Relational Database Management of Water Resources and Crop Production in Bihar State

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ABSTRACT

Water is a very important component of crop production. It is responsible for crop growth, crop production and also ensures the efficiency of other inputs like seeds, fertilizers and pesticide etc. Present work was an effort to maximize the existing water use through appropriate water management practices. Available water resources data collected and collated by multiple agencies and institutions employing diverse methodologies are scattered in different forms that do not match with the dynamic data requirement of complex agricultural environment. In diverse planning, research and developmental activities on the present and future use of water resources for crop production, a strong database could play a vital. In view of above comprehensive information system on water resources, and area wise crop production in Bihar state was developed to provide systematic and periodic information to the researchers, planners, decision makers and developmental agencies. This database consist a comprehensive data related to water resources such as ground water, surface water and area wise crop production of Bihar state as well as basin wise data about total ground water availability, utilization, balance and area wise crop production of different crops. It also contains informations about land potential and present land use pattern, irrigated and unirrigated area for different crops. This database has been first created in MS-Access and then it has been converted in to Oracle

Key words: Water resources, crop. Oracle, Access, relational database.

INTRODUCTION

Water is a very important component of crop production. It is responsible for crop growth, crop production and it also ensures the efficiency of other inputs like seeds, fertilizers and pesticide. One of the fundamental aspects of resource management is to

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have information on the extent, nature and properties of the water resources and their utilization for sustainable agricultural production for food security for the growing population of the country. In India, many organizations have proved their excellence in collection, interpretation and utilization of those data in their respective fields of operation, but at the same time it has restricted their application in a holistic mode for development as information are rarely available at one source, and the scattered way of data organization is a bottleneck in data accessibility. Thus, researchers, planners and developmental agencies have always faced a tough time to get data for planning at local and/or regional level, in bringing out the total perspective of the region in changing the social fabric of the people. The proposed project has strengthened the information system conceptualized by ICAR. Other agencies, in particular, the planning portfolio, are eagerly waiting for such a database. This project aims at giving suitable opportunity on multidisciplinary mode through enhanced linkages among research institutes and other development agencies by providing first hand information on problems and potential in the production systems. The information system will be intensively used with an ultimate aim of enhancing better quality of life of the farming community and society at large.

National agricultural production on a sustainable nature depends on the efficient use of natural resources in general and water in particular with an acceptable technology management under prevailing socio-economic infrastructure. In order to achieve an economically sound society and environmentally benign development and utilization of water resources for crop production, it is necessary that a comprehensive information is developed to provide systematic and periodic information to the researchers, planners, policy makers, decision makers and developmental agencies. The diverse planning, research and development activities on the present and future use of water resources for crop production and to increase the area and area wise crop production, a strong database on water resources and crop production plays a vital role. This project will help in the identification of technologically appropriate, economically viable, socially acceptable and environmentally non-degrading approach for a land use planning with appropriate use of water resources for to increase area and area wise crop production. Application of information technology are typically particularly effective in solving problems that require significant data processing, and applications in hydrology (*B.A. Engel et al*).

METHODOLOGY

Development of Water resources and Crop Database

Above database has been developed in MS-ACCESS and then finally converted into ORACLE using RDBMS technologies for storage and maintenance of data. Data were collected from various government organizations related to water resources. Normalization is the process of organizing and refining database tables to provide accurate, unambiguous results when the tables are accessed. We have followed normalization techniques and adopted 3rd normalization form for database development. Entity-Relationship diagram of surface water database is shown in fig. 2. The overall logical structure of a database can be expressed graphically by an Entity-Relationship

diagram (Henery F. Korth and Abraham Silberschatz, 1991). Entity-Relationship model has been originated by Dr. Peter Chen, professor of computer science at Lousiana State University. Within relational database, data is generally stored in two dimensional tables. Contained within the tables are sets of rows and columns. A row represents a record in the table, and one or more columns represent the details of that record. ACID (Atomicity, Consistency, Isolation, Durability) is used to represent the four fundamentals of effective relational database (Robert G. Freeman and Mark D. Bloomberg). A relational database also demonstrates the principles of structures, operations and integrity defined by Dr. E.F. Codd. SQL Plus is a separate Oracle client side tool. Interactive SQL and PL/SQL are two distinct parts of SQL-Plus. Interactive SQL is designed to create, access and manipulate and maintain data structures like tables, indexes etc. and PL/SQL can be used to create programs for validation and manipulation of table data. (Ivan Bayross). Surface water database contains information about major and minor irrigation schemes, Surface water database contains informations about canals, distributaries, dams, reservoirs, tanks, rivers, navigable length, river catchment area total surface water available for irrigation, utilization in irrigation and balance of surface water, irrigated and unirrigated area for different crops. Ground water database contains information about dugwell, shallow tube well, deep tubewell, private and govt. tube well, irrigated and unirrigated area for different crops. It also contains information about total replenishible ground water, availability, utilization and balance of ground water which are district wise or basin wise as per availability of data. Crop database contains district wise information about crop area and crop production.

