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Remote Sensing Based Irrigation And Drainage Management System For Namakkal District

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Abstract

Irrigation is one of the most important inputs for an efficient and sustainable agricultural production. Thus the subject of efficient irrigation water management has been the talk of the last few decades. It has been emphasized that proper monitoring and evaluation is the key to successful management. Irrigation management in the most projects has so far been essentially water supply based. The dynamics of crop water demands are not explicitly considered. Consequently, irrigation systems do not supply the right quantities of water at the right time. Irrigation experts are seeking the ways in which the water is used very efficiently. The first step of this achievement is to increase in effectiveness of irrigation management. Analyzing large amount of data is necessity for management of irrigation projects. Data must be collected, stored and interrelated with each other in such a way that the data are readily accessible. The aim of this study is to present a Geographic Information Systems (GIS) for Namakkal irrigation and drainage project located in the southern west of Tamilnadu. GIS was developed to provide a powerful tool to analyze large volumes of geographic data. It stores a considerable amount of spatial information in a compact and accessible form and it has the ability to work with spatial and non-spatial data and create information by integrating data layers. In this work, several layers of information such as: canals, drainage system, landuse, farms, groundwater surface level, etc have been imported or created in ArcGIS. In addition, several scripts have been developed to calculate the irrigation requirements and necessary results.

Keywords: Remote Sensing, Irrigation, Drainage Management System, Namakkal District

1 INTRODUCTION

Irrigated agriculture generally uses large volumes of water. Water resources limitations caused the water supply to become a critical issue in recent years. Thus, it is important to improve water management practices in agriculture to save water for expanded agricultural activity and for other uses. Monitoring and performance evaluation is the key to the successful management. In many irrigation systems, water is delivered based on availability; and it has been supply based. Therefore, the dynamics of crop water demands are not explicitly considered. The irrigation systems do not supply the right quantities of water at the right time (Anonymous, 2001). Many new technologies, such as remote sensing, geographic information system and expert system, are now available for application to irrigation systems and can significantly enhance the ability of water managers (Mennati et al., 1995, Ray and Dadhwal, 2001, and Xanthoulis et al., 1998). The assessment of management strategies requires the analysis of the current irrigation and drainage system and prediction of the potential changes to various parameters. To enable these to be assessed and monitored in a quick and efficient way, computer-based spatial analytical capabilities are needed. GIS has shown their potential for developing the database and computational models (Yang et al., 2000).

GIS is a combination of software, hardware and experts for storing, retrieving, transforming and displaying the spatial data. Data are stored digitally in GIS, therefore, they need less space compared to traditional systems like paper maps. In addition, it is possible to combine different maps and data and do several analyses in short time. This feature makes GIS different from other graphical softwares like AutoCAD. The fast progress of computer technology in last two decades caused the improvement in GIS capabilities. According to FAO standards, irrigation performance in the lower reaches of the Amu Darya River in Central Asian Uzbekistan is grossly under-performing and a major reason for increasing economic and ecological problems in the Aral Sea region ("Aral Sea dilemma"). Yet, this generalized statement is based upon inconsistent, outdated and unreliable data provided by national structures. These data lack an adequate methodological basis for a more accurate data collection, especially on percolation and seepage losses in rivers and channels and unregistered withdrawals. For the intended and highly demanded introduction of an Integrated Water Resource Management (IWRM) in Central Asia, it is a prerequisite to master these problems which constitutes the present focus of the scientific branch of the Interstate Water Distribution Commission Remote sensing may help filling this gap by improving the understanding and assessment of the irrigation complexes at different spatial scales and may contribute to better-informed decision-making of water resources management.

1.1 Selected Remote Sensing Research In Irrigated

Airborne and satellite borne remote sensing technologies can measure spectral reflectances and emittances. These radiances can be used for spatial interpretation and description of regional scale crop water stress. Thermal infrared images are collected coincident with shortwave reflectance. The current satellites having a thermal infrared band are Landsat, Aster, MODIS, AVHRR, AATSR and MSG.

Canopy temperature has been long recognized as an indicator of crop water status and pending moisture stress (see for instance Jackson et al., 1981). Surface temperature measurement in a developing wine grape vineyard in Spain revealed differences of 20°C between crop canopy and soil surface on a typical midday during summer (Bolle et al., 1993). The canopy temperature of the grapes is cooled by transpiration to a level at which air and canopy temperature tend to equilibriate at 30°C, whereas the soil skin temperature rises to 50°C, due to the absence of surface soil moisture. Sadler et al. (1995) also showed a 20°C difference in temperature between evaporating canopy and nonevaporating surfaces in corn. The impact of evaporation on surface temperature was recognized back in the sixties. Early experiments indicated that canopy temperature reflects the effect of canopy conductance and plant water potential on evaporative cooling (Gates, 1964; Fuchs and Tanner, 1966; Fuchs et al., 1967; Ehrlers et al., 1978). Although not exhaustive, a theoretical framework between surface temperature and heat fluxes was presented by Monteith (1981) and Jackson et al. (1981). Choudhury (1989) presented a great synopsis of the link between surface temperature, ET, biomass production and crop yield. Yet, nearly 20 to 30 years later, thermal-infrared technology is still not fully utilized. Some primary reasons for the limited use are

- the limited operational availability of thermal infrared radiation measurements,
- (ii) conversion and interpretation of the instantaneous temperature measurements into plant or soil wetness indices and
- (iii) lack of awareness of past successes and current tools.

