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Water Resources using GIS: A Survey

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Abstract*— Geographical Information Systems (GIS) are computer-based systems that enable users to collect, store, and process, analyze and present spatial data. It provides an electronic representation of information, called spatial data, about the Earth's natural and man-made features. A GIS references these real-world spatial data elements to a coordinate system. These features can be separated into different layers. A GIS system stores each category of information in a separate "layer" for ease of maintenance, analysis, and visualization. For example, layers can represent terrain characteristics, census data, demographics information, environmental and ecological data, roads, land use, river drainage and flood plains, and rare wildlife habitats. Different applications create and use different layers. A GIS can also store attribute data, which is descriptive information of the map features. This attribute information is placed in a database separate from the graphics data but is linked to them. A GIS allows the examination of both spatial and attribute data at the same time. Also, a GIS lets users search the attribute data and relate it to the spatial data. Therefore, a GIS can combine geographic and other types of data to generate maps and reports, enabling users to collect, manage, and interpret location-based information in a planned and systematic way. In short, a GIS can be defined as a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information. GIS systems are dynamic and permit rapid updating, analysis, and display. They use data from many diverse sources such as satellite imagery, aerial photos, maps, ground surveys, and global positioning systems (GPS).

***Keywords*— Water Resources, GIS, GPS, RS**

I. INTRODUCTION

Remote Sensing is used to the study of earth's features from images taken from space using satellites, aircrafts. Remote sensing technique has got momentum in the past few years, mainly due to the availability of digital computers, improved communication systems, digital imaging techniques and space technology. Remotely sensed data can be said to have its origin in photography, where the information about a target area is interpreted from photographs. Later this technique was extended to airplane - borne cameras giving rise to the science of aerial photography. This technique is still used, but largely the signal cameras have been replaced by Laser operated ones where the reflectance of a Laser beam projected from the bottom of the aircraft is sensed by electronic sensors. The satellite launching program of our country is one of the most ambitious in the world, and is still continuing to be so in the future as well. Amongst other fields, the Water Resources Engineers have benefited greatly by using satellite imaging techniques. Geographic Information System (GIS) that has wide applications in planning any spatially distributed projects. Fundamentally, a GIS is a map in an electronic form, representing any type of spatial features. Additionally, properties or attributes may be attached to the spatial features. Apart from its spatial data analysis capabilities, it provides an interface to remotely sensed images and field surveyed data. This technique has specifically benefited the Water Resources Engineers.

A GIS is a computer application program that stores Spatial and Non-Spatial information in a digital form. Spatial information for an area is what is traditionally represented in maps which for a region. The corresponding source of such data for our country is also indicated. Non-Spatial data, also called Attributes, refer to information like demographic distribution of a town or a village, width or identification tag of a road (like NH-6), daily discharge of a river at a particular place, etc. Thus, a GIS conveniently manages all variety of data of a given region in a single electronic file in a computer. This is helpful to any regional planner, including that of a Water Resources Project since all information is conveniently stored and accessed with the computer. Further, though the scales of various printed maps may be different, a GIS stores all of them in the same scale. Normally, different spatial features are stored in subfiles, called layers.

Hence, one may use the GIS to open all the layers showing all thematic features. Else, one may display one or a few themes at a time by activating the respective layers. For example, the land-use layer may be displayed along with elevation contours, the other layers being kept off. Important features of GIS software includes handling of spatial and attribute data, data input and editing, data analysis and output of data. A GIS may be considered to comprise of the following components:

•A software package, the components of which include various tools to enter, manipulate, analyze and output data

• A computer system, consisting of the hardware and operating systems.

II. LITERATURE

A lot of research is going on in this area as it has wide range of application. A few important contributions are discussed in the following text.

MENDONCA and REZENDE, 2000, used Geographical Information Systems (GIS) techniques for selection of best river transversal sections for building dams to create reservoirs. GIS is a fast procedure selecting the best sites taking into account the environmental impacts from inundation. They described the joint application of GIS and Stochastic Hydrology for selection of location and sizing of water reservoirs in Brazil. Periodic Auto-Regressive Moving Average (PARMA) Models and Reservoir Water Balance techniques were utilized for defining the size of the reservoirs.

