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OPTIMIZATION OF AGRICULTURAL WATERSHED MANAGEMENT SYSTEMS

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ABSTRACT

Watershed management is a supplied way to deal with alleviate the crevice amongst request and supply of water and other common assets, especially in the delicate parched and semi-bone-dry tropics (SAT). As this is a mind boggling wonder, there is requirement for a solid Information System/Decision Support System (DSS). Watershed Management Information System (WATMIS) is a suitable and nonexclusive toolbox for coordinated watershed arranging and administration of its regular assets utilizing numerous advances like Geographical Information System (GIS), Remote Sensing (RS), Global Positioning System (GPS), hydrological displaying and delicate registering apparatuses. In this framework, an endeavor has been made to incorporate measurements in Agriculture–Water–Soil–Climate continuum for economical administration of land and water assets wisely. The use of WATMIS will be helpful to different partners, for example, agriculturists, provincial expansion group and water assets chiefs for better basic leadership.

KEYWORDS: *Decision support system Geographical information systems Global positioning systems Hydrological modelling Remote sensing Soft computing tools Watershed management.*

INTRODUCTION

Irregularities and rivalry over shared water assets between different divisions, for example, horticulture, industry and residential area make it imperative segment of dry and semi-bone-dry tropics (SAT). Water is getting to be plainly scarcer and each cautioning alarm demonstrates that it will turn out to be considerably more basic later on. With financial improvement, logical inconsistency winds up noticeably obvious between require for water and its restricted assets, and it involves worry to the watershed group, for example, water asset specialists, researchers and arrangement producers. Hence, reasonable water administration is a critical need of great importance. Henceforth, it winds up noticeably essential to apply the developing apparatuses and advancements for pervasive watershed administration

1.1 Why Management of Natural Resources on Watershed Basis?

Soil, water and vegetation are the most crucial normal assets for supportable improvement and administration, and thus ought to be dealt with and overseen successfully, all things considered and at the same time. Dealing with the characteristic asset with supportable approach is a levelheaded marvel in its regular district. In this approach, the normal areas are developed to be as far as the stream of water, which impacts all fields of the earth, where the districts are differentiated as bowl, catchment, sub-catchment, large scale watershed ([50,000 ha), sub-watershed (10,000–50,000 ha), milli-watershed (1,000–10,000 ha), smaller scale watershed (100–1,000 ha), little watershed (1–100 ha) (Nair 2009). Be that as it may, a specific degree/size of a locale is basic with respect to the point of its improvement. Size will likewise be influenced by the conceivable significant segments of an improvement, for example, afforestation, development hones, and so on. Keeping in see the nearby conditions and fruition of the venture inside a sensibly brief time, a normal size of 2,000 ha is viewed as levelheaded for farming improvement no sweat of reviews and examinations and powerful arranging. In the present research work, a watershed has been taken as the littlest arranging unit, as it advantageously and effectively speaks to continuum of three crucial normal assets i.e. soil, water and vegetation.

Watershed administration program has developed as a reasonable procedure to monitor the characteristic assets i.e. water, timberland and soil in an incorporated way especially in the rainfed and dry season territories (Roy 2005). Arranging and administration of regular assets at smaller scale level of the watershed where there is a high spatio-fleeting changeability in Gio-physical and financial factors, especially in the delicate parched and semi-dry tropics (SATs), is the critical need of great importance (Aher et al. 2012). The genuine test on water assets arranging at a miniaturized scale level is to survey the quantum of water request and accessibility caused because of 18 P. D. Aher et al. inaccessibility of satisfactory database. Watershed based arranging through increase of current strategies, for example, remote detecting (RS) and Geographic Information System (GIS), for demonstrating the accessibility of water assets and sectoral request is being considered as the most suitable approach.

1.2 Role of Geographic Information System (GIS) and Remote Sensing (RS) in Watershed Management

A Geographical Information System (GIS) can be characterized as a framework, which encourages the capacity and keen utilization of geographic information and human exercises (Srivastava 2003). The basic components of GIS are the utilization of advanced PC equipment and programming to gather, store, control and process for geographic information (Singh 2010). GIS is an apparatus that take into account the preparing of spatial information into data (Samarakoon 2005). GIS can control spatial information and relating ascribe data to incorporate distinctive sorts of information in a solitary investigation at fast, which is unmatched with manual strategies (Rashed et al. 2006).

