watercourse, or distance from tubewells).

### 1.1.3 GIS and Satellite Imagery in the Integrated Approach

In 1995, IIMI-Pakistan initiated an important research activity aimed at developing an integrated approach to assess the impact of changes in irrigation management on agricultural production, salinity and sodicity. This activity includes an analysis of the main physical and decision-making processes that take place within the irrigation system. Simulation and optimization models have been developed for the most important processes. The analysis of processes is coupled with the assessment of the present conditions in terms of physical characteristics (soils, groundwater quality, water-table depth), irrigation water supplies and agricultural production.

A large part of the efforts of this assessment was to develop a spatial database and an analysis of the spatial heterogeneity of the variables analyzed using GIS and statistical techniques. The information used for the analysis relates to different levels of the irrigation system (*killa*, farm, watercourse, soil unit, etc.) that are to be linked.

A watercourse-level database (520 watercourses) has been prepared to assess the present conditions. The database will be linked with simulation models to predict the impact of changes in irrigation management on agricultural production and salinity. The GIS is also used to present results of the simulations.

### 1.1.4 Satellite Imagery for Crop Identification

Although the potential for the use of satellite imagery in irrigation system management is often said to be large, so far, little has been tested in the field of irrigation in Pakistan. IIMI-Pakistan initiated activities on the use of satellite imagery for land use mapping and crop identification in 1995. The initial objectives were to test techniques applied elsewhere in the context of Pakistan, and also to train IIMI-Pakistan researchers in the use of hardware and software.

SPOT XS images were acquired for the Chishtian Sub-division in October 1994 and March 1995. Ground truth information was collected through a crop survey for 31 well-scattered watercourses. Supervised classification techniques were applied and land use classes obtained for *Kharif* 1994 and *Rabi* 1994-95 seasons. Classification results permit the separation of cropped and non-cropped areas, but between crops, confusion still exists.

To date, the focus of the research has shifted from the application to the development of methodologies. The main question addressed during 1997-98, in the context of collaboration with the Watercourse Monitoring and Evaluation Directorate of WAPDA and Cemagref, relates to the identification of the appropriate methodology (satellite frequency, ground truth information) to identify cropping intensity or cropping pattern at a given level of accuracy.

### *1.1.5 Satellite Imagery and Salinity Monitoring*

Due to the size of the irrigation and drainage project currently undertaken in Pakistan, monitoring and evaluation of the impact of these projects on salinity is a difficult and time-consuming task. Often, it is difficult to attach any accuracy to the salinity indicators estimated from this information.

In this context, IIMI-Pakistan and Cemagref started activities on the use of satellite imagery for salinity monitoring in 1995. A classification procedure uses the vegetation and brightness indices derived from SPOT images (acquired in March 1995), and compares these values to levels of visual salinity collected through surveys.

With the classification obtained, highly saline areas are identified with good accuracy. However, results are less satisfying for cropped areas with low or medium salinity levels. In order to refine the analysis of the signal obtained from the satellite, a measurement campaign was organized in August 1997. Also, images from the Landsat satellite (with additional bands) were acquired. Final research results will be obtained in 1998 and compared to results of approaches developed by other organizations (e.g. Soil Survey of Pakistan, Directorate of Land Reclamation).

### *1.1.6 Collaborations*

The research program on the use of GIS and remote sensing for irrigation management is jointly undertaken by the French research institute, Cemagref, with exchange information and results, visits, development of joint research studies, planning of research activities, etc..

More recently, efforts have focused on the development and strengthening of collaboration with Pakistani institutes. Organizations that have been associated with GIS / RS activities in the Chishtian Sub-division include; (i) SCARP Monitoring Organization (use of ground water data); (ii) Directorate of Land Reclamation (use of GIS for the development of reclamation programs); and, (iii) Soil Survey of Pakistan (soil mapping and salinity risk assessment).

Also, links have been established with the WAPDA Watercourse Monitoring and Evaluation Directorate (WMED). Technical assistance that IIMI-Pakistan has provided to WMED in the Fordwah / Eastern Sadiqia (South) Irrigation and Drainage Project includes joint activities initiated to develop an appropriate methodology to assess crop-related indicators at various levels of the irrigation system (from the pixel to the sub-division as a whole).

### *1.1.7 Training*

CEMAGREF and IIMI-Pakistan researchers jointly developed training activities in France and Pakistan, respectively. Activities range from one week's training on the use of



the PC version of the Arc/Info software in Pakistan, to one month's training on the use of satellite imagery for crop classification in France.

Training has mainly been provided to IIMI-Pakistan researchers, WAPDA staff from the Watercourse Monitoring & Evaluation Directorate (WMED), staff from the Directorate of Land Reclamation, etc..

Training imparted to WMED staff, so far, has included:

- (i) initial training in GIS concepts and digitizing techniques (1 year, on-the-job training);
- (ii) one month's training, on the use of satellite imagery for crop identification, in France;
- (iii) four months' training on the same subject, in Pakistan;
- (iv) three weeks' training in the use of the PC Arc/Info software;
- (v) one week's training on the use of satellite imagery for salinity monitoring; and
- (vi) two days' theoretical introduction to remote sensing.

As there is a general increase in the demand for training in the use of (mainly) GIS and RS in Pakistan, one week's training on the *Use of GIS and RS for Irrigation Management* was organized by IIMI-Pakistan in 1997. Participants attending this training included staff from agencies and research institutes working in the fields of agriculture and water in Pakistan.

## 1.2 *Metadata*

Generally speaking, Metadata refers the "data about data", and describes the content, quality, condition, and other characteristics of data (FGDC, 1994). Metadata are comprehensive, systematic and deductive information about the content, the relationships, the representation, and the use context of the data stored in the underlying database (ESRI, 1995)<sup>2</sup>. Metadata is a toolbox containing geographical data that indicates if the data of one's interest is available and fit for use. But, it also provides a solution towards accessing and processing that data.

### 1.2.1 *Why is Metadata so Strategic?*

Metadata systems are application users-oriented; in a standard and concise form, it will provide the potential user with information about the adequacy of existing data to that of the actual need for study. Additional details about the data is not required, so that data pertaining to past projects do not lose its real value because of the absence of documentation (as frequently occurs in project-dependent organizations). With the passage of time, the lack of knowledge about existing data can lead to replication of studies.

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<sup>2</sup> Endo, K., 1997. Metadata for a multi-disciplinary project. A case study in Alora, Spain. ITC. Wageningen, The Netherlands.

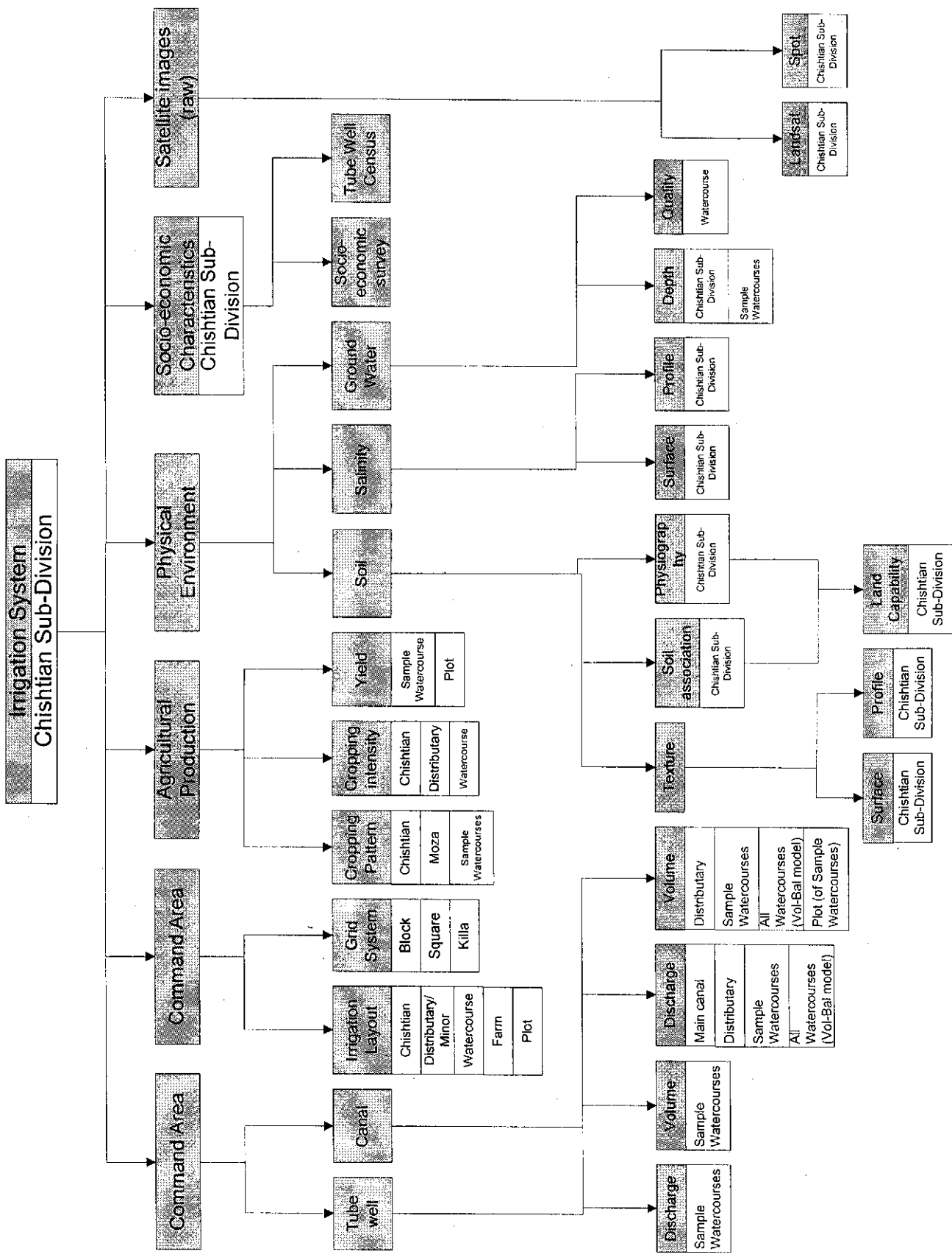
### 1.2.2 *What Standard has been used?*

The standard used has been referred to as Metadata developed in irrigation science. A comprehensive irrigation system geographical database developed in a study area in Spain is best suited to the present project in all aspects (data available, domain of activity and uses). However, the full Metadata is too developed for the real frame of applications in the Chishtian Sub-division, therefore, an effective and practical selection has been tailored to our requirements for future users.

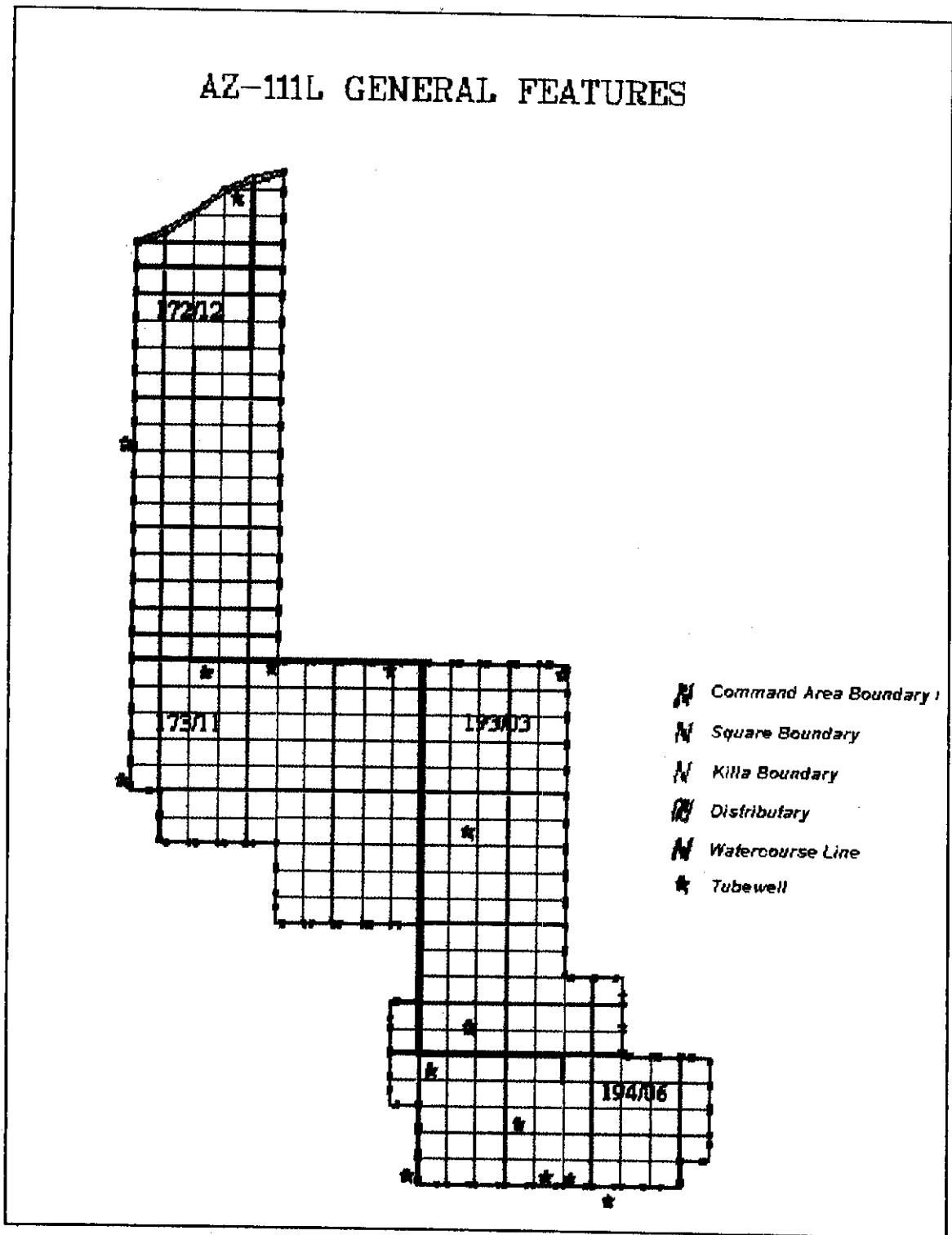
### 1.3 *Development of Metadata for the Chishtian Sub-division*

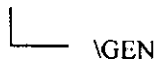
Considering the importance and utility of Metadata, it was decided to prepare a standard format of Metadata for IIMI-Pakistan, which would represent irrigation systems in Pakistan well. For information storage, two options, i.e. type and level, existed. Type of information refers to the physical environment, water supply, command area, agricultural production, socio-economic characteristics and satellite images. Whereas, level of information refers to irrigation sub-division, canal command, distributary, watercourse, field and / or block, square and *killa*. Finally, a structure, which takes both categories into account, has been developed (shown in the following flow chart). In this figure, shaded portions represent *type* of information, and white boxes, *level* of information.