Jawad and Yahya, used geographic information systems (GIS) tools and remote sensing data prepare and analyze digital layers of lithology, geological structure, drainage and topography to detect the most promising sites for groundwater exploration in an arid basin in Jordan. Maps of existing wells and generated maps were intersected to calculate the percentage of wells in each interval of density and count of lineaments and drainage. Different GIS functions of intersection and spatial query were then applied to produce the final map for the most promising sites for groundwater exploration. The study showed that remote sensing and GIS provided efficient tools for mapping promising sites for groundwater exploration. However, the data of groundwater wells would contribute to refining the final locations of the most promising sites.

Prattana and Royol, addressed the capability of a computer system to integrate, store, analyze, and display geographic information. Earlier, the GIS was limited to cartography and various data management such as natural resource management, environmental impact assessment, etc. Internet allows more geographic information sharing for multiple users at same time. The Internet GIS system facilitates the access, processing, and dissemination of geographic or non-geographic information. They developed internet GIS application water resource management for the better understanding of the user for overall country watershed.

Khadri, Pande et al linked GIS and RS facilities with mapping of urban drinking network, positioning of the storage water tank and selection of the source of water for the water supply system, with consideration of ground surface properties. They addressed use of GIS, GPS and RS technology for visualization and network planning and Mapping. They collected information from various sources and integrated it with GIS to identify the distribution supply networks. A spatial database was designed and created and results were displayed in GIS maps, tables, and graphics. It was proved that GIS is a competent and effective tool for managing networks. They explained water network distributions supply system in and around Chalisgaon city using Remote Sensing, GPS and GIS techniques. The pattern of urban expansion over the demographic change and land use modifications was also analyzed.

Larsen, Mark et al, presented examples of how GIS can be a good partner for hydraulics modeling and integrating with asset management system to form an efficient work bench for building maintaining and graphically presenting accurate water supply and sewer models. The ability of GIS to work with large amounts of data is a visual and easy way to understand than other slow and cumbersome processes such as building hydraulic models.

Vairavamoorthy andYan et al, presented a GIS based spatial decision support system for modeling contaminant intrusion into water distribution system. Three models were developed to simulate the process and risk of contamination. A seepage model predicts the contaminant zone of pollution sources and the change of concentration during migration through soil. A pipe condition assessment model ranks the condition of water pipe in terms of the potential of contaminant ingress. An ingress model combines the geometry algorithm with contaminant zone to obtain the potential pollution areas of water distribution pipe. They integrated three models with ArcView GIS to support decision making for risk mitigation. The contaminant ingress potential and potential pollution area of water pipes were displayed as thematic maps in GIS. The areas resulting in high risk were identified from the GIS maps. Thus GIS based spatial decision support system helped to achieve maximum risk reduction.

Yan and Sultan et al, developed an integrated, remote sensing-based approach to improve estimation of renewable water resources. They incorporated extraction of spatial and temporal data using remote sensing techniques and then integrated data to determine precipitation, soil moisture, reservoir volume and stages, and flows in large river channels, which are key components in hydrologic processes. They developed hydrologic model that simulates hydrologic processes, water usage for energy production, and agricultural activities with a GIS capability to interpret and implement multiple satellite sensor data for model input and model calibration. This integrated; characterization method has been applied to the arid to semiarid areas, Egypt. Their model provided estimates for potential water resources and can be used as a tool for future management optimization.

Yu Weng and Huiting Liu, mentioned GIS technology to share information with users effectively in the industry. In an era of big data, the main feature of GIS is sharing and storage of spatial information. The idea of cloud computing turned all IT resources into services, combined the model of HADOOP and GIS Technology, which will be popular as water and electricity.