Development of Graphic User Interface (front end tools)

Graphic User Interface (Front end tool) has been developed in Visual Basic 6.0 for data entry, modification, deletion and retrieval of data. It is shown in the fig-1. Also reports can be generated through this software. Access level and security of data is assured through password protection mechanism.. This software can be customized according

Fig. 1: Graphic User Interface (front end tool) for Ground Water Irrigation Schemes

to changing needs of user. For example back-end (database) can be changed and also form and reports can be easily changed or added to the software. Back end developed in Access 2000. Database is finally converted into Oracle.

The Tools that have been used

- Database Tools: MS-Access, Oracle 8i
- GUI Development Tools: Visual Studio 6
- Connectivity Tools: ODBC, ADO, DAO, OLEDB
- Editors: word, Notepad
- Other tools: ActiveX Controls, COM/DCOM

Fig. 2: E-R Diagram for Surface Water Database
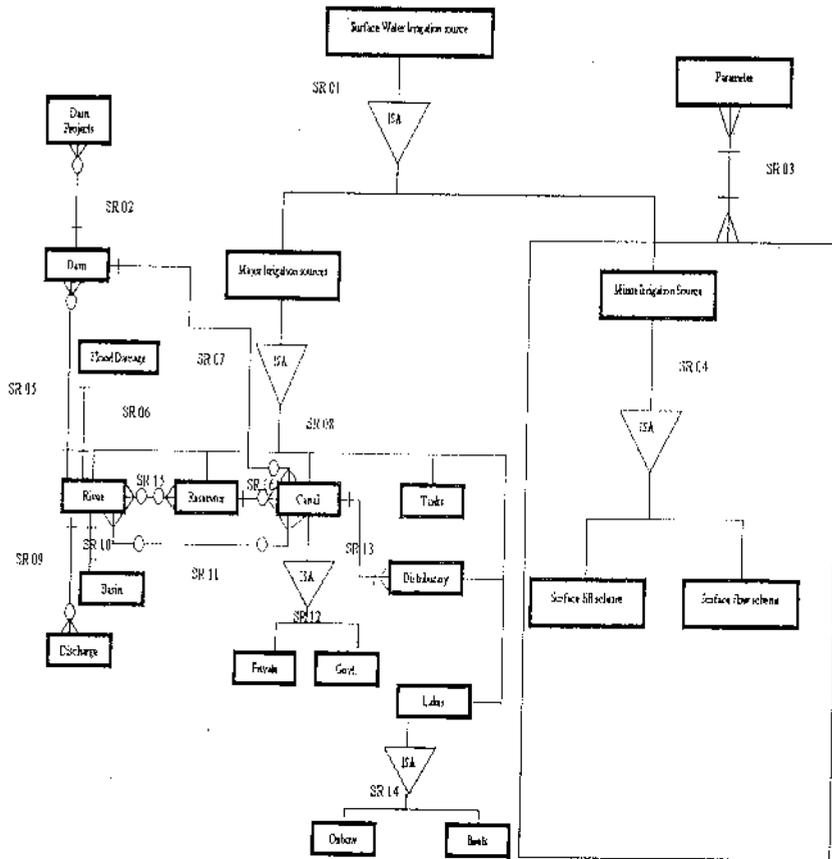
E-R Diagram for Surface Water Database

RESULT AND DISCUSSION

Development of Water resources and crop database

Some useful results have been derived from the application of database as given in Fig. 3, Fig. 4 and Fig. 5. This database contains information about total ground and surface water available for irrigation, utilization in irrigation, balance of water resources,

Fig. 3: Area Wise Crop Production of Winter Rice (2000-01)
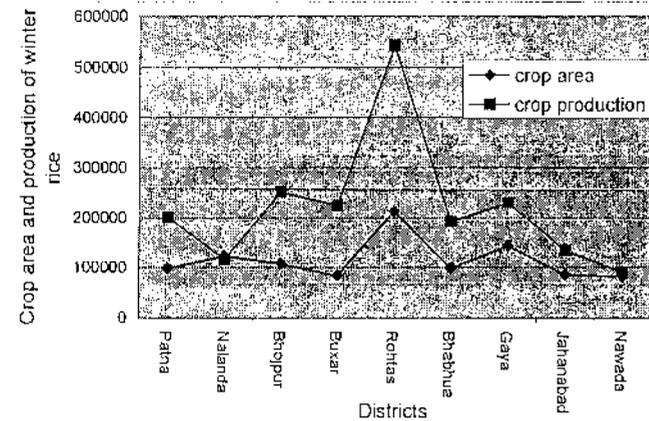
Application:

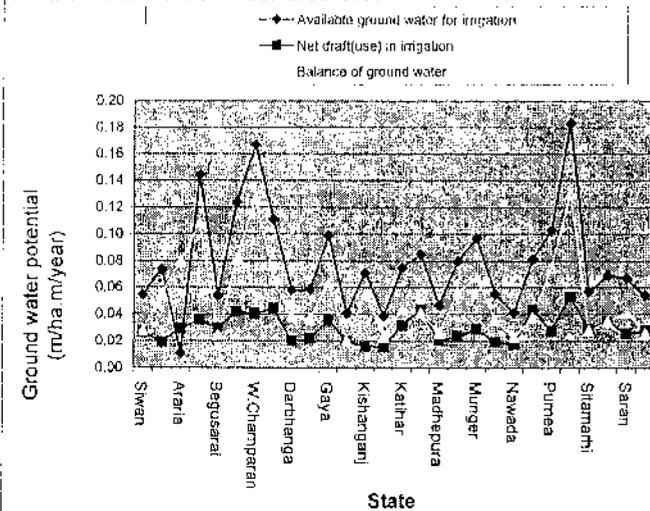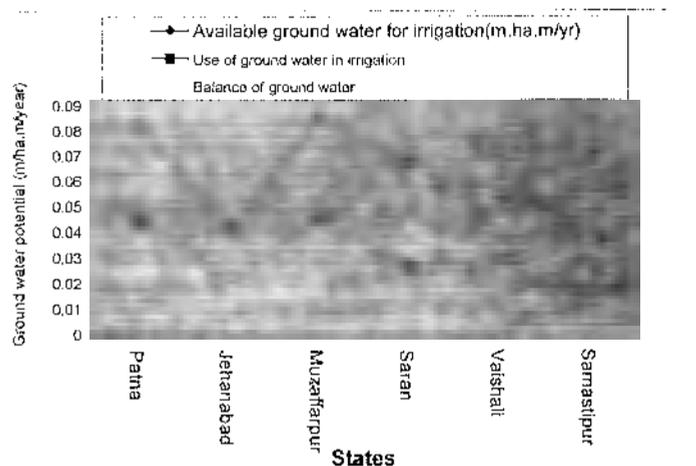### Fig. 4: Ground Water Potential for Bihar

Fig. 5: Ground Water Availability and Utilization in Patna and its Surrounding Districts

domestic use of water, irrigated, unirrigated area for different crops. This database contains huge amount of water resources data and crop area and crop production data which are useful for researchers, planners, policy makers, decision makers, other end users etc.

A Graphic User Interface (GUI)/Front end tools is useful for data entry, data modification, deletion, updation and retrieval of data. Any one can do above mentioned work with the help of this GUI who have a little knowledge of computer software and hardware.

Table 1
Land use Classification and Irrigation Statistics in some States Ground
Water Potential in Bihar (m/ha.m/year)

District	Available ground water for irrigation	Net draft (use) in irrigation	Balance of ground water
Siwan	0.05437	0.02667	0.0277
Aurangabad	0.07377	0.01918	0.05459
Araria	0.010901	0.02942	0.0796
Bhagalpur	0.14364	0.03564	0.108
Begusarai	0.05396	0.02982	0.02414
Bhojpur	0.12366	0.0421	0.08156
W.Champaran	0.16676	0.04063	0.12613
E.Champaran	0.11046	0.04448	0.06598
Darbhanga	0.05815	0.0201	0.03804
Gopalganj	0.05837	0.02201	0.03636
Gaya	0.09876	0.03548	0.06328
Jehanabad	0.04071	0.0205	0.02022

District	Available ground water for irrigation	Net draft (use) in irrigation	Balance of ground water
Kishanganj	0.07084	0.01619	0.05465
Khagaria	0.0387	0.01577	0.02293
Katihar	0.07508	0.03168	0.0434
Muzaffarpur	0.08485	0.04392	0.04093
Madhepura	0.04649	0.0205	0.026
Madhubani	0.07985	0.02382	0.05603
Munger	0.09668	0.02923	0.06745
Nalanda	0.05514	0.01947	0.03567
Nawada	0.04089	0.01764	0.02325
Patna	0.08116	0.0438	0.03735
Purnea	0.10238	0.02726	0.07512
Rohtas	0.18291	0.05295	0.12996
Sitamarhi	0.05677	0.02886	0.02791
Samastipur	0.06919	0.03462	0.03457
Saran	0.06695	0.02557	0.04138
Vaishali	0.0538	0.02797	0.02583

CONCLUSION

This database contains water resource information of Bihar state such as surface and ground water availability, its utilization in irrigation and balance. It also contains information about total numbers and their capacity of canals, distributaries, wells, dugwell, shallow tubewell, deep tubewell, surface flow and surface lift irrigation schemes, major and minor irrigation schemes, irrigated and unirrigated area for different crops. This database also contains information about district wise crop area and production. This database has been developed in MS-ACCESS and then converted in ORACLE .Now it is available in ORACLE. Graphic User Interface has been developed in Visual Basic 6.0.

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