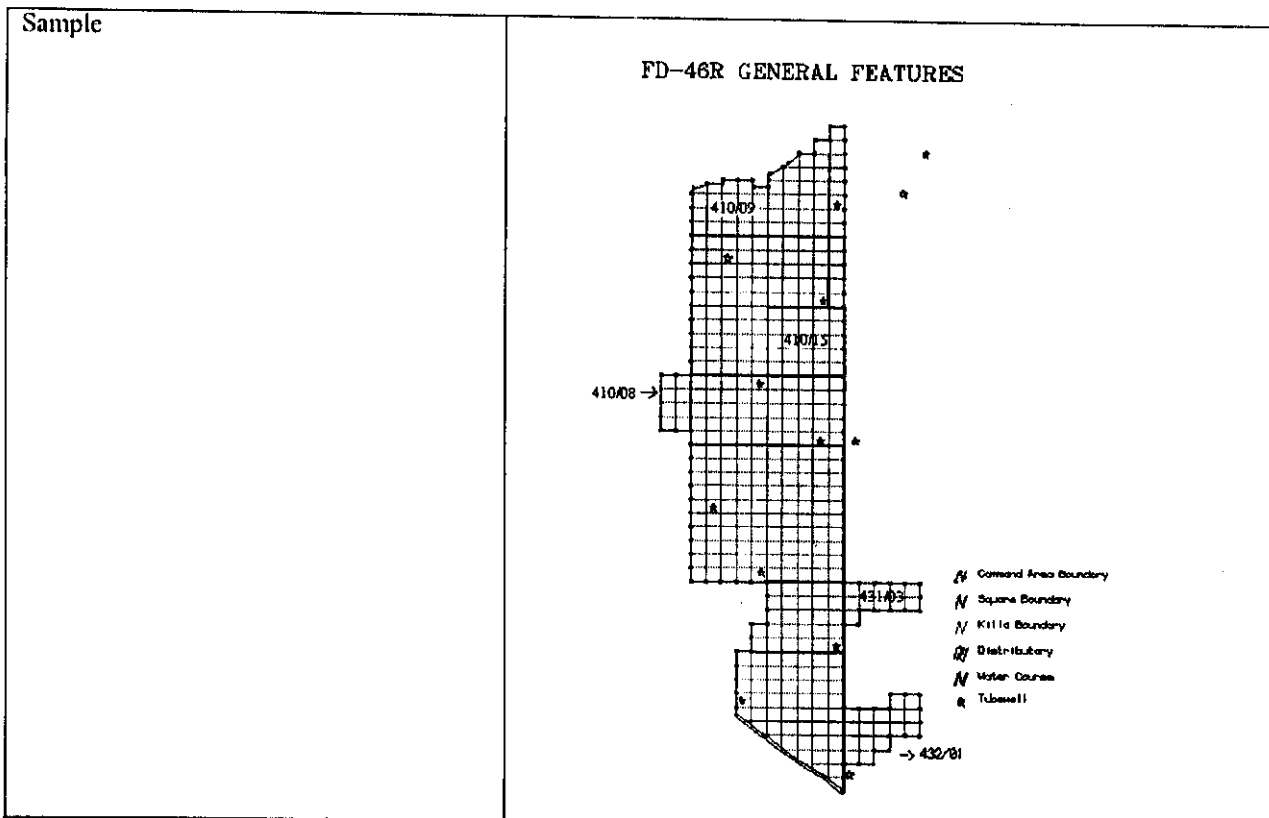
Once the overall structure was finalized, a proforma, comprising different components, i.e. data set identification, data set overview, data set quality information, object type, attribute type, organization and organization role, point of contact and point of contact role, distribution and Metadata reference, was developed. For now, as described in the Metadata, the following data is available.



2 GENERAL FEATURES  
Eight Sample Watercourses



Metadata	Description
<b>2.1 Data set identification</b>	
Data set title	General Feature Maps of Eight Sample Watercourses
Physical name	\ DB-CHISHTIAN \ COMMAND AREA \ IRRIGATION LAYOUT \ GENERAL FEATURES \ SAMPLE WATER-COURSES \ WATERCOURSE  
Format	PC Arc/Info
<b>2.2 Data set overview</b>	
Abstract	This data set is for eight watercourses along the Fordwah and Azim Distributaries in the Chishtian Sub-division, containing the spatial information pertaining to the square and <i>killa</i> grid, watercourse line, roads, drains and tubewells in respective watercourses.
Purpose of production	This information could be useful for various researches carried out along these watercourses.
Usage	Used by Pierre Strosser, Salman Asif, Salman Ashraf, Helene Debernardi, Ayesha Manzer, Samia Ali, Yann Chemin, etc. Period: 1994 to 1997  This spatial database is prepared by Salman Asif and Salman Ashraf and updated by Samia Ali.
Geographical extent	The coverage has been prepared for eight watercourses from the Fordwah and Azim Distributaries along the Chishtian Sub-division, with four watercourses selected from each of these. The watercourses selected from the Azim Distributary are Az-20L, Az-43L, Az-63L and Az-111L, and from the Fordwah Distributary, Fd-14R, Fd-46R, Fd-62R and Fd-130R.
Temporal extent	
From	<i>Kharif</i> 1994
To	<i>Rabi</i> 1994-95
Output document	<ul style="list-style-type: none"> <li>• "Spatial Analysis of Irrigation Water Supply Performance: A Case Study in the Fordwah 14-R Command Area", Salman Asif and Salman Ashraf.</li> <li>• "Spatial Analysis of Canal Water Allocation and Distribution at Tertiary Level in the Chishtian Sub-division", Helen Debernardi.</li> <li>• The Soil Survey of Pakistan and International Irrigation Management Institute, Pakistan: Detailed Soil Survey of Eight Watercourse Command Areas in Chishtian and Hasilpur <i>Tehsils</i>, Blue Report No. R-19.</li> </ul> Reference of raw information: Field maps and tubewell census data.
Document reference	-



**2.3 Data set quality indicators**

Process history	<ul style="list-style-type: none"> <li>• <b>DATA ENTRY:</b> Two grids, square and <i>killa</i>, have been produced using Arc/Info. The size of one grid cell is provided according to the square and <i>killa</i> sizes in meters, respectively, and two grids were built to cover the watercourses. Finally, these two grids were intersected in Arc/Info to develop a square-<i>killa</i> grid. A point-coverage giving the locations of tubewells in each watercourse was also prepared. Similarly, canals, roads and drains were digitised.</li> <li>• <b>DATA PROCESSING:</b> A map composition was prepared to overlay all the coverage in order to provide a complete impression of the watercourse. This watercourse map was also labeled with block and square numbers.</li> </ul>
Overall positional accuracy	These grids for the eight watercourses are not geo-referenced.
Overall thematic accuracy	For the location of tubewells, block, square and <i>killa</i> numbers are available. As it is unknown where these are fixed within the <i>killa</i> , this data is accurate up to the <i>killa</i> level.
Overall temporal accuracy	This will still be valid after 100 years, or more, except for abandoned tubewells or those replaced by new ones.
Overall completeness	This is available for the eight watercourses selected from the Fordwah and Azim Distributaries in the Chishtian Sub-division. Watercourses selected from Azim Distributary are Az-20L, Az-43L, Az-63L, Az-111L, and from Fordwah Distributary, Fd-14-R, Fd-46-R, Fd-62R and Fd-130R were selected.

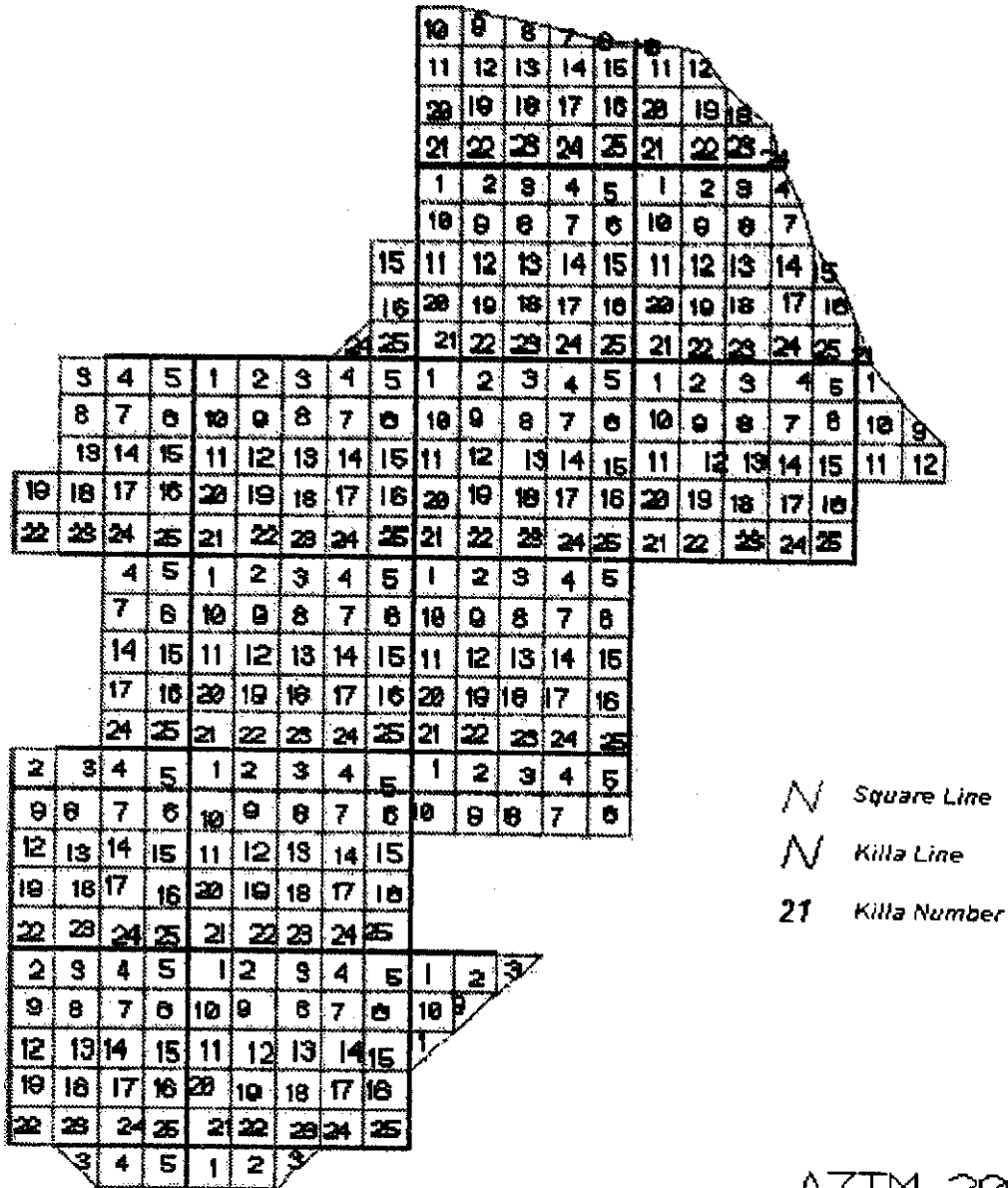
**2.4 Object type**

Object type name	Geographical object
Object type definition	Numerous objects are indicated in this map.
Object type definition	Block, square, <i>killa</i> , tubewell, road, drain and watercourse line.
Object type code	-

<b>2.5 Attribute type</b>		DBI fields
Attribute type name	-	
Attribute type definition	-	
Attribute type code	-	
Thematic accuracy	-	
<b>2.6 Organization and organization role</b>		Data collection
Organization name	International Irrigation Management Institute	
Organisation abbreviation name	IIMI-Pakistan	
Organisation address	12 km Multan Road Lahore, 53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 E-mail: <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>	
Organisation role	IIMI-Pakistan field staff collected the data.	
Function of the organisation	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.	
<b>Organization and organization role</b>		Data entry and analysis
Organisation name	International Irrigation Management Institute	
Organisation abbreviation name	IIMI-Pakistan	
Organisation address	12 km Multan Road Lahore, 53700 Phone: (042) 541-00 0-53 Fax: (042) 541-0054 E-mail: <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>	
Organisation role	The data is entered and analysed by IIMI Lahore-based staff.	
Function of the organisation	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.	
<b>2.7 Point of contact and point of contact role</b>		
Point of contact name	Director	
Point of contact address	12 km Multan Road Lahore, 53700 Phone: (042) 541-0050-53 E-mail: <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>	
Point of contact role	Director, IIMI-Pakistan	
<b>2.8 Distribution</b>		
Restrictions on use	Prior permission from the Director, IIMI-Pakistan and acknowledgements in the published document.	
Copyright owners	IIMI-Pakistan	
Media	Hard and soft copies; whole data set on CD-ROM.	
Formats	Arc/Info Coverage	
Order	Request to the Director, IIMI-Pakistan	
Support services	Not available at the moment.	
<b>2.9 Metadata reference</b>		
Entry date	December 15, 1997	
Last check date	December 22, 1997	
Last update date	December 22, 1997	

3 **KILLA COVERAGES**  
 Eight Sample Watercourses

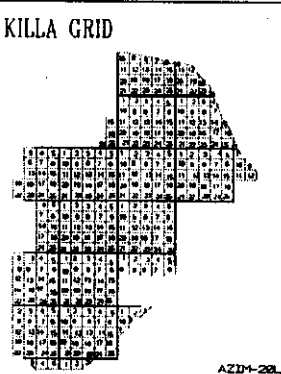
# KILLA GRID



AZIM-201



Metadata <b>3.1 Data set identification</b>	Description
Data set title	<i>Killa</i> Grid Coverage of Eight Sample Watercourses
Physical name	\DB-CHISHTIAN\COMMAND AREA\GRID SYSTEM\SAMPLE WATERCOURSES\KILLA  \WATERCOURSE Azim 20-L = Az20 Azim 43-L = Az43 Azim 63-L = Az63 Azim 111-L = Az111 Fordwah 14-R = Fd14 Fordwah 46-R = Fd46 Fordwah 62-R = Fd62 Fordwah 130-R = Fd130  \COVERAGE NAME Killa Coverage = KL_COV
Format	PC Arc/Info Coverage
<b>3.2 Data set overview</b>	
Abstract	<p>This data set was the grid system coverage at the <i>killa</i> level for the eight watercourses selected from the Fordwah and Azim Distributaries in the Chishtian Sub-division.</p> <p>The irrigation system design divides all land area into a scheme of measurement values for the Block, Square and <i>Killa</i> into:</p> <ul style="list-style-type: none"> <li>• Block: X=1341.12m and Y=1207.008m.</li> <li>• Square: X=335.28m and Y=301.752m.</li> <li>• <i>Killa</i>: X=67.056m and Y=60.3504m.</li> </ul> <p>The diagram illustrates the grid hierarchy. On the left, a 3x3 grid of 'BLOCKS' is shown with block numbers 1, 21, 581, 582, 583, 584, 585, 586, 587. A dashed line connects block 581 to a 4x4 grid of 'BLOCK 581' with square numbers 1, 5, 9, 13, 2, 6, 10, 14, 3, 7, 11, 15, 4, 8, 12, 16. Another dashed line connects square 15 to a 5x5 grid of 'SQUARE 15' with kill numbers 1-25. An arrow points to kill 4 in the square grid, labeled 'KILLA 4'.</p> <p>Block: X=1341.12m and Y=1207.008m.            Square: X=335.28m and Y=301.752m.            Killa: X=67.056m and Y=60.3504m.</p>
Purpose of production	<p>This <i>killa</i> grid has been used in all the spatial studies carried out for these eight watercourses, especially for that of a large project focused on the development of an integrated approach to analyze the impact of changes in water management on agricultural production and salinity / sodicity. This <i>killa</i> grid was also used to ascertain plot coverage using the dissolve command in Arc/Info.</p>