Dasika P. Rao, developed a remote sensing and geographic information system (GIS)-based integrated approach for sustainable development of land and water resources. The information on soils, water resources and land use/land cover was collected from various sources and integrating them with the social, cultural, and economic needs of the people, and using GIS as a tool. The integration helped in the generation of an action plan identifying specific interventions in a watershed. The implementation of action plans in some selected watersheds resulted in slowing down of land degradation, rising of ground water levels, and greening of wastelands. It was concluded that for sustainable development, it is essential to take into account analysis of multiple objectives, impact and risk analysis.

Fletcher and Sun et al, developed a set of tools and procedures that combine the power of GIS with a set of water quality models to support the management of water resources and in-stream water quality. They focused on the Watershed Characterization and Modeling System (WCMS), a set of GIS tools highlighted on watershed issues in West Virginia including flow estimation, delineation of watersheds for a selected pour point, identified potentially affected streams from a pollutant source, rank watersheds for remediation, and use water quality data to estimate pollutant loadings and concentrations related to acid mine drainage. Water Quality Modeling System (WQMS), was developed to dynamically estimate the impacts of pollutant or treatment on downstream water quality. WQMS uses a stream network model developed with Java tools as an adjunct to WCMS. WCMS and WQMS are designed as tools for regulators, industrial operators, environmental planners, and communities to better understand stream conditions and the cumulative impacts of pollution and treatment on water quality.

Yang and Liu et al, described the severity of drought in Yellow River basin which the second largest river in China and plays main roles in water resources. They used Drought Index to express the meteorological drought and NDVI mean deviation to express the real drought. On the basis of various data, the value of Drought Index and NDVI mean deviation was calculated and developed a model of Slop and Correlation. The drought was divided into four regional classes and respectively analyzed the temporal and spatial features of meteorological and real drought.

Lin, Chu et al, used remote sensing and GIS techniques for Drought risk assessment in arid environments. Using remote sensing and GIS techniques, they quantified cumulative vegetative and hydrological drought risks in Ejin Oasis, western China. They analysed spatial distributions in drought are often influenced by spatial autocorrelation. The use of the Getis statistic (Gi*) provided insights on the spatial relationships of land cover changes to drought risk assessment. Specially, the location of significant Gi* values identified areas where the differences in cumulative vegetative and hydrological drought risks occur and are spatially clustered. Analyzing the local spatial autocorrelation of the differences between vegetative and hydrological drought risks identified those areas that have systematic sensitivity to areas of high drought risk.

Shakoor, Shehjad et al, described the importance and capabilities of modern techniques such as remote sensing (RS) and geographic information systems (GIS) as water resource management and conservation tool. They calculated accurate crop water requirement by using RS/GIS in combination with hydraulic models. Data was collected from various sources to find water requirement and CROPWAT model at various stages of crop growth developed. Then water required for each individual crop was calculated. The study can help in avoiding wastage of canal water at farm level, which can be optimally used for increasing irrigated areas and crop productivity in the area.

Chiu, Liaw et al, developed a GIS based decision supporting system (DSS) incorporating hydraulic simulation and economic analysis (Benefit –Cost-Ratio, B/C), and uses the rooftop (Rain Water Harvesting Systems)RWHSs in Taipei City. Two RWHS designs were tested in DSS to visualize the spatial distribution of the reliability and B/C ratio, and to seek the optimum design. Rainwater harvesting increased the water availability and reduced the dependence on centralized water supply systems. However, the spatial, temporal, and economic factors have not been well integrated to support RWHS design. The DSS in showed to be useful for quantifying and visualizing the performances of RWHSs. DSS included the spatial information, the simulation of hydraulic performance, and optimized design. Sensitivity analysis further verifies that the DSS renders higher information value than the traditional generalized method. Consequently, this DDS is a feasible tool and has potential in enlarging the public participation and subsequently promote the implementation of RWHS to ease the water shortage problems.

Wang, Wei et al, designed a water supply network based on GIS, the system based on Arc GIS platform, using Client-Server and Browser-Server model to form a new composite model to set up the system. They explained seamless integration of GIS of water supply pipeline network and hydraulic model which was based on building pipeline network concise model dynamic and use the hydraulic calculation function to guarantee the authenticity of hydraulic model, hydraulic model which can help to simulate the whole system and analyze the condition of pipeline network. The model can help operator to know the condition of water pipe every segment in the system and forecast the events of pipe blowout, and according to the requirements of system, the fast locating algorithm was modified to reduce the time of searching objects. All these important technologies can strengthen the security, improve the speed of locating objects and help operator to analyze the pipeline condition.