Canopy temperature can be measured rapidly and non-invasively with portable infrared thermometers. Most of the thermal-infrared measurements for irrigation scheduling are interpreted into plant water status using crop water stress indices (Moran et al., 1994). Nowadays thermal infrared camera's are inexpensive (~US$ 100). Despite the limited possibility to measure thermal infrared radiation from space platforms, it seems to be a viable technique to schedule irrigation. Some examples are provided in Table 1. Evans et al. (2000) and Peters and Evett (2004, 2006) have provided an example of thermal infrared radiation measured from a rotating center pivot irrigation system. Cohen et al. (2005) investigated precision irrigation with established relationships between thermal infrared radiation and leaf water potential. Results of their work show that the spatial structure of thermal infrared radiation provides useful information for determining local bio-physical parameters. Moller et al. (2007) recently demonstrated the effectiveness of using very high resolution thermal Infrared data in an Israeli vineyard for scheduling irrigation. Naor (2006) concluded that thermal infrared measurements enable growers to produce maps of relative water stress. Loveys et al. (2008) and Hornbuckle et al. (2008) showed how quad bikes can be used to quickly measure thermal infrared radiation within vineyards and to make irrigation scheduling decisions. The latter technology is relatively inexpensive and provides immediate access to data without dependency on space agencies who supply the image data.

1.2 Important Function In GIS

There have been several applications of GIS in irrigation and drainage systems around the world. Sarangi et al. (2001) used GIS in development of input data set for a conceptual small watershed runoff generation model. In addition, they used ARC/INFO for canal system within the project area of Patna Canal and distributaries of Some command area in India. Amor et al. (2002) combined the GIS with a crop growth model to estimate the water productivity in time and space in Philippine. Three products, rice, corn and peanut were modeled in their research.

They analyzed the water limitation for each crop in different seasons and determined the productivity potential in the region.

In Tamil nadu also GIS has been started being used since 1990's and it has been applied in different field of water sciences such as hydrology, flood control, water erosion, and groundwater. Daneshkar et al. (2000) used GIS and Modflow for simulation of Ab-Barik groundwater plain. Flood plain mapping was studied by Barkhordar and Chavoshian (2000). Alvankar et al. (2000) applied GIS in watershed characterization of Latian dam watershed.

In this paper, the GIS of Namakkal irrigation and drainage system was developed to be able to update the information easily, doing different queries, computing the performance assessment indices. In addition, it has been used to compute the volume of irrigation requirement for each farm or at the secondary canal intake gate. The objective of this study was the development of a management tool to increase the water efficiency by delivering the water in right quantity.

2 MATERIALS AND METHOD

The necessary data and information were obtained from the NRSA and PWD which the project location is in its jurisdiction and from the consulting engineers company involved in the design and construction the project. Some of the maps were drawn in AutoCAD and therefore were easier to convert them into the GIS environment but they needed to be corrected. The other part of information and maps had to be digitized first. In order to make the developed tool more practical, several managers and operators of irrigation systems have been interviewed.

3 DATA COLLECTIONS

3.1 Satellite Data Collection

To monitor irrigated area, cropping pattern, and rice yield during the rabi (post-monsoon) seasons from 1986-87 to 1993-94, high resolution data from Landsat-5 and Indian remote-sensing satellites (IRS-1A and IRS1B) were used. Satellite data were directly received at the Indian Earth Station at Shadnagar about 60 kilometers from Hyderabad and processed at the National Remote Sensing Agency facilities in Hyderabad. Data from the Landsat Multispectral Scanner (MSS) (80 m ground resolution), the Landsat Thematic Mapper (TM) (30 m resolution), and the IRS Linear Imaging Self Scanning Sensor (LISS I) (72.5 m resolution) were analyzed (see annex for orbital and sensor characteristics of remote sensing satellites). At the time of the study, India had not yet launched the satellites IRS-1C and IRS-P3. Hence, the data from Wide Field Sensor (WiFS) of 188 meters resolution and 5-days revisit capability were simulated from LISS I data and evaluated.

To maintain consistency in the results generated through the years, MSS and LISS I data, which have a similar spatial resolutions, were selected for analysis. A preliminary analysis of a sample area with both LISS I and LISS II data showed that acceptable crop classification accuracy could be achieved even with LISS I. This finding significantly reduced the cost of acquiring satellite data and carrying out analysis because each LISS I scene covers an area equal to the area of four LISS II scenes. Although the package of satellite remote sensing applications has been developed in a rice-based irrigation system, a similar approach with suitable modifications could be developed for irrigation systems involving other crops.

3.2 Overview Of Data Analysis

The analysis of satellite data involves the following

- mapping irrigated crop areas and discriminating rice from other crop areas
- mapping spatial variability of the rice transplanting period across the com-
- mand area
- estimating rice yield through spectral index yield models
- measuring yields from satellite-derived
- data on the condition of the rice crop using an improved design for selecting representative sample areas
- evaluating the impact of reported water logging on rice productivity
- radiometric normalization between satellites, sensors, and acquisition periods
- comparative evaluation of satellite data of different spatial resolution
- integrating cadastral maps with satellite data

To evaluate the system performance and to diagnose and analyze the poorly performing distributaries, a geographic information system (GIS) was developed at two levels of the command area and for selected distributaries.

3.3 Crop Classification

Approaches selected for classifying crops in earlier studies have been dependent on the context, with no single classifier having universal applicability. In the Bhadra irrigation system the major area is under rice. Other crops are sugarcane, groundnut, sunflower, and garden crops such as coconut, betel nut, and vegetables. Rice transplanting is staggered over a period of more than a month, and other crops are sown considerably earlier than rice. Because of this heterogeneity in the crop calendar, we analyzed satellite data from two dates:

(1) the time of maximum ground cover and canopy growth and

(2) when rice was being transplanted and other crops had already grown to the vegetative stage. The objective was to ensure a complete estimate of the area under crops and to achieve better discriminability. Based on a review of alternative approaches, a multivariate classification approach was selected in an attempt to merge the data from the two dates into a single multichannel data set.

