INTRODUCTION OF AN INFORMATION SYSTEM FOR FACILITATING CANAL OPERATIONS

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ABSTRACT

Pakistan possesses one of the largest continuous irrigation systems in the world. Large command areas are supplied water through the operation of a single gate. An important factor in controlling degradation of irrigated lands by waterlogging and salinity is good irrigation management, ensuring every farmer an equitable and reliable irrigation supply. At present, fluctuations in the secondary system resulting from numerous gate operations endanger these objectives.

This paper discusses the collaborative efforts of the Punjab Irrigation and Power Department (PIPD) and the International Irrigation Management Institute (IIMI) to further improve existing irrigation management,' The aim is to provide the irrigation managers with fools and procedures to take better founded decisions on operation and maintenance. These tools and procedures are called a Decision Support System (DSS).

Pilot areas for implementation were identified within the Fordwah / Eastern Sadiqia area. In these areas, IIMI and PIPD strengthened tlie existing procedures concerned with the collection, conveyance and display of data for the irrigation managers. Furthermore, a computer tool by the name of irrigation Management Information System (IMIS), which allows monitoring of the actual water distribution and performance of the irrigation system was selected for supportive use to the irrigation manager.

Results show an iniproved insight of the irrigation manager in the actual water distribution within his system, allowing him to give the gate operators set targets and thus, improving equity in water distribution. Through the display of data in the irrigation manager's office, the visiting fanners and others who are interested, are easily informed, ensuring'their confidence in the working of the irrigation system. Both IIMI and PIPD field staff have received additional training in ensuring the collection of accurate data and have improved their system awareness /performance .

Within the pilot areas, training in the use of the computer tool IMIS was not always of lasting effect, due to changes in the PIPD staff. Some problems were caused by a troublesome communication system.

In future planning the computer tool IMIS will continue to be reviewed, so that it will be able to spread the implementation in the whole of Bahawalnagar Circle and further on into the Province of Punjab.

In the end, overall conclusions show a strengthening of existing departmental procedures and practices in monitoring the irrigation system, resulting in improved equity through reduced gate operations and more confidence of the beneficiaries in the system.

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1. BACKGROUND

Pakistan possesses one of the largest continuous irrigation systems in the world. It encompasses a large part of the Indus Basin. Construction of the irrigation system started in the early 20th century. The system is being operated as supply-oriented, spreading the available irrigation water over a large area of the Indus plains and distributing it equally among the farmers according *to* their farm size. The irrigation managers operate the system only through gates at the heads of canals and distributaries. Fixed outlets take their due share from a distributary, whenever the distributary is running at its design level. As a result, large command areas (15,000 - 50,000 acres) are supplied water by operation of a single gate.

During the years after construction of the irrigation system, the groundwater table rose, causing waterlogging and salinity and, as a result, forcing large parts of the command area out of agriculture. An important factor in controlling further degradation of irrigated lands will be good irrigation management, ensuring every farmer an equitable and reliable irrigation supply. Large fluctuations within the irrigation system have been observed, resulting from numerous gate operations, causing inequitable and unreliable irrigation supplies. Table l shows inequity in water distribution in a sample distributary by comparing the design and measured discharges for a number of outlets.

In 1989, the International Irrigation Management Institute (IIMI) started a project funded by the Government of the Netherlands, to identify possible improvements in the irrigation management that will prevent degrading of the land through waterlogging or salinity. Part of this project is carried out in collaboration with the Punjab Irrigation and Power Department (PIPD) and aims *to* develop tools and procedures to assist irrigation managers to take better founded decisions on operation and maintenance of the main system. These tools and procedures are also known as Decision Support Systems (DSS).

In order to manage an irrigation system properly, its manager needs accurate information. Information on the past, present and, if possible, on the future state of his system. Having easy access to all this information will enable him to make the best decisions on operation and maintenance.

Table 1. Outlets Discharge Comparison for Gujjiani Disty (2 September 1996).