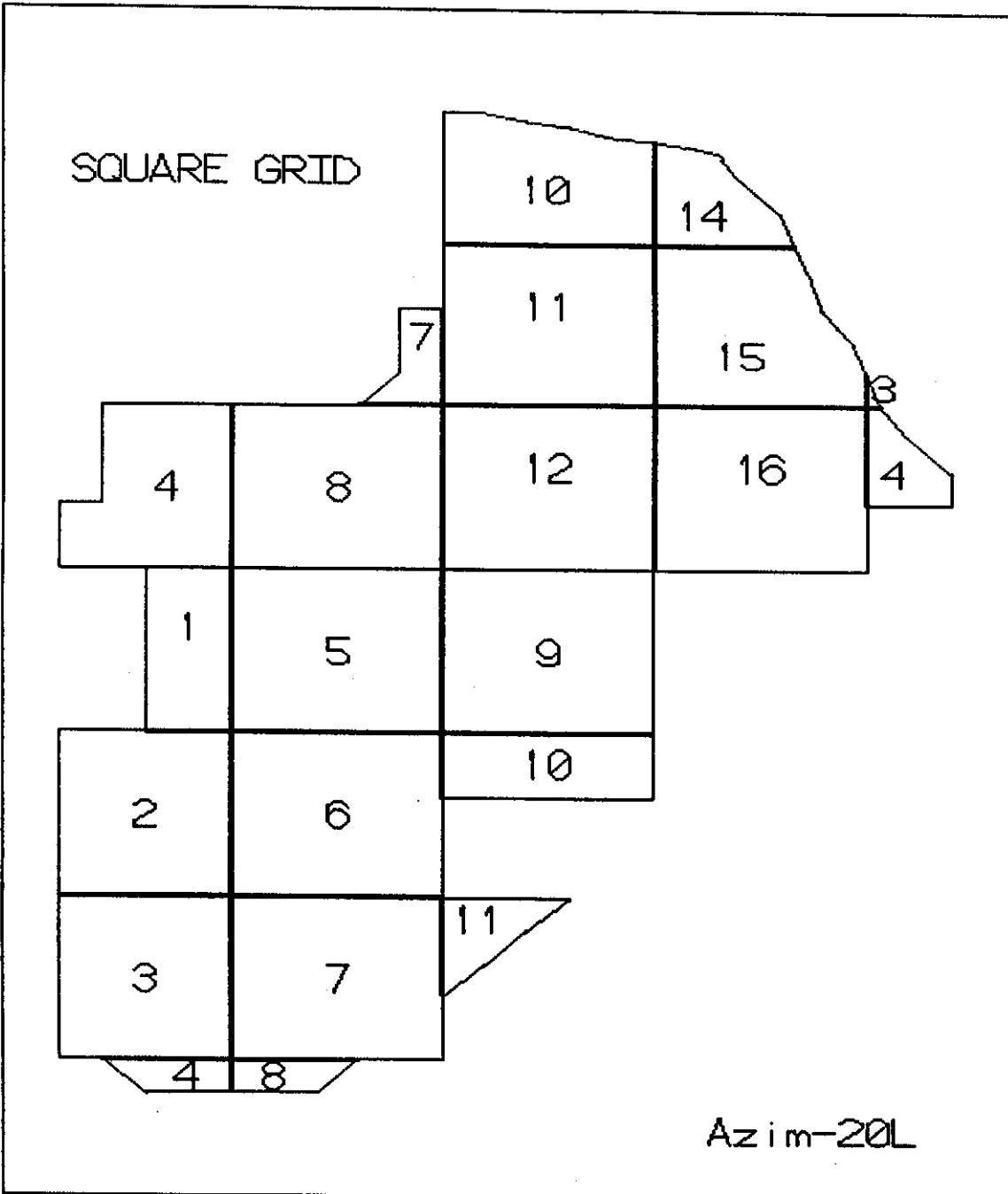
Usage	Used by Pierre Strosser, Salman Asif, Salman Ashraf, Helene Debarnardi, Ayesha Manzer, Samia Ali, etc. Period: 1994 to 1996
Geographical extent	This spatial database is prepared by Salman Asif and Salman Ashraf. These coverages were prepared for eight watercourses along the Fordwah and Azim Distributaries; four from each. The watercourses selected from Azim Distributary are Az-20L, Az-43L, Az-63L and Az-111L, and from Fordwah Distributary, Fd-14R, Fd-46R, Fd-62R and Fd-130R.
Temporal extent	
From date	-
To date	-
Output document	<ul style="list-style-type: none"> <li>• "Spatial Analysis of Irrigation Water Supply Performance: A Case Study in the Fordwah 14-R Command Area", Salman Asif and Salman Ashraf.</li> <li>• "Spatial Analysis of Canal Water Allocation and Distribution at Tertiary Level in Chishtian Sub-division", Helen Debarnardi.</li> <li>• Soil Survey of Pakistan and International Irrigation Management Institute, Pakistan: Detailed Soil Survey of Eight Watercourse Command Areas in Chishtian and Hasilpur <i>Tehsils</i>", Blue Report No. R-19.</li> </ul> <p>Reference of processed information: Plot coverage.</p>
Document reference	-
Sample	<p>KILLA GRID</p>  <p>AZIM-20L</p>
<b>3.3 Data set quality indicators</b>	
Process history	<ul style="list-style-type: none"> <li>• <b>DATA ENTRY:</b> A grid has been produced using Arc/Info. One grid cell size is given according to the <i>killa</i> size in meters. One grid was then built to cover the watercourse.</li> <li>• <b>DATA PROCESSING:</b> The grid has been overlaid to the relevant watercourse coverage with the help of Ground Control Points spread all over the area to determine the external boundary of the irrigation system. As a result, the grid has shifted from the upper to the lower part, providing the observed effect on the coverage.</li> </ul>
Overall positional accuracy	These grids for the eight watercourses are not geo-referenced.
Overall thematic accuracy	Numbering is automatic as a standardized system is followed.
Overall temporal accuracy	This will still be valid after 100 years, or more.
Overall completeness	This is available for the eight watercourses selected from the Fordwah and Azim Distributaries in the Chishtian Sub-division. The watercourses selected from the Azim Distributary are Az-20L, Az-43L, Az-63L and Az-111L. From Fordwah Distributary, Fd-14-R, Fd-46-R, Fd-62R and Fd-130R were selected.

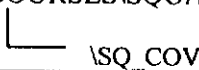
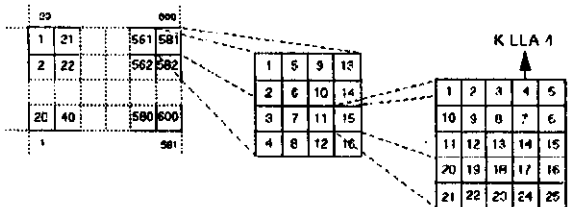
<b>3.4 Object type</b>	
Object type name	Geographical object <i>Killa</i>
Object type definition	<i>Killa</i> is the smallest unit of the grid system. There are sixteen squares in one block and twenty-five <i>killas</i> in one square. The size of the <i>killa</i> in meters is 67.056 x 60.3504.
Object type code	<i>Killa</i>
<b>3.5 Attribute type</b>	
Attribute type name	PAT.DBF fields 1) <i>Block</i> 2) <i>Square</i> 3) <i>Killa</i> 4) <i>Bksqkl</i>
Attribute type definition	1) <i>Block Number (Grid group system)</i> 2) <i>Square Number (Block sub-group system)</i> 3) <i>Killa Number</i> 4) <i>Combined numbering of Block, Square and Killa (Block@10,000+ Square@100 + Killa)</i>
Attribute type code	<p style="text-align: center;">BLOCKS                      BLOCK 581                      SQUARE 15</p> <ul style="list-style-type: none"> <li>• Block: X=1341.12m and Y=1207.008m.</li> <li>• Square: X=335.28m and Y=301.752m.</li> <li>• Killa: X=67.056m and Y=60.3504m.</li> </ul>
Thematic accuracy	Attributes to thematic accuracy have been conducted systematically, by computer entry, and fulfilling ground truth data.
<b>3.6 Organization and organization role</b>	
Organization name	Data collection and entry. International Irrigation Management Institute
Organisation abbreviation name	IIMI-Pakistan
Organisation address	12 km Multan Road Lahore, 53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 E-mail: iimi-pak@cgiar.org
Organisation role	IIMI-Pakistan staff entered the data.
Function of the organisation	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.
<b>Organization and organization role</b>	
Organisation name	Data analysis International Irrigation Management Institute
Organisation abbreviation name	IIMI-Pakistan
Organisation address	12 km Multan Road Lahore, 53700

	Phone: (042) 541-0050-53 Fax: (042) 541-0054 E-mail: <a href="mailto:iimi-pak@cgnet.com">iimi-pak@cgnet.com</a>
Organisation role	IIMI-Pakistan staff entered the data.
Function of the organisation	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.
<b>3.7 Point of contact and point of contact role</b>	
Point of contact name	Director
Point of contact address	12 km Multan Road Lahore, 53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 E-mail: <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>
Point of contact role	Director, IIMI-Pakistan
<b>3.8 Distribution</b>	
Restrictions on use	Prior permission from the Director, IIMI-Pakistan, and acknowledgements in the published document.
Copyright owners	IIMI-Pakistan
Media	Hard and soft copies; whole data set on CD-ROM.
Formats	Arc/Info Coverage
Order	Request to the Director, IIMI-Pakistan
Support services	Not available at the moment.
<b>3.9 Metadata reference</b>	
Entry date	December 15, 1997
Last check date	December 22, 1997
Last update date	December 22, 1997

#### 4 SQUARE COVERAGES

Eight Sample Watercourses



Metadata	Description
<b>4.1 Data set identification</b>	
Data set title	Square Grid Coverages of Eight Sample Watercourses
Physical name	\VDB-CHISHTIAN\COMMAND AREA\GRID SYSTEM\SAMPLE WATERCOURSES\SQUARE 
Format	PC Arc/Info Coverage
<b>4.2 Data set overview</b>	
Abstract	<p>This data set is the grid system coverage at the square level for the eight watercourses selected from the Fordwah and Azim Distributaries in the Chishtian Sub-Division.</p> <p>The irrigation system design divides all land area into a scheme of Measurement values for the Block, Square and <i>Killa</i>:</p> <ul style="list-style-type: none"> <li>• Block: X=1341.12m and Y=1207.008m.</li> <li>• Square: X=335.28m and Y=301.752m.</li> <li>• <i>Killa</i>: X=67.056m and Y=60.3504m.</li> </ul>  <p style="text-align: center;">BLOCKS                      BLOCK 581                      SQUARE 15</p> <ul style="list-style-type: none"> <li>• Block: X=1341.12m and Y=1207.008m.</li> <li>• Square: X=335.28m and Y=301.752m.</li> <li>• <i>Killa</i>: X=67.056m and Y=60.3504m.</li> </ul>
Purpose of production	This square grid has been used in all the spatial studies carried out for these eight watercourses, especially for a large project focused on the development of an integrated approach to analyse the impact of changes in water management on agricultural production and salinity / sodicity.
Usage	Used by Pierre Strosser, Salman Ashraf, Salman Asif, Helene Debarnardi, Ayesha Manzer, Samia Ali, Yann Chemin. Period: 1994 to 1996
Geographical extent	This spatial database is prepared by Salman Asif and Salman Ashraf.
Temporal extent	-
From date	-
To date	-
Output document	<ul style="list-style-type: none"> <li>• "Spatial Analysis of Irrigation Water Supply Performance: A Case Study in the Fordwah 14-R Command Area", Salman Asif</li> </ul>

	<p>and Salman Ashraf.</p> <ul style="list-style-type: none"> <li>• “Spatial Analysis of Canal Water Allocation and Distribution at Tertiary Level in Chishtian Sub-division”, Helen Debarnardi.</li> <li>• Soil Survey of Pakistan and International Irrigation Management Institute, Pakistan: Detailed Soil Survey of Eight Watercourse Command Areas In Chishtian and Hasilpur <i>Tehsils</i>, Blue Report.</li> </ul> <p>Reference of raw information:</p>
Document reference	

Sample	
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**4.3 Data set quality indicators**

Process history	<ul style="list-style-type: none"> <li>• <b>DATA ENTRY:</b> A grid has been produced using Arc/Info. One cell size is provided according to the square size in meters. A grid was then built to cover the watercourse.</li> <li>• <b>DATA PROCESSING:</b> The grid has been overlaid to the relevant watercourse coverage, with the help of Ground Control Points spread all over the area. This enables ascertaining the external boundary of the irrigation system. As a result, the grid has shifted from the upper to the lower part, giving the observed effect on the coverage.</li> </ul>
Overall positional accuracy	These grids of the eight watercourses are not geo-referenced.
Overall thematic accuracy	Numbering is automatic, as it follows a standardized system.
Overall temporal accuracy	This will still be valid after 100 years, or more.
Overall completeness	This is available for the eight watercourses selected from the Fordwah and Azim Distributaries in the Chishtian Sub-division. The watercourses selected from Azim Distributary are Az-20L, Az-43L, Az-63L, and Az-111L. From Fordwah Distributary, Fd-14-R, Fd-46-R, Fd-62R and Fd-130R were selected.

**4.4 Object type**

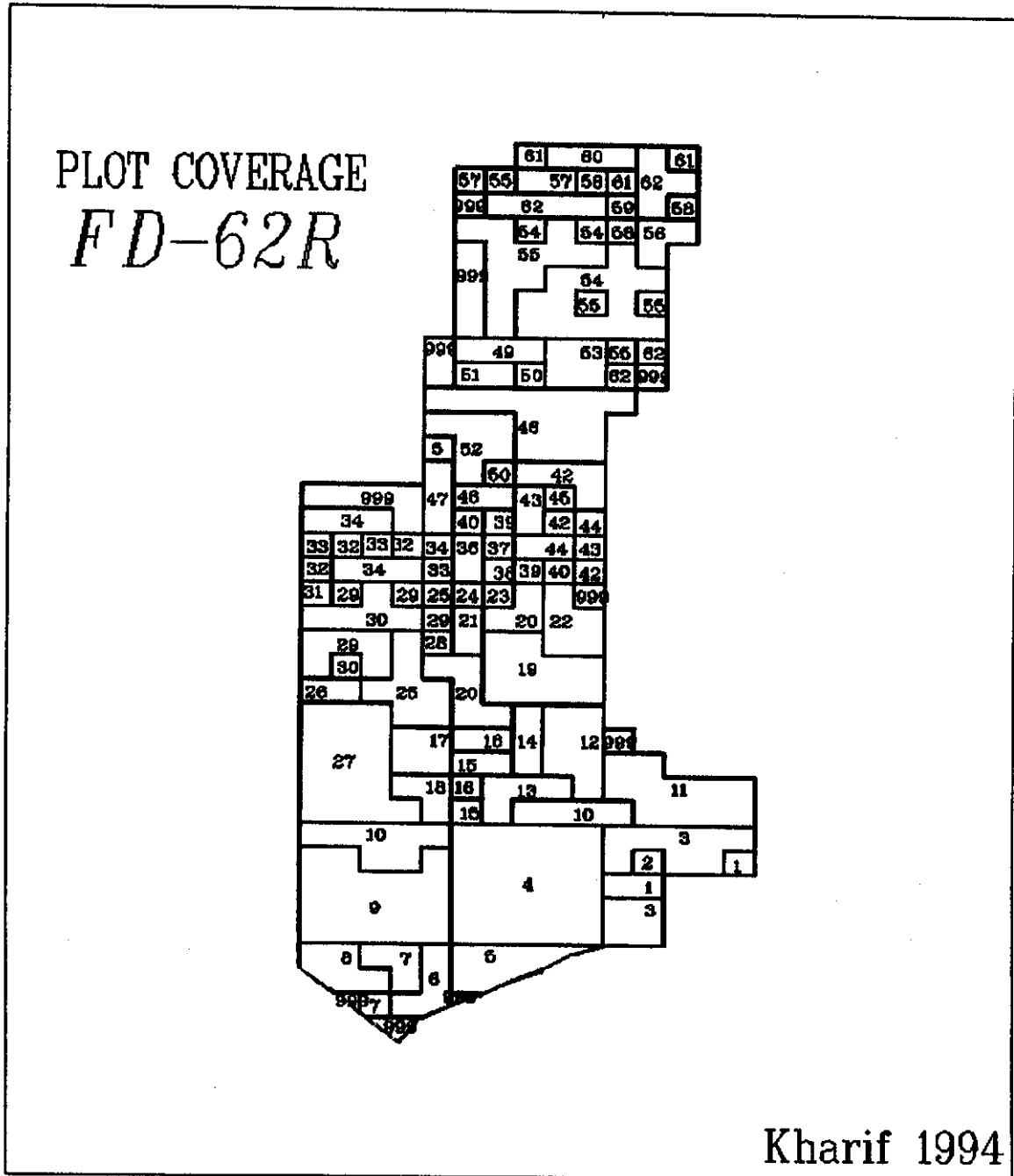
Object type name	Geographical object
Object type definition	Square
	Square is the second biggest unit of the grid system. There are sixteen squares in one block. The size of the square in meters is