3.4 Spatial Variability In The Rice Calendar

Spatial information on the transplanting time for rice across the command area has been mapped (map 2). The seasonal NDVI profile of every pixel of rice crop was analyzed to identify the peak greenness stage. The fact that this stage corresponds to the heading stage of rice was used to calculate the time of transplanting and to generate information on spatial staggering of rice transplantation, i.e., the time of transplanting in different areas. This information is useful for evaluating the compatibility between the canal delivery schedule and the rice transplanting calendar at the distributary level. This capability will be further enhanced when WiFS data from IRS-1C and IRS-P3 are operationally available. Those satellites provide individual 5-day revisit periods and a combined 2- to 3-day revisit period.

Crop-soil parameters such as soil moisture, soil water tension, stem water potential, leaf water potential and stomatal conductance can be measured in situ. Although these supporting devices are very useful to help farmers decide when and how much to irrigate, these in situ sensors are always point measurements and therefore may not provide information on spatial variability. Hence, there is an intrinsic deficit between demands for an alert water management programme and the ET reduction and water use efficiency tools to establish and implement best practices at the local and regional scale. More accurate ET guidelines need to be developed by research and extension services to provide operational programmes that increase the utilization of water resources. Evapotranspiration is often assessed by means of the classical weather-based reference ET. Regulated Deficit Irrigation and Partial Root zone Drying are new technologies and strategies to reduce ET and enhance water use efficiency. The values and amount of ET reduction associated with these water saving irrigation technologies at the regional scale are, however, only marginally understood and predictable. Colaizzi et al draw the conclusion that thermal infrared based monitoring is more reliable for detecting water stress than in situ soil moisture measurements. Hence, there is a need for new ET quantification and estimation technologies and approaches, especially at the regional scale to compare on-farm practices among different farmers.

3.5 Concurrent Monitoring Of Rice Growth And Stress

Satellite data of IRS and Landsat satellites are available only at certain times during the growing period, and this availability is further limited by cloud cover. Although a combination of satellites can provide frequent coverage, the process of data normalization from multiple satellites can significantly overload analysts. Hence, to concurrently monitor crop growth and crop condition through the season, satellite sensors such as IRS-1C's WiFS, with a 5-day revisit period, must be used. NOAA-11's AVHRR sensor, though providing twice-daily revisit capability, has a spatial resolution of 1.1 kilometers at nadir, which is too coarse for effective spatial monitoring within the com- mand area.

Analysis of simulated WiFS data indi- cated that temporal information on rice development can be effectively captured. In spite of its 188-meter resolution, WiFS allows satisfactory classification of large-area crops such as rice even at the distributary level. The profiles of rice growth obtained from the NDVI of WiFS data at the distributary level were verysimilar to those obtained from LISS I data. NDVI provides the capability of monitoring not only the physiological development of rice over time and in its spatial variability, but also its condition, because many studies have related abnormal NDVI to crop stress. The effect of stress is to decrease the near infrared reflection and to increase the reflection in the red wavelengths, giving lowerthan-normal NDVI values. Based on analysis of high resolution field spectrometer measurements, Shibayama et al. Showed that NDVI is a sensitive measure of stress in rice 2 weeks after drainage. The effective use of WiFS data requires radiometric correction to compensate for changing illumination geometry between successive revisits (because the WiFS paths shift by 117 kilometers every 5 days) and across the scan (in case of latitudinally oblong irrigated areas) and for atmospheric effects. WiFS data from the IRS-IC satellite have been operationally available from the Indian Earth Station since June 1996. Where direct reception is not available, the on-board tape recorder permits acquisition of data over such areas, which subsequently can be downlinked to the Indian Earth Station.

3.6 Data Normalization

To use data from multiple satellites with different sensor characteristics for close monitoring of irrigated areas, the data must be normalized geometrically and radiometrically. A technique for radiometrically rectifying multiple Landsat images of acally transform other images. The method worked well for the visible and near-infrared bands of the Landsat Thematic Mapper. To maintain consistency in the results generated through the years, MSS and LISS I data, which have a similar spatial resolutions, were selected for analysis. A preliminary analysis of a sample area with both LISS I and LISS II data showed that acceptable crop classification accuracy could be achieved even with LISS I. This finding significantly reduced the cost of acquiring satellite data and carrying out analysis because each LISS I scene covers an area equal to the area of four LISS II scenes. A procedure for selecting appropriate bands to compare NDVI values from multiple satellite has been described by Jeyaseelan and Thiruvengadachari. Jonna et al reviewed existing procedures such as histogram normalization, use of scene statistics, linear transformation, and use of spectrally invariant features, and, for This study, a simple regression between different data sets was adopted.

4 STUDY AREA

Namakkal is located at 11.23°N 78.17°E.[5] It has an average elevation of 218 metres (726 ft). It is close to Kolli Hills - which is part of the Eastern Ghats. The closest river is Kaveri and it is located 360 km southwest of Chennai and 250 km south of Bangalore.Namakkal or Namagiri is a city and a municipality in Namakkal district in the Indian state of Tamil Nadu.(Figure.1) It is the headquarters of Namakkal district. It is the first ISO 14001-2004 certified municipality in Asia for environmental management,[3] specifically the provision and maintenance of water supply, solid waste and sewage management, town planning, lighting and other social services.As of 2011, the town had a population of 55,145.