OIL No	Location	Q Design (cusecs)	Q Measured (cusecs)	% Increase or decrease
1	900-R	1.50	1.69	13
2	6640-L	1.11	1.37	77
3	16550-L	2.13	2.45	15
4	24800-R	1.49	1.58	6
5	32120-R	0.90	1.32	47
6	41720-L	1.29	1.73	34
7	49640-L	1.94	3.45	78
8	54260-R	1.08	1.93	79
9	64545-L	1.11	1.36	23
10	74690-L	1.28	1.93	51
11	80040-R	0.66	2.08	215
12	87120-R	2.36	3.02	28
13	93080-L	1.58	2.22	41
14	98100-R	1.58	4.20	166
15	106060-L	2.26	2.68	19
16	110780-L	1.82	3.35	84
17	118130-R	1.16	1.44	24

Design discharge of Gujjiani Disty = 319 cusecs
Measured discharge of Gujjiani Disty = 427 cusecs
Design average cropping intensity = 80% (Kharif 32% and Rabi 48%)
Actual average cropping intensity = 125%

The time space with which certain information should be collected and presented to the manager varies. Some of the information should be collected on a monthly basis (e.g. bed levels), while other informntlon Is required by tho hour (e.g. upstream water levels).

Tools and procedures can assist in collecting, processing and presenting information at the right time and in the right way. At present, quite a number of tools have been developed for use in a DSS. Many of these tools are computer based.

At the start of the project, IIMI was asked by the Secretaries of Irrigation and Power and Agriculture of the Government of Punjab to commence work in the Fordwah/ Eastern Sadiqia area. Given the fact that this area was highly affected by shortages of irrigation water, waterlogging and salinity, a number of other projects would be initiated in the area. In May 1993 the joint implementation of DSS started in Chishtian subdivision (Fordwah division) Implementation in Malik Subdivision (Sadiqia Division) followed around August 1995.

2. PLAN

At the start of the implementation phase, initial observations were done on the situation in the pilot areas. From these observations, the following steps were anticipated to establish a Decision Support System (DSS) within the subdivisions:

* Installation of gauges
* Calibration of structures
* Preparing / revising discharge tables
* Ensuring regular collection and conveyance of data
* Storage and temporary display of collected data
* Identification of computer tools:
  - To improve operation of the system / sub-system
  - To improve insight into water distribution and performance of the irrigation system
  - To improve irrigation management

To ensure a sustainable implementation of the different steps, trainings were planned in the calibration of structures / preparing of discharge tables and the use of the identified computer tools.

3. IMPLEMENTATION

The planned implementation started in Chishtian Subdivision, located at the tail end of the Fordwah Branch Canal system. Within the subdivision both perennial and non-perennial channels are located, making it a difficult system to manage. Farmers have the tendancy to ensure a year round water supply, whenever they see water available nearby. The implementation procedure was followed and tested within these demanding circumstances. In this period, a computer tool was to be identified, which could support the existing irrigation management.

One of the available computer tools for use in a DSS, and implemented with help of IIMI in countries like Sri Lanka and Mexico, is called Irrigation Management Information System (IMIS). It consists of a database and a series of computational modules. In the database, data is stored on the configuration of the concerned irrigation system and the recorded actual water levels, while in the computational modules this data is processed into information on water distribution and performance of the irrigation system. The main advantage of this tool is its flexibility. Apart from using the predefined setup, the user has the possibility to define himself what kind of information he wants to receive and in which way it should be presented to hirn. IIMI and PIPD decided to use this tool as the primary computer tool to assist the irrigation managers in their tasks.

After the first experiences within Chishtian Subdivision, a middle reach subdivision with perennial channels was chosen as a second pilot area. This area was Malik Subdivision in the Eastern Sadiqia Canal command area. Before implementation in this second subdivision, the IMIS program was updated according to the findings within the Chishtian Subdivision. For example, in the discharge calculations, the structure formula was replaced by the PIPD procedure of using the KD-formula. With this, and other gained experiences, the implementation procedure went even better and clear achievements were seen.

4. ACHIEVEMENTS

Following are selected achievements in Malik Subdivision, which indicate an improved irrigation management:

- ★ After adopting the described procedure, the tail shortage has diminished.
- ★ The disty / minors gate / karries operation are minimized, which can be seen from the constant tail gauges of the minor and disties in the research area. Table 2 shows the tail gauges of several distributaries in Malik Subdivision for the years 1995 (PIPD record) and 1996 (PIPD data, verified by IIMI).

Table 2. Tail conditions of Gujjiani Distributary Minors for May 1995-1996.