Shi, Ye et al, used Geographic Information Systems (GIS) as tools in hydrology & hydrodynamic modeling and used in the evaluation of integrative development and utilization of water resource. They related coupling of hydrology & hydrodynamic models and GIS system, collaborative work of heterogeneous systems and the integration of distributed spatial database. They described the system GIS based modeling of hydrological analysis and cascade hydroelectric station however the data and process were undertaken on separate platforms. It reported a framework, system design, function design; correlative techniques for GIS based modeling and analysis in digital valley system integration. A three-tier architecture was introduced as framework in the system integration process, spatial database middleware ArcSDE integrate with Oracle to realize the integrative management of spatial and property database, a COM-based GIS component MapObjects was used for the GIS client-tier development, and different specific models are developed as COM-based component, The integrated system realizes both GIS and specific functions in hydrological analysis and cascade hydroelectric station optional dispatching, the function and data integration are both realized in some degree. This integrated system, explained the basic GIS functions such as space query, statistics and analysis, but also supplies a tool for visualization of the hydrology & hydrodynamic analysis and simulation result and COM-based framework makes it convenient to extend system function flexible by developing new specific models as a component.

Wand, Fang et al, Based on the multi-angled underlying surface information provided and generated by GIS, the authors took into account topology, vegetation and soil’s effects in the developmental process of runoff and built a spatial distributed model of basin water storage capacity. On the base of these studies, IHMS-VSWSC (Integrated Hydrological Modeling System Based on Various Spatial Water Storage Capacity) was explored and developed to simulate basin rainfall runoff process ， which simulated hydrologic processes including canopy interception, snow melt, evapotranspiration, runoff production and flow concentration. Lastly, this model was applied and verified in the hydrologic simulation of Laoha River Dianzi basin, China. An average NASH-Sutcliffe coefficient of 0.807 was achieved and it indicated that this hydrologic model was a good one, as well as the spatial distributed model of water storage capacity the authors built could describe relative spatial distribution of water storage capacity in cold and arid area.

Hongqi, Huili et al, found Remote sensing technology a powerful tool for the eco-environment status evaluation with its rapid updating, big scale and multi-resolution characteristics, which enhanced the working efficiency and saved the labor force. It was proved by the practices that RS combining the GIS technology can provide powerful support for the eco-environment status evaluation and regionalization. Through the analysis of evaluation result, eco-environment status of Beijing kept stable overall, having a status of “Good”. Vegetation coverage and urban building area change, water resources reduction and air pollutants emission control became the most important factors influencing eco-environment transformation.

Kurnaz and Salahova, developed a database using RS and GIS to grab resources and opportunities of prediction, to reduce natural risk by implementing appropriate engineering and technology with time in hand. They used GIS to bridge gaps between data gathering, modeling and flood prediction. DEM-based models were used to represent floodplain geomorphology. Potential inundation zones were determined with the help of DEM-based surface and satellite image by data layers.

Guo and Ding build a data warehouse based on GIS and Data Mining technology to dine out the area of the distinct difference. However, the results are using data extracted from the excavation is comprehensive information, but not numerical results, which can provide real-time decision-making based on analysis.

Hailini, yi et al, carried out a primary assessment for flood risk in Hubei Province on the basis of digital topographic map of 1/ 250000 scale and strong function on space analysis and overlapping of GIS (Geographic Information System) platform.

They calculated four raster coverages through analysis and digitization for precipitation, topography, water system and frequency of historical floods for flood risks. Then, a map of assessment for flood risk in Hubei Province is made by overlapping these raster coverages of the four factors. They reached to a results which matched with pasthistory.