It is a part of Kongu Nadu (Kongu Desam) region of Tamil Nadu which was hotly contested and coveted by both the ancient Pallavas and the Pandyas. Namakkal was in the hands of Atiakula King called Gunasila who has marriage with Pallava King. Later the taluk was overrun by the Cholas in the Kongu Mandalam .After the struggle between the Cheras, Cholas and Pandiyas, the Hoysalas rose to power and had control till the 14th century followed by Vijayanagar Kings till 1565 AD. Then the Madurai Nayakas came to power in 1623 AD. Two of the Polygons of Thirumalai Nayak namely, Ramachandran Nayaka and Gatti Mudaliars ruled the Salem area. The Namakkal Fort is reported to have been built by Ramachandra Nayakas. After about 1625 AD, the area came successively under the rule of Muslim Sultans of Bijapur and Golkonda Mysore kings and then the Marathas, when about the year 1750 AD. Hyder Ali came to power. During this period, it was a history of power struggle between Hyder Ali and later Tippu, with the British.

The Rock Fort in Namakkal is a special feature of the Town. The Fort covers an area of one and half acres of flat surface and is accessible from South-West by a flight of narrow steps. Namakkal was held by Killdhar (Caption) on Hyder Ali until it was captured by British in 1768. For a brief period during late 18th and early 19th century Namakkal was under Tiruchirappalli district of British Rule. Later Namakkal was transferred back to Salem District.

Namakkal District comes under the North Western Agro climatic zone of Tamil Nadu. It is situated in the dividing portion of two watersheds between Cauvery and the Vellar System with the Taluks of Attur, Rasipuram and Namakkal on the East and Salem, Omalur and Mettur on the West. Tiruchengode taluk alone is placed under Western Agro-climatic zone. Besides the above two zones, Kolli and a few isolated hills and ridges are scattered over Namakkal, Rasipuram and Tiruchengode and along with the valleys and rolling hills, make up the characteristic topography of the district.

The State's irrigation potential in per capita terms is 0.08 ha. when compared to the all-India average of 0.15 ha. The three main sources of irrigation in the State are Agriculture is the single largest consumer of water in the State consuming 75 percent of the State's water resources. About 58.78 percent of the net area sown is benefited by irrigation. The State has a net irrigated area of 29.12 lakh hectares (L.ha) (2010-11). The irrigation intensity (ratio of gross irrigated area to net irrigated area), worked out to 129.32 percent during the 1950s, and it declined to 124.90 percent during the 1990s and it has come down further to 115.00 percent in 2010-11.

The area irrigated by canals marginally increased from 7.88 L.ha in 1950-51 to 8.01 L.ha in Table 3.9.2: Source-wise/year-wise Irrigated Area - Tamil Nadu (in L.ha.) S. No. Source 1950-51 2000-01 2010-11 1 Canals 7.88(42.48) 8.01(28.60) 7.47(25.65) 2 Tanks 5.65(30.46) 5.37(19.17) 5.33(18.3) 3 Wells 4.26(22.96) 14.49(51.73) 16.23(55.73) 4 Others 0.76 (4.10) 0.14(0.50) 0.09(0.3) 5 Net area irrigated 18.55 28.01 29.12 6 Gross area irrigated 24.45 34.12 33.48 Source: Season and Crop Report.(Various Issues) Figures in parentheses indicate percentage to net area irrigated. rivers, tanks and wells. There are about 41,127 tanks, 2,239 irrigation main canals and 18.26 lakh irrigation wells in the state. The area irrigated by various sources is furnished in the Table 3.9.2 and Graph 3.9.2 2000-01 and subsequently declined to 7.47 L.ha in 2010-11. However, the share of canal irrigation in the net area irrigated declined from 42.48 to 28.60 percent between 1950- 51 and 2000-01 and has further fallen to around 25.65 percent in 2010-11.The approximate storage capacity of tanks in the State is estimated as 5,067 Mcum (178.94 TMCft - 21 percent of the annual water potential), which is almost equal to that of the reservoirs. However, the tank irrigation system has deteriorated over time, which is shown by the decline in the area irrigated under tanks falling from 30.46 percent in the 1950's to roughly 18.30 percent in 2010-11. This might be due to failure of monsoon, reduction in the storage capacity of tanks due to silting, lack of adequate management of tanks and the supply channels and unscientific water management practices followed by farmers. Next to tank irrigation, lift irrigation through individually owned wells is the major source.

The number of wells, which in 1951 was only 14,400, increased to 15.28 lakhs 0 10 20 30 40 50 60 Canals Tanks Wells 42.48 30.46 22.96 25.65 18.31 55.73 0.00 10.00 20.00 30.00 40.00 50.00 60.00 Canals Tanks Wells 1950-51 2010-11 Graph 3.9.2: Sources of Irrigation (in %) 167 Agriculture and Allied Sectors by 1996 and to 18.26 lakhs in 2010-11. The drinking water and domestic needs are growing with the increase in population and also improvement in lifestyle. The drinking and domestic requirement has been projected as 2438 Mcum for the year 2010 and as 2791 Mcum for the year 2025

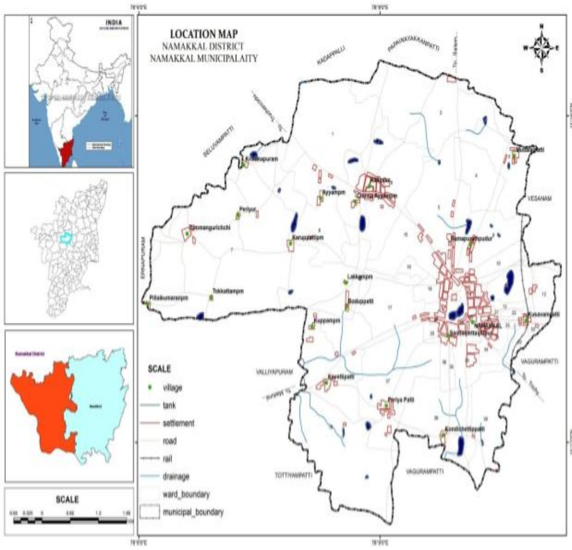


Figure 1 Study Area Map

As per the National Water Policy 2002, the drinking water gets first priority. (Report of the Expert Committee on Development and Management of Water Resources of Tamil Nadu- Vol I, March 2003). The total demand of water for all sectors works out to 54403 Mcum as of now which may increase up to 57716 Mcum by the year 2050. But the availability of water resources both ground and surface water in a normal year is only 47125 Mcum. Thus there will be a deficit of 10591 Mcum in 2050. The Water Resources Department (WRD) piloted a multi-disciplinary approach to work in an integrated manner in modernizing irrigated agriculture over a demonstration area of about