DATE	BHUKAN		KOKNI		CHATALA	
	1995*	1996	1995*	1996	1995*	1996
	feet	feet	feet	feet	feet	feet
1	1.15	1.10	1.20	0.90	1.20	0.80
2	1.15	1.20	1.20	1.40	1.20	1.45
3	1.15	0.80	1.20	1.50	1.20	1.35
4	1.15	0.90	1.20	1.50	1.20	1.55
5	1.15	0.90	1.20	1.30	1.20	1.50
6	1.15	1.10	1.15	1.30	1.15	1.45
7	1.15	1.10	1.15	1.40	1.15	1.40
8	1.15	1.10	1.25	1.10	1.20	1.00
9	1.15	1.10	1.25	0.80	1.20	0.70
10	1.15	1.10	1.25	0.90	1.20	0.80
11	1.15	1.10	1.25	1.00	1.20	1.00
12	1.15	1.20	1.25	1.20	1.20	1.30
13	1.15	1.00	1.25	1.15	1.20	1.10
14	1.15	1.10	1.20	1.20	1.20	1.05
15	1.15	1.20	1.20	1.20	1.20	1.10
16	1.15	1.20	1.20	1.40	1.20	1.50
17	1.15	1.20	1.20	1.45	1.20	1.55
18	1.15	1.20	1.20	1.55	1.20	1.60
19	1.20	1.20	1.20	LKG	1.20	LKG
20	1.20	1.20	1.20	LKG	1.20	LKG
21	1.15	1.20	1.15	0.70	1.15	0.80
22	1.15	1.30	1.20	LKG	1.20	LKG
23	1.15	1.10	1.20	0.50	1.20	0.60
24	1.15	1.20	1.20	1.20	1.20	1.30
25	1.15	1.10	1.10	1.25	1.10	1.35
26	1.15	1.10	1.10	1.30	1.10	1.30
27	1.15	1.10	1.10	1.35	1.10	1.30
28	1.15	1.20	1.10	1.40	1.10	1.35
29	1.15	1.20	1.15	1.45	1.10	1.50
30	1.15	1.20	1.15	1.40	1.15	1.55
31	1.15	1.20	1.15	1.45	1.15	1.60

* According to PIPD records, not verified by IIMI

LKG Leakage (very small amount of water)

* Set targets have been defined for the gate operators in order to minimize gate operations. This has reduced both gate and supply fluctuations.

* Due to access to reliable and on time data, the irrigation manager is able to reduce his frequent visits to the field, leaving more time to pursue other assignments.

* The crests of some minors were adjusted after identifying that these minors were drawing more water than allocated, which was causing an excess of water at the tail.

* Due to accurate and timely arrival of data to the irrigation manager's office and by using a display white board, it is now easy for the irrigation manager to inform farmers, visitors and his superiors on the actual condition of the system, thus, improving users' confidence.

* Both IIMI and PIPD field staff have been trained in calibrating structures and have been improving their system awareness / performance.

5. ISSUES / DIFFICULTIES

The road to the implementation of a DSS for operation of the irrigation system is not always very easy. The communication system for transfer of data and other information between the gate operators and the office of the irrigation manager is oflen malfunctioning. Use of the computer for irrigation management is a new phenomena and many of the concerned irrigation managers have little prior computer knowledge Training of the managers should therefore be one of the key points in the implementation of the **DSS.** In both subdivisions in which trainings were given to the irrigation managers, personnel changes made it difficult to see the result of the training. In Chishtian Subdivision, eight people held the position of Subdivisional Officer in the period between 1994 and 1996.

6. FUTURE PLANS

In the near future, the communication system should be modernized, making it less vulnerable to breakdowns. The computer tool IMIS will be reviewed for its user friendliness and its applicability within the irrigation management in Pakistan. It is anticipated that IMIS will be updated with a new version in the coming year. The DSS implementation will continue to proceed, spreading the tools and procedures over the whole of the Bahawalnagar Circle. **A** planning will be made to introduce the DSS to the entire Punjab Province.

7. CONCLUSIONS

At the present stage of the on-going efforts, a few concluding remarks can be made:

- The procedural part of implementing the DSS strengthens the existing departmental procedures / practices ensuring its success.
- The irrigation system monitoring is enhanced, which helps the managers to identify any possible problems and diagnose their underlying causes.
- The implementation of a DSS ensures the confidence of the beneficiaries in the irrigation system.
- As the gate operators are given set targets, fluctuations in the irrigation channels are reduced.
- The communication problems in this huge irrigation system are largely underestimated. Unless an efficient data transmission network is in place, the data will not reach the decision making center in time and may prove of little use for the management.