Object type code	335.28 x 301.752 m.
<b>4.5 Attribute type</b>	Sq. DBF fields
Attribute type name	1) <i>Block</i> 2) <i>Square</i> 3) <i>Bksq</i>
Attribute type definition	1) <i>Block Number (Grid group system)</i> 2) <i>Square Number (Block sub-group system)</i> 3) <i>Combined numbering of Block and Square (Block@100+ Square)</i>
Attribute type code	<p style="text-align: center;">BLOCKS                      BLOCK 581                      SQUARE 15</p> <p style="text-align: center;">       • Block: X=1341.12m and Y=1267.008m.        • Square: X=335.28m and Y=301.752m.        • Killa: X=67.056m and Y=60.350m.     </p>
Thematic accuracy	Attributes of thematic accuracy have been systematically conducted by computer entry, and by fulfilling the ground truth data.
<b>4.6 Organization and organization role</b>	Data collection and entry.
Organization name	International Irrigation Management Institute
Organisation abbreviation name	IIMI-Pakistan
Organisation address	12 km Multan Road Lahore, 53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 E-mail: <a href="mailto:iimi-pak@cgnet.com">iimi-pak@cgnet.com</a>
Organisation role	IIMI-Pakistan entered the data.
Function of the organisation	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.
<b>Organization and organization role</b>	Data analysis
Organization name	International Irrigation Management Institute
Organisation abbreviation name	IIMI-Pakistan
Organisation address	12 km Multan Road Lahore, 53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 E-mail: <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>
Organisation role	IIMI-Pakistan entered the data.
Function of the organisation	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of

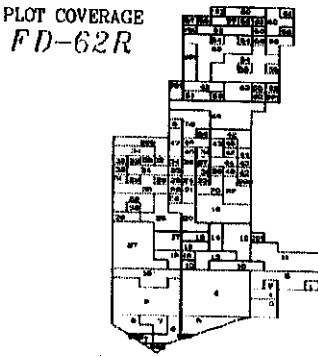


	water used in agriculture through better management of irrigation and water basin systems.
<b>4.7 Point of contact and point of contact role</b>	
Point of contact name	Director
Point of contact address	12 km Multan Road Lahore, 53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 E-mail: <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>
Point of contact role	Director, IIMI-Pakistan
<b>4.8 Distribution</b>	
Restrictions on Use	Prior permission from the Director, IIMI-Pakistan and acknowledgements in the published document.
Copyright Owners	IIMI-Pakistan
Media	Hard and soft copies; whole data set on CD-ROM.
Formats	Arc/Info Coverage
Order	Request to the Director, IIMI-Pakistan
Support services	Not available at the moment.
<b>4.9 Metadata reference</b>	
Entry date	December 15, 1997
Last check date	December 22, 1997
Last update date	December 22, 1997

**5 PLOT COVERAGES**  
 Eight Sample Watercourses



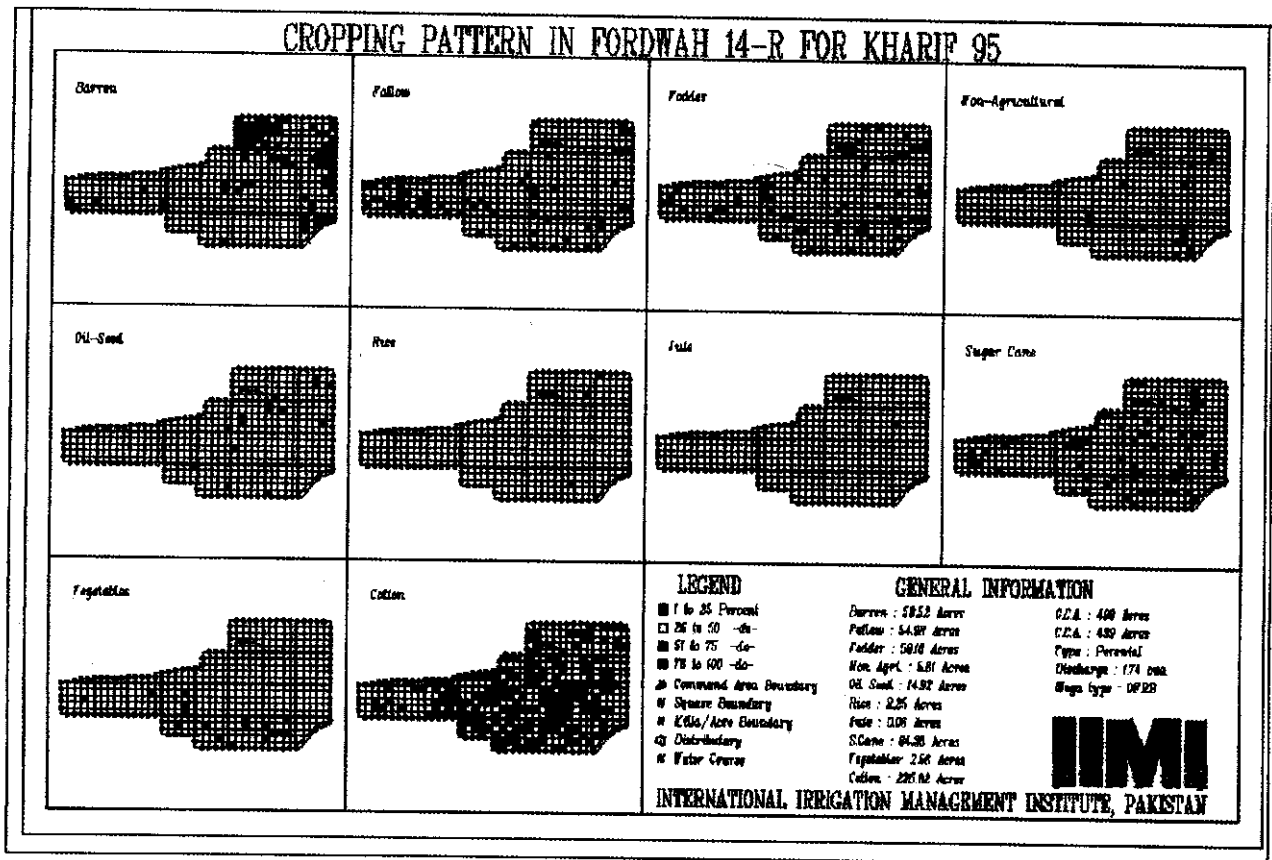
Metadata	Description
<b>5.1 Data set identification</b>	
Data set title	Plot Coverages of Eight Sample Watercourses
Physical name	\DB-CHISHTIAN \COMMAND AREA \IRRIGATION LAYOUT \PLOT (OF SAMPLE WATERCOURSES)  └─ \SEASON Kharif 1994 = K94 Rabi 1994-95 = R9495  └─ \WATERCOURSE Azim 20-L = Az20 Azim 43-L = Az43 Azim 63-L = Az63 Fordwah 14-R = Fd14 Fordwah 46-R = Fd46 Fordwah 62-R = Fd62 Fordwah 130-R = Fd130  └─ \COVERAGE NAME Plot Coverage = PLOT
Format	PC Arc/Info Coverage
<b>5.2 Data set overview</b>	
Abstract	This data set is the plot coverage for the seven watercourses selected from the Fordwah and Azim Distributaries in the Chishtian Sub-division. A plot is that part of the land assigned a <i>warabandi</i> number for the allocation of canal water. This plot coverage was derived from <i>killa</i> coverage using the dissolve command in Arc/Info.
Purpose of production	This plot coverage has been used in all the spatial studies carried out for these seven watercourses, especially for a large project focused on the development of an integrated approach to analyze the impact of changes in water management on agricultural production and salinity / sodicity.
Usage	Used by Pierre Strosser, Helene Debarnardi, Yann Chemin, Ayesha Manzer and Samia Ali. Period: 1995 to 1996  This spatial database is prepared by Samia Ali and Ayesha Manzer.
Geographical extent	These coverages are prepared for seven watercourses from the Fordwah and Azim Distributaries in the Chishtian Sub-division. The watercourses selected from Azim Distributary are Az-20L, Az-43L, Az-63L. From Fordwah Distributary, Fd-14R, Fd-46R, Fd-62R and Fd-130R were selected.
Temporal extent	
From date	For <i>Kharif</i> 1994 April 16, 1994 For <i>Rabi</i> 1994-95 October 16, 1994
To date	For <i>Kharif</i> 1994 October 15, 1994 For <i>Rabi</i> 1994-95 April 15, 1995

Output document	<ul style="list-style-type: none"> <li>“Spatial Analysis of Canal Water Allocation and Distribution at Tertiary Level in Chishtian Sub-division”, Helen Debernardi</li> </ul>
Document reference	Reference of raw information: <i>Killa coverage</i> .
Sample	 <p>PLOT COVERAGE FD-62R</p> <p>Kharif 1994</p>
<b>5.3 Data set quality indicators</b>	
Process history	<ul style="list-style-type: none"> <li><b>DATA ENTRY:</b> The <i>killa</i> coverage pat file was used for data entry. The <i>warabandi</i> number for respective seasons in each <i>killa</i> was entered in this pat file.</li> <li><b>DATA PROCESSING:</b> This <i>killa</i> coverage was then dissolved to plot coverage on the basis of a <i>warabandi</i> column (entered in pat file) using the dissolve command in Arc/Info.</li> </ul>
Overall positional accuracy	These plot coverages are not geo-referenced.
Overall thematic accuracy	In this grid system, the <i>killa</i> is the smallest unit. Hence, the plot coverage is accurate up to the <i>killa</i> level, but where two plots exist within the same <i>killa</i> , the <i>killa</i> is not divided further; the whole is assigned to the bigger plot.
Overall temporal accuracy	This is only valid for one agronomic season.
Overall completeness	Available for the seven watercourses selected from the Fordwah and Azim Distributaries in the Chishtian Sub-division. The watercourses selected from Azim Distributary are Az-20L, Az-43L and Az-63L. From Fordwah Distributary, Fd-14-R, Fd-46-R, Fd-62R and Fd-130R were selected. Fordwah Distributary's watercourses have separate plot coverages for <i>Kharif</i> 94 and <i>Rabi</i> 94-95, but only one coverage exists for the Azim Distributary. Azim Distributary is non-perennial, thus, <i>warabandi</i> is not re-established for the <i>Rabi</i> season.
<b>5.4 Object type</b>	
Object type name	Plot
Object type definition	A plot is that part of the land assigned a <i>warabandi</i> number for the allocation of canal water.
Object type code	Plot
<b>5.5 Attribute type</b>	
Attribute type name	1) <b>WB_IDKH94 / WB_IDRB94</b>
Attribute type definition	1) For plot coverage for <i>Kharif</i> 1994, the column in the pat file is <i>Wb_idkh94</i> , which gives the <i>warabandi</i> numbers for the <i>Kharif</i> season.

	For plot coverage for the <i>Rabi</i> season, the field for <i>warabandi</i> numbers established for <i>Rabi</i> 1994-95, is Wb_idrb94.
Attribute type code	
Thematic accuracy	
<b>5.6 Organization and organization role</b>	Data collection and entry.
Organization name	International Irrigation Management Institute
Organization abbreviation name	IIMI-Pakistan
Organization address	12 km Multan Road Lahore, 53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 E-mail: <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>
Organization role	IIMI-Pakistan staff collected and entered the data.
Function of the organization	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.
<b>Organization and organization role</b>	Data analysis
Organization name	International Irrigation Management Institute
Organization abbreviation name	IIMI-Pakistan
Organization address	12 km Multan Road Lahore, 53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 E-mail: <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>
Organization role	IIMI-Pakistan analyzed the data.
Function of the organization	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.
<b>5.7 Point of contact and point of contact role</b>	
Point of contact name	Director
Point of contact address	12 km Multan Road Lahore, 53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 E-mail: <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>
Point of contact role	Director, IIMI-Pakistan
<b>5.8 Distribution</b>	
Restrictions on use	Prior permission from the Director, IIMI-Pakistan, and acknowledgements in the published document.
Copyright owners	IIMI-Pakistan
Media	Hard and soft copies; whole data set on CD-ROM.
Formats	Arc/Info Coverage
Order	Request to the Director, IIMI-Pakistan
Support services	Not available at the moment.
<b>5.9 Metadata reference</b>	
Entry date	January 07, 1998
Last check date	January 08, 1998
Last update date	January 08, 1998

# 6 CROPPING PATTERN

Eight Sample Watercourses (Processed Information from Crop Census Data)



Metadata <b>6.1 Data set identification</b>	Description
Data set title	Cropping Pattern Maps For Eight Sample Watercourses
Physical name	\DB-CHISHTIAN\AGRICULTURAL PRODUCTION\CROPPING PATTERN\SAMPLE WATERCOURSES  \SEASON Kharif 1994 = K94 Rabi 1994-95 = R9495 Kharif 1995 = K95  \WATERCOURSE Azim 20-L = Az20 Azim 43-L = Az43 Azim 63-L = Az63 Azim 111-L = Az111 Fordwah 14-R = Fd14 Fordwah 46-R = Fd46 Fordwah 62-R = Fd62 Fordwah 130-R = Fd130  \FILE NAME Cropping Pattern Map = CROP.MAP
Format	Arc/Info Coverages and Maps
<b>6.2 Data set overview</b>	
Abstract	These maps show percentages for barren, fallow and non-agriculture areas, and for areas under various crops in a watercourse command area. These maps are prepared for eight watercourses along the Fordwah and Azim Distributaries in the Chishtian Sub-division, and contain general information about the watercourses in text format. This information is available for three seasons, <i>Kharif 1994, Rabi 1994-95 and Kharif 1995.</i>
Purpose of production	This cropping pattern data was collected as part of an integrated approach to assess farmers' strategies, e.g. decision-making pertaining to whether different crops should be planted or whether land should be left fallow, problems related to water deficiency, salinity / sodicity, economics, etc..
Usage	Pierre Strosser, Helene Debarnardi, Ayesha Manzer, Samia Ali, Yann Chemin, Salman Asif and Salman Ashraf used these in different analyses and reports. Period: 1994 to 1996  This spatial database is prepared by Salman Asif and Salman Ashraf.
Geographical extent	This information was prepared for eight watercourses along the Fordwah and Azim Distributaries in the Chishtian Sub-division, encompassing four watercourses from each. Watercourses selected from Azim Distributary were Az-20L, Az-43L, Az-63L and Az-111L. From the Fordwah Distributary, Fd-14R, Fd-46R, Fd-62R and Fd-130R were selected.
Temporal extent	
From date	For <i>Kharif 1994</i> : April 16, 1994 For <i>Rabi 1994-5</i> : October 16, 1994 For <i>Kharif 1995</i> : April 16, 1995