GIS gives an advanced portrayal of landform which could be utilized as a part of hydrological demonstrating. The database accessible in GIS condition encourages osmosis of various topical datasets to comprehend interrelationships. GIS assumes a vital part in data administration, examination, and giving answers for the arranging of normal assets. The use of GIS for arrive utilize reviews and mapping is picking up significance, generally due to its capacity to give fast and solid information inside a given time system (Jain 1996). Many GIS-based watershed applications have been produced since the mid 1990s because of advances in desktop GIS abilities, programming dialects, and information accessibility (Strager et al. 2010). What's more, it encourages combination of financial data with the assets information to comprehend the neighborhood needs. Once the capability of assets and improvement needs of the watershed are comprehended, it is conceivable to advance particular activity get ready for advancement of land and water assets. It assumes a key part in actualizing soil and water preservation rehearses that are basic for maintainable farming generation.

1.3 Decision Support System in Watershed Management

Decision Support System (DSS) are a model-based arrangement of strategies for handling information and judgments to help a supervisor in his/her choice (Little 1970). Adelman (1992) has characterized DSS as intelligent PC programs that use diagnostic strategies, for example, choice examination, improvement

calculations, program booking schedules, et cetera, for creating models to assist chiefs with formulating choices, break down their effects, and decipher and select proper alternatives for execution. DSS is a PC based arrangement of reconciliation of database, models and UI which are modified for effortlessly interpretable outcomes to help the leaders (Walsh 1993). A DSS can be composed on the premise of client application require as an individual remain solitary or data benefit based. A remain solitary DSS can be keep running on a PC committed to DSS errand where PC goes about as desktop microcomputer/elite workstations or on a various client PC utilized as a part of a period sharing mode in which clients can share the equipment yet with discrete remain solitary application (Mallach 2002). DSS can likewise be produced utilizing webbased administrations that might be generally utilized or might be utilized by different units of an association are starting to be offered as online DSS (Power and Sharda 2007). What's more, the online DSS extends the accessibility of operations and simple openness on web without limitation of time and preparing capacities of the customer machine universally with the increases of hyperlinks and outer information/record sources over the remain solitary framework (Power 2002).

1.4 Need for Advanced and Augmented Techniques for Watershed Management

In the past, the greater part of the examinations consider the watershed administration that comprises of water assets getting ready for whole waterway bowl/catchment/sub-catchment scale. The test on watershed administration at large scale/smaller scale level is to make dependable evaluation of water request and accessibility with the given information. The significant hole in the advancing watershed administration idea at full scale or miniaturized scale level is because of extremely restricted dissemination and trade of data and datasets caused by various standards, approaches, institutional and authoritative variables. Thus, it was discovered that, for concentrate the point by point parts of soil and water administration and in addition to execute hydrological displaying methods with sufficient datasets, it is important to comprehend watershed administration at small scale level for decentralized arranging. Likewise, arrive irrigability and ability grouping for small scale level watershed arranging are required so the agriculturist can utilize better packages for serious development with appropriate protection measures and soil enhancing hones.

Advancements are accessible to tackle numerous watershed issues (water system planning, water discharge cycles in trench order region, and so on.). Be that as it may, techniques are additionally expected to successfully show the advantages of establishing naturally solid watershed administration programs. Advancements should be exhibited in a compelling route for simple achievement of planes and Information System for Integrated Watershed Management 21 executions by the clients. These instruments and systems additionally should be practical. Moreover, the physically based hydrological models are extremely perplexing and have bunches of info parameters and, as beforehand clarified, the real issue is being identified with accessibility of satisfactory database. Henceforth, feasible technique must be beaten to serve the learner client.

System Architecture

WATMIS is an easy to understand intelligent online choice emotionally supportive network that comprises of various hydrological forms and their displaying for reasonable advancement and administration of characteristic assets on a watershed premise. The basic procedures of hydrological cycle, for example, precipitation, surface spillover, ET, and so forth alongside different segments of watershed administration methods were incorporated and demonstrated for building up the WATMIS that can coordinate and handle different models and GIS informational collections. Furthermore, an incorporated hydrological recreation demonstrate was created and absorbed with UIs to shape a comprehensive structure for watershed administration basic leadership forms.