Sulin and Wenbin, developed information system (GIS)-MapInfo software using Matlab software, and visual basic language in this paper for the study of groundwater resources management in Poyang Lake. The user interface was developed using visual basic language, which can provide the running background work environment of MapInfo. Matlab was used to accomplish numerical calculation. The MapInfo’s functions of spatial analysis and display were used in this system by visual basic program activating MapInfo. Many functions could be accomplished including the spatial and attribute data displaying, editing and querying, spatial statistics and analysis, thematic map compiling, and groundwater quality visual evaluation. Groundwater resources effective management and groundwater quality visual evaluation could be realized by development of this system. The development of this system will provide assistant decision supports for reasonable exploiting groundwater resources.

Liu, Wang et al, presented a GIS-Based WRCC assessment System. This system is composed of index system of WRCC assessment, data collection module, data preprocessing module, data integration module etc. Hydrological data, meteorological phenomena, water level, social economy, subsoil water, land use zone, water environment etc. can all be input and processed in this system. Based on the classification and regionalization of the ecosystem, multiple ecological management objectives and the spatial variability of the environmental flow requirements of the Shule River Basin can be analyzed in this system. An Index system of water resources carrying capacity assessment was constructed in this system, with the help of the dynamic data collection system.

Du, Zhang et al, developed GIS-based water supply demand model has been to estimate the water supply demand. The model was used to predict the future water demand of Wujiang City in the year of 2010, 2015 and 2020. The results indicated an increase of about 9.8%, 24.0%, 31.8% in water demand due to future development of Wujiang City. The results show that the water demand model is sufficient enough to be employed to predict water demand in urban areas in Wujiang City.

Mie and Lijie developed a network of hydro-geological information systems on the basis of GIS for Evaluation and management of groundwater. Model base management subsystem is designed, in which parameter calculation model, mining prediction model, and groundwater resources management model are included. Groundwater resource management model is build and applied. Groundwater resources management model offers support for optimizing management and rational use of water resource.

Meng, Bian et al, presented an application of webbased GIS and GPS technology to assess water quality, by using a case study of comparing and contrasting watersheds in Michigan. A simple and interactive web-based GIS provides functions of the watershed management which can be opened in Internet/Intranet for specific users or general public users. A palm-size GPS device provides location information, x and y coordinates, in the observation site that can bring all associate data of physical, chemical, and biological conditions.

Hsueh-Sheng, Chen et al, utilized the geographic information system (GIS) as a basic space analysis method to conduct the regional planning on broken, perforated and the cutting of farmlands, and integrate them with living, production, ecological and other aspect indicators so as to carry out space overlay mapping and suitability analysis. Through farmland resources and space planning, current use of farmland resources, adjust the unsuitable sites, and adverse environmental conditions or improper use of farmlands by coordinating with state land functions and divisional simulation results.

Zhang, Li et al, Extracted watershed features from DEM (Digital Elevation Model) for Hydrologic study and pre-process of hydrological simulation analysis using Arc Hydro Tools. ArcHydro is a geospatial data model especially GIS for Water Resources, developed for building hydrologic information systems to synthesize geospatial and temporal water resources data supporting hydrologic modeling and analysis. ESRI cooperated with the Center for Research in Water Resources (CRWR) at The University of Texas at Austin, based on GeoDatabase, designed and developed the Arc Hydro geospatial data model, which is specially used in hydrological data model. DEM preprocessing, stream flow definition, accumulated grid generation, automatic stream network generation and watershed boundaries generation are five steps for the procedure. Hillsborough River watershed, located in the central Florida, U.S. was studied for the research. Arc Hydro Tools were used to extract watershed features and obtain the intended delineated watersheds for future hydrologic model research. The study results showed that, automatically extracting watershed features based on Arc Hydro tools is feasible and effective.

Bo, Chang-lai et al, applied Vector Drawing Function in GIS Software to draw single index figures in the actual conditions of the plain area of Jilin Province. The attributive database of GIS is applied to evaluate the antipollution capability of groundwater in the plain area of Jilin Province. The assessment results are coincident with the hydro geological conditions of the study area.