3000 ha in Hanumanadhi subbasin of the Tamiraparani river system.(Figure.2)

Under this project, interventions like system tank improvement, drip and sprinkler irrigation and introduction of tissue culture banana were undertaken. This approach is the first of its kind in the department which fostered engineer-extensionist-farmer linkages and helped line departments to work together. The Project Appraisal Document of ICR Mission for the Water Resources Consolidation Project (WRCP) reported that there was a perceptible change in the mindset of officers and farmers. In the Eleventh Five Year Plan period, the multi-disciplinary approach continued and the Irrigated Agriculture Modernization and Water bodies Restoration and Management (IAMWARM) project envisaged the promotion of activities of all the eight line departments with a view to ensure benefits to all the stakeholders at sub-basin level. During the Twelfth Five Year Plan period, the non-system and rainfed tanks, the anicuts/ diversion weirs and supply channels which are the life line to tanks and other tank appurtenances will be given importance for rehabilitation.

This approach will ensure the sustainability of rainfed agriculture. The need for capacity building of farmers, functioning of Water User Associations (WUAs) in water management etc is seriously felt and towards this, appropriate training was imparted which paved the way for adoption of drip, sprinkler irrigation and System of Rice Intensification (SRI) method of rice cultivation. Another aspect threatening water sector is the over-exploitation of groundwater. In order to overcome this issue and to augment the groundwater potential, Master Plan for Artificial Recharge scheme was conceived and construction of check dams, percolation ponds, recharge shafts etc., were implemented and such groundwater development schemes ensured the income for small farmers. The past experiences revealed that floods and drought occur in a cyclic manner and both affect the agricultural activities. The management of floods has been given serious thought and right choice of schemes are posed and implemented with the grant assistance from the Government of India (GoI). Present requirement for the State with limited water resources is to take up more number of Extension, Renovation and Modernization (ERM) projects with the funds under Accelerated Irrigation Benefit Programme (AIBP). Our State has not yet efficiently utilized the funds of GoI under AIBP. Apart from this, the utilization of surplus flood flows in the coastal areas through pumping schemes for the benefit of higher command, artificial recharge schemes, flood management programmes, coastal protection work, restoration of traditional waterbodies are the viable solutions which would lead the irrigation sector to cater to the increasing demand.

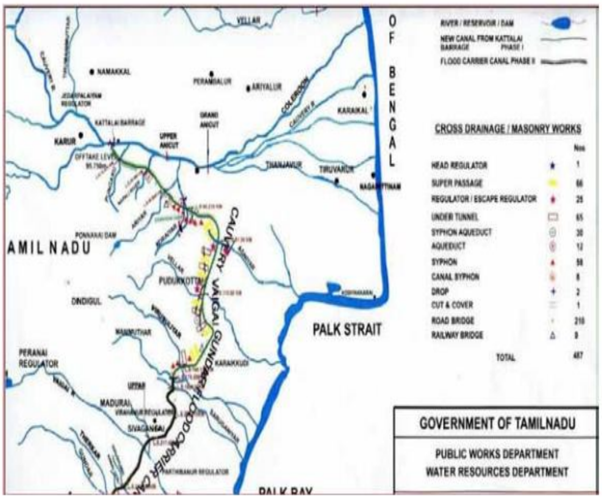
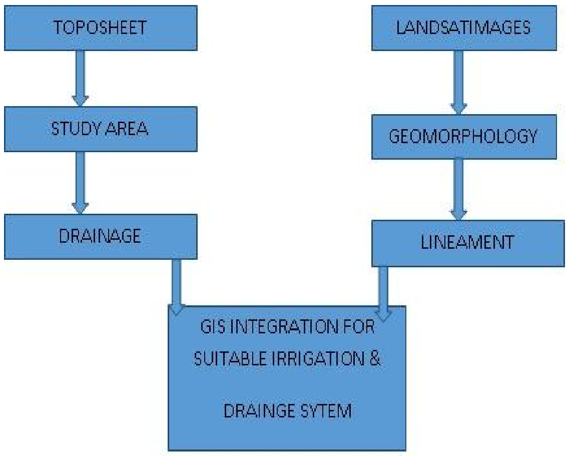


Figure 2 River Systems in Namakkal

5 METHODOLOGY



In our project data were collected and digitized to generate study area, drainage to find out the flow of water system, Landsat images from NRSA to generate the geomorphology, lineament to find out the slope area and soil condition. All the thematic maps were integrated in the GIS environment to find out the suitable irrigation and drainage.

6 GEOGRAPHIC INFORMATION SYSTEM

In order to develop the GIS of Namakkal project, the first step was to digitize all maps and available information and data. These information and maps were divided into two categories. One category was those maps and information which were constant in time such as canal and drainage locations, observation wells, farm layouts, roads and railroads. The second category was those maps which are variable through time. Crop pattern, groundwater level, and farm productivity are in this category.

The second step after data entry was to develop the necessary tools and subprograms for analyzing and calculating the system management elements. Calculating the irrigation requirement based on the crop pattern, area of farm, evapotranspiration and crop coefficient was one of those tools.The information and data related to each layer and infrastructure in GIS has a database connected to the object in the map. The developed tool is able to make different kinds of queries either on maps or on related tables. ArcGIS 8.1 was used as the basis for this GIS application. The software is able to process both raster and vector images and it has the feature for writing scripts for especial operation.