To date	For Kharif 1994: October 15, 1994 For Rabi 1994-95: April 15, 1995 For Kharif 1995: October 15, 1995																		
Output document	<input type="checkbox"/> "Spatial Analysis of Canal Water Allocation and Distribution at Tertiary Level in Chishtian Sub-division", Helen Debernardi. <input type="checkbox"/> "Spatial Analysis of Irrigation Water Supply Performance: A Case Study in the Fordwah 14-R Command Area", Salman Asif and Salman Ashraf. <input type="checkbox"/> Reference of Raw Metadata: Crop Census Data																		
Document reference	C:\DB-Chishtian \ Agricultural Production \ Cropping Pattern \ Sample Watercourses \ Readme.txt																		
Sample	<p style="text-align: center;">CROPPING PATTERN IN AZIM 20-L FOR KHARIF 94</p> <p><b>LEGEND</b></p> <ul style="list-style-type: none"> <li>■ 1 to 20 Perennial</li> <li>□ 20 to 40</li> <li>□ 40 to 75</li> <li>□ 75 to 100</li> <li>□ Command Area Boundary</li> <li>□ Survey Boundary</li> <li>□ 200/250 Boundary</li> <li>□ Distributory</li> <li>□ Futer Course</li> </ul> <p><b>GENERAL INFORMATION</b></p> <table border="0"> <tr> <td>Derwas : 2000 Acres</td> <td>Old Canal : 100 Acres</td> </tr> <tr> <td>Faldar : 2000 Acres</td> <td>Gal : 200 Acres</td> </tr> <tr> <td>Faldar : 2000 Acres</td> <td>Type : Non-Perennial</td> </tr> <tr> <td>Faw, Apr : 500 Acres</td> <td>Discharge : 100 cusec</td> </tr> <tr> <td>Old Canal : 100 Acres</td> <td>Map Type : R/W</td> </tr> <tr> <td>Gal : 2000 Acres</td> <td></td> </tr> <tr> <td>Galvan : 2000 Acres</td> <td></td> </tr> <tr> <td>Fyathia : 2000 Acres</td> <td></td> </tr> <tr> <td>Galan : 2000 Acres</td> <td></td> </tr> </table> <p style="text-align: right;"><b>IIMI</b> INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE, PAKISTAN</p>	Derwas : 2000 Acres	Old Canal : 100 Acres	Faldar : 2000 Acres	Gal : 200 Acres	Faldar : 2000 Acres	Type : Non-Perennial	Faw, Apr : 500 Acres	Discharge : 100 cusec	Old Canal : 100 Acres	Map Type : R/W	Gal : 2000 Acres		Galvan : 2000 Acres		Fyathia : 2000 Acres		Galan : 2000 Acres	
Derwas : 2000 Acres	Old Canal : 100 Acres																		
Faldar : 2000 Acres	Gal : 200 Acres																		
Faldar : 2000 Acres	Type : Non-Perennial																		
Faw, Apr : 500 Acres	Discharge : 100 cusec																		
Old Canal : 100 Acres	Map Type : R/W																		
Gal : 2000 Acres																			
Galvan : 2000 Acres																			
Fyathia : 2000 Acres																			
Galan : 2000 Acres																			
<b>6.3 Data set quality indicators</b>																			
Process history	<ul style="list-style-type: none"> <li>• <b>Data collection</b> The data has been collected by IIMI-Pakistan field staff designated to be in the field for one month each season. They visited the watercourses, inspected the cultivated and uncultivated land, and noted observations in the specific proforma, including any special remarks.</li> <li>• <b>Data entry and processing</b> This data was checked and computer-entered at the Lahore office under the supervision of relevant staff. Each file was divided into 8-10 separate files, depending on crop names in each watercourse. These DBF files were then joined with the Arc/Info coverage of the watercourse, as individual coverages were prepared for each crop. With the use of this coverage, one final map was prepared for one watercourse, and one season.</li> </ul>																		
Overall positional accuracy	There could be a difference of less than one <i>marla</i> in crop area.																		
Overall thematic accuracy	All crops that are not very dominant are classified as 'OTHERS'. Although the 'REMARKS' column in DBF files often indicate these, the case is not the same on maps.																		
Overall temporal accuracy	This data is valid for one agronomic season.																		
Overall completeness	These maps are available for all eight watercourses for two seasons, i.e., <i>Kharif</i> 94 and <i>Rabi</i> 94-95. For <i>Kharif</i> 95, however, maps for watercourses Fordwah-46 and Azim-43 were not prepared.																		

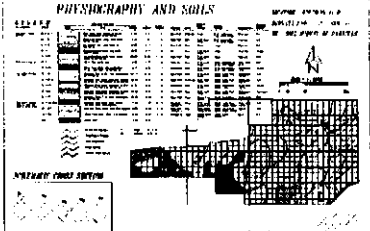


<b>6.4 Object type</b>	
Object type name	One <i>killa</i> .
Object type definition	<i>Killa</i> is the smallest unit of the grid system. The size of one <i>killa</i> is equivalent to 8 acres; and in dimension, 198x220 feet.
Object type code	Killa
<b>6.5 Attribute type</b>	
	CROP.PAT fields
Attribute type name	1) <b>BLOCK</b> 2) <b>SQUARE</b> 3) <b>KILLA</b> 4) <b>CROP</b> 5) <b>KANALS</b> 6) <b>MARLAS</b> 7) <b>C_AREA</b> 8) <b>AREA_PER</b> 9) <b>AREA_ACRE</b>
Attribute type definition	1) Block number 2) Square number 3) <i>Killa</i> number 4) Crop name 5) Area in <i>kanals</i> covered by that crop 6) Area in <i>marlas</i> covered by that crop 7) Total area converted into <i>kanals</i> 8) Percentage of crop area in that particular <i>killa</i> 9) Crop area converted into acres
Attribute type code	
<b>6.6 Organization and organization role</b>	
	Data collection
Organization name	International Irrigation Management Institute
Organization abbreviation name	IIMI
Organization address	12 km Multan Road Lahore, 53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 E-mail: <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>
Organization role	IIMI-Pakistan field staff collected the data.
Function of the organization	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.
<b>Organization and organization role</b>	
	Data entry and analysis
Organization name	International Irrigation Management Institute
Organization abbreviation name	IIMI
Organization address	International Irrigation Management Institute 12 km Multan Road, Chowk Thokar Niaz Baig Lahore-53700 Phone: (042) 541-0050-53 Email : <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>
Organization role	IIMI-Pakistan staff collected the data.
Function of the organization	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.

<b>6.7 Point of contact and point of contact role</b>	
Point of contact name	Director
Point of contact address	12 km Multan Road, Chowk Thokar Niaz Baig Lahore-53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 Email : <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>
Point of contact role	Director, IIMI-Pakistan
<b>6.8 Distribution</b>	
Restrictions on use	Prior Permission from the Director, IIMI-Pakistan, and acknowledgements in the published document.
Copyright owners	IIMI-Pakistan
Media	Hard and soft copies, and the entire data set for the Chishtian Sub-division, may be available on CD.
Formats	Arc/Info
Order	Request to the Director, IIMI-Pakistan
Support services	Not available at the moment.
<b>6.9 Metadata reference</b>	
Entry date	November 04, 1997
Last check date	November 14, 1997
Last update date	November 14, 1997



Metadata	Description
<b>7.1 Data set identification</b>	
Data set title	Physiography and Soil for Eight Sample Watercourses
Physical name	\DB-CHISHTIAN\PHYSICAL ENVIRONMENT\SOIL\SOIL ASSOCIATION\ SAMPLE WATERCOURSES  \WATERCOURSE Azim 20-L = Az20 Azim 43-L = Az43 Azim 63-L = Az63 Azim 111-L = Az111 Fordwah 14-R = Fd14 Fordwah 46-R = Fd46 Fordwah 62-R = Fd62 Fordwah 130-R = Fd130  \COVERAGE AND MAP NAME Soil Coverage = SOIL Soil Map = FINAL.MAP
Format	Arc/Info Coverage and Maps
<b>7.2 Data set overview</b>	
Abstract	Detailed soil investigations of eight watercourse command areas along the Fordwah and Azim Distributaries were carried out by the Soil Survey of Pakistan at the request of the International Irrigation Management Institute (IIMI-Pakistan), Lahore. These investigations form part of IIMI-Pakistan's research activities related to managing irrigation systems in general, and in particular, to the incidence of waterlogging and salinity related to irrigation management (Kuper and Strosser, 1992). Soil lithology and other soil characteristics like infiltration rates, hydraulic conductivity, salinity and / or sodicity natures, soil fertility and water table depths are prerequisites for researches of this nature.
Purpose of production	Present investigations were carried out in view of IIMI-Pakistan's research program, and included the following: <ul style="list-style-type: none"> <li>• Detailed investigations of the soil in the area and its identification at soil-phase levels.</li> <li>• Preparation of detailed survey maps at the scale of 1:10,000 for each watercourse command.</li> <li>• Characterization of each soil series with special reference to soil lithology (mechanical analysis of soil horizons), hydraulic characteristics (infiltration rates, permeability) bulk density, porosity, soil fertility (organic matter contents and micro nutrients), etc..</li> </ul> These investigations will help to improve planning and executing research projects related to irrigation management. Results can also be applied on the related soil in the area.
Usage	Marcel Kuper, Pierre Strosser, Neeltje Kielen and several other researchers have used these maps. Period: 1995-96.  This database and maps are prepared by Salman Ashraf and Salman Asif.
Geographical extent	This data set was prepared for eight watercourses along the Fordwah and Azim Distributaries in the Chishtian Sub-division. The Fordwah Distributary is

	perennial, but becomes non-perennial later. Four watercourses were selected from the Fordwah Distributary, i.e. Fd-14R, Fd-46R, Fd-62R, Fd-130R. From Azim Distributary, Az-20L, Az43L, Az63L and Az-111L were selected.
Temporal extent	
From date	The survey was initiated in October 1995.
To date	The survey concluded in November 1995.
Output document	"Detailed Soil Survey of Eight Watercourse Command Areas in the Chishtian and Hasilpur Tehsils", Soil Survey of Pakistan and IIMI-Pakistan, joint report, November 1996.
Document reference	
Sample	

### 7.3 Data set quality indicators

Process history	<ul style="list-style-type: none"> <li> <b>Data collection</b>  A detailed soil survey of the project area was conducted during October through November 1995. Base maps of all eight watercourses command areas were prepared separately at a scale of 1:5000. Each watercourse command area was transferred to available (1:40,000 scale) air-photos flown under the Colombo Plan in 1955-56. The air photos were scanned under a mirror stereoscope to delineate physiography and associated soils in the areas on the basis of air photo patterns and tonalities. Field investigations were carried out using the interpretative physiography soil map and sampling with auger the soils to a depth of 150 to 200 cm, mostly in alternate fields. Wherever necessary, observation sites were supplemented by additional checks, to trace the exact soil boundaries. However, in barren or dunal areas, the observation density was lowered. The information recorded at each auger observation site included the depth and thickness of horizons / layers; data for each horizon included the moist Munsell's color, mottles, texture, structure, porosity, soil moisture status, consistence, calcareousness / gypsum and soil reaction. In addition, surface salt crust, depth to water table, land use and other factors influencing soil management were also noted. Soil types and related phases were differentiated on the basis of these characteristics. In total, about 1100 auger observations were made in each of the eight watercourse command areas. The information was recorded in a proforma using a separate sheet for each observation site. The sites were precisely located, marked, indexed and numbered on the base maps. Twelve soil pits were exposed to a depth of two meters on representative sites of the soils recognized in the survey area, and were described and sampled according to the procedures laid down in the guidelines for soil description (FAO, 1977). The laboratory team performed replicated tests for infiltration (double ring infiltrometer) and permeability (auger hole and inverse auger hole methods) at the 12 sites, and collected undisturbed core samples from defined depths. In total, 213 disturbed soil samples and 73 undisturbed core samples were collected for detailed analysis in the laboratories of SSOP, Lahore. </li> <li> <b>Data entry</b>  Finalizing soil boundaries drawn in the field was facilitated through a deep insight of field observations recorded, and by comparison, supplemented with the air-photo studies. Soil maps were digitized at the scale of 1:10,000 for the eight watercourse command areas by the IIMI-Pakistan GIS section. </li> </ul>
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Overall positional accuracy	The position of boundaries between different classes is relatively accurate. The order of outlying boundaries of different soil classes is 1-3 meters.
Overall thematic accuracy	The SSOP field staff has long experience in soil recognition in the Punjab province. Their skills are trusted.
Overall temporal accuracy	These maps may be valid beyond 25-30 years.
Overall completeness	Available for the eight sample watercourses. These eight watercourses selected by IIMI-Pakistan along the Fordwah Distributary are Fd-14R, Fd-46R, Fd-62R and Fd-130R, and Az-20L, AZ43L, Az63L and Az-111L from along the Azim Distributary.
<b>7.4 Object type</b>	
Object type name	Area under one soil class.
Object type definition	The boundary limitation of each soil class within each watercourse.
Object type code	Soil
<b>7.5 Attribute type</b>	
Attribute type name	SOIL.Pat fields
Attribute type name	1) <b>SOIL_TYPE</b> 2) <b>SOIL_CODE</b> 3) <b>NSOILCODE</b>
Attribute type definition	1) Soil association type with series and various water table depths (W1, W2, W3 and W4). 2) Numeric codes were assigned to each soil type. 3) Color codes were assigned for map composition.
Attribute type code (Name and definition)	1)→Ad 6:-Adilpur loam Ad6-Jk6X(b):-Adilpur loam – Jhakkar loam complex (barren) Bg 4/W1:-Bagh fine sandy loam, water table at 90-150 cm Bg 6:-Bagh loam Bg 6/3C W1:-Bagh loam, over coarse at 60-90 cm, water table at 90-150 cm D.L.:-Low sand dunes G.Y.:-Grave Yard Gd 6:-Gandhra loam Hr 4/W1:-Haroonabad fine sandy loam, water table at 90-150 cm Hr 4p:- Haroonabad fine sandy loam with alkali crust Hr 6:- Haroonabad loam Hr 6/W1:- Haroonabad loam, water table at 90-150 cm Hr 6p:-Haroonabad loam with alkali crust Jg 2:- Jhang loamy fine sand Jg 2(av):-Jhang loamy fine sand alkali variant Jg 2(av)-DLX:- Jhang loamy sand alkali variant-dune land complex Jg 2-DL:- Jhang loamy sand, dune land complex Jg 2-DLX:- Jhang loamy sand-dune land complex Jg 2p:- Jhang loamy fine sand with alkali crust Jg 4p:- Jhang fine sandy loam with alkali crust Jk 4/W1:- Jhakkar fine sandy loam, water table at 90-150 cm Jk 6:- Jhakkar loam Jk 7:- Jhakkar silt loam Jk 7/W1:- Jhakkar silt loam, water table at 90-150 cm Kiln:- Kiln Lake:- Water logged area Mi 10:- Miani silty clay loam Mi 10/3mc:- Miani silty clay loam over moderately coarse at 60-90 cm Mi 6:- Miani loam Mi 7:- Miani silt loam Mt 4:- Matli fine sandy loam Mt 4p/W1:- Matli fine sandy loam with alkali crust, water table at 90-150 cm Nb 6/3c:- Nabipur loam over coarse at 60-90 cm