- Database Management System (DBMS)
- Application layer (AL)
- User-Database-Model Interface (UDMI)

The Database Management System (DBMS) incorporates different spatial and in addition nonspatial multi source (satellite, GPS, ground and guide based information and reports) datasets of the watershed, for example, soil, hydrologic, meteorological, geologic, land and vegetation. Server Side Application Layer (AL) is actualized utilizing Apache server-2.2 (Apache 2013) which is a capable and adaptable innovation for facilitating dynamic website pages. This gives easy to understand and strong stage for different displaying situations through information absorption combination investigation. The User Database-Model Interface (UDMI) comprises of various structures for getting the data from the client by utilizing HTML (Hyper Text Markup Language) and PHP (Hypertext Preprocessor) dialects. UDMI presents strong system for exchange/access of the information for client group. It additionally gives stage to information investigation and demonstrating of the hydrologic segments for effective watershed administration.

Online Generation and Implementation of WATMIS

In SAT areas, the accessible water can be either surface water or sub-surface water (ground water) or both because of precipitation. Horticultural water prerequisite is a noteworthy segment of water request in a watershed. Likewise, the water requests can be local needs of human populace and also of creatures. Especially in semi-bone-dry tropics, to get the coveted advantages of watershed administration approach, reception of certain dirt and water preservation measures in the watershed is fundamental. Henceforth, an endeavor has been made for characteristic assets arranging and administration on a watershed premise. The watershed based regular assets arranging

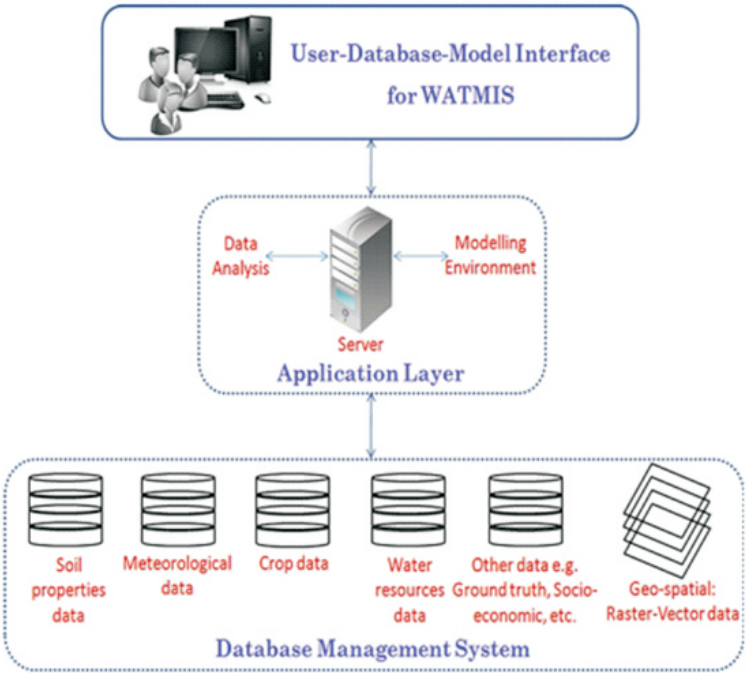

Fig. 1 System architecture of watershed management information system (WATMIS)

approach will basically consists of water availability assessment, modelling of major water availability-demand components, and operational planning of water resources by considering all the processes in hydrological cycle of a watershed. Ahmednagar district in Maharashtra, an inland and drought-prone district, falling under SAT region has been chosen in order to verify the management approaches and suggest the best management practices (BMPs) by demonstrating and developing a user friendly and widely supported open-source software based watershed management information system for better decision making.

CONCLUSION

A viable, cost-effective, object-oriented and generic toolkit, called ''WATMIS: Watershed Management Information System'' using emerging tools and technologies such as, soft computing, GIS, RS, GPS, hydrological modelling, etc. was Fig. 5 Simulation of hydrological model 30 P. D. Aher et al. developed for online integrated watershed planning and management of its natural resources. The effective development of the WATMIS illustrates successful formulation of the framework for supported web-based sustainability.

WATMIS successfully assimilates Agriculture–Water–Soil–Climate continuum for attaining the suitable irrigation level for multiple cropping systems. In addition, it assesses crop yield, demarcating prioritization zones for soil and water conservation management and implementing knowledge repository services during information-decision support with spatial/non-spatial database management, visualization, analysis, query and user individualized customization utilities for optimization and management of land and water resources properly. With augmentation of the frequent temporal variation in satellite data, the system can be improved towards real to near-real time evaluation. The application of WATMIS will be useful to various stakeholders such as agriculturists, rural extension community, and water resources managers for better decisions making.

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