7 DATABASE MANAGEMENT SYSTEM

7.1 introduction

The source maps for soil, geology, geomorphology, lineament are published maps of state ground and surface water resources data centre, Chennai in 1:500000 scale. Contour map is derived from the Survey of India (SOI) topographical maps bearing no 58E/11, 58E/14, 58E/15, 58E/16, 58I/2, 58I/3, 58I/4, 58I/6, 58I/7 and 58I/8 in 1:50000 scale.

The objective of using a database management system is to efficiently store and manipulate various types of data related to canal irrigation system. The available database in ArcGIS was used to store data. These data consisted of thematic data such as physical properties of irrigation and drainage canals and related structures and temporal data such as gate opening, flow rates, water depth in observation holes. Database is related to the spatial data in GIS environment and data can be retrieved by clicking on images or doing queries.

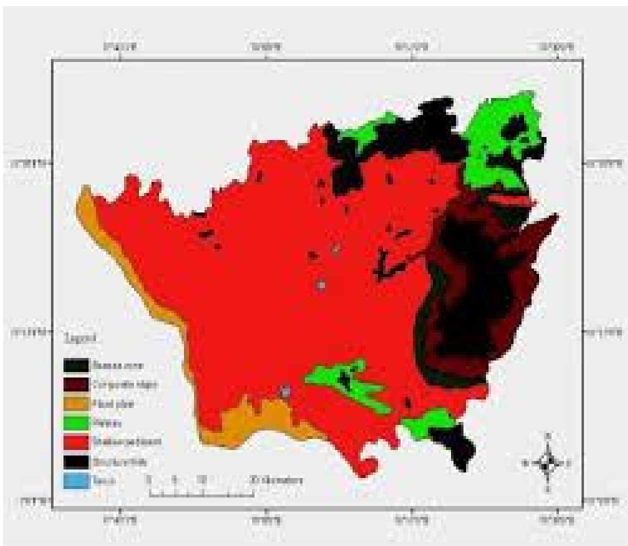
7.2 Maps Prepared Priliminary

7.2.1 Geomorphology Of Namakkal

Namakkal district forms part of the upland plateau region of Tamil Nadu with many hill ranges, hillocks and undulating terrain with a gentle slope towards east. The prominent geomorphic units identified in the district through interpretation of Satellite imagery are 1) Structural hills, 2) Bazada zone, 3) Valley fill, 4) Pediments, 5) Shallow Pediments and 6) Deep Pediments. A number of hill ranges are located in the eastern and northeastern parts of the district, whereas the southern, western and northern parts of the district are plain to undulating, dotted with a few isolated hillocks. The important hill ranges in the district are Kollimalai hills, Bodamalai hills, Naraikinaru hills and Pachamalai hills. The highest peak in the district is the Kollimalai hill peak with an elevation of 1293 m. above MSL. Other important peaks are Kedda Malai (1284 m) and Melur hill in the Bodamalai hill range.(Table 2 CGWB,2008) Structural Geology Structural Features denote geologic structure that are formed by internal deformation forces in the earth crust. The structure features such as folds, fault and joints etc.

The structure of the study area is highly tectonised and is complex is structure. As described earlier gneisses show well foliation in the NE-SW to SSW direction with sub vertical to vertical trending NNE-SSW and NE-SW direction in the eastern part. There are a number of folds, faults, shears and joints in the area, with has experienced at least three district phase of the tectonic movement. Fold The Salem-Namakkal Fold Thrust Belt consists of number of low-angle south-dipping thrust sheets demarcated by ductile shear zones .In many places they have been steepened by refolding, i.e. along the L. Kanavaipatti Shear Zone south of Namakkal .Mylonites are prominently developed in the foothills of Godumalai and Kanjamalai hill. These show kinematic indicators, mainly S-C fabrics, rotated porphyroclasts and intragranular faults, suggesting thrustrelated tectonics with N to NE verging shear However, in many instances the mylonites have undergone static recrystallisation .The mylonitisation is post-kinematic with granulite facies metamorphism. Peak granulite metamorphism has occurred during the F1 stage of folding, which is characterised by isoclinal folds developed in bedding planes, represented by BMQ layers in quartzofeldspatic gneisses.

The F1 fold have produced penetrative gneissic fabrics and are coaxially refolded by open to tight upright F2 folds producing type 3 interference patterns. The F2 folds are accompanied by shear bands along the limbs that show mylonitisation and rootless folds in quartzite bands .Thus it is interpreted that the mylonitisation is synkinematic with F2 stage of folding. The mylonitic foliation has been refolded by F3 folds, which have probably removed the shear fabric to a large extent due static recrystallisation. The Sangakiri Shear Zone separates the Idapadi Block from the Salem Block. The shear zone shows mylonitic foliation nearly E-W trend showing dip towards north .The Salem Block shows the dominants of metagabbro/mafic granulite.