Zhang, Zeng et al, analyzed the business application requirements of Three Gorges Reservoir area water environment risk assessment and early warning platform, referred to “Federal Enterprise Architecture”, based on the "SOA" and "modular" system architecture design, and then according to the needs of data resources “big focus”, established standard database exchange and procedure interactive interface based on web services, as well as water environment database based on GIS, explored the loosely coupled standard interface, the embedded water quality model and the display method with GIS integration.

Guo, Xiao et al, designed a GIS based system to assist water resources professionals in making economical and efficient decision. GIS and remote sensing techniques are effectively used to replace, complement and supplement data collection in various facets of different kinds of water resources projects. The system consists of five parts: Geographical Information System (GIS), the database, the mathematical model, the knowledge database and the User Graphical Interface. The system can help water resource manager to appreciate the potential of remote sensing capabilities for application in the management of precious water wealth. The system can dynamically monitor water and provide decision support for precious water management It has obvious economic, environmental and social benefits.

Huang and Huang presented a water resource and environment management information system based on GIS technology. The system select ArclMS product as service platform, then use the EJB technology to encapsulate the map realization. They described the key technology in the system development, including the system architecture, the class to encapsulate the map realization and the function of the system.

Zhang and Yang, analyzed the uniqueness of using the RS (Remote Sensing) / GIS (Geography Information System) technology as an assistant tool in the practical teaching. From the teaching practices, it showed that this method can broaden the horizon of geography environment education way of thinking and explore new ways to enhance the education quality. It is significant for not only consisting with the requirements of essential-qualities-oriented education and geography curriculum reform, but also representing the trend of development in geography and the information society.

Nan-xiang and Xin-hui proposed a research method based on GIS and Analytic Hierarchy Process (AHP). The influential factors including river basin, landform, etc, are selected as the indicators. Then the weights of these factors are calculated using AHP. Combining with the spatial analysis function of GIS technology, the groundwater resources partition in Zhongmu County is studied. The result shows the method is valid and rationable.

Song, Zheng et al, used Artificial neural network (ANN) based on Arc Engine (AE) of GIS to predict surface water quality in the Chanzhi Reservoir, Qingdao, China. The results reflected the water quality change trends with less than 10% average relative error. Using MS SQL Server database technology combined with Geodatabase, the system achieves the fundamental geographic information and hydrological data management, and water quality prediction. It uses GIS component technology to build an efficient and stable platform which applied to general surface water quality prediction. This software had good information extraction and query functions to help decision-makers to manage water resource better.

Lui, Currit et al, generalized several water body characteristics in optical remotely sensed images and then proposes a segmentation-based water body extraction method. The proposed algorithm exploits several features and uses a perception machine (PM) of neural network (NN) to build a classifier. An overall classification accuracy of 96% indicates that this method holds promise for extracting water bodies from optical remotely sensed images.

Li, Sun et al, developed a 3D water resources information system. On the basis of contrast and analysis of current 3D GIS software, the GIS database was established and the techniques of COM (Component Object Model) and 3D visualization were implemented. The system breaks through the limitation of traditional two-dimensional display and is independent of the development environment and current GIS platform, which can quickly provide decision support for the flood regulation and water storage. The proposed method can be applied into other related fields, such as design, development and application of 3D.

Ma and Cui, explained the design and technological implementation method of water quality information management system based on GIS, providing reference for scientific management of water quality information for Fuzhou city of Jiangxi province taking MapInfo as the platform.

Jia, Qian et al, extracted data by remote sensing image and functions of Arcgis software, a new index system for the importance of water conservation districts Chengde regions has been established by AHP. The result of the study is as follows: the degree of water conservation in Chengde is divided into 4 classes, which are extremely important area, medium important area, slightly important area and ordinary area. Besides, corresponding suggestions on the development and construction of various regions are put forward finally.

Luo, Xu et al, explored the integration of data warehouse (DW), virtual reality (VR) and GIS in water resources information system to solve the problems of water conservation. Firstly, DW was built in this system to integrate hydrological data from ultra-short wave (USW) telemetering system with those from general packet radio service (GPRS) telemetering system, providing the system with desirable data without massive calculation in clients. Secondly, remote sensing image was utilized as the base map of the system, which was also used for three-dimensional animations generation so that watershed characteristics could be demonstrated more intuitively. Finally, with the help of GIS, water resources information system was developed which could meet diverse practical requirements of water conservancy management.