	<p>Nb 6p:- Nabipur loam with alkali crust  Pc 10:- Pacca silty clay loam  Rs 2:- Rasulpur loamy sand  Rs 2(av):- Rasulpur loamy sand alkali variant  Rs 2(av) b:- Rasulpur loamy sand alkali variant (barren)  Rs 2/W1:- Rasulpur loamy fine sand, water table at 90-150 cm  Rs 2-DLX:- Rasulpur loamy sand, dune land complex  Rs 2p:- Rasulpur loamy sand with alkali crust  Rs 4:-Rasulpur fine sandy loam  Rs 4(av):- Rasulpur fine sandy loam, alkali variant  Rs 4(av)-DLX:- Rasulpur fine sandy loam alkali variant-dune land complex  Rs 4/3C W1:- Rasulpur fine sandy loam over coarse at 60-90 cm, water table at 90-150 cm  Rs 4/3m:- Rasulpur fine sandy loam over medium at 90-150 cm  Rs 4/3mf:- Rasulpur fine sandy loam over moderately fine at 60-90 cm  Rs 4/W1:- Rasulpur fine sandy loam, water table at 90-150 cm  Rs 4a/W1:- Rasulpur fine sandy loam with alkali surface, water table at 90-150 cm  Rs 4p:- Rasulpur fine sandy loam with alkali crust  Rs 4p/W1:- Rasulpur fine sandy loam with alkali crust, water table at 90-150 cm  Rs 6:- Rasulpur loam  RS 6/3m:- Rasulpur loam over medium at 60-90 cm.  Rs 6/3m W1:- Rasulpur loam over medium at 60-90 cm, water table at 90-150 cm  Rs 6/W1:- Rasulpur loam, water table at 90-150 cm  Rs 6p:- Rasulpur loam with alkali crust  Sd 2/W1:- Sodhra loamy fine sand, water table at 90-150 cm  Sd 4:- Sodhra fine sandy loam  Sd 4(av)/W1:- Sodhra fine sandy loam alkali variant, water table at 90-150 cm  Sd 6:- Sodhra loam  Sd 6/W2:- Sodhra loam, water table at 45-90 cm  St 7:- Satgarah silt loam  Su 1:- Sultanpur sandy over wash  Su 6:- Sultanpur loam  Su 6/3c:- Sultanpur loam over coarse at 60-90 cm  Su 6/W2:- Sultanpur loam, water table at 45-90 cm  Su 6p:- Sultanpur loam with alkali crust  Su 7:- Sultanpur silt loam  Su 7/3c:- Sultanpur silt loam over coarse at 60-90 cm  Su 7/3c W2:- Sultanpur silt loam over coarse at 60-90 cm, water table at 45-90 cm  U.L.:- Urban Land</p>
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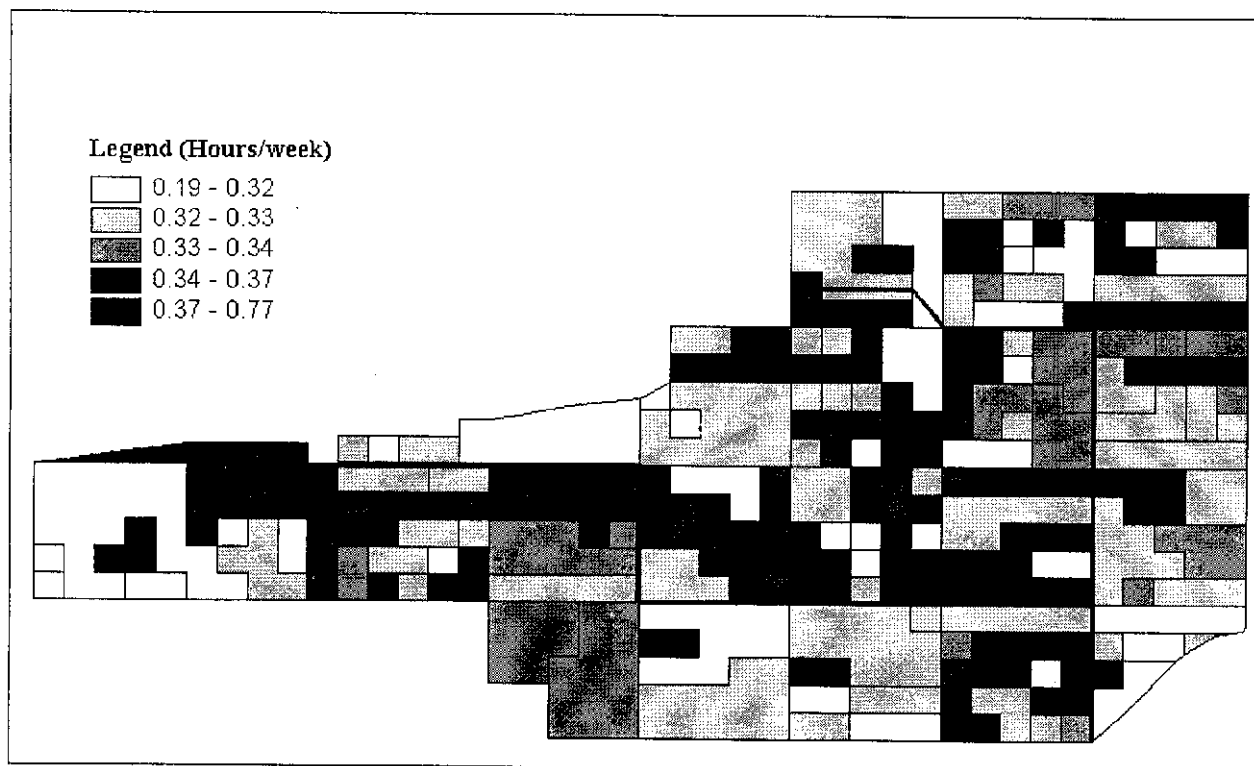
<b>7.6 Organization and organization role</b>	Data collection
Organization name	Soil Survey of Pakistan
Organization abbreviation name	SSOP
Organization address	Multan Road Lahore, 54780 Phone: (042) 7843691 Fax: (042) 7832209
Organization role	SSOP collected the data.
Function of the organization	Survey of all related soil sciences in Pakistan
<b>Organization and organization role</b>	Data entry and analysis

Organization name	International Irrigation Management Institute
Organization abbreviation name	IIMI-Pakistan
Organization address	12 Km Multan Road Lahore, 53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 E-mail: <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>
Organization role	IIMI-Pakistan staff analyzed the data.
Function of the organization	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.
<b>7.7 Point of contact and point of contact role</b>	
Point of contact name	Director
Point of contact address	12 km Multan Road Lahore, 53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 E-mail: <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>
Point of contact role	Director, IIMI-Pakistan
<b>7.8 Distribution</b>	
Restrictions on use	Prior permission from the Director, IIMI-Pakistan, and acknowledgments in the published document.
Copyright owners	IIMI-Pakistan
Media	Hard and soft copies and an entire data set for the Chishtian Sub-division may be available on CD.
Formats	PC Arc/Info
Order	Request to the Director, IIMI-Pakistan
Support services	Not available at the moment.
<b>7.9 Metadata reference</b>	
Entry date	January 08, 1998
Last check date	January 09, 1998
Last update date	January 09, 1998



## 8 CANAL WATER ALLOCATION

Eight Sample Watercourses (processed information from agreed upon *warabandi*)



Metadata <b>8.1 Data set identification</b>	Description
Data set title	Agreed Upon Warabandi (Canal Water Allocation) For Watercourse Command Area.
Physical name	\DB-CHISHTIAN\WATER SUPPLY\CANAL\WARABANDI\PLOT (OF SAMPLE WATERCOURSES)  └─ \SEASON Kharif 1994 = K94 Rabi 1994-95 = R9495  └─ \WATERCOURSE Azim 20-L = Az20 Azim 43-L = Az43 Azim 63-L = Az63 Fordwah 14-R = Fd14 Fordwah 46-R = Fd46 Fordwah 62-R = Fd62 Fordwah 130-R = Fd130  └─ A UWBD.WQ1  └─ CWA (Arc/Info Coverage)
Format	Worksheet and Arc/Info Coverage
<b>8.2 Data set overview</b>	
Abstract	<p>This dataset is an agreement between the farmers of a watercourse. The farmers who want to introduce some modifications in the official warabandi list (e.g. due to changes in land ownership, tenure status or may be influence of some power relationship etc.) they meet at the beginning of the season to make this warabandi list by mutual agreement. This list with some modifications in the official warabandi list is named as Agreed Upon Warabandi list. This list is a timetable for one week in which each plot of the watercourse is considered. Here the start and end time for having the canal water is fixed in proportion to the operated area and it has to be repeated in 26 weeks of the season. Sometimes Nikal and Khal bharai timings are also given according to the location of the plot.</p> <p>A plot is that part of the land that is assigned a warabandi number for the allocation of canal water.</p> <p>Khal bharai is the time required to fill the unit length of empty watercourse before nakkah and Nikal is time duration required to empty watercourse after end of the water turn.</p>
Purpose of production	It is produced to see farmers' role in water management activities. With time allocation some other parameters were collected in this list to see which type of farmers are more powerful and able to get high canal water allocation. The farmers who are big landholders or old settled families are more powerful in making decisions or it is related to tenure status.
Usage	Data used by Saeed-ur-Rehman, Helene, Samia, Yann, Ayesha and Salman Ashraf During : 1995 – 1996  Samia Ali, Helen Debernardi and Ayesha Manzer developed spatial database and

	maps from this dataset.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Geographical extent	This dataset is collected for the eight watercourses from the two distributaries in Chishtian sub-division. These two distributaries are Fordwah and Azim and four watercourses are selected from each of these. The watercourses selected from Azim distributary are Az-20L, Az-43L, Az-63L and Az-111L and the other four selected from the Fordwah distributary are Fd-14R, Fd-46R, Fd-62R and Fd-130R.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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Output document	<ul style="list-style-type: none"> <li>"Analysis of Canal Water Supply at Tertiary Level in the Chishtian Sub-division", Helen Debamardi.</li> </ul> <p><b>GIS OUTPUT:-</b> From this dataset Arc/Info coverages are prepared and maps showing four different classes of canal water allocation within a watercourse command area. The quartile method was used for classification.</p> <p><b>Reference of Processed information:</b> Agreed upon Canal Water Volumes.</p>																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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**8.3 Data set quality indicators**

Process history	<ul style="list-style-type: none"> <li><b>Data collection</b> The data collected is at plot level in this warabandi list. The information collected for each plot is the name of the owner with father name, his land holding, warabandi identification number, cultivator name with father name, operated area, tenure status and start and end time for irrigation. The field staff was provided with the specific proformas to fill up with the collected information. They interviewed the farmers to fill these proformas with the complete cycle of rotation of warabandi, which is one week long. After they went to the field for the confirmation and after verification of each water turn, the proformas were filled finally by the field staff.</li> <li><b>Data entry and Processing</b> These proformas were brought to the Lahore office. After checking, data was entered in computer by the data entry person under the supervision of the relevant person. After time allocation per acre for each plot is calculated and these files are processed to use in Arc/Info for the spatial analysis.</li> </ul>
Overall positional accuracy	This information is accurate up to the plot level, but sometimes, when water turns for two or more plots are combined, acquiring exact and accurate information is impossible.
Overall thematic accuracy	
Overall temporal accuracy	This list is not in accordance to the agronomic season and it is always behind the time. In Kharif season it is revised four or five weeks after the season is started and in Rabi season it is revised after the canal closure when ten or eleven weeks of Rabi have been passed.
Overall completeness	It is available for the eight watercourses selected from Fordwah and Azim distributaries for the two seasons (Kh-94 and Rb-94_5). But since Azim distributary is non-perennial, therefore the agreed upon warabandi data for the

	four watercourses of Azim distributary are not available for Rabi 1994-95 due to the canal closure rule in Rabi season for Azim disty.
<b>8.4 Object type</b>	
Object type name	Plot
Object type definition	A plot is that part of the land assigned a warabandi identification code for the allocation of canal water.
Object type code	Plot
<b>8.5 Attribute type</b>	
Attribute type name	ACVOL.DBF fields 1) DY 2) WC 3) OWNER'S NAME 4) Lhold 5) ID 6) CULTIVATOR'S NAME 7) OPAREA 8) TENURE 9) DAY 10) SAGWT 11) EAGWT 12) DURWT 13) WTHRS 14) ACTWT 15) ACRHRS 16) NIKAL 17) HRSNI 18) KBHRAI 19) HRSKB 20) INNAKKA 21) OUTNAKKA 22) REMARKS
Attribute type definition	1) Name of the distributary 2) Name of the watercourse. 3) Name of the owner with father's name 4) Land owned by the owner (Acre) 5) The warabandi number (water turn) assigned to the cultivator for the allocation of canal water for that particular season. 6) Name of the cultivator with father's name 7) Area cultivated by the cultivator (Acre) 8) Tenure status, i.e., on what terms and conditions the cultivator is cultivating owner's land 9) The day of the week on which the plot has to be irrigate. 10) Time at which irrigation for the plot is agreed to be start 11) Time at which irrigation for the plot is agreed to be stopped 12) Time duration of irrigation for the plot 13) Time is converted to hours 14) Gross time of irrigation either by including Nikal or excluding khal bharai 15) Time of irrigation per acre 16) It is the time (in minutes) required emptying the watercourse after the nakkah has been closed. 17) Nikal mentioned in hours. 18) It is the time (in minutes) required to fill the watercourse after the opening of

	<p>nakkah.</p> <p>19) Khal bharai mentioned in hours.</p> <p>20) The location (block, square and killa) of nakkah from where the farmers take the allocated water.</p> <p>21) The location (block, square and killa) of nakkah from where the farmers leaves the water after taking his turn.</p> <p>22) Any special remarks.</p>
Attribute type code	<p>1) <b>FD:</b> Fordwah distributary <b>AZ:</b> Azim Distributary</p> <p>2) The number represents the reduced distance in thousand feet from the head of the distributary to the outlet of the watercourse. <b>R:-</b> It shows the WC is on right side of the distributary. <b>L:-</b> It shows the WC is on left side of the distributary.</p> <p>6) <b>T:</b> Tenant <b>L:</b> Lease <b>OC:</b> Owner is cultivating his land himself</p>
Thematic accuracy	
<b>8.6 Organization and organization role</b>	Data collection
Organization name	International Irrigation Management Institute
Organization abbreviation name	IIMI
Organization address	<p>12 km Multan Road, Chowk Thokar Niaz Baig Lahore-53700 Phone: (042) 541-0050-53 Fax: 541-0054 Email : <a href="mailto:iimi-pak@cgjar.org">iimi-pak@cgjar.org</a></p>
Organization role	IIMI-Pakistan field staff collected the data.
Function of the organization	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.
<b>Organization and organization role</b>	Data entry and analysis
Organization name	International Irrigation Management Institute
Organization abbreviation name	IIMI
Organization address	<p>12 km Multan Road, Chowk Thokar Niaz Baig Lahore-53700 Phone: (042) 541-0050-53 Fax: 5410054 Email : <a href="mailto:iimi-pak@cgjar.org">iimi-pak@cgjar.org</a></p>
Organization role	The collected data was entered, checked and analysed by IIMI staff.
Function of the organization	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.