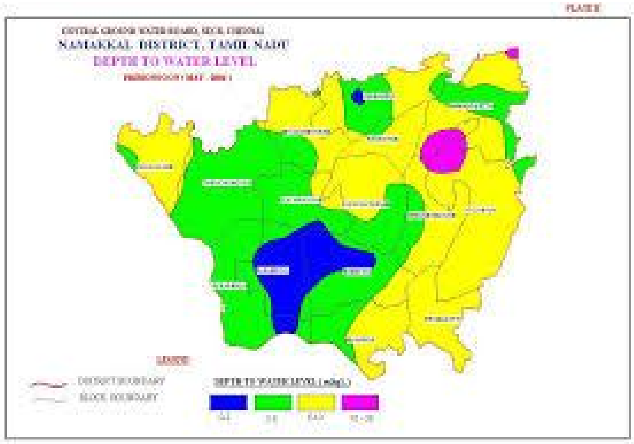


Figure 3 Depth Of Water Level In Namakkal

The outcrop shows synformal structure. The mafic granulites have been retrograded to amphibolite near Mallasamudram. The mylonitic foliation strikes NE-SW and dips toward E. The amphibolite shows nappe structure over the granite gneisses. The Kanjamalai Shear Zone near Kanjamalai hill takes an easterly trend. The mylonitic foliation shows NNW dip. The Udayapatti Shear Zone has an E-W strike and dips toward north. The Udayapatti shear zone south of Godumalai shows extensive mylonite development. The mylonitic foliations are E-W and dip north and contain down dip stretching lineation . The Umayalpuram Shear Zone shows the emplacement of syenite and the mylonitic foliation shows the southerly dip. The L. Kanavaipatti Shear Zone is the southernmost shear zone.

The mylonitic foliation shows both southerly and northerly dipping due to late stage folding. From the analysis of mylonites it is quite evident that the finite strain varies from one block to another. In Salem thrust sheet the static crsytallisation is very prominent while the Namakkal thrust sheet retains the assymetric fabric to a large extent. (Sundralingam et al, 2012) Fault A limited metamorphic study has been conducted on metagabbro/mafic granulites and from the namakkal Block. In Salem thrust sheet the static crsytallisation is very prominent. Area of different types of geomorphology S.No Types of Geomrphology Area in sq.km 1 Structural Hill 513.35 2 Plateau 237.519 3 Flood plain 179.936 4 Composite Slope 275.366 5 Bazada zone 82.79 6 Shallow Pediment 2115.339 Total Area 3404

7.3 Lineament

The Lineament map of Namakkal district has been prepared from the LAND SAT and IRS imageries of scale 1:250000 by visual image interpretation Figure 6. Groundwater occurrences in most of the boreholes, located in the lineament zones are good. In Namakkal district, there are 3 sets of lineaments, they are, NE-SW trending lineaments 2. N-S trending lineaments and 3. NW-SE trending lineaments. The course of river Cauvery is controlled by NW-SE lineament sand the course of Tirumanimuthar is controlled by N-S and NE-SW lineaments. Intersections of lineaments are proven as potential zones of groundwater. Almost the entire shallow aquifer zone is tapped for agricultural development in hard rock areas. The open fractures can be utilized for artificial recharge and for storing groundwater in the underground reservoir. Figure 4 shows the results for Namakkal project area.

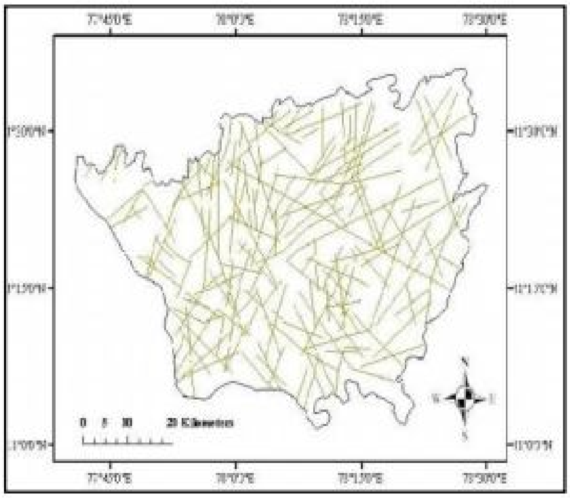


Figure 4 IRS Imageries of Scale 1:250000 By Visual Image

7.4 Industrial And Commercial Use

Namakkal finds a place of importance in the map of India because of its Lorry body building industry, a unique feature of the town. More than 150 Lorry body building work shops and a number of subsidiary industries of auto body works are operating since 1960. There are Lorries, Trailers and L.P.G. Tanker Lorries in Namakkal district. Therefore it is called as 'Transport City'. Namakkal is the major producer of Egg in Southern Region. Hence, called as ' Egg City '. The formation of Railway route from Salem to Karur is soon to be completed at the end of this year. The famous Tamil Poet" Namakkal Kavingnar Ramalingam Pillai" was born in this district. In memory of the poet, the State Government has established an arts and science college for women . On of the most famous Government Veterinary College is also situated near by Namakkal Town . More and more private educational/technical institutions are coming up in recent years which is a blossom for the district.

7.5 Educational Use

The town has various educational institutions on around the Namakkal like Government and Private sector, Engineering, Science and Arts Colleges, and other Technical Institution. The school education is dominant in the district especially in the in and around of the town. The schools in the town are like metric and non-metric schools are situated the district. From the Landsat image find the location of the educational points in radial pattern, developed various decades.

7.6 Transport And Communication Use

In the past few decades, the growth of transport, use of the population, developed the infrastructure, facilities, trade and commerce and other facilities in the Namakkal urban town. The Urban town is one of the major industrial zone in the tamilnadu, connected SH. NH like salemTiruchy, Salem-Karur passing through the town.

7.7 Recreational Use

As per the secondary data information with field visit, check the Urban Land use of the Namakkal Town, various use, with in the land the heart of the town were attracted the Children park, Lake and other Recreational plays benefit to the people of the town. The Urban Land use delineated through the Landsat TM Images, identify the Recreational use.

7.8 Mixed/Open Land Use

The Urban land use of Namakkal town is rapidly developed due to the Industrial and commercial activities, concentrated in the mean centre, and along the highways. The mixed/Open land use, either waste land or land without scrub/ for uses to the burial ground in the various community peoples . From the Land sat Images , identify the open land in the east ward of the town.