Li, Sun et al, presented the 3D development tool and system architecture for contrasting and analyzing current system development patterns. On the base of research on 3D scene construction by OpenGL and hydrological feature extraction in GIS, the Tangjiashan Barrier Lake in Sichuan, China, is considered as a study area in the system implementation. Because of basic development, the system is independent of any current GIS platform or control and able to extend function flexibly. The system also breaks through the limitation of traditional two-dimensional display and enables hydrological analysis. The proposed method can be applied into other relevant projects by reason of flexible function, lower cost and cross platform.

Jin, Liu et al, discussed the mature development of Geographic Information System (GIS) and wide use of the DRASTIC (Depth to water, Net recharge, Aquifer media, Soil media, Topography, Impact of the vadose zone and hydraulic Conductivity) model, a GIS-based DRASTIC model has been a main method in groundwater vulnerability assessment. GIS-based DRASTIC model, analyses the research advances of improved model at home and abroad, including reasonable adjustment of evaluation indices, the coupling of the Analytic Hierarchy Process (AHP) and the fuzzy mathematics theory, and discusses the trends of further research as well.

Qian, Shen et al, explored the potential census data of pollution sources, with the application of environmental management theory and GIS technology, the work of integrating geospatial data and remote sensing of the data of Tangshan has achieved successfully in 2010, the Symbolic of pollution sources has also been realized, the Establishment of industrial pollution GIS provides the function of query and analysis, it is important for quantifying and level to level management of the sources, Furthermore it laid the foundation for the establishment of early warning platform in the future.

Huang and Zhang, proposed a decision support system for the water resources exploitation and overall planning. They showed the system structure and introduced the application of remote sensing technique and GIS in that realm. Decision Support Sub-system (DSS) for water resources management and scheme evaluation was explained.

Kong and Yang, explained water resource information management system which is based on Web GIS, internet and database technology. Therefore, the study aimed to realize the water management internet and visualize based on water data.

Agen, Yangyang et al, designed a site selection algorithm for water resources points based on GIS technology. By analyzing the relationship between supply and demand constraints, it plans points-site and solves the water resources allocation problem. Although suboptimal, the algorithm has the merit of simplicity and concision. Water resources distribution system using this algorithm is implemented on the base of real geographic data from Qinghai province.

Ye, Wang et al, utilized geospatial data, supported by the water resource and civil engineering data, the dam-break and flood simulation results can be dynamically visualized in a creative 3D spatio-temporal Geographic Information System (GIS). The spatio-temporal analysis, the bi-temporal comparison and theme statistic analysis provided details of the inundated area. By taking the Smoothed Particle Hydrodynamics (SPH) simulation output results into spatiotemporal modeling, the 3D dynamic visualization of GIS was achieved.

Huang, Lin et al, introduced the design and implementation of the decision support system based on GIS for flood control. This system is based on the hydrology information system colligates real-time precipitation and flow inspection, flood control administration, flood forecast and simulation, flood information dissemination, related damage evaluation and illustrated the system architecture, the functional framework and the design of decision support subsystem.

Cui, Jia et al, designed and implemented architecture of municipal water resources MIS (Management Information System) based on GIS. They designed an algorithm for auto-generating of water isoline based on TIN. An algorithm for the same color weighted minimum distance was proposed; GML was used to represent and store the spatial information and map data.

III. CONCLUSIONS

To develop an integrated Information System, including Geographic Information System (GIS), Remote Sensing (RS), Image Processing System (IPS), and Decision Support System (DSS), Data Base and Modeling and guidelines for applications in local and regional planning application of methods of data acquisition and processing by GIS and remote sensing directed to local knowledge and translation of this knowledge into GIS. To develop ground water recharge techniques using Remote Sensing (RS) and Geographic Information System (GIS).To develop drought management model using Remote Sensing and Geographic Information System. To develop flood assessment system using remote Sensing and Geographic Information System.

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