**8.7 Point of contact and  
point of contact role**

Point of contact name	Director
Point of contact address	12 km Multan Road Chowk Thokar Niaz baig Lahore-53700, Phone: (042) 541-0050-53, Fax: (042) 541-0054 Email : <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>
Point of contact role	Director, IIMI-Pakistan

**8.8 Distribution**

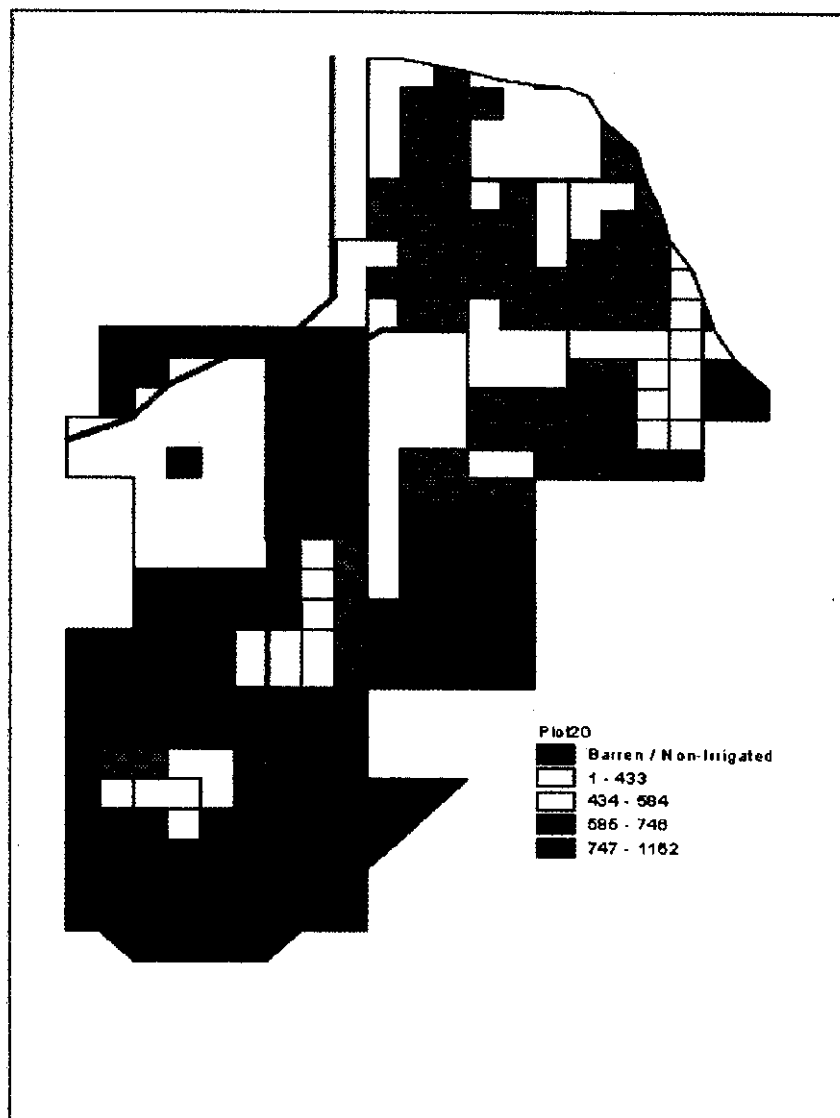
Restrictions on use	Prior permission from the Director, IIMI-Pakistan, and acknowledgments in the published document.
Copyright owners	IIMI-Pakistan
Media	Hard and soft copies and the entire data set for the Chishtian Sub-division may be available on CD.
Formats	Quattro and Arc/Info
Order	Request to the Director, IIMI-Pakistan
Support services	Not available at the moment.

**8.9 Metadata reference**

Entry date	August 8, 1997
Last check date	September 16, 1997
Last update date	September 23, 1997

## 9 ACTUAL CANAL WATER SUPPLIES

Eight Sample Watercourses (processed information from actual *warabandi* and daily Watercourse head discharges).



Metadata <b>9.1 Data set identification</b>	Description
Data set title	Actual Canal Water Volumes Within Watercourse Command Area.
Physical name	\DB-CHISHTIAN\WATER SUPPLY\CANAL\VOLUME\PLOT (OF SAMPLE WATERCOURSES)  └─ \SEASON Kharif 1994 = K94 Rabi 1994-95 = R9495  └─ \WATERCOURSE Azim 20-L = Az20 Azim 43-L = Az43 Azim 63-L = Az63 Fordwah 14-R = Fd14 Fordwah 46-R = Fd46 Fordwah 62-R = Fd62 Fordwah 130-R = Fd130  └─ ACVOL.DBF  └─ ACVOL (Arc/Info Coverage)
Format	Dbase files and Arc/Info Coverage
<b>9.2 Data set overview</b>	
Abstract	<p>This data set describes the actual canal water volumes (in cubic meters) supplied to the farms and plots within a watercourse command area. The information has been recorded on a weekly level, and is available for seven watercourses in the Chishtian Sub-division from two of the distributaries; three from the Azim Distributary are Az-20L, Az-43L, Az-63L, and four from the Fordwah Distributary are Fd-14R, Fd-46R, Fd-62R and Fd-130R.</p> <p>A plot is the area that has to be irrigated in one <i>warabandi</i> turn, and farm is the area under cultivation by one farmer along a watercourse. Thus, a plot can also sometimes be a farm.</p>
Purpose of production	<p>This data set was produced to determine an estimate of the surface water supplied to farms within a watercourse command area, and to relate it with cropping patterns, crop yields and salinity. The study of water markets and farmers' strategies under different circumstances is also possible by the comparison of agreed-upon and actual volumes.</p>
Usage	<p>Pierre Strosser, Helene Debarnardi, Samia Ali, Ayesha Manzer and Yann Chemin used this data, which is valid for two seasons; <i>Kharif</i> 1994 and <i>Rabi</i> 1994-95.            Period: April 96 – November 96</p> <p>This data is developed by Salman Asharaf, Ayesha Manzer, Helene Debarnardi and Samia Ali.</p>
Geographical extent	<p>This data set has been collected for seven watercourses from two of the Fordwah and Azim Distributaries in the Chishtian Sub-division. The former is perennial, but becomes non-perennial later. Four watercourses selected from the Fordwah</p>

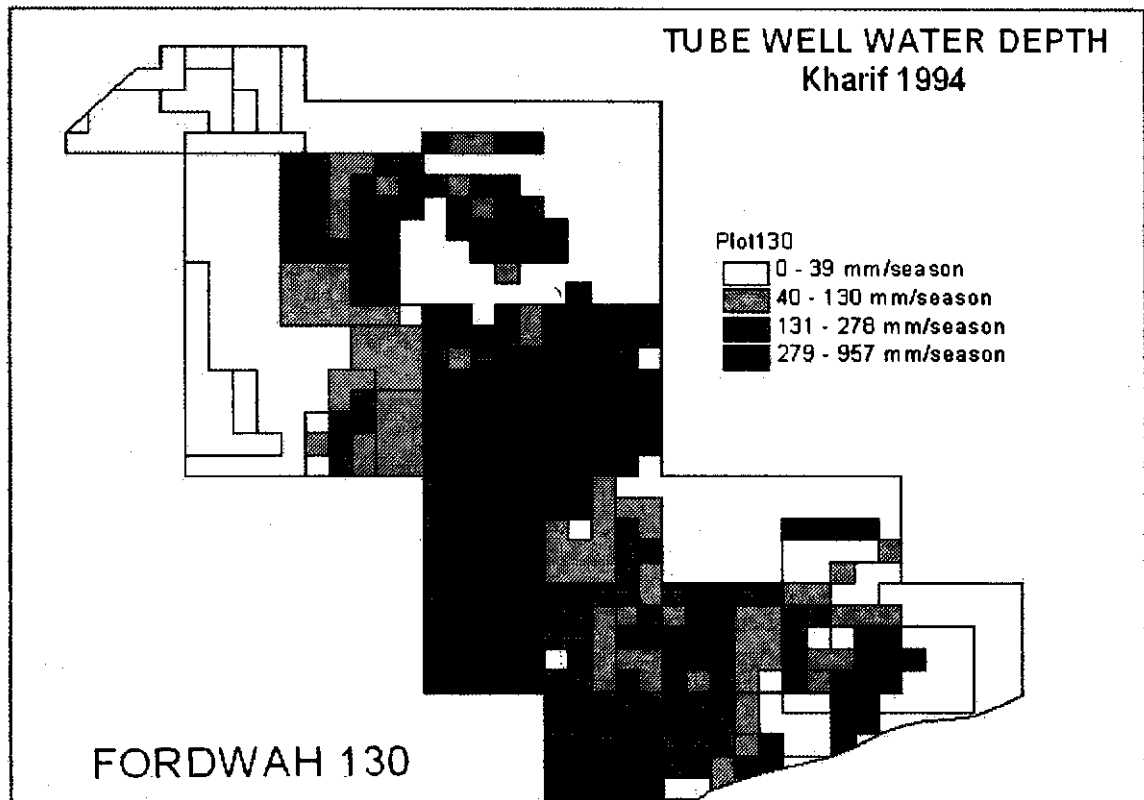


	Distributary are Fd-14R, Fd-46R, Fd-62R and Fd-130R, and three watercourses selected from the Azim Distributary are Az-20L, Az-43L and Az-63L.																																																																																																																																																																																																																																																																																																																														
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To date	Rabi 1994-95																																																																																																																																																																																																																																																																																																																														
Output document	<ul style="list-style-type: none"> <li>“Analysis of Canal Water Supply at Tertiary Level in the Chishtian Sub-division”, Helen Debarnardi.</li> </ul> <p><b>GIS OUTPUT:-</b> From this dataset Arc/Info coverages and maps are prepared. In map form (ACVOL.MAP) indicating four different classes of canal water distribution along a watercourse. The quartile method was used for classification. For this, the weekly volumes were combined for the whole season and computed per acre (in millimetres). The Simple Macro Language (SML) file and the key (Legend) file from which this map was prepared are: CWS.SML CWS2.KEY</p> <p><b>Reference of raw information:</b> Actual <i>warabandi</i> data and daily discharges at the head of the watercourse.</p>																																																																																																																																																																																																																																																																																																																														
Document reference	C:\wstudy\Readme.doc																																																																																																																																																																																																																																																																																																																														
Sample	<table border="1"> <thead> <tr> <th>NAME</th> <th>WEEK</th> <th>VOL1</th> <th>VOL2</th> <th>VOL3</th> <th>VOL4</th> <th>VOL5</th> <th>VOL6</th> <th>VOL7</th> <th>VOL8</th> <th>VOL9</th> <th>VOL10</th> <th>VOL11</th> <th>VOL12</th> <th>VOL13</th> <th>VOL14</th> <th>VOL15</th> <th>VOL16</th> <th>VOL17</th> <th>VOL18</th> <th>VOL19</th> <th>VOL20</th> <th>VOL21</th> <th>VOL22</th> <th>VOL23</th> <th>VOL24</th> <th>VOL25</th> <th>VOL26</th> </tr> </thead> <tbody> <tr> <td>MUNAWWADAM</td> <td>1</td> <td>270</td> <td>0</td> <td>0</td> <td>0</td> <td>21</td> <td>274</td> <td>150</td> <td>0</td> <td>0</td> <td>260</td> <td>0</td> <td>0</td> <td>244</td> <td>0</td> <td>113</td> <td>0</td> <td>200</td> <td>0</td> <td>32</td> <td>267</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>MUNAWWADAM</td> <td>2</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>400</td> <td>0</td> <td>267</td> <td>267</td> <td>0</td> <td>241</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>224</td> <td>214</td> </tr> <tr> <td>MUNAWWADAM</td> <td>3</td> <td>161</td> <td>200</td> <td>0</td> <td>122</td> <td>20</td> <td>141</td> <td>170</td> <td>156</td> <td>140</td> <td>37</td> <td>164</td> <td>152</td> <td>132</td> <td>0</td> <td>132</td> <td>61</td> <td>0</td> <td>0</td> <td>101</td> <td>0</td> <td>78</td> <td>143</td> <td>0</td> <td>0</td> <td>0</td> <td>956</td> <td>105</td> </tr> <tr> <td>MUNAWWADAM</td> <td>4</td> <td>407</td> <td>399</td> <td>0</td> <td>446</td> <td>43</td> <td>427</td> <td>407</td> <td>361</td> <td>403</td> <td>460</td> <td>460</td> <td>474</td> <td>460</td> <td>314</td> <td>532</td> <td>524</td> <td>401</td> <td>0</td> <td>460</td> <td>0</td> <td>75</td> <td>404</td> <td>0</td> <td>0</td> <td>0</td> <td>444</td> <td>434</td> </tr> <tr> <td>MUNAWWADAM</td> <td>5</td> <td>145</td> <td>254</td> <td>0</td> <td>309</td> <td>70</td> <td>397</td> <td>372</td> <td>409</td> <td>0</td> <td>225</td> <td>171</td> <td>0</td> <td>150</td> <td>402</td> <td>107</td> <td>0</td> <td>465</td> <td>0</td> <td>0</td> <td>0</td> <td>32</td> <td>171</td> <td>0</td> <td>0</td> <td>0</td> <td>584</td> <td>151</td> </tr> <tr> <td>MUNAWWADAM</td> <td>6</td> <td>300</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>370</td> <td>254</td> <td>0</td> <td>0</td> <td>0</td> <td>154</td> <td>0</td> <td>0</td> <td>0</td> <td>409</td> <td>90</td> <td>0</td> <td>224</td> <td>0</td> <td>72</td> <td>122</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>525</td> <td>120</td> </tr> <tr> <td>MUNAWWADAM</td> <td>7</td> <td>0</td> <td>106</td> <td>0</td> <td>112</td> <td>0</td> <td>31</td> <td>0</td> <td>0</td> <td>0</td> <td>230</td> <td>230</td> <td>412</td> <td>201</td> <td>0</td> <td>281</td> <td>242</td> <td>0</td> <td>401</td> <td>0</td> <td>60</td> <td>230</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>222</td> <td>240</td> </tr> <tr> <td>MUNAWWADAM</td> <td>8</td> <td>314</td> <td>431</td> <td>0</td> <td>432</td> <td>100</td> <td>422</td> <td>404</td> <td>409</td> <td>244</td> <td>434</td> <td>444</td> <td>443</td> <td>394</td> <td>710</td> <td>644</td> <td>596</td> <td>435</td> <td>0</td> <td>481</td> <td>0</td> <td>146</td> <td>616</td> <td>0</td> <td>0</td> <td>0</td> <td>847</td> <td>877</td> </tr> <tr> <td>MUNAWWADAM</td> <td>9</td> <td>592</td> <td>537</td> <td>250</td> <td>600</td> <td>100</td> <td>603</td> <td>607</td> <td>714</td> <td>546</td> <td>636</td> <td>650</td> <td>1640</td> <td>670</td> <td>700</td> <td>1213</td> <td>1282</td> <td>812</td> <td>0</td> <td>650</td> <td>0</td> <td>202</td> <td>940</td> <td>0</td> <td>0</td> <td>0</td> <td>926</td> <td>640</td> </tr> <tr> <td>MUNAWWADAM</td> <td>10</td> <td>570</td> <td>0</td> <td>0</td> <td>337</td> <td>110</td> <td>1</td> <td>100</td> <td>410</td> <td>407</td> <td>600</td> <td>477</td> <td>700</td> <td>670</td> <td>670</td> <td>0</td> <td>670</td> <td>0</td> <td>670</td> <td>0</td> <td>100</td> <td>0</td> <td>100</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>314</td> <td>212</td> </tr> </tbody> </table>	NAME	WEEK	VOL1	VOL2	VOL3	VOL4	VOL5	VOL6	VOL7	VOL8	VOL9	VOL10	VOL11	VOL12	VOL13	VOL14	VOL15	VOL16	VOL17	VOL18	VOL19	VOL20	VOL21	VOL22	VOL23	VOL24	VOL25	VOL26	MUNAWWADAM	1	270	0	0	0	21	274	150	0	0	260	0	0	244	0	113	0	200	0	32	267	0	0	0	0	0	0	MUNAWWADAM	2	0	0	0	0	0	0	0	0	0	400	0	267	267	0	241	0	0	0	0	0	0	0	0	0	0	224	214	MUNAWWADAM	3	161	200	0	122	20	141	170	156	140	37	164	152	132	0	132	61	0	0	101	0	78	143	0	0	0	956	105	MUNAWWADAM	4	407	399	0	446	43	427	407	361	403	460	460	474	460	314	532	524	401	0	460	0	75	404	0	0	0	444	434	MUNAWWADAM	5	145	254	0	309	70	397	372	409	0	225	171	0	150	402	107	0	465	0	0	0	32	171	0	0	0	584	151	MUNAWWADAM	6	300	0	0	0	0	370	254	0	0	0	154	0	0	0	409	90	0	224	0	72	122	0	0	0	0	525	120	MUNAWWADAM	7	0	106	0	112	0	31	0	0	0	230	230	412	201	0	281	242	0	401	0	60	230	0	0	0	0	222	240	MUNAWWADAM	8	314	431	0	432	100	422	404	409	244	434	444	443	394	710	644	596	435	0	481	0	146	616	0	0	0	847	877	MUNAWWADAM	9	592	537	250	600	100	603	607	714	546	636	650	1640	670	700	1213	1282	812	0	650	0	202	940	0	0	0	926	640	MUNAWWADAM	10	570	0	0	337	110	1	100	410	407	600	477	700	670	670	0	670	0	670	0	100	0	100	0	0	0	0	314	212
NAME	WEEK	VOL1	VOL2	VOL3	VOL4	VOL5	VOL6	VOL7	VOL8	VOL9	VOL10	VOL11	VOL12	VOL13	VOL14	VOL15	VOL16	VOL17	VOL18	VOL19	VOL20	VOL21	VOL22	VOL23	VOL24	VOL25	VOL26																																																																																																																																																																																																																																																																																																				
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<b>9.3 Data set quality indicators</b>																																																																																																																																																																																																																																																																																																																															
Process history	<ul style="list-style-type: none"> <li><b>Data collection</b> To calculate the actual canal water volumes for all the plots within a watercourse, two types of data was collected. One is the actual <i>warabandi</i> that contains the time duration during which canal water is supplied to the plots within a watercourse in 26 weeks of the season. The second is the daily discharges calculated at the watercourse outlet.</li> <li><b>Data entry</b> Canal water volumes within a watercourse command area are calculated using a model called WCMODEL. The input required for this model is the above two data sets that are actual <i>warabandi</i> data and daily head discharges. The output of the model is actual weekly volumes for each plot that is assigned a <i>warabandi</i> identification code.</li> </ul> <p>Volume (m<sup>3</sup>) = <math>Q \times T \times 28.3 \times 3.6 \times S</math> Where: Q = Water Discharge at the head of the watercourse in cusecs T = Time duration of watering to the plot in hours S = Seepage loss factor</p>																																																																																																																																																																																																																																																																																																																														
Overall positional accuracy	This information is accurate up to the plot level, but sometimes, when water turns for two plots are combined, acquiring exact and accurate information is impossible.																																																																																																																																																																																																																																																																																																																														
Overall thematic accuracy	The WCMODEL takes into account the seepage losses only up to the farm gate, but afterwards, seepage loss is not considered. Thus, neglected percentage losses are estimated to be up to 30 percent.																																																																																																																																																																																																																																																																																																																														
Overall temporal accuracy	Temporally, it is almost accurate because in case of head discharges, the data has to be collected daily. In the case of holidays, the average number of surrounding																																																																																																																																																																																																																																																																																																																														