7.9 Urban Land Use Change Between 1971-2011

In general, every place developing any one of the factor, may be the growth of industrial activities, or infrastructure, economic importance of the activities, in other factors for better employment, education, and atmost the commercial points one. Namakkal is one of the growing industrial sector among the Tamilnadu. We state in the previous chapters about the industrial activities in and around of the Namakkal town. The present paper, have studied the urban Land use, with Land sat images in various decadal . The overall concentration between 1971-2011, based on the Land sat image, in 1971, based on the SOI , the concentration of the settlement in the core portion of the town, seen scatterly in radial pattern, than 1981, just few places only expanding toward in the S-W direction. In 1991 year, the growth means were randomly seen in the entire urban town. Again the 2001, S-S, S-W direction and 2011, is comparatively more concentration of the growth in the all direction. In other uses like, education, health, Recreational is more concentration the core of the town. The overall the urban land use, transport and pattern of settlement is concentration around the Namakwa fort and southern portion of the town.

The Landsat TM image was used to correct the roads, rivers, and existing farms' borders. The image with the overlaid features. ILWIS 3.1 was used to analyze the remote sensing image and dereferencing it. Then, the results imported into the ArcGIS.

To determine the priority of drainage need in the project's land, different criteria such as salinity, depth to the water table, soil type, and irrigation canal layouts combined together using GIS

7.10 Irrigation Requirement

For planning irrigated agricultural projects and distribution of water, accurate knowledge of water requirement is essential. Irrigation requirements of crops depend upon the evapotranspiration, consumptive use and effective rainfall, irrigation efficiency, irrigation frequency, and crop pattern. In order to give the manager the knowledge of water requirement for each farm and consequently for each distributary canal, a special tool has been developed using VBScript programming language in ArcGIS. This script allows manager to choose the farm or canal intake on the map, then program calculates the volume of water needed to be released at farm or canal intake based on the area of farm, the crop pattern and their water requirement. The volume of water is also depends on the irrigation frequency, irrigation efficiency, and month. This information can be entered by user. Crop water requirement is calculated using five different methods including Blaney-Criddle, Radiation, Penman FAO 24, Hargreaves, and PenmanMonteith method (Jensen et al., 1990). User can choose the method which is best for the area and calculation will be done based on that selection.

8 CONCLUSION

Drainage and irrigation system managers are facing with large volumes of data and information which are most of them digital. Since they are not classified and difficult to use all of them properly, a geographic information system can organize the spatial and attribute data in one environment. In this paper, application of new technologies in irrigation and drainage system management has been investigated and as a case study, Namakkal irrigation and drainage system was selected to apply the developed tool The main problem in using GIS is the time consuming process in digitizing maps and entering data into computer. On the other hand, the availability of remote sensing images helps to collect digital information easier but usually these images are expensive.

The developed tool for Namakkal system consists of spatial and attributed data which show the manager the condition of farms and canals. The GIS has provided the platform for the integration of previously incompatible data sets from different agencies and in different formats. The cartographic and data overlaying capability of GIS coupled with its dynamic linking ability to models plays a vital role in water management. In addition, its ability of writing scripts gives the decision makers this power to produce the necessary outputs the way they need them. Much more management aspects than the ones presented in this paper can be processed with the power of the GIS developed in this project. The system is dynamic and has the ability to update based on new information. The challenge now is the integration of GIS into the everyday lives of government departments and irrigation system managers.

References

[1] T.Subramani, K.Babu ,A Study On Agricultural Drainage Systems , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, May 2015 , pp. 304-312 , 2015
[2] T.Subramani, D.John Prabakaran ,Uniformity Studies And Performance Of Sprinkler And Drip Irrigation , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5 , pp. 284-293 , 2015
[3] T.Subramani, P.Malathi ,Drainage And Irrigation Management System For Salem Dist Tamilnadu Using GIS , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 199-210 , 2015
[4] T.Subramani, Identification Of Ground Water Potential Zone By Using GIS, International Journal of Applied Engineering Research (IJAER), Volume 10, Number 38, Special Issues, pp.28134-28138, 2015
[5] T.Subramani, C.T.Sivakumar, C.Kathirvel, S.Seka, Identification Of Ground Water Potential Zones In Tamil Nadu By Remote Sensing And GIS Technique International Journal of Engineering Research and Applications , Vol. 4 , Issue 12(Version 3), pp.127-138, 2014.
[6] T.Subramani, S.Badrinarayanan, K.Prasath, S.Sridhar, Performanance Evaluation of the Cauvery Irrigation System, India Using Remote Sensing and Gis Technology, International Journal of Engineering Research and Applications, Vol. 4, Issue 6(Version 2), pp.191-197, 2014.
[7] T.Subramani, M.Chandrasekaran, Saline Ground Water and Irrigation Water on Root Zone Salinity, International Journal of Engineering Research and Applications,Vol. 4, Issue 6(Version 2), pp.173-179, 2014.
[8] T.Subramani, T.Manikandan, Analysis Of Urban Growth And Its Impact On Groundwater Tanneries By Using Gis, International Journal of Engineering Research and Applications, Vol. 4, Issue 6(Version 2), pp.274-282, 2014.
[9] T.Subramani, P.Malathi , " Land Slides Hazardous Zones By Using Remote Sensing And GIS" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 211-222 , 2015
[10] T.Subramani,"Identification Of Ground Water Potential Zone By Using GIS", International Journal of Applied Engineering Research (IJAER), Volume 10, Number 38, Special Issues, pp.28134-28138, 2015
[11] T.Subramani, P.Krishnamurthi, "Geostatical Modelling For Ground Water Pollution in Salem by Using GIS", International Journal of Engineering Research and Applications ,Vol. 4, Issue 6(Version 2), pp.165-172, 2014.

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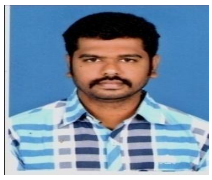

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