	days has been used to compute discharge.
Overall completeness	This is available for seven out of eight sample watercourses. The eight watercourses selected by IIMI-Pakistan along the Fordwah Distributary are Fd-14R, Fd-46R, Fd-62R, Fd-130R, and from along the Azim Distributary, Az-20L, Az-43L, Az-63L and Az-111L. Since Az-111L has not received canal water at all for over four years, therefore, this data set is not available for this watercourse.
<b>9.4 Object type</b>	
Object type name	Plot
Object type definition	A plot is that part of the land assigned a <i>warabandi</i> identification code for the allocation of canal water.
Object type code	Plot
<b>9.5 Attribute type</b>	
	ACVOL.DBF fields
Attribute type name	23) NAME 24) ID 25) VOL1 26) VOL2 27) VOL3 ... ... 27) VOL25 28) VOL26
Attribute type definition	23) Name of the Cultivator 24) The <i>warabandi</i> number (water turn) assigned for the allocation of canal water during a particular season 25) Canal water volume supplied to a particular farm or plot in cubic meters during Week 1 26) Canal water volume (in cubic meters) supplied to a particular farm or plot during Week 2 27) Canal water volume (in cubic meters) supplied to a particular farm or plot during Week 3 ... ... 27) Canal water volume (in cubic meters) supplied to a farm or plot during Week 25 28) Canal water volume supplied to a particular farm or plot during Week 26 (in cubic meters)
Attribute type code	1) Name 2) ID
Thematic accuracy	Discharge is (ideally) supposed to be sampled daily, but in case of holidays, previous and newest data are averaged on the period. This is quite an inaccuracy already, adding to it the discharge was taken once a day, and flow of water is indeed variable on a day span, reducing the accuracy. For more details please refer to the WCMODEL document.
<b>9.6 Organization and organization role</b>	
	Data collection
Organization name	International Irrigation Management Institute
Organization abbreviation name	IIMI
Organization address	12 km Multan Road, Chowk Thokar Niaz Baig Lahore-53700 Phone: (042) 541-0050-53 Fax: 541-0054 Email : <a href="mailto:iimi-pak@cgiar.org">iimi-pak@cgiar.org</a>
Organization role	IIMI-Pakistan field staff collected the data.

Function of the organization	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.
<i>Organization and organization role</i>	Data entry and analysis
Organization name	International Irrigation Management Institute
Organization abbreviation name	IIMI
Organization address	12 km Multan Road, Chowk Thokar Niaz Baig Lahore-53700 Phone: (042) 541-0050-53 Fax: 5410054 Email : iimi-pak@cgiar.org
Organization role	The collected data was entered and checked by IIMI-Pakistan staff. This data was used as input in WCMODEL to calculate canal water volumes at IIMI-Pakistan.
Function of the organization	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.
<b>9.7 Point of contact and point of contact role</b>	
Point of contact name	Director
Point of contact address	12 km Multan Road Chowk Thokar Niaz baig Lahore-53700, Phone: (042) 541-0050-53, Fax: (042) 541-0054 Email : iimi-pak@cgiar.org
Point of contact role	Director, IIMI-Pakistan
<b>9.8 Distribution</b>	
Restrictions on use	Prior permission from the Director, IIMI-Pakistan, and acknowledgments in the published document.
Copyright owners	IIMI-Pakistan
Media	Hard and soft copies and the entire data set for the Chishtian Sub-division may be available on CD.
Formats	Dbase and Arc/Info
Order	Request to the Director, IIMI-Pakistan
Support services	Not available at the moment.
<b>9.9 Metadata reference</b>	
Entry date	August 15,1997
Last check date	September 16, 1997
Last update date	September 23, 1997

**10 TUBE WELL WATER VOLUMES**  
Eight Sample Watercourses



Metadata <b>10.1 Data set identification</b>	Description
Data set title	Tubewell Water Volumes Within Watercourse Command Area
Physical name	\DB-CHISHTIAN\WATER SUPPLY\TUBEWELL\VOLUME\PLOT (OF SAMPLE WATERCOURSES)  └─── \SEASON Kharif 1994 = K94 Rabi 1994-95 = R9495  └─── \WATERCOURSE Azim 20-L = Az20 Azim 43-L = Az43 Azim 63-L = Az63 Fordwah 14-R = Fd14 Fordwah 46-R = Fd46 Fordwah 62-R = Fd62 Fordwah 130-R = Fd130  └─── TWVOL.DBF  └─── TWVOL (Arc/Info Coverage)
Format	Dbase File and Arc/Info Coverage
<b>10.2 Data set overview</b>	
Abstract	<p>This dataset describes the tubewell water volumes (in cubic meters) supplied to the farms / plots within a watercourse command area. The information was recorded each week and is available for the eight watercourses in the Chishtian Sub-division from two distributaries. Four watercourses were selected from the Azim Distributary are Az-20L, Az-43L, Az-63L and Az-111L, and four selected from the Fordwah Distributary are Fd-14R, Fd-46R, Fd-62R and Fd-130R. Identification numbers for tubewells are also given against each plot to indicate tubewells supplying water to respective plots.</p> <p>Plot is the area that has to be irrigated in one <i>warabandi</i> turn, and farm is that area that is under cultivation by one farmer along a watercourse. Thus, a plot can sometimes also be a farm.</p>
Purpose of production	<p>This data set was collected as part of a large project focused on the development of an integrated approach to analyse the impact of changes in water management on agricultural production and salinity /sodicity. Canal water supplied to the lands is not reliable and adequate to fulfil the demands of an increasing population. To compensate, farmers use tubewell water, the poor quality of which may increase problems of soil salinity / sodicity. Thus, this information shows how much ground water had been used, in addition to surface water. Another data set is available to determine the quality of the groundwater used.</p>
Usage	<p>Sophie E. Richard and Christophe L. Rigourd used this data for their analyses during their M.Sc. thesis, December 1996.</p> <p>This data base and maps are prepared by Ayesha Manzer, Samia Ali and Helene Debernardi.</p>
Geographical extent	<p>This data set was collected for eight watercourses from two distributaries along the Chishtian Sub-division. Four watercourses from the Fordwah Distributary were Fd-14R, Fd-46R, Fd-62R and Fd-130R, and from the Azim Distributary, Az-20L, Az-43L, Az-63L and Az-111L were selected.</p>

Temporal extent	
From date	Kharif 1994
To date	Rabi 1994-95
Output document	<p>Water Markets in Pakistan: Qualitative and Quantitative Analysis Using an Economic Modelling Tool by Sophie E. Richard and Christophe L. Rigourd</p> <p><b>GIS OUTPUT:- TWVOL.MAP</b></p> <p>This is presented in map format indicating the distribution of tubewell water along a watercourse. Volumes were aggregated at plot level, regardless of the tubewell. The weekly volumes are combined for the whole season and computed as volume per acre (in millimetres). The quartile method was used for classification of these two data sets.</p> <p>The Simple Macro Language (SML) and the key (Legend) files used to prepare this map are:          TWV.SML          TWS.KEY</p> <p>Reference of raw information: Tubewell Operation Data</p>
Document reference	
Sample	<pre> 1  1994  1995  1996  1997  1998  1999  2000  2001  2002  2003  2004  2005  2006  2007  2008  2009  2010  2011  2012  2013  2014  2015  2016  2017  2018  2019  2020  2021  2022  2023  2024  2025  2026  2027  2028  2029  2030  2031  2032  2033  2034  2035  2036  2037  2038  2039  2040  2041  2042  2043  2044  2045  2046  2047  2048  2049  2050  2051  2052  2053  2054  2055  2056  2057  2058  2059  2060  2061  2062  2063  2064  2065  2066  2067  2068  2069  2070  2071  2072  2073  2074  2075  2076  2077  2078  2079  2080  2081  2082  2083  2084  2085  2086  2087  2088  2089  2090  2091  2092  2093  2094  2095  2096  2097  2098  2099  2100  2101  2102  2103  2104  2105  2106  2107  2108  2109  2110  2111  2112  2113  2114  2115  2116  2117  2118  2119  2120  2121  2122  2123  2124  2125  2126  2127  2128  2129  2130  2131  2132  2133  2134  2135  2136  2137  2138  2139  2140  2141  2142  2143  2144  2145  2146  2147  2148  2149  2150  2151  2152  2153  2154  2155  2156  2157  2158  2159  2160  2161  2162  2163  2164  2165  2166  2167  2168  2169  2170  2171  2172  2173  2174  2175  2176  2177  2178  2179  2180  2181  2182  2183  2184  2185  2186  2187  2188  2189  2190  2191  2192  2193  2194  2195  2196  2197  2198  2199  2200  2201  2202  2203  2204  2205  2206  2207  2208  2209  2210  2211  2212  2213  2214  2215  2216  2217  2218  2219  2220  2221  2222  2223  2224  2225  2226  2227  2228  2229  2230  2231  2232  2233  2234  2235  2236  2237  2238  2239  2240  2241  2242  2243  2244  2245  2246  2247  2248  2249  2250  2251  2252  2253  2254  2255  2256  2257  2258  2259  2260  2261  2262  2263  2264  2265  2266  2267  2268  2269  2270  2271  2272  2273  2274  2275  2276  2277  2278  2279  2280  2281  2282  2283  2284  2285  2286  2287  2288  2289  2290  2291  2292  2293  2294  2295  2296  2297  2298  2299  2300  2301  2302  2303  2304  2305  2306  2307  2308  2309  2310  2311  2312  2313  2314  2315  2316  2317  2318  2319  2320  2321  2322  2323  2324 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 3657  3658  3659  3660  3661  3662  3663  3664  3665  3666  3667  3668  3669  3670  3671  3672  3673  3674  3675  3676  3677  3678  3679  3680  3681  3682  3683  3684  3685  3686  3687  3688  3689  3690  3691  3692  3693  3694  3695  3696  3697  3698  3699  3700  3701  3702  3703  3704  3705  3706  3707  3708  3709  3710  3711  3712  3713  3714  3715  3716  3717  3718  3719  3720  3721  3722  3723  3724  3725  3726  3727  3728  3729  3730  3731  3732  3733  3734  3735  3736  3737  3738  3739  3740  3741  3742  3743  3744  3745  3746  3747  3748  3749  3750  3751  3752  3753  3754  3755  3756  3757  3758  3759  3760  3761  3762  3763  3764  3765  3766  3767  3768  3769  3770  3771  3772  3773  3774  3775  3776  3777  3778  3779  3780  3781  3782  3783  3784  3785  3786  3787  3788  3789  3790  3791  3792  3793  3794  3795  3796  3797  3798  3799  3800  3801  3802  3803  3804  3805  3806  3807  3808  3809  3810  3811  3812  3813  3814  3815  3816  3817  3818  3819  3820  3821  3822  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 3990  3991  3992  3993  3994  3995  3996  3997  3998 </pre>

<b>10.4 Object type</b>	
Object type name	Tubewell
Object type definition	Pump of groundwater from shallow depth
Object type code	TW
<b>10.5 Attribute type</b>	
	TWVOL.DBF fields
Attribute type name	1) IDUSER 2) NMR 3) WCCODE 4) WK1 5) WK2 6) WK3 ... ... ... 29) WK26 30) WK27
Attribute type definition	1) The <i>warabandi</i> number of the farmer who is using tubewell water on his land 2) The identification number given to each tubewell. These numbers are unique for all the tubewells in these eight sample watercourses 3) Watercourse name 4) Volume of tubewell water during the first week of the season. The unit is cubic meters 5) Volume of tube well water in cubic meters during Week 2 6) Volume of tube well water in cubic meters during Week ... ... ... 29) Tubewell volumes in cubic meters during Week 26 30) Volume of tube well water in the last week of the season
Attribute type code (Name and definition)	3) FD: - Fordwah Distributary AZ: - Azim Distributary 14 (e.g.): -The number represents the reduced distance in thousand feet from the head of the distributary to the outlet of the watercourse R: - The watercourse is on the right side of the distributary L: - The watercourse is on left side of the distributary
<b>10.6 Organization and organization role</b>	
	Data collection
Organization name	International Irrigation Management Institute
Organisation abbreviation name	IIMI-Pakistan.
Organisation address	12 km Multan Road, Chowk Thokar Niaz Baig Lahore-53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 Email : iimi-pak@cgiar.org
Organisation role	IIMI-Pakistan field staff collected this data.
Function of the organisation	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.
<b>Organization and organization role</b>	
	Data entry and analysis
Organization name	International Irrigation Management Institute

Organisation abbreviation name	IIMI-Pakistan.
Organisation address	12 km Multan Road, Chowk Thokar Niaz Baig Lahore-53700 Phone: (042) 541-0050-53 Fax: (042) 541-0054 Email : iimi-pak@cgiar.org
Organisation role	The collected data was entered, checked and analysed by IIMI-Pakistan staff.
Function of the organisation	IIMI-Pakistan's mission is to improve food security and the lives of poor people by fostering sustainable increases in the productivity of water used in agriculture through better management of irrigation and water basin systems.
<b>10.7 Point of contact and point of contact role</b>	
Point of contact name	Director
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Point of contact role	Director, IIMI-Pakistan
<b>10.8 Distribution</b>	
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Formats	Dbase and Arc/Info
Order	Request to the Director, IIMI-Pakistan
Support services	Not available at the moment.
<b>10.9 Metadata reference</b>	
Entry date	August 20, 1997
Last check date	September 30, 1997
Last update date	October 01, 1997.



# IIMI-PAKISTAN PUBLICATIONS

## RESEARCH REPORTS

Report No.	Title	Author	Year
R-1	<b>Crop-Based Irrigation Operations Study in the North West Frontier Province of Pakistan</b> Volume I: Synthesis of Findings and Recommendations	Carlos Garces-R D.J. Bandaragoda Pierre Strosser	June 1994
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